
Brian M. Adams, Mohamed S. Ebeida, Michael S. Eldred, John D. Jakeman, Kathryn A. Maupin, Jason A. Monschke, Laura P. Swiler, J. Adam Stephens, Dena M. Vigil, Timothy M. Wildey
Optimization and Uncertainty Quantification Department

William J. Bohnhoff
Radiation Transport Department

Keith R. Dalbey
Mission Analysis and Simulation Department

John P. Eddy
System Readiness and Sustainment Technologies Department

Russell W. Hooper
Multiphysics Applications Department

Kenneth T. Hu
Validation and Uncertainty Quantification Department

Patricia D. Hough
Quantitative Modeling and Analysis Department

Elliott M. Ridgway
Data-driven and Neural Computing

Sandia National Laboratories
P.O. Box 5800
Albuquerque, New Mexico 87185

Ahmad Rushdi
Institute for Computational and Engineering Sciences

The University of Texas at Austin
P.O. Box 4.102
Austin, TX 78712
Abstract

The Dakota (Design Analysis Kit for Optimization and Terascale Applications) toolkit provides a flexible and extensible interface between simulation codes and iterative analysis methods. Dakota contains algorithms for optimization with gradient and nongradient-based methods; uncertainty quantification with sampling, reliability, and stochastic expansion methods; parameter estimation with nonlinear least squares methods; and sensitivity/variance analysis with design of experiments and parameter study methods. These capabilities may be used on their own or as components within advanced strategies such as surrogate-based optimization, mixed integer nonlinear programming, or optimization under uncertainty. By employing object-oriented design to implement abstractions of the key components required for iterative systems analyses, the Dakota toolkit provides a flexible and extensible problem-solving environment for design and performance analysis of computational models on high performance computers.

This report describes the Dakota class hierarchies. It is derived from annotation of the source code and provides detailed class documentation, including all member functions and attributes.
## Contents

1 Dakota Developers Manual .......................... 13
   1.1 Introduction .................................. 13
   1.2 Overview of Dakota ........................... 13
   1.3 Services ...................................... 18
   1.4 Development Practices and Guidance ............. 18
   1.5 Additional Resources .......................... 19

2 Coding Style Guidelines and Conventions .......... 21
   2.1 Introduction .................................. 21
   2.2 C++/c Style Guidelines ....................... 21
   2.3 File Naming Conventions ...................... 23
   2.4 Class Documentation Conventions ................ 24
   2.5 CMake Style Guidelines ...................... 24

3 Instructions for Modifying Dakota’s Input Specification ........ 27
   3.1 New XML specification ....................... 27
   3.2 Deprecated: Modify dakota.input.nspec ........... 29
   3.3 Rebuild generated files ...................... 30
   3.4 Update NIDRProblemDescDB.cpp in Dakota/src ....... 30
   3.5 Update ProblemDescDB.cpp in Dakota/src ......... 31
   3.6 Update Corresponding Data Classes ............... 32
   3.7 Use get_<data_type>() Functions ............... 33
   3.8 Update the Documentation ..................... 33

4 Understanding Iterator Flow ........................ 35

5 Interfacing with Dakota as a Library ............... 37
   5.1 Introduction ................................ 37
   5.2 Basic Dakota library instantiation .......... 38
   5.3 Configuring Dakota operation ................. 39
   5.4 Creating a simulator plugin interface .......... 42
   5.5 Retrieving data after a run .................. 45
   5.6 Linking against the Dakota library .......... 45

6 Performing Function Evaluations .................... 47
   6.1 Synchronous function evaluations ............... 47
   6.2 Asynchronous function evaluations ............. 47
   6.3 Analyses within each function evaluation ........ 48
7 Working with Variable Containers and Views 49
  7.1 Storage in Variables 49
  7.2 Storage in SharedVariablesData 50
  7.3 Active and inactive views 51

8 Namespace Index 53
  8.1 Namespace List 53

9 Hierarchical Index 55
  9.1 Class Hierarchy 55

10 Class Index 61
  10.1 Class List 61

11 File Index 71
  11.1 File List 71

12 Namespace Documentation 73
  12.1 Dakota Namespace Reference 73
  12.2 SIM Namespace Reference 254

13 Class Documentation 255
  13.1 ActiveSet Class Reference 255
  13.2 ActiveSubspaceModel Class Reference 257
  13.3 Analyzer Class Reference 263
  13.4 ApplicationInterface Class Reference 270
  13.5 Approximation Class Reference 286
  13.6 ApproximationInterface Class Reference 293
  13.7 APPSEvalMgr Class Reference 299
  13.8 APPSOptimizer Class Reference 302
  13.9 ApreproWriter Class Reference 304
  13.10 BaseConstructor Struct Reference 309
  13.11 BootstrapSampler< Data > Class Template Reference 309
  13.12 BootstrapSampler< Teuchos::SerialDenseMatrix< OrdinalType, ScalarType > > Class Template Reference 306
  13.13 BootstrapSamplerBase< Data > Class Template Reference 307
  13.14 BootstrapSamplerWithGS< Data, Getter, Setter > Class Template Reference 309
  13.15 callback_data Struct Reference 310
  13.16 COLINAApplication Class Reference 310
  13.17 COLINOptimizer Class Reference 313
  13.18 CollabHybridMetaIterator Class Reference 318
  13.19 CommandLineHandler Class Reference 319
  13.20 CommandShell Class Reference 320
  13.21 ConcurrentMetaIterator Class Reference 322
  13.22 CONMINOptimizer Class Reference 325
  13.23 ConsoleRedirector Class Reference 332
  13.24 Constraints Class Reference 333
  13.25 DataEnvironment Class Reference 343
  13.26 DataEnvironmentRep Class Reference 344
  13.27 DataFitSurrModel Class Reference 346
CONTENTS

13.28 DataInterface Class Reference .................................................. 359
13.29 DataMethod Class Reference ...................................................... 360
13.30 DataMethodRep Class Reference .................................................. 361
13.31 DataModel Class Reference ....................................................... 376
13.32 DataModelRep Class Reference ................................................... 377
13.33 DataResponses Class Reference .................................................. 382
13.34 DataResponsesRep Class Reference .............................................. 383
13.35 DataTransformModel Class Reference ......................................... 387
13.36 DataVariables Class Reference ................................................... 390
13.37 DataVariablesRep Class Reference .............................................. 392
13.38 DDACEDesignCompExp Class Reference ....................................... 387
13.39 DirectApplicInterface Class Reference ........................................ 409
13.40 DiscrepancyCorrection Class Reference ....................................... 413
13.41 DOTOptimizer Class Reference ................................................. 417
13.42 JEGAOptimizer::Driver Class Reference ...................................... 421
13.43 EffGlobalMinimizer Class Reference .......................................... 423
13.44 EmbedHybridMetaIterator Class Reference .................................. 425
13.45 Environment Class Reference ................................................... 427
13.46 NomadOptimizer::Evaluator Class Reference ................................. 431
13.47 JEGAOptimizer::Evaluator Class Reference .................................. 433
13.48 JEGAOptimizer::EvaluatorCreator Class Reference ......................... 438
13.49 ExecutableEnvironment Class Reference ..................................... 439
13.50 ExperimentData Class Reference .............................................. 439
13.51 ExperimentResponse Class Reference ......................................... 447
13.52 FileReadException Class Reference .......................................... 449
13.53 ForkApplicInterface Class Reference ......................................... 449
13.54 FSUDesignCompExp Class Reference .......................................... 451
13.55 FunctionEvalFailure Class Reference ......................................... 455
13.56 GaussProcApproximation Class Reference .................................... 455
13.57 GeneralReader Class Reference ................................................ 460
13.58 GeneralWriter Class Reference ................................................. 461
13.59 GetLongOpt Class Reference .................................................... 461
13.60 Graphics Class Reference ......................................................... 464
13.61 GridApplicInterface Class Reference .......................................... 466
13.62 HierarchSurrModel Class Reference ........................................... 467
13.63 Interface Class Reference ........................................................ 472
13.64 Iterator Class Reference .......................................................... 481
13.65 IteratorScheduler Class Reference .............................................. 495
13.66 JEGAOptimizer Class Reference ................................................ 501
13.67 LabelsWriter Class Reference ................................................... 507
13.68 LeastSq Class Reference .......................................................... 508
13.69 LibraryEnvironment Class Reference ......................................... 511
13.70 LightWtBaseConstructor Struct Reference .................................... 514
13.71 MatchesWC Struct Reference ..................................................... 514
13.72 MatlabInterface Class Reference ............................................... 515
13.73 MetaIterator Class Reference ................................................... 516
13.74 Minimizer Class Reference ....................................................... 518
13.75 MixedVarConstraints Class Reference ....................................... 525
13.76 MixedVariables Class Reference ............................................... 526
13.77 Model Class Reference ................................................................. 528
13.78 MPIManager Class Reference ..................................................... 561
13.79 MPIPackBuffer Class Reference .................................................. 562
13.80 MPIUnpackBuffer Class Reference .............................................. 564
13.81 NCSUOptimizer Class Reference ................................................ 566
13.82 NestedModel Class Reference .................................................... 570
13.83 NIDRProblemDescDB Class Reference ........................................ 580
13.84 NL2Res Struct Reference .......................................................... 585
13.85 NL2SOLLeastSq Class Reference ................................................. 586
13.86 NLPQLP Optimizer Class Reference ............................................ 588
13.87 NLSSOLLeastSq Class Reference ................................................. 593
13.88 NoDBBaseConstructor Struct Reference ..................................... 596
13.89 NomadOptimizer Class Reference .............................................. 596
13.90 NonD Class Reference .............................................................. 599
13.91 NonDAdaptImpSampling Class Reference ..................................... 610
13.92 NonDAdaptiveSampling Class Reference ..................................... 614
13.93 NonDBayesCalibration Class Reference ...................................... 619
13.94 NonDCalibration Class Reference .............................................. 625
13.95 NonDCubature Class Reference ................................................ 628
13.96 NonDDREAMBayesCalibration Class Reference .............................. 630
13.97 NonDExpansion Class Reference ............................................... 634
13.98 NonDGlobalEvidence Class Reference ....................................... 640
13.99 NonDGlobalInterval Class Reference ........................................ 642
13.100 NonDGlobalReliability Class Reference .................................... 645
13.101 NonDGlobalSingleInterval Class Reference ............................... 648
13.102 NonDGImpSampling Class Reference ....................................... 649
13.103 NonDGPMSABayesCalibration Class Reference ............................. 652
13.104 NonDIntegration Class Reference ........................................... 655
13.105 NonDInterval Class Reference ................................................ 658
13.106 NonDLHSEvidence Class Reference .......................................... 660
13.107 NonDLHSInterval Class Reference ........................................... 661
13.108 NonDLHSSampling Class Reference ......................................... 662
13.109 NonDLHSSingleInterval Class Reference ................................... 666
13.110 NonDLocalEvidence Class Reference ....................................... 667
13.111 NonDLocalInterval Class Reference ........................................ 668
13.112 NonDLocalReliability Class Reference ..................................... 670
13.113 NonDLocalSingleInterval Class Reference ............................... 680
13.114 NonDMultilevelSampling Class Reference ................................ 681
13.115 NonDPolynomialChaos Class Reference ................................... 686
13.116 NonDQuadrature Class Reference ........................................... 689
13.117 NonDQUESOBayesCalibration Class Reference ........................... 695
13.118 NonDReliability Class Reference ............................................. 705
13.119 NonDRKDDarts Class Reference ............................................... 706
13.120 NonDSampling Class Reference ............................................... 709
13.121 NonDSparseGrid Class Reference ............................................ 718
13.122 NonDStochCollocation Class Reference .................................... 721
13.123 NonDWASABIBayesCalibration Class Reference ......................... 723
13.124 NonlinearCGOptimizer Class Reference .................................... 726
<table>
<thead>
<tr>
<th>Section</th>
<th>Reference</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.12 NPSOLOptimizer Class Reference</td>
<td></td>
<td>729</td>
</tr>
<tr>
<td>13.12 OptDartsOptimizer Class Reference</td>
<td></td>
<td>732</td>
</tr>
<tr>
<td>13.12 Optimizer Class Reference</td>
<td></td>
<td>735</td>
</tr>
<tr>
<td>13.12 OutputManager Class Reference</td>
<td></td>
<td>739</td>
</tr>
<tr>
<td>13.12 OutputWriter Class Reference</td>
<td></td>
<td>742</td>
</tr>
<tr>
<td>13.13 ParallelConfiguration Class Reference</td>
<td></td>
<td>743</td>
</tr>
<tr>
<td>13.13 ParallelDirectApplicInterface Class Reference</td>
<td></td>
<td>745</td>
</tr>
<tr>
<td>13.13 ParallelLevel Class Reference</td>
<td></td>
<td>746</td>
</tr>
<tr>
<td>13.13 ParallelLibrary Class Reference</td>
<td></td>
<td>749</td>
</tr>
<tr>
<td>13.13 ParamResponsePair Class Reference</td>
<td></td>
<td>758</td>
</tr>
<tr>
<td>13.13 ParamStudy Class Reference</td>
<td></td>
<td>762</td>
</tr>
<tr>
<td>13.13 partial_prp.equality Struct Reference</td>
<td></td>
<td>767</td>
</tr>
<tr>
<td>13.13 partial_prp.hash Struct Reference</td>
<td></td>
<td>767</td>
</tr>
<tr>
<td>13.13 PebblBranching Class Reference</td>
<td></td>
<td>768</td>
</tr>
<tr>
<td>13.14 PebblBranchSub Class Reference</td>
<td></td>
<td>769</td>
</tr>
<tr>
<td>13.14 PebblMinimizer Class Reference</td>
<td></td>
<td>770</td>
</tr>
<tr>
<td>13.14 PecosApproximation Class Reference</td>
<td></td>
<td>772</td>
</tr>
<tr>
<td>13.14 ProbabilityTransformModel Class Reference</td>
<td></td>
<td>777</td>
</tr>
<tr>
<td>13.14 ProblemDescDB Class Reference</td>
<td></td>
<td>784</td>
</tr>
<tr>
<td>13.14 ProcessApplicDB Class Reference</td>
<td></td>
<td>794</td>
</tr>
<tr>
<td>13.14 ProcessHandleApplicInterface Class Reference</td>
<td></td>
<td>798</td>
</tr>
<tr>
<td>13.14 ProgramOptions Class Reference</td>
<td></td>
<td>802</td>
</tr>
<tr>
<td>13.14 StudyDACE Class Reference</td>
<td></td>
<td>807</td>
</tr>
<tr>
<td>13.14 SUADEDesignCompExp Class Reference</td>
<td></td>
<td>809</td>
</tr>
<tr>
<td>13.15 PythonInterface Class Reference</td>
<td></td>
<td>812</td>
</tr>
<tr>
<td>13.15 QuesoJointPdf&lt; V, M &gt; Class Template Reference</td>
<td></td>
<td>814</td>
</tr>
<tr>
<td>13.15 QuesoVectorRV&lt; V, M &gt; Class Template Reference</td>
<td></td>
<td>815</td>
</tr>
<tr>
<td>13.15 RandomForestModel Class Reference</td>
<td></td>
<td>815</td>
</tr>
<tr>
<td>13.15 RecastModel Class Reference</td>
<td></td>
<td>820</td>
</tr>
<tr>
<td>13.15 ReducedBasis Class Reference</td>
<td></td>
<td>829</td>
</tr>
<tr>
<td>13.15 RelaxedVarConstraints Class Reference</td>
<td></td>
<td>830</td>
</tr>
<tr>
<td>13.15 RelaxedVariables Class Reference</td>
<td></td>
<td>832</td>
</tr>
<tr>
<td>13.15 Response Class Reference</td>
<td></td>
<td>834</td>
</tr>
<tr>
<td>13.15 RestartWriter Class Reference</td>
<td></td>
<td>841</td>
</tr>
<tr>
<td>13.16 ResultsDBAny Class Reference</td>
<td></td>
<td>842</td>
</tr>
<tr>
<td>13.16 ResultsEntry&lt; StoredType &gt; Class Template Reference</td>
<td></td>
<td>844</td>
</tr>
<tr>
<td>13.16 ResultsFileError Class Reference</td>
<td></td>
<td>845</td>
</tr>
<tr>
<td>13.16 ResultsID Class Reference</td>
<td></td>
<td>846</td>
</tr>
<tr>
<td>13.16 ResultsManager Class Reference</td>
<td></td>
<td>847</td>
</tr>
<tr>
<td>13.16 ResultsNames Class Reference</td>
<td></td>
<td>849</td>
</tr>
<tr>
<td>13.16 RichExtrapVerification Class Reference</td>
<td></td>
<td>850</td>
</tr>
<tr>
<td>13.16 ScalingModel Class Reference</td>
<td></td>
<td>853</td>
</tr>
<tr>
<td>13.16 ScalingOptions Class Reference</td>
<td></td>
<td>859</td>
</tr>
<tr>
<td>13.16 ScilabInterface Class Reference</td>
<td></td>
<td>860</td>
</tr>
<tr>
<td>13.17 SensAnalysisGlobal Class Reference</td>
<td></td>
<td>860</td>
</tr>
<tr>
<td>13.17 SeqHybridMetaIterator Class Reference</td>
<td></td>
<td>864</td>
</tr>
<tr>
<td>13.17 SerialDirectApplicInterface Class Reference</td>
<td></td>
<td>867</td>
</tr>
<tr>
<td>13.17 SharedApproxData Class Reference</td>
<td></td>
<td>868</td>
</tr>
<tr>
<td>13.17 SharedPecosApproxData Class Reference</td>
<td></td>
<td>873</td>
</tr>
</tbody>
</table>
CONTENTS

Bibliographic References 986

Index 988
Chapter 1

Dakota Developers Manual

Author


1.1 Introduction

The Dakota software (http://dakota.sandia.gov/) delivers advanced parametric analysis techniques enabling quantification of margins and uncertainty, risk analysis, model calibration, and design exploration with computational models. Dakota contains algorithms for optimization with gradient and nongradient-based methods, uncertainty quantification with sampling, reliability, stochastic expansion, and interval estimation methods, parameter estimation with nonlinear least squares methods, and sensitivity/variance analysis with design of experiments and parameter study capabilities. (Solution verification and Bayesian approaches are also in development.) These capabilities may be used on their own or as components within advanced algorithms such as surrogate-based optimization, mixed integer nonlinear programming, mixed aleatory-epistemic uncertainty quantification, or optimization under uncertainty. By employing object-oriented design to implement abstractions of the key components required for iterative systems analyses, the Dakota toolkit provides a flexible problem-solving environment for design and performance analysis of computational models on high performance computers.

The Developers Manual focuses on documentation of Dakota design principles and class structures; it derives principally from annotated source code. For information on input command syntax, refer to the Reference Manual[1], and for more details on Dakota features and capabilities, refer to the Users Manual.

1.2 Overview of Dakota

In Dakota, the environment manages execution modes and input/output streams and defines the top-level iterator. This top-level iterator may be either a standard iterator or a meta-iterator. In the former case, the iterator identifies a model and the environment executes the iterator on the model to perform a single study. In the latter case, iterator recursions are present and sub-iterations may identify their own models. In both cases, models may contain additional recursions in the case of nested iteration or surrogate modeling. In a simple example, a hybrid meta-iterator might manage a global optimizer operating on a low-fidelity model that feeds promising design points into a local optimizer operating on a high-fidelity model. And in a more advanced example, a surrogate-based optimization under uncertainty approach would employ an uncertainty quantification iterator nested within an
optimization iterator and would employ truth models contained within surrogate models. Thus, iterators and models provide both stand-alone capabilities as well as building blocks for more sophisticated studies.

A model contains a set of variables, an interface, and a set of responses, and the iterator operates on the model to map the variables into responses using the interface. Each of these components is a flexible abstraction with a variety of specializations for supporting different types of iterative studies. In a Dakota input file, the user specifies these components through environment, method, model, variables, interface, and responses keyword specifications.

The use of class hierarchies provides a mechanism for extensibility in Dakota components. In each of the various class hierarchies, adding a new capability typically involves deriving a new class and providing a set of virtual function redefinitions. These redefinitions define the coding portions specific to the new derived class, with the common portions already defined at the base class. Thus, with a small amount of new code, the existing facilities can be extended, reused, and leveraged for new purposes. The following sections tour Dakota’s class organization.

### 1.2.1 Environment

Class hierarchy: Environment.

Environments provide the top level abstraction for managing different execution modes and managing input and output streams. Specific environments include:

- **ExecutableEnvironment**: the environment for execution of Dakota as a stand-alone application.
- **LibraryEnvironment**: the environment for execution of Dakota as an embedded library service.

### 1.2.2 Iterators

Class hierarchy: Iterator. Iterator implementations may choose to split operations up into run-time phases as described in Understanding Iterator Flow.

The iterator hierarchy contains a variety of iterative algorithms for optimization, uncertainty quantification, nonlinear least squares, design of experiments, and parameter studies. The hierarchy is divided into MetaIterator, Minimizer, and Analyzer branches.

The MetaIterator classes manage sequencing and collaboration among multiple methods with support for concurrent iterator parallelism. Methods include:

- **SeqHybridMetaIterator**: hybrid minimization using a set of iterators employing a corresponding set of models of varying fidelity. The sequential hybrid passes the best solutions from one method in as the starting points of the next method in the sequence.
- **CollabHybridMetaIterator**: hybrid minimization employing collaboration and sharing of response data among methods during the course if iteration. This class is currently a placeholder.
- **EmbedHybridMetaIterator**: hybrid minimization involving periodic use of a local search method for refinement during the iteration of an outer global method. This class is currently a placeholder.
- **ConcurrentMetaIterator**: two similar algorithms are available: (1) multi-start iteration from several different starting points, and (2) pareto set optimization for several different multi-objective weightings. Employs a single iterator with a single model, but runs multiple instances of the iterator concurrently for different settings within the model.

The Minimizer classes address optimization and deterministic calibration and are grouped into:
1.2. OVERVIEW OF DAKOTA

- **Optimization**: Optimizer provides a base class for gradient-based (e.g., CONMINOptimizer and SNL-LOptimizer) and derivative-free (e.g., NCSUOptimizer, JEGAOptimizer) optimization solvers. Most of these are wrappers for third-party libraries that implement the optimization algorithms. Classes APPS-EvalMgr and COLINApplication provide the function evaluation interface for APPSOptimizer and COLINOptimizer, respectively.

- **Parameter estimation**: LeastSq provides a base class for NL2SOLLeastSq, a least-squares solver based on NL2SOL, SNLLLeastSq, a Gauss-Newton least-squares solver, and NLSSOLLeastSq, an SQP-based least-squares solver.

- **Surrogate-based minimization** (both optimization and nonlinear least squares): SurrBasedMinimizer provides a base class for SurrBasedLocalMinimizer, SurrBasedGlobalMinimizer, and EffGlobalMinimizer. The surrogate-based local and global methods employ a single iterator with any of the available Surrogate-Model capabilities (local, multipoint, or global data fits or hierarchical approximations) and perform a sequence of approximate optimizations, each involving build, optimize, and verify steps. The efficient global method, on the other hand, hard-wires a recursion involving Gaussian process surrogate models coupled with the DIRECT global optimizer to maximize an expected improvement function.

The Analyzer classes are grouped into:

- **Uncertainty quantification**: NonD provides a base class for non-deterministic methods in several categories:

  - Sampling: NonDSampling is further specialized with the NonDLHSSampling class for Latin hypercube and Monte Carlo sampling, and a number of other classes supporting incremental and adaptive sampling such as NonDAdaptImpSampling for multi-modal adaptive importance sampling.

  - Reliability Analysis: NonDReliability is further specialized with local and global methods (NonDLocalReliability and NonDGlobalReliability). NonDPOFDarts implements a computational geometry-based reliability method.

  - Stochastic Expansions: NonDExpansion includes specializations for generalized polynomial chaos (NonDPolynomialChaos) and stochastic collocation (NonDStochCollocation) and is supported by the NonDIntegration helper class, which supplies cubature, tensor-product quadrature and Smolyak sparse grid methods (NonDCubature, NonDQuadrature, and NonDSparseGrid).

  - Bayesian Calibration: NonDCalibration provides a base class for nondeterministic calibration methods with specialization to Bayesian calibration in NonDBayesCalibration, and specific implementations such as NonDQUESOBayesCalibration.

  - NonDInterval provides a base class for epistemic interval-based UQ methods. Three interval analysis approaches are provided: LHS (NonDLHSSampling), efficient global optimization (NonDGlobalInterval), and local optimization (NonDLocalInterval). Each of these three has specializations for single interval and Dempster-Shafer Theory of Evidence approaches.

- **Parameter studies and design of experiments**: PStudyDACE provides a base class for ParamStudy, which provides capabilities for directed parameter space interrogation, PSUADEDesignCompExp, which provides access to the Morris One-At-a-Time (MOAT) method for parameter screening, and DDACEDesignCompExp and FSUDesignCompExp, which provide for parameter space exploration through design and analysis of computer experiments. NonDLHSSampling from the uncertainty quantification branch also supports design of experiments when in active all variables mode.

- **Solution verification studies**: Verification provides a base class for RichExtrapVerification (verification via Richardson extrapolation) and other solution verification methods in development.
1.2.3 Models

Class hierarchy: Model.

The model classes are responsible for mapping variables into responses when an iterator makes a function evaluation request. There are several types of models, some supporting sub-iterators and sub-models for enabling layered and nested relationships. When sub-models are used, they may be of arbitrary type so that a variety of recursions are supported.

- **SimulationModel**: variables are mapped into responses using a simulation-based Interface object. No sub-iterators or sub-models are used.

- **SurrogateModel**: variables are mapped into responses using an approximation. The approximation is built and/or corrected using data from a sub-model (the truth model) and the data may be obtained using a sub-iterator (a design of experiments iterator). SurrogateModel has two derived classes: DataFitSurrModel for data fit surrogates and HierarchSurrModel for hierarchical models of varying fidelity. The relationship of the sub-iterators and sub-models is considered to be "layered" since they are not used as part of every response evaluation on the top level model, but rather used periodically in surrogate update and verification steps.

- **NestedModel**: variables are mapped into responses using a combination of an optional Interface and a sub-iterator/sub-model pair. The relationship of the sub-iterators and sub-models is considered to be "nested" since they are used to perform a complete iterative study as part of every response evaluation on the top level model.

- **RecastModel**: recasts the inputs and outputs of a sub-model for the purposes of variable transformations (e.g., variable scaling, transformations to standardized random variables) and problem reformulation (e.g., multi-objective optimization, response scaling, augmented Lagrangian merit functions, expected improvement).

1.2.4 Variables

Class hierarchy: Variables.

The Variables class hierarchy manages design, aleatory uncertain, epistemic uncertain, and state variable types for continuous, discrete integer, and discrete real domain types. This hierarchy is specialized according to how the domain types are managed:

- **MixedVariables**: domain type distinctions are retained, such that separate continuous, discrete integer, and discrete real domain types are managed. This is the default Variable perspective, and draws its name from "mixed continuous-discrete" optimization.

- **RelaxedVariables**: domain types are combined through relaxation of discrete constraints; i.e., continuous and discrete variables are merged into continuous arrays through relaxation of integrality (for discrete integer ranges) or set membership (for discrete integer or discrete real sets) requirements. The branch and bound minimizer is the only method using this approach at present.

Whereas domain types are defined based on the derived Variables class selection, the selection of active variable types is handled within each of these derived classes using variable views. These permit different algorithms to work on different subsets of variables. Data shared among Variables instances is stored in SharedVariablesData. For details on managing variables, see Working with Variable Containers and Views.

The Constraints hierarchy manages bound, linear, and nonlinear constraints and utilizes the same specializations for managing bounds on the variables (see MixedVarConstraints and RelaxedVarConstraints).
1.2.5 Interfaces

Class hierarchy: Interface.

Interfaces provide access to simulation codes or, conversely, approximations based on simulation code data. In the simulation case, an ApplicationInterface is used. ApplicationInterface is specialized according to the simulation invocation mechanism, for which the following nonintrusive approaches are supported:

- **SysCallApplicInterface**: the simulation is invoked using a system call (the C function `system()`). Asynchronous invocation utilizes a background system call. Utilizes the CommandShell utility.

- **ForkApplicInterface**: the simulation is invoked using a fork (the `fork/exec/wait` family of functions). Asynchronous invocation utilizes a nonblocking fork.

- **SpawnApplicInterface**: for Windows, fork is replaced by spawn. Asynchronous invocation utilizes a nonblocking spawn.

Fork and Spawn are inherited from ProcessHandleApplicInterface and System and ProcessHandle are inherited from ProcessApplicInterface. A semi-intrusive approach is also supported by:

- **DirectApplicInterface**: the simulation is linked into the Dakota executable and is invoked using a procedure call. Asynchronous invocations will utilize nonblocking threads (capability not yet available). Specializations of the direct interface are implemented in MatlabInterface, PythonInterface, ScilabInterface, and (for built-in testers) TestDriverInterface, while examples of plugin interfaces for library mode in serial and parallel, respectively, are included in SerialDirectApplicInterface and ParallelDirectApplicInterface.

Scheduling of jobs for asynchronous local, message passing, and hybrid parallelism approaches is performed in the ApplicationInterface class, with job initiation and job capture specifics implemented in the derived classes.

In the approximation case, global, multipoint, or local data fit approximations to simulation code response data can be built and used as surrogates for the actual, expensive simulation. The interface class providing this capability is

- **ApproximationInterface**: builds an approximation using data from a truth model and then employs the approximation for mapping variables to responses. This class contains an array of Approximation objects, one per response function, which support a variety of approximation types using the different Approximation derived classes. These include SurfpackApproximation (provides kriging, MARS, moving least squares, neural network, polynomial regression, and radial basis functions), GaussProcApproximation (Gaussian process models), PecosApproximation (multivariate orthogonal and Lagrange interpolation polynomials from Pecos), TANA3Approximation (two-point adaptive nonlinearity approximation), and TaylorApproximation (local Taylor series).

which is an essential component within the DataFitSurrModel capability described above in Models.

1.2.6 Responses

Class: Response.

The Response class provides an abstract data representation of response functions and their first and second derivatives (gradient vectors and Hessian matrices). These response functions can be interpreted as objective functions and constraints (optimization data set), residual functions and constraints (least squares data set), or generic response functions (uncertainty quantification data set). This class is not currently part of a class hierarchy, since the abstraction has been sufficiently general and has not required specialization.
CHAPTER 1. DAKOTA DEVELOPERS MANUAL

1.3 Services

A variety of services and utilities are used in Dakota for parallel computing, failure capturing, restart, graphics, etc. An overview of the classes and member functions involved in performing these services is included here.

- **Multilevel parallel computing:** Dakota supports multiple levels of nested parallelism. A meta-iterator can manage concurrent iterators, each of which manages concurrent function evaluations, each of which manages concurrent analyses executing on multiple processors. Partitioning of these levels with MPI communicators is managed in ParallelLibrary and scheduling routines for the levels are part of IteratorScheduler, ApplicationInterface, and ForkApplicInterface.

- **Option management:** Global options controlling behavior are managed in ProgramOptions, with the help of command-line option parsing in CommandLineHandler.

- **Parsing:** Dakota employs NIDR (New Input Deck Reader) via Dakota::ProblemDescDB::parse_inputs to parse user input files. NIDR uses the keyword handlers in the NIDRProblemDescDB derived class to populate data within the ProblemDescDB base class, which maintains a DataEnvironment specification and lists of DataMethod, DataModel, DataVariables, DataInterface, and DataResponses specifications. Procedures for modifying the parsing subsystem are described in Instructions for Modifying Dakota’s Input Specification.

- **Failure capturing:** Simulation failures can be trapped and managed using exception handling in ApplicationInterface and its derived classes.

- **Restart:** Dakota maintains a record of all function evaluations both in memory (for capturing any duplication) and on the file system (for restarting runs). Restart options are managed through ProgramOptions (with the help of CommandLineHandler); file management in OutputManager; and restart file insertions occur in ApplicationInterface. The dakota_restart_util executable, built from restart_util.cpp, provides a variety of services for interrogating, converting, repairing, concatenating, and post-processing restart files.

- **Memory management:** Dakota employs the techniques of reference counting and representation sharing through the use of letter-envelope and handle-body idioms (Coplien, “Advanced C++”). The former idiom provides for memory efficiency and enhanced polymorphism in the following class hierarchies: Environment, Iterator, Model, Variables, Constraints, Interface, ProblemDescDB, and Approximation. The latter idiom provides for memory efficiency in data-intensive classes which do not involve a class hierarchy. The Response and parser data (DataEnvironment, DataMethod, DataModel, DataVariables, DataInterface, and DataResponses) classes use this idiom. When managing reference-counted data containers (e.g., Variables or Response objects), it is important to properly manage shallow and deep copies, to allow for both efficiency and data independence as needed in a particular context.

- **Graphics and Output:** Dakota provides 2D iteration history graphics using Motif widgets. Graphics data can also be cataloged in a tabular data file for post-processing with 3rd party tools such as Matlab, Tecplot, etc. These capabilities are encapsulated within the Graphics class. An experimental results database is implemented in ResultsManager and ResultsDBAny. Options for controlling output and facilities for managing it are in OutputManager.

1.4 Development Practices and Guidance

The following links provide guidance for core software components or specific development activities:

- **Coding Style Guidelines and Conventions** - coding practices used by the Dakota development team.
1.5. ADDITIONAL RESOURCES

- **Instructions for Modifying Dakota’s Input Specification** - how to interact with NIDR and the associated Dakota classes.
- **Interfacing with Dakota as a Library** - embed Dakota as a service within your application.
- **Understanding Iterator Flow** - explanation of the full granularity of steps in Iterator execution.
- **Performing Function Evaluations** - an overview of the classes and member functions involved in performing function evaluations synchronously or asynchronously.
- **Working with Variable Containers and Views** - discussion of data storage for variables and explanation of active and inactive views of this data.

1.5 Additional Resources

Additional development resources include:

- The Dakota Developer Portal linked from [http://dakota.sandia.gov/developer/](http://dakota.sandia.gov/developer/) includes information on getting started as a developer and links to project management resources.

- Project web pages are maintained at [http://dakota.sandia.gov/](http://dakota.sandia.gov/) including links to frequently asked questions, documentation, publications, mailing lists, and other resources.
Chapter 2

Coding Style Guidelines and Conventions

2.1 Introduction

Common code development practices can be extremely useful in multiple developer environments. Particular styles for code components lead to improved readability of the code and can provide important visual cues to other developers. Much of this recommended practices document is borrowed from the CUBIT mesh generation project, which in turn borrows its recommended practices from other projects, yielding some consistency across Sandia projects. While not strict requirements, these guidelines suggest a best-practices starting point for coding in Dakota.

2.2 C++/c Style Guidelines

Style guidelines involve the ability to discern at a glance the type and scope of a variable or function.

2.2.1 Class and variable styles

Class names should be composed of two or more descriptive words, with the first character of each word capitalized, e.g.:

```cpp
class ClassName;
```

Class member variables should be composed of two or more descriptive words, with the first character of the second and succeeding words capitalized, e.g.:

```cpp
double classMemberVariable;
```

Temporary (i.e. local) variables are lower case, with underscores separating words in a multiple word temporary variable, e.g.:

```cpp
int temporary_variable;
```

Constants (i.e. parameters) and enumeration values are upper case, with underscores separating words, e.g.:

```cpp
const double CONSTANT_VALUE;
```
2.2.2 Function styles

Function names are lower case, with underscores separating words, e.g.:

```c
int function_name();
```

There is no need to distinguish between member and non-member functions by style, as this distinction is usually clear by context. This style convention allows member function names which set and return the value of a similarly-named private member variable, e.g.:

```c
int memberVariable;
void member_variable(int a) { // set
    memberVariable = a;
}
int member_variable() const { // get
    return memberVariable;
}
```

In cases where the data to be set or returned is more than a few bytes, it is highly desirable to employ const references to avoid unnecessary copying, e.g.:

```c
void continuous_variables(const RealVector& c_vars) { // set
    continuousVariables = c_vars;
}
const RealVector& continuous_variables() const { // get
    return continuousVariables;
}
```

Note that it is not necessary to always accept the returned data as a const reference. If it is desired to be able change this data, then accepting the result as a new variable will generate a copy, e.g.:

```c
// reference to continuousVariables cannot be changed
const RealVector& c_vars = model.continuous_variables();
// local copy of continuousVariables can be changed
RealVector c_vars = model.continuous_variables();
```

2.2.3 Miscellaneous

Appearance of typedefs to redefine or alias basic types is isolated to a few header files (`data_types.h`, `template_defs.h`), so that issues like program precision can be changed by changing a few lines of typedefs rather than many lines of code, e.g.:

```c
typedef double Real;
```

`xemacs` is the preferred source code editor, as it has C++ modes for enhancing readability through color (turn on "Syntax highlighting"). Other helpful features include "Paren highlighting" for matching parentheses and the "New Frame" utility to have more than one window operating on the same set of files (note that this is still the same edit session, so all windows are synchronized with each other). Window width should be set to 80 internal columns, which can be accomplished by manual resizing, or preferably, using the following alias in your shell resource file (e.g., `.cshrc`):

```c
alias xemacs "xemacs -g 81x63"
```

where an external width of 81 gives 80 columns internal to the window and the desired height of the window will vary depending on monitor size. This window width imposes a coding standard since you should avoid line wrapping by continuing anything over 80 columns onto the next line.

Indenting increments are 2 spaces per indent and comments are aligned with the code they describe, e.g.:
2.3 File Naming Conventions

In addition to the style outlined above, the following file naming conventions have been established for the Dakota project.

File names for C++ classes should, in general, use the same name as the class defined by the file. Exceptions include:

- with the introduction of the Dakota namespace, base classes which previously utilized prepended Dakota identifiers can now safely omit the identifiers. However, since file names do not have namespace protection from name collisions, they retain the prepended Dakota identifier. For example, a class previously named DakotaModel which resided in DakotaModel.cpp/hpp, is now Dakota::Model (class Model in namespace Dakota) residing in the same filenames. The retention of the previous filenames reduces the possibility of multiple instances of a Model.hpp causing problems. Derived classes (e.g., NestedModel) do not require a prepended Dakota identifier for either the class or file names.

- in a few cases, it is convenient to maintain several closely related classes in a single file, in which case the file name may reflect the top level class or some generalization of the set of classes (e.g., DakotaResponse.[CH] files contain Dakota::Response and Dakota::ResponseRep classes, and DakotaBinStream.[CH] files contain the Dakota::BiStream and Dakota::BoStream classes).

The type of file is determined by one of the four file name extensions listed below:

- .hpp A class header file ends in the suffix .hpp. The header file provides the class declaration. This file does not contain code for implementing the methods, except for the case of inline functions. Inline functions are to be placed at the bottom of the file with the keyword inline preceding the function name.

- .cpp A class implementation file ends in the suffix .cpp. An implementation file contains the definitions of the members of the class.
• .h A header file ends in the suffix .h. The header file contains information usually associated with procedures. Defined constants, data structures and function prototypes are typical elements of this file.

• .c A procedure file ends in the suffix .c. The procedure file contains the actual procedures.

### 2.4 Class Documentation Conventions

Class documentation uses the doxygen tool available from [http://www.doxygen.org](http://www.doxygen.org) and employs the JAVA-doc comment style. Brief comments appear in header files next to the attribute or function declaration. Detailed descriptions for functions should appear alongside their implementations (i.e., in the .cpp files for non-inlined, or in the headers next to the function definition for inlined). Detailed comments for a class or a class attribute must go in the header file as this is the only option.

**NOTE:** Previous class documentation utilities (class2frame and class2html) used the “//-” comment style and comment blocks such as this:

```plaintext
//- Class: Model
//- Description: The model to be iterated by the Iterator.
//- Contains Variables, Interface, and Response objects.
//- Owner: Mike Eldred
```

These tools are no longer used, so remaining comment blocks of this type are informational only and will not appear in the documentation generated by doxygen.

### 2.5 CMake Style Guidelines

Dakota conventions for CMake files, such as CMakeLists.txt, FooConfig.cmake, etc., follow. Our goal is ease of reading, maintenance, and support, similar to the C++ code itself. Current CMake versions and build hints are maintained at the Developer Portal [http://dakota.sandia.gov/developer/](http://dakota.sandia.gov/developer/).

#### 2.5.1 CMake Code Formatting

- Indentation is 2 spaces, consistent with Dakota C++ style.
- Lines should be kept to less than 80 chars per line where possible.
- Wrapped lines may be indented two spaces or aligned with prior lines.
- For ease of viewing and correctness checking in Emacs, a customization file is available: [http://www.-cmake.org/CMakeDocs/cmake-mode.el](http://www.-cmake.org/CMakeDocs/cmake-mode.el)

#### 2.5.2 CMake Variable Naming Conventions

These variable naming conventions are especially important for those that ultimately become preprocessor defines and affect compilation of source files.

- Classic/core elements of the CMake language are set in lower_case, e.g., option, set, if, find_library.
- Static arguments to CMake functions and macros are set in UPPER_CASE, e.g. REQUIRED, NO_MODULE, QUIET.
- Minimize "global" variables, i.e., don’t use 2 variables with the same meaning when one will do the job.
2.5. **CMAKE STYLE GUIDELINES**

- Feature toggling: when possible, use the "$\text{HAVE}_{<\text{pkg/feature}>}$" convention already in use by many CMake-enabled TPLs, e.g.,

```bash
$ grep HAVE_SYSTEM Dakota/src/CMakeLists.txt
check_function_exists(system HAVE_SYSTEM)
if(HAVE_SYSTEM)
  add_definitions("-DHAVE_SYSTEM")
endif(HAVE_SYSTEM)
```

- When a variable/preprocessor macro could result in name clashes beyond Dakota scope, e.g., for library-mode users, consider prefixing the "$\text{HAVE}_{<\text{pkg}>}$" name with DAKOTA_, e.g. DAKOTA_HAVE_MPI. Currently, MPI is the only use case for such a variable in Dakota, but many examples can be found in the CMake Modules source, e.g.

```bash
grep HAVE_<cmake_prefix_dir>/share/cmake-2.8/Modules/*
```
Chapter 3

Instructions for Modifying Dakota’s Input Specification

To modify Dakota’s input specification (for maintenance or addition of new input syntax), specification maintenance mode must be enabled at Dakota configure time with the `-DENABLE_SPEC_MAINT` option, e.g.,

```
./cmake -DENABLE_SPEC_MAINT:BOOL=ON ..
```

This will enable regeneration of NIDR and Dakota components which must be updated following a spec change.

3.1 New XML specification

The authoritative source for valid Dakota input grammar is now `dakota/src/dakota.xml`. The schema defining valid content for this XML file is in `dakota/src/dakota.xsd`. In the transition period (until parser work is complete), Dakota input grammar will be edited in the .xml file and translated using Java to `dakota/src/dakota.input.nspec` for consumption by the Dakota build process.

Process overview for updating the XML input definition:

- Make sure `ENABLE_SPEC_MAINT` is enabled in your build and necessary Java development tools are installed (see below).
- Edit the XML spec in `dakota.xml`.
- Perform a `make` in `dakota.build/src which will regenerate` `dakota.source/src/dakota.input-nspec`.
- Review that any changes induced in the `dakota.input.nspec` file are as expected.
- Proceed with verifying code changes and making downstream parse handler changes as normal.
- Commit the modified `dakota.xml` and `dakota.input.nspec` with other code changes.

3.1.1 XML Build Requirements

Editing the XML and then compiling Dakota requires

- Java Development Kit (JDK) for Java 6, providing the Java compiler javac. Version 1.6 or newer should work. Can satisfy on RHEL6 with RPM packages `java-1.6.0-openjdk-devel` and `java-1.6.0-openjdk`. This is needed to build the Java-based XML to NIDR translator. If this becomes too burdensome, we can check in the generated `xml2nidr.jar` file.
3.1.2 XML Editing Tools

The following tools will make editing dakota.input.xml easier.

- **Recommended: Eclipse Web Tools Platform.** Includes both graphical and text editors.

  1. Download Eclipse Standard (Classic)
  2. Configure proxy if needed, setting to manual: Window > Preferences > General > Network Connection > Proxy
  3. Install Web Tools Platform
     - Help > Install New Software
     - Work With: Kepler - [http://download.eclipse.org/releases/kepler](http://download.eclipse.org/releases/kepler)
     - Search "Eclipse X" and install two packages under Web, XML, Java
       * Eclipse XML Editors and Tools
       * Eclipse XSL Developer Tools
     - Optionally install C/C++ Development Tools
  4. Optional: add Subclipse for subversion (Subversive is the other major competing tool and I don’t think requires JavaHL) Help > Install New Software Work With: [http://subclipse.tigris.org/update1.6.x](http://subclipse.tigris.org/update1.6.x) Install Subclipse On Linux: `yum install subversion-javahl.x86_64`
  5. Alternately install Eclipse for Java or Eclipse Java EE development which includes webtools, then optionally add subclipse and C/C++ dev

- **Alternate: Emacs or your usual editor.** For example, Emacs supports an Nxml mode. You can tell it where to find the schema, edit XML, and have it perform validation against the schema. See help at [http://www.gnu.org/software/emacs/manual/html_mono/nxml-mode.html](http://www.gnu.org/software/emacs/manual/html_mono/nxml-mode.html)

- **Other SuggestedAlternates:** XMLSpy, DreamWeaver, XML Copy Editor

3.1.3 XML Features (with map to NIDR)

Out of necessity, the initial Dakota XML `dakota.xml` closely mirrors `dakota.input.nspec`. Valid Dakota input grammar is constrained by `dakota.xml`, an XML document which must validate against `dakota.xsd`. The top-level element of interest is `<input>`, which is comprised of a sequence of content elements (keywords, alternates, etc.), which may themselves contain additional child content elements. The key content types are:

- **Keyword** (`<keyword>`): specified with the `<keyword>` element whose definition is given by keyword-Type in `dakota.xsd`. The required attributes are:
  - **name**: the keyword name as it will be given in user input; must follow same uniqueness rules are historical NIDR.
  - **code**: the verbatim NIDR handler to be invoked when parsed. In NIDR this was specified with `{N_-macro(...)}`.

Optional/useful parser-related elements/attributes in order of importance are:

- **param sub-element**: Parameters and data types: A keyword may have an associated parameter element with a specified data type: `<param type="PARAMTYPE" />`. NIDR data types remain the same (INTEGER, REAL, STRING and LISTs thereof, but new data types INPUT_FILE and OUTPUT_FILE add convenience for the GUI, mapping to STRING for NIDR purposes. Parameters can also include attributes constraint, in_taglist, or taglist, which are used to help validate the user-specified parameter value. For example `constraint >= 0 LEN normal_uncertain`
3.2. DEPRECATED: MODIFY DAKOTA.INPUT.NSPEC

- **alias sub-element**: historical aliases for this keyword (can appear multiple times). Alias has a single attribute **name**
- **id**: unique ID for the keyword, usually name with an integer appended
- **minOccurs**: minimum occurrences of the keyword in current context (set to 1 for required, 0 for optional)
- **maxOccurs**: maximum occurrences of the keyword in current context (for example environment may appear at most once)

And optional/useful GUI-related attributes are:

- **help**: a pointer to the corresponding reference manual section (deprecated as not needed with new reference manual format which mirrors keyword hierarchy)
- **label**: a friendly label for the keyword to use in the GUI
- **group**: category or group for this keyword, e.g., optimization vs. parameter study

- **Alternation** ( `<oneOf>` ): Alternation of groups of content is done with the element `<oneOf>` which indicates that its immediate children are alternates. In NIDR this was done with the pipe symbol: OptionA | OptionB

- **Required Group** ( `<required>` ): A required group can be specified by enclosing the contents in the `<required>` element. In NIDR this was done by enclosing the content in parentheses: ( required group... )

- **Optional Group** ( `<optional>` ): An optional group can be specified by enclosing the contents in the `<optional>` element. In NIDR this was done by enclosing the content in brackets: [ optional group... ]

### 3.2 Deprecated: Modify dakota.input.nspec

The master input specification dakota.input.nspec in Dakota/src is the primary file to update when making a specification change. It uses the following syntactic elements:

- () for required group specifications
- [] for optional specifications
- | for alternatives
- {} for functions to process keywords to express logical relationships. These syntactic elements can be used to express various dependency relationships in the input specification. It is recommended that you review the existing specification and have an understanding of the constructs in use before attempting to add new ones.

**Warning**

- Do not skip this step. Attempts to modify the NIDR_keywds.hpp file in Dakota/src without using the NIDR table generator are very error-prone. Moreover, the input specification provides a reference to the allowable inputs of a particular executable and should be kept in synch with the parser files; modifying the parser files independent of the input specification creates, at a minimum, undocumented features.
- All keywords in dakota.input.nspec are lower case by convention. All user inputs are converted to lower case by the parser prior to keyword match testing, resulting in case insensitive parsing.
• Since the NIDR parser allows abbreviation of keywords, you must avoid adding a keyword that could be misinterpreted as an abbreviation for a different keyword within the same top-level keyword, such as "environment" and "method". For example, adding the keyword "expansion" within the method specification would be a mistake if the keyword "expansion_factor" already was being used in this specification.

• The NIDR input is somewhat order-dependent, allowing the same keyword to be reused multiple times in the specification. This often happens with aliases, such as lower_bounds, upper_bounds and initial_point. Ambiguities are resolved by attaching a keyword to the most recently seen context in which it could appear, if such exists, or to the first relevant context that subsequently comes along in the input file. With the earlier IDR parser, non-exclusive specifications (those not in mutually exclusive blocks) were required to be unique. That is why there are such aliases for initial_point as cdv_initial_point and ddv_initial_point: so older input files can be used with no or fewer changes.

3.3 Rebuild generated files

When configured with -DENABLE_SPEC_MAINT, performing a make in Dakota/src will regenerate all files which derive from dakota.input.nspec, including NIDR_keywds.hpp, dakota.input.summary, NIDR_guikywds.h, and dakota.input.desc. If you commit changes to a source repository, be sure to commit any automatically generated files in addition to any modified in the following steps. It is not strictly necessary to run make at this point in the sequence, and in fact may generate errors if necessary handlers aren’t yet available.

3.4 Update NIDRProblemDescDB.cpp in Dakota/src

Many keywords have data associated with them: an integer, a floating-point number, a string, or arrays of such entities. Data requirements are specified in dakota.input.nspec by the tokens INTEGER, REAL, STRING, INTEGERLIST, REALLIST, STRINGLIST. (Some keywords have no associated data and hence no such token.) After each keyword and data token, the dakota.input.nspec file specifies functions that the NIDR parser should call to record the appearance of the keyword and deal with any associated data. The general form of this specification is

\{ startfcn, startdata, stopfcn, stopdata \}

i.e., a brace-enclosed list of one to four functions and data pointers, with trailing entities taken to be zero if not present; zero for a function means no function will be called. The startfcn must deal with any associated data. Otherwise, the distinction between startfcn and stopfcn is relevant only to keywords that begin a group of keywords (enclosed in parentheses or square brackets). The startfcn is called before other entities in the group are processed, and the stop function is called after they are processed. Top-level keywords often have both startfcn and stopfcn; stopfcn is uncommon but possible for lower-level keywords. The startdata and (if needed) stopdata values are usually pointers to little structures that provide keyword-specific details to generic functions for startfcn and stopfcn. Some keywords that begin groups (such as "approx_problem" within the top-level "environment" keyword) have no need of either a startfcn or a stopfcn; this is indicated by "\{0\}".

Most of the things within braces in dakota.input.nspec are invocations of macros defined in NIDRProblemDescDB.cpp. The macros simplify writing dakota.input.nspec and make it more readable. Most macro invocations refer to little structures defined in NIDRProblemDescDB.cpp, usually with the help of other macros, some of which have different definitions in different parts of NIDRProblemDescDB.cpp. When adding a keyword to dakota.input.nspec, you may need to add a structure definition or even introduce a new data type. NIDRProblemDescDB.cpp has sections corresponding to each top-level keyword. The top-level keywords are in alphabetical order, and most entities in the section for a top-level keyword are also in alphabetical order. While not required, it is probably good practice to maintain this structure, as it makes things easier to find.
3.5. UPDATE PROBLEMDESCDB.CPP IN DAKOTA/SRC

Any integer, real, or string data associated with a keyword are provided to the keyword's startfcn, whose second argument is a pointer to a Values structure, defined in header file nidr.h.

Example 1: if you added the specification:

[method_setting REAL {method_setting_start, &method_setting_details}]

you would provide a function

```cpp
  void NIDRProblemDescDB::method_setting_start(const char *keyname, Values *val, void **g, void *v)
  {
    ...
  }
```

in NIDRProblemDescDB.cpp. In this example, argument &method_setting_details would be passed as v, val->n (the number of values) would be 1 and *val->r would be the REAL value given for the method_setting keyword. The method_setting_start function would suitably store this value with the help of method_setting_details.

For some top-level keywords, g (the third argument to the startfcn and stopfcn) provides access to a relevant context. For example, method_start (the startfcn for the top-level method keyword) executes

```cpp
  DataMethod *dm = new DataMethod;
  g = (void*)dm;
```

(and supplies a couple of default values to dm). The start functions for lower-level keywords within the method keyword get access to dm through their g arguments. Here is an example:

```cpp
  void NIDRProblemDescDB::method_str(const char *keyname, Values *val, void **g, void *v)
  {
    (*(DataMethod**)g)->**(String DataMethod::**)v = *val->s;
  }
```

In this example, v points to a pointer-to-member, and an assignment is made to one of the components of the DataMethod object pointed to by *g. The corresponding stopfcn for the top-level method keyword is

```cpp
  void NIDRProblemDescDB::method_stop(const char *keyname, Values *val, void **g, void *v)
  {
    DataMethod *p = *(DataMethod**)g;
    pDDBInstance->dataMethodList.insert(*p);
    delete p;
  }
```

which copies the now populated DataMethod object to the right place and cleans up.

Example 2: if you added the specification

```
  [method_setting REALLIST {{N_mdm(RealL,methodCoeffs)}]
```

then method_RealL (defined in NIDRProblemDescDB.cpp) would be called as the startfcn, and methodCoeffs would be the name of a (currently nonexistent) component of DataMethod. The N_mdm macro is defined in NIDRProblemDescDB.cpp; among other things, it turns RealL into NIDRProblemDescDB::method_RealL. This function is used to process lists of REAL values for several keywords. By looking at the source, you can see that the list values are val->r[i] for 0 <= i < val->n.

3.5  Update ProblemDescDB.cpp in Dakota/src

3.5.1 Augment/update get_<data_type>() functions

The next update step involves extending the database retrieval functions in ProblemDescDB.cpp. These retrieval functions accept an identifier string and return a database attribute of a particular type, e.g., a RealVector:
```cpp
const RealVector& get_rv(const String& entry_name);

The implementation of each of these functions contains tables of possible entry_name values and associated pointer-to-member values. There is one table for each relevant top-level keyword, with the top-level keyword omitted from the names in the table. Since binary search is used to look for names in these tables, each table must be kept in alphabetical order of its entry names. For example,

```cpp
else if ((L = Begins(entry_name, "model."))) {
    if (dbRep->methodDBLocked)
        Locked_db();

#define P &DataModelRep::
static KW<RealVector, DataModelRep> RVdmo[] = {
    // must be sorted
    {"nested.primary_response_mapping", P primaryRespCoeffs},
    {"nested.secondary_response_mapping", P secondaryRespCoeffs},
    {"surrogate.kriging.conmin_seed", P krigingConminSeed},
    {"surrogate.kriging.correlations", P krigingCorrelations},
    {"surrogate.kriging_max_correlations", P krigingMaxCorrelations},
    {"surrogate.kriging_min_correlations", P krigingMinCorrelations}};
#undef P
KW<RealVector, DataModelRep> *kw;
if ((kw = (KW<RealVector, DataModelRep>*)Binsearch(RVdmo, L)))
    return dbRep->dataModelIter->dataModelRep->*kw->p;
```
3.7. USE GET.<DATA_TYPE>() FUNCTIONS

3.6.2 Update the .cpp file

Define defaults for the new attributes in the constructor initialization list. Add the new attributes to the assign() function for use by the copy constructor and assignment operator. Add the new attributes to the write(MPIPackBuffer&), read(MPIUnpackBuffer&), and write(ostream&) functions, paying careful attention to the use of a consistent ordering.

3.7 Use get.<data_type>() Functions

At this point, the new specifications have been mapped through all of the database classes. The only remaining step is to retrieve the new data within the constructors of the classes that need it. This is done by invoking the get.<data_type>() function on the ProblemDescDB object using the identifier string you selected in Augment/update get.<data_type>() functions. For example:

```cpp
cost String interface_type = problem_db.get_string("interface.type");
```

passes the "interface.type" identifier string to the ProblemDescDB::get_string() retrieval function, which returns the desired attribute from the active DataInterface object.

Warning

Use of the get.<data_type>() functions is restricted to class constructors, since only in class constructors are the data list iterators (i.e., dataMethodIter, dataModelIter, dataVariablesIter, dataInterfaceIter, and dataResponsesIter) guaranteed to be set correctly. Outside of the constructors, the database list nodes will correspond to the last set operation, and may not return data from the desired list node.

3.8 Update the Documentation

Doxygen comments should be added to the Data class headers for the new attributes, and the reference manual sections describing the portions of dakota.input.nspec that have been modified should be updated. In particular, the reference manual tables summarizing keywords provide help data to the Jaguar user interface so need to be kept updated.
Chapter 4

Understanding Iterator Flow

This page explains the various phases comprising Iterator::run_iterator(). Prior to Iterator construction, when command-line options are parsed, Boolean run mode flags corresponding to PRERUN, RUN, and POSTRUN are set in ParallelLibrary. If the user didn’t specify any specific run modes, the default is for all three to be true (all phases will execute).

Iterator is constructed.

When called, run_iterator() sequences:

- initialize_run(): unconditionally called, virtual. Performs common initialization such as allocating workspaces, setting communicators and evaluation counts. When re-implementing this virtual, a derived class must call its nearest parent’s initialize_run(), typically before performing its own implementation steps.

- Not implemented: pre-run input

- IF PRERUN, invoke pre_run(): virtual function; default no-op. Purpose: derived classes should implement pre_run() if they are able to generate all parameter sets (variables) at once, separate from run(). Derived implementations should call their nearest parent’s pre_run(), typically before performing their own steps.

- IF PRERUN, invoke pre_output(): non-virtual function; if user requested, output variables to file.

- Not implemented: run input

- IF RUN, invoke virtual function run(). Purpose: at a minimum, evaluate parameter sets through computing responses; for iterators without pre/post capability, their entire implementation is in run() and this is a reasonable default for new Iterators.

- Not implemented: run output

- IF POSTRUN, invoke post_input(): virtual function, default only print helpful message on mode. Purpose: derived iterators supporting post-run input from file must implement to read file and populate variables/responses (and possibly best points) appropriately. Implementations must check if the user requested file input.

- IF POSTRUN, invoke post_run(): virtual function. Purpose: generate statistics / final results. Any analysis that can be done solely on tabular data read by post_input() can be done here. Derived re-implementations should call their nearest parent’s post-run(), typically after performing their specific post-run activities.

- Not implemented: post-run output
• `finalize_run()`: unconditionally called, virtual. Purpose: free workspaces. Default base class behavior is no-op, however, derived implementations should call their nearest parent’s `finalize_run` after performing their specialized portions.

Iterator is destructed.
Chapter 5

Interfacing with Dakota as a Library

5.1 Introduction

Tightly integrating or linking Dakota into another application can improve user experience by delivering a more unified, inter-operable software tool for optimization and UQ analyses, improving performance by eliminating file system-based interfaces, and reducing challenges with parallel computing inter-operation. This benefit has been realized within several Sandia and external simulation applications. This section describes how to link Dakota into another C++ application.

Dakota has two primary application programming interfaces (APIs). The LibraryEnvironment class facilitates use of Dakota as an algorithm service library within another application. In this case, the simulation application is providing a "front end" for Dakota. The second API, provided by the DirectApplicInterface class, provides an interface for Dakota to call the simulation code directly to perform function evaluations in core. This permits the simulation to be the "back end" for Dakota. The most complete library integration of Dakota would use both in combination, with the overall simulation framework providing both the front end and back end for Dakota, creating a sandwich, as loosely depicted here:

```
[------------
[ Application
[ |
[ | { -----
[ | { Dakota {LibraryEnvironment)
[ |
[ | { | Function evaluation callback to Application (via DirectApplicInterface)
[ |
[ |<------/
[ |
[ |
[ |
[ |
[ |{ ----
[-------------
```

Attention

Dakota may be integrated as a library in other software applications subject to the terms of the GNU Lesser General Public License (LGPL). Refer to http://www.gnu.org/licenses/lgpl.html or the LICENSE file included with Dakota.

When Dakota is compiled and installed, the relevant library API headers are installed to CMAKE_INSTALL_PREFIX/include and the runtime libraries primarily to CMAKE_INSTALL_PREFIX/lib/ (on some platforms,
to CMAKE_INSTALL_PREFIX/bin/. The core C/C++ code is in the library dakota_src, while Fortran code lives in the dakota_src_fortran library. Information on using the API in Dakota headers is included throughout this section, while considerations for configuring and linking against Dakota and its various required and optional third–party libraries are emphasized in the section Linking against the Dakota library.

Steps involved in integrating Dakota into another application typically include:

1. Writing C++ code for your application to instantiate, configure, and execute Dakota’s LibraryEnvironment ("front end"); see Basic Dakota library instantiation and Configuring Dakota operation.

2. Writing C++ code for Dakota to call a function in your application to perform function evaluations ("back end"); see Creating a simulator plugin interface.

3. Compiling Dakota and linking into your application (Linking against the Dakota library).

Several source code examples demonstrate Dakota library interfaces. The classes SIM::SerialDirectApplicInterface and SIM::ParallelDirectApplicInterface demonstrate serial and parallel simulation function evaluation plug-ins. The file library_mode.cpp includes a main program that exercises Dakota libraries in serial and parallel modes with these mock simulator programs, with various ways of configuring Dakota problem definition and operation. Finally, library_split.cpp demonstrates running Dakota as a library modular on an MPI sub-communicator.

### 5.2 Basic Dakota library instantiation

The function run_dakota_parse() in library_mode.cpp demonstrates the basic use of Dakota library objects as one would in another main application that embeds Dakota. In this example, Dakota is configured based on a typical user-provided text-based Dakota input file (the same that would be provided at the command line with dakota -i dakota_optimization.in) and a function evaluator derived from a DirectApplicInterface is plugged into the Dakota library environment.

First, an object of type ProgramOptions which manages top-level Dakota settings is instantiated and configured to specify the name of the Dakota user input file. Additional options for output and error redirection, restart operation, and more may be set via ProgramOptions. See its class documentation for details.

```cpp
string dakota_input_file = "dakota_optimization.in";
Dakota::ProgramOptions opts;
opts.input_file(dakota_input_file);
```

Next, a LibraryEnvironment is created, passing the desired settings from opts:

```cpp
Dakota::LibraryEnvironment env(opts);
```

This standard constructor will parse the specified input and create Dakota objects. It assumes many default settings, including that the parent application initialized MPI if running in parallel mode. (In this case, Dakota will detect whether MPI was initialized and not call MPI_Init or MPI_Finalize.) For more advanced use cases described below, alternate constructors allow constructing based on MPI communicators, with delayed finalization, and with Dakota database update function callbacks. Then the application’s function evaluator implementing Dakota’s DirectApplicInterface is plugged in with a convenience function serial_interface_plugin() or parallel_interface_plugin(). Finally, the Dakota analysis is run by calling

```cpp
env.execute();
```

The next two sections offer additional details on (1) alternative and supplementary ways to configure Dakota’s operation (Configuring Dakota operation) and (2) how to specialize Dakota’s DirectApplicInterface to provide a function evaluator plugin to Dakota (Creating a simulator plugin interface).
5.3. Configuring Dakota Operation

Remarks

After `LibraryEnvironment` construction, all MPI communicator partitioning has been performed and the `ParallelLibrary` instance may be interrogated for parallel configuration data. For example, the lowest level communicators in Dakota’s multilevel parallel partitioning are the analysis communicators, which can be retrieved using:

```cpp
// retrieve the set of analysis communicators for simulation initialization:
// one analysis comm per ParallelConfiguration (PC), one PC per Model.
Array<MPI_Comm> analysis_comms = parallel_lib.analysis_intra_communicators();
```

These communicators can then be used for initializing parallel simulation instances when registering the plugin interface, where the number of MPI communicators in the array corresponds to one communicator per `ParallelConfiguration` instance. This is demonstrated below in `Derivation`.

5.3 Configuring Dakota operation

This section describes several alternate ways to initially set and later manipulate Dakota’s configuration, including alternatives to using a text-based input file. The algorithm configuration for a particular Dakota analysis run is managed in its `ProblemDescDB`, which can be populated via an input file, string literal, or C++ API, and later modified through Dakota’s C++ API. All Dakota objects then draw information from this database upon instantiation.

5.3.1 Input data parsing

The simplest way for an application to configure a Dakota analysis problem is to use Dakota’s normal input parsing system to populate its problem database (`ProblemDescDB`). This is done by providing standard Dakota input file syntax through the library interface, via either a file name or string literal. An advantage is that native Dakota syntax can be used, but disadvantages include the requirement for an additional input file beyond those already required by the parent application and that application users also need to know Dakota syntax.

The two ways to configure Dakota via input parsing are shown near the beginning of `run_dakota_mixed()` in `library_mode.cpp`. Here the `ProgramOptions` are set to either parse from a named file:

```cpp
Dakota::ProgramOptions opts;
opts.input_file(dakota_input_file);
```

or from a string literal provided by the wrapping application:

```cpp
string serial_input = "# Dakota input file ...";
opts.input_string(serial_input);
```

This library approach is coarse-grained in that input is parsed, objects constructed, and the environment is immediately ready to run. The next approaches are more modular.

5.3.2 Problem database insertion

A second approach to configuring Dakota’s operation is to bypass parsing phases and directly populate the `ProblemDescDB` with information on the methods, variables, interface, responses, etc., that define the Dakota analysis problem. This approach requires more interaction with Dakota classes and data structures. However, it can offer usability benefit when the integrating application does not want their users to interact with the full Dakota syntax, or efficiency benefit when for example there are a large number of variables to configure.

In the direct database population approach, Dakota `DataMethod`, `DataModel`, `DataVariables`, `DataInterface`, and `DataResponses` objects are instantiated and populated with the desired problem data. These objects are then
published to the problem database using `insert_nodes()` . An example of this approach is available in `run_dakota_data()` in `library_mode.cpp`, where the OPT++ Quasi-Newton method is configured to work on a plugin version of `text_book` or `rosenbrock`. The data objects are populated with their default values upon instantiation and are often sufficient for basic Dakota studies. Only the non-default values need to be specified. Moreover, the default Dakota Model is a SingleModel, so this object need not be configured unless tailoring its configuration or using a more advanced model type. Refer to the DataMethod, DataModel, DataVariables, DataInterface, and DataResponses class documentation and source code for lists of attributes and their defaults. Here is an excerpt of `run_dakota_data()` that specifies the OPT++ solver after default construction of DataMethod:

```cpp
Dakota::DataMethod dme;
Dakota::DataMethodRep* dmr = dme.data_rep();
dmr->methodName = Dakota::OPTPP_QNEWTON;
```

When using direct database population, it is critical to leave the database in an open, accessible state after initial construction. In this `run_dakota_data()` example, a flag `check_bcast_construct` is passed into the `LibraryEnvironment` constructor, indicating that it should not finalize the database and construct Dakota objects. Moreover, it is only necessary to populate the database on rank 0 of the MPI Comm on which Dakota is running. After database objects are inserted or adjusted, the `LibraryEnvironment::done_modifying_db()` function must be called before proceeding to execute. This synchronizes problem data across all ranks and constructs Dakota objects needed to run the specified analysis.

```cpp
bool check_bcast_construct = false;
Dakota::LibraryEnvironment env(MPI_COMM_WORLD, opts, check_bcast_construct);
if (rank == 0)
  // insert/modify DB, then lock and proceed:
  env.done_modifying_db();
  env.execute();
```

### 5.3.3 Mixed mode, callbacks, and late updates

The LibraryEnvironment API also supports mixed approaches that combine the parsing of a Dakota input file (or input string literal) with direct database updates. This approach is motivated by large-scale applications where large vectors are cumbersome to specify in a Dakota input file or where later updates to an input template are needed. The example `run_dakota_mixed()` in `library_mode.cpp` demonstrates the combination of these more advanced approaches: (1) input text parsing, (2) database updates via a callback, (3) database updates via direct manipulation, and (4) further runtime updates to the Model before running.

First, a `ProgramOptions` class is instantiated and configured to parse either an input file or input string literal (as in earlier examples). The passed input data must contain all required inputs so the parser can validate them. Since vector data like variable values/bounds/tags, linear/nonlinear constraint coefficients/bounds, etc., are optional, these potentially large vector specifications can be omitted from the input file and updated later through the database API. Only the variable/response counts necessary for sizing, e.g.:

```cpp
method
  linear_inequality_constraints = 500

variables
  continuous_design = 1000

responses
  objective_functions = 1
  nonlinear_inequality_constraints = 100000
```

and not the lists of values are required in this case. To update or add data after this initial parse, we use the ProblemDescDB::set() family of overloaded functions, e.g.

```cpp
Dakota::RealVector drv(1000, 1.); // vector of length 1000, values initialized to 1.
problem_db.set("variables.continuous_design.initial_point", drv);
```
where the string identifiers are the same identifiers used when pulling information from the database using one of the get_<datatype>() functions (refer to ProblemDescDB for a full list). However, the supported ProblemDescDB::set() options are a restricted subset of the database attributes, focused on vector inputs that can be large scale.

Second, the example demonstrates a user-provided callback function which Dakota will invoke after input parsing to update ProblemDescDB. In library_mode.cpp, callback_function() is a user-provided post-parse callback that implements the type Dakota::DbCallbackFunction.

static void callback_function(Dakota::ProblemDescDB* db, void *ptr);

When Dakota calls this function it will pass back pointers to the ProblemDescDB instance and to user-provided data, so the application may convey its settings by calling methods on the ProblemDescDB, optionally using the provided data. An example of a user data structure is demonstrated in callback_data. In this case, when the LibraryEnvironment is constructed, it is constructed with the input data to initially parse, the callback function, and to leave it unlocked for further updates:

```cpp
bool done_with_db = false;
Dakota::LibraryEnvironment env(opts, done_with_db,
        callback_function, &data);
```

Third, the example demonstrates changes to the database after parsing and callback-based updates. Again, these only need happen on Dakota’s rank 0 before finalizing the DB with LibraryEnvironment::done_modifying_db(). The example demonstrates:

1. Getting access to the database through env.problem_description_db()
2. Setting the database nodes to the appropriate method through problem_db.resolve_top_method()
3. Getting data from the DB with a get string array function: problem_db.get_sa("interface.application.-analysis_drivers")
4. Setting update data with problem_db.set("variables.continuous_design.initial_point", ip);

After any of these three types updates, calling LibraryEnvironment::done_modifying_db() will broadcast any updates (including potentially large vector data and post-process specification data to fill in any vector defaults that have not yet been provided through either file parsing or direct updates. (Note: scalar defaults are handled in the Data class constructors.)

Fourth and finally, run_dakota_mixe() demonstrates modifying a Model’s data after database operations and interface plugin are complete. This involves finding the right Model (or other class) instance to modify, and directly adjusting its data through the public API. Since the database is finalized, any updates must be performed through direct set operations on the constructed objects. For example, to update other data such as variable values/bounds/tags or response bounds/targets/tags, refer to the set functions documented in Iterator and Model. As an example, the following code updates the active continuous variable values, which will be employed as the initial guess for certain classes of Iterators:

```cpp
ModelList& all_models = problem_db.model_list();
Model& first_model = all_models.begin();
Dakota::RealVector drv(1000, 1.); // vector of length 1000, values initialized to 1.
first_model.continuous_variables(drv);
```
CHAPTER 5. INTERFACING WITH DAKOTA AS A LIBRARY

Remarks

If performing such data updates within the constructor of a DirectApplicInterface extension/derivation (see Creating a simulator plugin interface), then this code is sufficient since the database is unlocked, the active list nodes of the ProblemDescDB have been set for you, and the correct method/model/variables/interface/responses specification instance will get updated. The difficulty in this case stems from the order of instantiation. Since the Variables and Response instances are constructed in the base Model class, prior to construction of Interface instances in derived Model classes, database information related to Variables and Response objects will have already been extracted by the time the Interface constructor is invoked and the database update will not propagate.

Therefore, it is preferred to perform these database set operations at a higher level (e.g., within your main program), prior to allowing Environment to broadcast, construct, and execute, such that instantiation order is not an issue. However, in this case, it is necessary to explicitly manage the list nodes of the ProblemDescDB using a specification instance identifier that corresponds to an identifier from the input file, e.g.:

```cpp
problem_db.set_db_variables_node("MY_VARIABLES_ID");
Dakota::RealVector drv(1000, 1.); // vector of length 1000, values initialized to 1.
problem_db.set("variables.continuous.design.initial_point", drv);
```

Alternatively, rather than setting just a single data node, all data nodes may be set using a method specification identifier:

```cpp
problem_db.set_db_list_nodes("MY_METHOD_ID");
```

since the method specification is responsible for identifying a model specification, which in turn identifies variables, interface, and responses specifications. If hard-wiring specification identifiers is undesirable, then

```cpp
problem_db.resolve_top_method();
```

can also be used to deduce the active method specification and set all list nodes based on it. This is most appropriate in the case where only single specifications exist for method/model/variables/interface/responses. This is the approach demonstrated in run_dakota_mixed(). In each of these cases, setting list nodes unlocks the corresponding portions of the database, allowing set/get operations.

5.4 Creating a simulator plugin interface

The DirectApplicInterface class provides an interface for Dakota to call the simulation code directly to perform function evaluations mapping variables to responses. This provides the "back end" for Dakota to call back to the simulation framework. Two approaches to defining this direct interface are described here. The first is less common, while the second is recommended when possible.

5.4.1 Extension

The first approach involves extending one of the existing DirectApplicInterface subclasses (TestDriverInterface, MatlabInterface, etc.) to support additional direct simulation interfaces. For example, Dakota algebraic test problems are implemented in TestDriverInterface. One could add additional direct functions to Dakota in TestDriverInterface::derived_map_ac(). In addition, TestDriverInterface::derived_map_if() and TestDriverInterface::derived_map_of() can be extended to perform pre- and post-processing tasks if desired, but this is not required.

While this approach is the simplest, it has the disadvantage that the Dakota library will need to be recompiled when the simulation or its direct interface is modified. If it is desirable to maintain the independence of the Dakota library from the host application, then the derivation approach described in the next section should be employed.
5.4. CREATING A SIMULATOR PLUGIN INTERFACE

Remarks

If the new direct evaluation function implementation will not be a member function of one of the Dakota classes, then the following prototype should be used in order to pass the required data:

```cpp
int sim(const Dakota::Variables& vars, const Dakota::ActiveSet& set, Dakota::Response& response);
```

If the new function will be a member function, e.g., in TestDriverInterface, then this can be simplified to

```cpp
int sim();
```

since the data access can be performed through the DirectApplicInterface class attributes.

5.4.2 Derivation

The second approach is to derive a new interface from DirectApplicInterface and redefine several virtual functions. As demonstrated in SIM::SerialDirectApplicInterface and SIM::ParallelDirectApplicInterface, a typical derived class declaration might be

```cpp
namespace SIM {

class SerialDirectApplicInterface: public Dakota::DirectApplicInterface {
public:

// Constructor and destructor
SerialDirectApplicInterface(const Dakota::ProblemDescDB& problem_db);
SerialDirectApplicInterface();

protected:

// Virtual function redefinitions
int derived_map_if(const Dakota::String& if_name);
int derived_map_ac(const Dakota::String& ac_name);
int derived_map_of(const Dakota::String& of_name);

private:

// Data
}
} // namespace SIM
```

where the new derived class resides in the simulation’s namespace. Similar to the case of Extension, the DirectApplicInterface::derived_map_ac() function is the required redefinition, and DirectApplicInterface::derived_map_if() and DirectApplicInterface::derived_map_of() are optional.

Typically the new derived_map_ac() implementation delegates to the main simulation application for a function evaluation. Here Dakota variables would get mapped into the simulation’s data structures, the simulation executed, and derived response data computed for return to Dakota.

Once a derived application class is created, it must be plugged in, or registered, with the appropriate Interface in the LibraryEnvironment. In MPI cases where Dakota is potentially managing concurrent evaluations of the simulation, the plugin must be configured to run on the right MPI sub-communicator, or Dakota analysis comm. The simpler case is demonstrated in serial INTERFACE Plugin in library_mode.cpp, while a more advanced case using the analysis communicator is shown in parallel INTERFACE Plugin.

The Dakota LibraryEnvironment provides a convenience function to plugin an Interface. This example will replace any interface found matching the given model, interface, and analysis driver with the passed plugin interface:
std::string model_type("" ); // demo: empty string will match any model type
std::string interf_type("direct");
std::string an_driver("plugin_rosenbrock" );
Dakota::ProblemDescDB& problem_db = env.problem_description_db();
Dakota::Interface* serial_iface = new SIM::SerialDirectApplicInterface(problem_db);

bool plugged_in =
env.plugin_interface(model_type, interf_type, an_driver, serial_iface);

The LibraryEnvironment also provides convenience functions that allow the client to iterate the lists of available interfaces or models for more advanced cases. For instance if the client knows there is only a single interface active, it could get the list of available interfaces of length 1 and plug into the first one. In the more advanced case where the simulation interface instance should manage parallel simulations within the context of an MPI communicator, one should pass in the relevant analysis communicator(s) to the derived constructor. For the latter case of looping over a set of models, the simplest approach of passing a single analysis communicator would use code similar to

Dakota::ModelList filt_models =
env.filtered_model_list("single", "direct", "plugin_text_book");
Dakota::ProblemDescDB& problem_db = env.problem_description_db();
Dakota::ModelIter ml_iter;
for (ml_iter = filt_models.begin(); ml_iter != filt_models.end(); ++ml_iter) {
  // set DB nodes to input specification for this Model
  problem_db.set_db_model_nodes(ml_iter->model_id());
  Dakota::Interface& model_interface = ml_iter->derived_interface();
  // Parallel case: plug in derived Interface object with an analysisComm.
  // Note: retrieval and passing of analysisComm is necessary only if
  // parallel operations will be performed in the derived constructor.
  // retrieve the currently active analysisComm from the Model. In the most
  // general case, need an array of Comms to cover all Model configurations.
  const MPI_Comm& analysis_comm = ml_iter->analysis_comm();
  // don’t increment ref count since no other envelope shares this letter
  model_interface.assign_rep(new SIM::ParallelDirectApplicInterface(problem_db, analysis_comm), false);
}

The file library_mode.cpp demonstrates each of these approaches. Since a Model may be used in multiple parallel contexts and may therefore have a set of parallel configurations, a more general approach would extract and pass an array of analysis communicators to allow initialization for each of the parallel configurations.

New derived direct interface instances inherit various attributes of use in configuring the simulation. In particular, the ApplicationInterface::parallelLib reference provides access to MPI communicator data (e.g., the analysis communicators discussed above), DirectApplicInterface::analysisDrivers provides the analysis driver names specified by the user in the input file, and DirectApplicInterface::analysisComponents provides additional analysis component identifiers (such as mesh file names) provided by the user which can be used to distinguish different instances of the same simulation interface. It is worth noting that inherited attributes that are set as part of the parallel configuration (instead of being extracted from the ProblemDescDB) will be set to their defaults following construction of the base class instance for the derived class plug-in. It is not until run-time (i.e., within derived_map_if/derived_map_ac/derived_map_of) that the parallel configuration settings are re-propagated to the plug-in instance. This is the reason that the analysis communicator should be passed into the constructor of a parallel plug-in, if the constructor will be responsible for parallel application initialization.
5.5 Retrieving data after a run

After executing the Dakota Environment, final results can be obtained through the use of Environment::variables_results() and Environment::response_results(), e.g.:

```cpp
// retrieve the final parameter values
const Variables& vars = env.variables_results();

// retrieve the final response values
const Response& resp = env.response_results();
```

In the case of optimization, the final design is returned, and in the case of uncertainty quantification, the final statistics are returned. Dakota has a prototype results database, which will eventually provide better access to the results from a study.

5.6 Linking against the Dakota library

This section presumes Dakota has been configured with CMake, compiled, and installed to a CMAKE_INSTALL_PREFIX using make install or equivalent. The Dakota libraries against which you must link will typically install to CMAKE_INSTALL_PREFIX/bin/ and CMAKE_INSTALL_PREFIX/lib/, while headers are provided in CMAKE_INSTALL_PREFIX/include/. The core Dakota C and C++ code is in the library dakota-src, while Fortran code lives in the dakota_src_fortran library. Runtime libraries for any configure-enabled Dakota third-party software components (such as DOT, NPSOL, OPT++, LHS, etc.) are also installed to the lib/ directory. Applications link against these Dakota libraries by specifying appropriate include and link directives.

There are two primary ways to determine the necessary Dakota-related libraries and link order for linking your application. First, when running CMake, a list of required Dakota and Dakota-included third-party libraries will be output to the console, e.g.,

```plaintext
-- Dakota_LIBRARIES: dakota-src; dakota-src_fortran; nitr; teuchos; pecos; pecos-src; lhs; mods; mod; fftpack; sparseglobal
```

While external dependencies will be output as:

```plaintext
-- Dakota_TPL_LIBRARIES: /usr/lib64/libcurl.so; /usr/lib64/openmpi/lib/libmpi_cxx.so; debug;/usr/lib64/libz.so; ...
```

Note that depending on how you configured Dakota, some libraries may be omitted from these lists (for example commercial add-ons NPSOL, DOT, and NLPQL), or additional libraries may appear.

A second option is to check which libraries appear in CMAKE_INSTALL_PREFIX/bin/ CMAKE_INSTALL_L_PREFIX/lib/, or more accurately, see the file Makefile.export.Dakota in the Dakota build/src/ or installation include/ directory. Here are some additional notes on specific libraries:

- Some Boost libraries (boost_regex, boost_filesystem, boost_system, boost_serialization) are required, and other Boost library components may be required depending on configuration, e.g., boost-sig when configuring with HAVE_ACRO=BOOL=TRUE

- System compiler and math libraries may need to be included, as may additional system libraries such as Expat and Curl, depending on how Dakota is configured.

- If configuring with graphics, you will need to add the dakota_sciplot library and system X libraries (partial list here):

  ```bash
  -lXpm -lXm -lXt -lXmu -lXp -lXext -lX11 -lSM -lICE
  ```
• When configuring with AMPL (HAVEAMPL:BOOL=ON), the AMPL solver library may require dl, funcadd0.o, and fl libraries. We have experienced problems with the creation of libamplsolver.a on some platforms; use the dakota-users mailing list to get help with any problems related to this.

• Optional library GSL (discouraged due to GPL license) and if linking with system-provided GSL, gslcblas may be needed if Dakota was configured with them.

• Newmat: as of Dakota 5.2, -lnewmat is no longer required.

Finally, it is important to use the same C++ compiler (possibly an MPI wrapper) for compiling Dakota and your application and potentially include Dakota-related preprocessor defines as emitted by CMake during compilation of Dakota and included in Makefile.export.Dakota. This ensures that the platform configuration settings are properly synchronized across Dakota and your application.
Chapter 6

Performing Function Evaluations

Performing function evaluations is one of the most critical functions of the Dakota software. It can also be one of the most complicated, as a variety of scheduling approaches and parallelism levels are supported. This complexity manifests itself in the code through a series of cascaded member functions, from the top level model evaluation functions, through various scheduling routines, to the low level details of performing a system call, fork, or direct function invocation. This section provides an overview of the primary classes and member functions involved.

6.1 Synchronous function evaluations

For a synchronous (i.e., blocking) mapping of parameters to responses, an iterator invokes Model::evaluate() to perform a function evaluation. This function is all that is seen from the iterator level, as underlying complexities are isolated. The binding of this top level function with lower level functions is as follows:

- Model::evaluate() utilizes Model::derived_evaluate() for portions of the response computation specific to derived model classes.
- Model::derived_evaluate() directly or indirectly invokes Interface::map().
- Interface::map() utilizes ApplicationInterface::derived_map() for portions of the mapping specific to derived application interface classes.

6.2 Asynchronous function evaluations

For an asynchronous (i.e., nonblocking) mapping of parameters to responses, an iterator invokes Model::evaluate_nowait() multiple times to queue asynchronous jobs and then invokes either Model::synchronize() or Model::synchronize_nowait() to schedule the queued jobs in blocking or nonblocking fashion. Again, these functions are all that is seen from the iterator level, as underlying complexities are isolated. The binding of these top level functions with lower level functions is as follows:

- Model::evaluate_nowait() utilizes Model::derived_evaluate_nowait() for portions of the response computation specific to derived model classes.
- This derived model class function directly or indirectly invokes Interface::map() in asynchronous mode, which adds the job to a scheduling queue.
- Model::synchronize() or Model::synchronize_nowait() utilize Model::derived_synchronize() or Model::derived_synchronize_nowait() for portions of the scheduling process specific to derived model classes.
• These derived model class functions directly or indirectly invoke \texttt{Interface::synch()} or \texttt{Interface::synch觐nowait(\texttt{)}}.

• For application interfaces, these interface synchronization functions are responsible for performing evaluation scheduling in one of the following modes: master dynamic, peer dynamic or peer static.

• \textsc{NOTE}: The \textit{Interface} evaluation scheduling in Dakota was refactored for releases 5.4 and 6.0. Discussion of the new \textit{Interface}-related functions is currently missing here.

### 6.3 Analyses within each function evaluation

\textsc{NOTE}: The \textit{Interface} evaluation scheduling in Dakota was refactored for releases 5.4 and 6.0. Discussion of the new \textit{Interface}-related functions for analyses is currently missing here.

The discussion above covers the parallelism level of concurrent function evaluations serving an iterator. For the parallelism level of concurrent analyses serving a function evaluation, similar schedulers are involved to support synchronous local, asynchronous local, message passing, and hybrid modes. Not all of the schedulers are elevated to the \texttt{ApplicationInterface} level since the system call and direct function interfaces do not yet support nonblocking local analyses (and therefore support synchronous local and message passing modes, but not asynchronous local or hybrid modes). Fork interfaces, however, support all modes of analysis parallelism.
Chapter 7

Working with Variable Containers and Views

Variable views control the subset of variable types that are active and inactive within a particular iterative study. For design optimization and uncertainty quantification (UQ), for example, the active variables view consists of design or uncertain types, respectively, and any other variable types are carried along invisible to the iterative algorithm being employed. For parameter studies and design of experiments, however, a variable subset view is not imposed and all variables are active. Selected UQ methods can also be toggled into an “All” view using the `active all` variables input specification. When not in an All view, finer gradations within the uncertain variable sets are also relevant: probabilistic methods (reliability, stochastic expansion) view aleatory uncertain variables as active, nonprobabilistic methods (interval, evidence) view epistemic uncertain variables as active, and a few UQ methods (sampling) view both as active. In a more advanced NestedModel use case such as optimization under uncertainty, design variables are active in the outer optimization context and the uncertain variables are active in the inner UQ context, with an additional requirement on the inner UQ level to return derivatives with respect to its “inactive” variables (i.e., the design variables) for use in the outer optimization loop.

For efficiency, contiguous arrays of data store variable information for each of the domain types (continuous, discrete integer, and discrete real), but active and inactive views into them permit selecting subsets in a given context. This management is encapsulated into the Variables and SharedVariablesData classes. This page clarifies concepts of relaxed (formerly merged) vs. mixed, fine-grained vs. aggregated types, domain types, and views into contiguous arrays.

We begin with an overview of the storage and management concept, for which the following two sections describe the storage of variable values and meta-data about their organization, used in part to manage views. They are intended to communicate rationale to maintainers of Variables and SharedVariablesData classes. The final section provides a discussion of active and inactive views.

7.1 Storage in Variables

As described in the Main Page Variables, a Variables object manages variable types (design, aleatory uncertain, epistemic uncertain, and state) and domain types (continuous, discrete integer, and discrete real) and supports different approaches to either distinguishing among these types or aggregating them. Two techniques are used in cooperation to accomplish this management: (1) class specialization (RelaxedVariables or MixedVariables) and (2) views into contiguous variable arrays. The latter technique is used whenever it can satisfy the requirement, with fallback to class specialization when it cannot. In particular, aggregation or separation of variable types can be accomplished with views, but for aggregation or separation of variable domains, we must resort to class
specialization in order to relax discrete domain types. In this class specialization, a `RelaxedVariables` object combines continuous and discrete types (relaxing integers to reals) whereas a `MixedVariables` object maintains the integer/real distinction throughout.

The core data for a `Variables` instance is stored in a set of three contiguous arrays, corresponding to the domain types: `allContinuousVars`, `allDiscreteIntVars`, and `allDiscreteRealVars`, unique to each `Variables` instance.

Within the core variable data arrays, data corresponding to different aggregated variable types are stored in sequence for each domain type:

- continuous: [design, aleatory uncertain, epistemic uncertain, state]
- discrete integer: [design, aleatory uncertain, (epistemic uncertain), state]
- discrete real: [design, aleatory uncertain, (epistemic uncertain), state]

Note there are currently no epistemic discrete variables. This domain type ordering (continuous, discrete integer, discrete real) and aggregated variable type ordering (design, aleatory uncertain, epistemic uncertain, state) is preserved whenever distinct types are flattened into single contiguous arrays. Note that the aleatory and epistemic uncertain variables contain sub-types for different distributions (e.g., normal, uniform, histogram, poisson), and discrete integer types include both integer ranges and integer set sub-types. All sub-types are ordered according to their order of appearance in `dakota.input.nspec`.

When relaxing in `MixedVariables`, the `allContinuousVars` will also aggregate the discrete types, such that they contain ALL design, then ALL uncertain, then ALL state variables, each in aggregated type order; the `allDiscreteIntVars` and `allDiscreteRealVars` arrays are empty.

### 7.2 Storage in SharedVariablesData

Each `Variables` instance contains a reference-counted `SharedVariablesData` object that stores information on the variables configuration. This configuration data includes counts, types, IDs, and labels, which are often the same across many `Variables` instances. Thus, `SharedVariablesData` is intended to reduce the memory footprint by allowing the sharing of a single copy of redundant information among different `Variables` instances.

One of the purposes of this shared information is to support mappings between variable types, IDs, and indices into the storage arrays. Variable "types" refer to the fine-grained variable types a user would specify in an input file, as enumerated in `DataVariables.hpp`, e.g., CONTINUOUS, DESIGN, WEIBULL_UNCERTAIN, DISCRETE_STATE_RANGE, etc. `variablesComponents` is a map from these variable types to counts of how many are present.

In contrast, the `variablesCompsTotals` array stores total counts of each "aggregated type" (design, aleatory uncertain, epistemic uncertain, state) which might be selected to be active in a given view. Thus this array has length 12 to track the combinations of three domain type storage arrays with four possible aggregated variable types: {continuous, discrete integer, discrete real} x {design, aleatory uncertain, epistemic uncertain, state}. For example, the first entry of this array stores the number of continuous design variables, the second the number of discrete integer design (including both discrete design range and discrete design set integer types), and the last the number of discrete real state variables.

The arrays `allContinuousTypes`, `allDiscreteIntTypes`, and `allDiscreteRealTypes` are sized to match the corresponding core domain type storage arrays. They track the fine-grained variable type stored in that entry of the data array (since when relaxed, the continuous array may be storing data corresponding to discrete data).

Finally `allContinuousIds` stores the 1-based IDs of the variables stored in the `allContinuousVars` array, i.e., the variable number of all the problem variables considered as a single contiguous set, in aggregate type order. For relaxed (formerly merged) views, `relaxedDiscreteIds` stores the 1-based IDs of the variables which have been relaxed into the continuous array.
These counts, types, and IDs are most commonly used within the Model classes for mappings between variables objects at different levels of a model recursion. See, for example, the variable mappings in the NestedModel constructor.

7.3 Active and inactive views

The pair SharedVariablesDataRep::variablesView tracks the active and inactive views of the data, with values taken from the enum in DataVariables.hpp. The valid values include EMPTY and the combinations \{relaxed, mixed\} x \{all, design, aleatory uncertain, epistemic uncertain, uncertain, state\}. The ALL cases indicate aggregation of the design, aleatory uncertain, epistemic uncertain, and state types, whereas the DISTINCT cases indicate either no aggregation (design, aleatory uncertain, epistemic uncertain, state) or reduced aggregation (aleatory+epistemic uncertain). The active view is determined by the algorithm in use, managed in Variables::getView(). Any inactive view is set based on higher level iteration within a model recursion (e.g., a NestedModel), which enables lower level iteration to return derivatives with respect to variables that are active at the higher level. In the case where there is no higher level iteration, then the inactive view will remain EMPTY. It is important to stress that "inactive" at one level corresponds to active at another, and therefore the inactive set of variables should not be interpreted as the strict complement of the active set of variables; rather, active and inactive are both subsets whose union may still be a subset of the total container (more precise terminology might involve "primary" active and "secondary" active or similar). An active complement view could potentially be supported in the future, should the need arise, although this view would require management of non-contiguous portions of the aggregated arrays.

Given these groupings (views), the active and inactive subsets of the allContinuousVars, allDiscreteIntVars, and allDiscreteRealVars arrays are always contiguous, permitting vector views of the underlying data using either Teuchos::View (for numerical vectors) or Boost.MultiArray (for book-keeping arrays) views.

When a Variables envelope is constructed, its letter is initialized to either a RelaxedVariables or Mixed-Variables object depending on the active view. The derived classes size the contiguous storage arrays to accommodate all the problem variables, and then initialize active views into them, which could involve either subsets (DISTINCT active views) or views of the full arrays (ALL active views). Inactive views, on the other hand, are initialized during construction of a model recursion (e.g., a call to Model::inactiveView() in the NestedModel constructor). Thus, active variable subsets are always available but inactive variable subsets will be EMPTY prior to them being initialized within a Model recursion.

Accessors for continuous variables include:

- continuous_variables(): returns the active view which might return all (ALL views) or a subset (DISTINCT views) such as design, uncertain, only aleatory uncertain, etc.
- inactive_continuous_variables(): returns the inactive view which is either a subset or empty
- all_continuous_variables(): returns the full vector allContinuousVars

and this pattern is followed for active/inactive/all access to discrete_int_variables() and discrete_real_variables() as well as for labels, IDs, and types in SharedVariablesData and variable bounds in Constraints.

Member SurfpackApproximation::build()

Right now, we’re completely deleting the old data and then recopying the current data into a SurfData object. This was just the easiest way to arrive at a solution that would build and run. This function is frequently called from addPoint rebuild, however, and it’s not good to go through this whole process every time one more data point is added.

Member SurfpackApproximation::hessian(const RealVector &c_vars)

Make this acceptably efficient
Member `SurfpackApproximation::hessian` (const Variables &vars)

Make this acceptably efficient
Chapter 8

Namespace Index

8.1 Namespace List

Here is a list of all documented namespaces with brief descriptions:

- **Dakota**
  - The primary namespace for DAKOTA .......................... 73
- **SIM**
  - A sample namespace for derived classes that use assign_rep() to plug facilities into DAKOTA 254
Chapter 9

Hierarchical Index

9.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

- ActiveSet .................................................. 255
- Approximation ............................................. 286
  - GaussProcApproximation ................................. 455
  - PecosApproximation .................................. 772
  - SurpackApproximation ................................ 912
  - TANA3Approximation .................................. 936
  - TaylorApproximation .................................. 939
  - VPSApproximation ..................................... 963
- APPSEvalMgr ............................................... 299
- ApreproWriter ............................................ 304
- BaseConstructor .......................................... 305
- BootstrapSamplerBase< Data > ............................. 307
  - BootstrapSampler< Data > ............................... 307
  - BootstrapSamplerWithGS< Data, Getter, Setter > ....... 309
- BootstrapSamplerBase< Teuchos::SerialDenseMatrix< OrdinalType, ScalarType > > .............. 307
  - BootstrapSampler< Teuchos::SerialDenseMatrix< OrdinalType, ScalarType > > .................. 306
- callback_data ............................................. 310
- COLINApplication ......................................... 310
- CommandShell ............................................. 320
- ConsoleRedirector ........................................ 332
- Constraints ............................................... 333
  - MixedVarConstraints ..................................... 525
  - RelaxedVarConstraints ................................. 830
- DataEnvironment .......................................... 343
- DataEnvironmentRep ...................................... 344
- DataInterface ............................................. 359
- DataMethod ............................................... 360
- DataMethodRep ............................................. 361
- DataModel .................................................. 376
- DataModelRep .............................................. 377
## CHAPTER 9. HIERARCHICAL INDEX

<table>
<thead>
<tr>
<th>Category</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DataResponses</td>
<td>382</td>
</tr>
<tr>
<td>DataResponsesRep</td>
<td>383</td>
</tr>
<tr>
<td>DataVariables</td>
<td>390</td>
</tr>
<tr>
<td>DataVariablesRep</td>
<td>392</td>
</tr>
<tr>
<td>DiscrepancyCorrection</td>
<td>413</td>
</tr>
<tr>
<td>JEGAOptimizer::Driver</td>
<td>421</td>
</tr>
<tr>
<td>Environment</td>
<td>427</td>
</tr>
<tr>
<td>ExecutableEnvironment</td>
<td>439</td>
</tr>
<tr>
<td>LibraryEnvironment</td>
<td>511</td>
</tr>
<tr>
<td>NomadOptimizer::Evaluator</td>
<td>431</td>
</tr>
<tr>
<td>JEGAOptimizer::Evaluator</td>
<td>433</td>
</tr>
<tr>
<td>JEGAOptimizer::EvaluatorCreator</td>
<td>438</td>
</tr>
<tr>
<td>ExperimentData</td>
<td>439</td>
</tr>
<tr>
<td>FileReadException</td>
<td>449</td>
</tr>
<tr>
<td>ResultsFileError</td>
<td>845</td>
</tr>
<tr>
<td>TabularDataTruncated</td>
<td>935</td>
</tr>
<tr>
<td>FunctionEvalFailure</td>
<td>455</td>
</tr>
<tr>
<td>GeneralReader</td>
<td>460</td>
</tr>
<tr>
<td>GeneralWriter</td>
<td>461</td>
</tr>
<tr>
<td>GetLongOpt</td>
<td>461</td>
</tr>
<tr>
<td>CommandLineHandler</td>
<td>319</td>
</tr>
<tr>
<td>Graphics</td>
<td>464</td>
</tr>
<tr>
<td>Interface</td>
<td>472</td>
</tr>
<tr>
<td>ApplicationInterface</td>
<td>270</td>
</tr>
<tr>
<td>DirectApplicInterface</td>
<td>409</td>
</tr>
<tr>
<td>MatlabInterface</td>
<td>515</td>
</tr>
<tr>
<td>PythonInterface</td>
<td>812</td>
</tr>
<tr>
<td>ScilabInterface</td>
<td>860</td>
</tr>
<tr>
<td>TestDriverInterface</td>
<td>940</td>
</tr>
<tr>
<td>ParallelDirectApplicInterface</td>
<td>745</td>
</tr>
<tr>
<td>SerialDirectApplicInterface</td>
<td>867</td>
</tr>
<tr>
<td>ProcessApplicInterface</td>
<td>794</td>
</tr>
<tr>
<td>ProcessHandleApplicInterface</td>
<td>798</td>
</tr>
<tr>
<td>ForkApplicInterface</td>
<td>449</td>
</tr>
<tr>
<td>SpawnApplicInterface</td>
<td>910</td>
</tr>
<tr>
<td>SysCallApplicInterface</td>
<td>932</td>
</tr>
<tr>
<td>GridApplicInterface</td>
<td>466</td>
</tr>
<tr>
<td>ApproximationInterface</td>
<td>293</td>
</tr>
<tr>
<td>Iterator</td>
<td>481</td>
</tr>
<tr>
<td>Analyzer</td>
<td>263</td>
</tr>
<tr>
<td>NonD</td>
<td>599</td>
</tr>
<tr>
<td>NonDCalibration</td>
<td>625</td>
</tr>
<tr>
<td>NonDBayesCalibration</td>
<td>619</td>
</tr>
<tr>
<td>NonDDREAMBayesCalibration</td>
<td>630</td>
</tr>
<tr>
<td>NonDGPMASBayesCalibration</td>
<td>652</td>
</tr>
<tr>
<td>NonDQUESOBayesCalibration</td>
<td>699</td>
</tr>
<tr>
<td>NonDWASABIBayesCalibration</td>
<td>723</td>
</tr>
</tbody>
</table>
9.1. CLASS HIERARCHY

NonDExpansion ................................................. 634
NonDPolynomialChaos ........................................... 689
NonDStochCollocation ......................................... 721
NonDIntegration ................................................. 655
NonDCubature .................................................... 628
NonDQuadrature ................................................. 695
NonDSparseGrid .................................................. 718
NonDInterval ..................................................... 658
NonDGlobalInterval ............................................. 642
NonDGlobalEvidence ............................................ 640
NonDGlobalSingleInterval ...................................... 648
NonDLHSInterval .................................................. 661
NonDLHSEvidence ............................................... 660
NonDLHSSingleInterval ......................................... 666
NonDLocalInterval ............................................... 668
NonDLocalEvidence .............................................. 667
NonDLocalSingleInterval ....................................... 680
NonDPOFDarts ..................................................... 686
NonDReliability .................................................. 705
NonDGlobalReliability .......................................... 645
NonDLocalReliability ........................................... 670
NonDRKDDarts ..................................................... 706
NonDSampling ..................................................... 709
NonDAadaptImpSampling .......................................... 610
NonDAdaptiveSampling .......................................... 614
NonDGPImpSampling ............................................. 649
NonDLHSSampling ............................................... 662
NonDMultilevelSampling ........................................ 681
PStudyDACE ....................................................... 807
DDACEDesignCompExp ........................................... 405
FSUDesignCompExp .............................................. 451
ParamStudy ......................................................... 762
PSUADEDesignCompExp ......................................... 809
Verification ......................................................... 960
RichExtrapVerification .......................................... 850
MetaIterator ......................................................... 516
CollabHybridMetaIterator ........................................ 318
ConcurrentMetaIterator ......................................... 322
EmbedHybridMetaIterator ....................................... 425
SeqHybridMetaIterator .......................................... 864
Minimizer .......................................................... 518
LeastSq ............................................................ 508
NL2SOLLeastSq .................................................... 586
NLSSOLLeastSq .................................................... 593
SNLLLeastSq ....................................................... 898
Optimizer .......................................................... 735
APPSOptimizer ...................................................... 302
COLINOptimizer .................................................... 313
<table>
<thead>
<tr>
<th>Class Name</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONMINOptimizer</td>
<td>325</td>
</tr>
<tr>
<td>DOTOptimizer</td>
<td>417</td>
</tr>
<tr>
<td>JEGAOptimizer</td>
<td>501</td>
</tr>
<tr>
<td>NCSUOptimizer</td>
<td>566</td>
</tr>
<tr>
<td>NLPLPOptimizer</td>
<td>588</td>
</tr>
<tr>
<td>NomadOptimizer</td>
<td>596</td>
</tr>
<tr>
<td>NonlinearCGOptimizer</td>
<td>726</td>
</tr>
<tr>
<td>NPSOLOptimizer</td>
<td>729</td>
</tr>
<tr>
<td>OptDartsOptimizer</td>
<td>732</td>
</tr>
<tr>
<td>SNLLOptimizer</td>
<td>902</td>
</tr>
<tr>
<td>PebblMinimizer</td>
<td>770</td>
</tr>
<tr>
<td>SurrBasedMinimizer</td>
<td>924</td>
</tr>
<tr>
<td>EffGlobalMinimizer</td>
<td>423</td>
</tr>
<tr>
<td>SurrBasedGlobalMinimizer</td>
<td>915</td>
</tr>
<tr>
<td>SurrBasedLocalMinimizer</td>
<td>917</td>
</tr>
<tr>
<td>IteratorScheduler</td>
<td>495</td>
</tr>
<tr>
<td>LabelsWriter</td>
<td>507</td>
</tr>
<tr>
<td>LightWtBaseConstructor</td>
<td>514</td>
</tr>
<tr>
<td>MatchesWC</td>
<td>514</td>
</tr>
<tr>
<td>Model</td>
<td>528</td>
</tr>
<tr>
<td>NestedModel</td>
<td>570</td>
</tr>
<tr>
<td>RecastModel</td>
<td>820</td>
</tr>
<tr>
<td>ActiveSubspaceModel</td>
<td>257</td>
</tr>
<tr>
<td>DataTransformModel</td>
<td>387</td>
</tr>
<tr>
<td>ProbabilityTransformModel</td>
<td>777</td>
</tr>
<tr>
<td>RandomFieldModel</td>
<td>815</td>
</tr>
<tr>
<td>ScalingModel</td>
<td>853</td>
</tr>
<tr>
<td>SimulationModel</td>
<td>893</td>
</tr>
<tr>
<td>SurrogateModel</td>
<td>928</td>
</tr>
<tr>
<td>DataFitSurrModel</td>
<td>346</td>
</tr>
<tr>
<td>HierarchSurrModel</td>
<td>467</td>
</tr>
<tr>
<td>MPIManager</td>
<td>561</td>
</tr>
<tr>
<td>MPIPackBuffer</td>
<td>562</td>
</tr>
<tr>
<td>MPIUnpackBuffer</td>
<td>564</td>
</tr>
<tr>
<td>NL2Res</td>
<td>585</td>
</tr>
<tr>
<td>NoDBBaseConstructor</td>
<td>596</td>
</tr>
<tr>
<td>OutputManager</td>
<td>739</td>
</tr>
<tr>
<td>OutputWriter</td>
<td>742</td>
</tr>
<tr>
<td>ParallelConfiguration</td>
<td>743</td>
</tr>
<tr>
<td>ParallelLevel</td>
<td>746</td>
</tr>
<tr>
<td>ParallelLibrary</td>
<td>749</td>
</tr>
<tr>
<td>ParamResponsePair</td>
<td>758</td>
</tr>
<tr>
<td>partial_prp_equality</td>
<td>767</td>
</tr>
<tr>
<td>partial_prp_hash</td>
<td>767</td>
</tr>
<tr>
<td>PebblBranching</td>
<td>768</td>
</tr>
<tr>
<td>PebblBranchSub</td>
<td>769</td>
</tr>
<tr>
<td>ProblemDescDB</td>
<td>784</td>
</tr>
<tr>
<td>NIDRProblemDescDB</td>
<td>580</td>
</tr>
<tr>
<td>ProgramOptions</td>
<td>802</td>
</tr>
</tbody>
</table>
9.1. CLASS HIERARCHY

QuesoJointPdf < V, M > .................................................. 814
QuesoVectorRV < V, M > ................................................. 815
ReducedBasis ............................................................. 829
Response ................................................................. 834
  ExperimentResponse ............................................... 447
  SimulationResponse ................................................ 895
RestartWriter ......................................................... 841
ResultsDBAny .......................................................... 842
ResultsEntry < StoredType > ......................................... 844
ResultsID ............................................................... 846
ResultsManager ....................................................... 847
ResultsNames .......................................................... 849
ScalingOptions ......................................................... 859
SensAnalysisGlobal .................................................. 860
SharedApproxData ..................................................... 868
  SharedPecosApproxData ........................................... 873
  SharedSurfpackApproxData ..................................... 880
SharedResponseData ................................................ 876
SharedResponseDataRep .............................................. 879
SharedVariablesData ................................................. 882
SharedVariablesDataRep ............................................. 887
SNLLBase ............................................................... 896
  SNLLLeastSq ....................................................... 898
  SNLLOptimizer ..................................................... 902
SOLBase ............................................................... 908
  NLSSOLLeastSq .................................................... 593
  NPSOLOptimizer ................................................... 729
TabularReader ........................................................ 935
TabularWriter ........................................................ 936
TrackerHTTP .......................................................... 946
UsageTracker ........................................................ 948
Var_iCheck ........................................................... 949
Var_rCheck ........................................................... 950
Variables .............................................................. 950
  MixedVariables .................................................... 526
  RelaxedVariables ................................................ 832
VLint ................................................................. 961
VLRéal ................................................................. 962
VLstr ................................................................. 962
WorkdirHelper ......................................................... 967
Chapter 10

Class Index

10.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

- **ActiveSet**
  Container class for active set tracking information. Contains the active set request vector and the derivative variables vector.
  
  
- **ActiveSubspaceModel**
  Active subspace model for input (variable space) reduction.

- **Analyzer**
  Base class for NonD, DACE, and ParamStudy branches of the iterator hierarchy.

- **ApplicationInterface**
  Derived class within the interface class hierarchy for supporting interfaces to simulation codes.

- **Approximation**
  Base class for the approximation class hierarchy.

- **ApproximationInterface**
  Derived class within the interface class hierarchy for supporting approximations to simulation-based results.

- **APPSEvalMgr**
  Evaluation manager class for APPSPACK.

- **APPSEOptimizer**
  Wrapper class for HOPSPACK.

- **ApreproWriter**
  Utility used in derived write_core to write in aprepro format.

- **BaseConstructor**
  Dummy struct for overloading letter-envelope constructors.

- **BootstrapSampler< Data >**
  Actual bootstrap sampler implementation for common data types.

- **BootstrapSampler< Teuchos::SerialDenseMatrix< OrdinalType, ScalarType > >**
  Bootstrap sampler that is specialized to allow for the bootstrapping of RealMatrix.

- **BootstrapSamplerBase< Data >**
  Base class/interface for the bootstrap sampler.

- **BootstrapSamplerWithGS< Data, Getter, Setter >**
  A derived sampler to allow for user specification of the accessor methods.

- **callback_data**

  
  

COLINApplication .............................................................. 310
COLINOptimizer .............................................................. 313
CollabHybridMetaIterator  
  Meta-iterator for hybrid iteration using multiple collaborating optimization and nonlinear least squares methods .............................................. 318
CommandLineHandler  
  Utility class for managing command line inputs to DAKOTA .............................................................. 319
CommandShell  
  Utility class which defines convenience operators for spawning processes with system calls .............................. 320
ConcurrentMetaIterator  
  Meta-iterator for multi-start iteration or pareto set optimization .............................................................. 322
CONMINOptimizer  
  Wrapper class for the CONMIN optimization library .............................................................. 325
ConsoleRedirector .................................................................. 332
Constraints  
  Base class for the variable constraints class hierarchy .................................................................................. 333
DataEnvironment  
  Handle class for environment specification data .................................................................................. 343
DataEnvironmentRep  
  Body class for environment specification data .................................................................................. 344
DataFitSurfModel  
  Derived model class within the surrogate model branch for managing data fit surrogates (global and local) .................................................................................. 346
DataInterface  
  Handle class for interface specification data .................................................................................. 359
DataMethod  
  Handle class for method specification data .................................................................................. 360
DataMethodRep  
  Body class for method specification data .................................................................................. 361
DataModel  
  Handle class for model specification data .................................................................................. 376
DataModelRep  
  Body class for model specification data .................................................................................. 377
DataResponses  
  Handle class for responses specification data .................................................................................. 382
DataResponsesRep  
  Body class for responses specification data .................................................................................. 383
DataTransformModel  
  Data transformation specialization of RecastModel .................................................................................. 387
DataVariables  
  Handle class for variables specification data .................................................................................. 390
DataVariablesRep  
  Body class for variables specification data .................................................................................. 392
DDACEDesignCompExp  
  Wrapper class for the DDACE design of experiments library .................................................................................. 405
DirectApplicInterface  
  Derived application interface class which spawns simulation codes and testers using direct procedure calls .................................................................................. 409
10.1. CLASS LIST

DiscrepancyCorrection
Base class for discrepancy corrections ........................................... 413

DOTOptimizer
Wrapper class for the DOT optimization library ................................ 417

JEGAOptimizer::Driver
A subclass of the JEGA front end driver that exposes the individual protected methods to execute the algorithm ........................................... 421

EffGlobalMinimizer
Implementation of Efficient Global Optimization/Least Squares algorithms ........................................... 423

EmbedHybridMetaIterator
Meta-iterator for closely-coupled hybrid iteration, typically involving the embedding of local search methods within global search methods ........................................... 425

Environment
Base class for the environment class hierarchy ..................................... 427

NomadOptimizer::Evaluator
NOMAD-based Evaluator class ...................................................... 431

JEGAOptimizer::Evaluator
An evaluator specialization that knows how to interact with Dakota .......... 433

JEGAOptimizer::EvaluatorCreator
A specialization of the JEGA::FrontEnd::EvaluatorCreator that creates a new instance of a Evaluator ...................................................... 438

ExecutableEnvironment
Environment corresponding to execution as a stand-alone application ......... 439

ExperimentData
Interpolation method for interpolating between experimental and model data. I need to work on inputs/outputs to this method. For now, this assumes interpolation of functional data ........ 439

ExperimentResponse
Container class for response functions and their derivatives. ExperimentResponse provides the body class ...................................................... 447

FileReadException
Base class for Dakota file read exceptions (to allow catching both tabular and general file truncation issues) ...................................................... 449

ForkApplicInterface
Derived application interface class which spawns simulation codes using fork/execvp/waitpid ...................................................... 449

FSUDesignCompExp
Wrapper class for the FSUDace QMC/CVT library ................................ 451

FunctionEvalFailure
Exception class for function evaluation failures ..................................... 455

GaussProcApproximation
Derived approximation class for Gaussian Process implementation ........ 455

GeneralReader
Utility used in derived read_core to read in generic format ..................... 460

GeneralWriter
Utility used in derived write_core to write in generic format .................. 461

GetLongOpt
GetLongOpt is a general command line utility from S. Manoharan (Advanced Computer Research Institute, Lyon, France) ..................... 461
CHAPTER 10. CLASS INDEX

Graphics
Single interface to 2D (motif) and 3D (PLPLOT) graphics; there is only one instance of this
OutputManager::dakotaGraphics ................................................. 464

GridApplicInterface
Derived application interface class which spawns simulation codes using grid services such as
Condor or Globus ................................................................. 466

HierarchSurModel
Derived model class within the surrogate model branch for managing hierarchical surrogates
(models of varying fidelity) .................................................... 467

Interface
Base class for the interface class hierarchy .................................. 472

Iterator
Base class for the iterator class hierarchy .................................... 481

IteratorScheduler
This class encapsulates scheduling operations for concurrent sub-iteration within an outer level
context (e.g., meta-iteration, nested models) .................................. 495

JEGAOptimizer
A version of Dakota::Optimizer for instantiation of John Eddy’s Genetic Algorithms (JEGA) ... 501

LabelsWriter
Utility used in derived write_core to write labels in tabular format ........ 507

LeastSq
Base class for the nonlinear least squares branch of the iterator hierarchy ....... 508

LibraryEnvironment
Environment corresponding to execution as an embedded library ............. 511

LightWtBaseConstructor
Dummy struct for overloading constructors used in on-the-fly Model instantiations ... 514

MatchesWC
Predicate that returns true when the passed path matches the wild_card with which it was
configured. Currently supports * and ? ....................................... 514

MatlabInterface ................................................................. 514

MetaIterator
Base class for meta-iterators .................................................... 515

Minimizer
Base class for the optimizer and least squares branches of the iterator hierarchy ...... 518

MixedVarConstraints
Derived class within the Constraints hierarchy which separates continuous and discrete vari-
ables (no domain type array merging) ........................................ 525

MixedVariables
Derived class within the Variables hierarchy which separates continuous and discrete variables
(no domain type array merging) .............................................. 526

Model
Base class for the model class hierarchy ...................................... 528

MPIManager
Class MPIManager to manage Dakota’s MPI world, which may be a subset of MPI_COMM_-WORLD .............................................. 561

MPIPackBuffer
Class for packing MPI message buffers ....................................... 562

MPIUnpackBuffer
Class for unpacking MPI message buffers .................................... 564
10.1. CLASS LIST

NCSUOptimizer
Wrapper class for the NCSU DIRECT optimization library

NestedModel
Derived model class which performs a complete sub-iterator execution within every evaluation of the model

NIDRProblemDescDB
The derived input file database utilizing the new IDR parser

NL2Res
Auxiliary information passed to calcr and calcj via ur

NL2SOLLeastSq
Wrapper class for the NL2SOL nonlinear least squares library

NLPQLPOptimizer
Wrapper class for the NLPQLP optimization library, Version 2.0

NLSSOLLeastSq
Wrapper class for the NLSSOL nonlinear least squares library

NoDBBaseConstructor
Dummy struct for overloading constructors used in on-the-fly instantiations without ProblemDescDB support

NomadOptimizer
Wrapper class for NOMAD Optimizer

NonD
Base class for all nondeterministic iterators (the DAKOTA/UQ branch)

NonDAdeptImpSampling
Class for the Adaptive Importance Sampling methods within DAKOTA

NonDAdeptiveSampling
Class for testing various Adaptively sampling methods using geometric, statistical, and topological information of the surrogate

NonDBayesCalibration
Base class for Bayesian inference: generates posterior distribution on model parameters given experimental data

NonDCalibration
NonDCubature
Derived nondeterministic class that generates N-dimensional numerical cubature points for evaluation of expectation integrals

NonDDREAMBayesCalibration
Bayesian inference using the DREAM approach

NonDExpansion
Base class for polynomial chaos expansions (PCE) and stochastic collocation (SC)

NonDGloba1Evidence
Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ

NonDGloba1Interval
Class for using global nongradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification

NonDGloba1Reliability
Class for global reliability methods within DAKOTA/UQ

NonDGloba1SingleInterval
Class for using global nongradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification
<table>
<thead>
<tr>
<th>Class Name</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>NonDGPImpSampling</td>
<td>Class for the Gaussian Process-based Importance Sampling method</td>
<td>649</td>
</tr>
<tr>
<td>NonDGPMSSABayesCalibration</td>
<td>Generates posterior distribution on model parameters given experiment data</td>
<td>652</td>
</tr>
<tr>
<td>NonDIntegration</td>
<td>Derived nondeterministic class that generates N-dimensional numerical integration points for evaluation of expectation integrals</td>
<td>655</td>
</tr>
<tr>
<td>NonDInterval</td>
<td>Base class for interval-based methods within DAKOTA/UQ</td>
<td>658</td>
</tr>
<tr>
<td>NonDLHSEvidence</td>
<td>Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ</td>
<td>660</td>
</tr>
<tr>
<td>NonDLHSInterval</td>
<td>Class for the LHS-based interval methods within DAKOTA/UQ</td>
<td>661</td>
</tr>
<tr>
<td>NonDLHSSampling</td>
<td>Performs LHS and Monte Carlo sampling for uncertainty quantification</td>
<td>662</td>
</tr>
<tr>
<td>NonDLHSSingleInterval</td>
<td>Class for pure interval propagation using LHS</td>
<td>666</td>
</tr>
<tr>
<td>NonDLocalEvidence</td>
<td>Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ</td>
<td>667</td>
</tr>
<tr>
<td>NonDLocalInterval</td>
<td>Class for using local gradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification</td>
<td>668</td>
</tr>
<tr>
<td>NonDLocalReliability</td>
<td>Class for the reliability methods within DAKOTA/UQ</td>
<td>670</td>
</tr>
<tr>
<td>NonDLocalSingleInterval</td>
<td>Class for using local gradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification</td>
<td>680</td>
</tr>
<tr>
<td>NonDMultilevelSampling</td>
<td>Performs Multilevel Monte Carlo sampling for uncertainty quantification</td>
<td>681</td>
</tr>
<tr>
<td>NonDPOFDarts</td>
<td>Base class for POF Dart methods within DAKOTA/UQ</td>
<td>686</td>
</tr>
<tr>
<td>NonDPolynomialChaos</td>
<td>Nonintrusive polynomial chaos expansion approaches to uncertainty quantification</td>
<td>689</td>
</tr>
<tr>
<td>NonDQuadrature</td>
<td>Derived nondeterministic class that generates N-dimensional numerical quadrature points for evaluation of expectation integrals over uncorrelated standard normals/uniforms/exponentials/betas/gammas</td>
<td>695</td>
</tr>
<tr>
<td>NonDQUESTOBayesCalibration</td>
<td>Bayesian inference using the QUESO library from UT Austin</td>
<td>699</td>
</tr>
<tr>
<td>NonDReliability</td>
<td>Base class for the reliability methods within DAKOTA/UQ</td>
<td>705</td>
</tr>
<tr>
<td>NonDRKDDarts</td>
<td>Base class for the Recursive k-d Dart methods within DAKOTA/UQ</td>
<td>706</td>
</tr>
<tr>
<td>NonDSampling</td>
<td>Base class for common code between NonDLHSSampling, NonDAdaptImpSampling, and other specializations</td>
<td>709</td>
</tr>
<tr>
<td>NonDSparseGrid</td>
<td>Derived nondeterministic class that generates N-dimensional Smolyak sparse grids for numerical evaluation of expectation integrals over independent standard random variables</td>
<td>718</td>
</tr>
</tbody>
</table>
10.1. CLASS LIST

NonDStochCollocation
Nonintrusive stochastic collocation approaches to uncertainty quantification 721

NonDWasabiBayesCalibration
WASABI - Weighted Adaptive Surrogate Approximations for Bayesian Inference 723

NonlinearCGOptimizer
Wrapper class for the NPSOL optimization library 729

OptDartsOptimizer
Wrapper class for OptDarts Optimizer 732

Optimizer
Base class for the optimizer branch of the iterator hierarchy 735

OutputManager
Class to manage redirection of stdout/stderr, keep track of current redir state, and manage rank 0 output. Also manage tabular data output for post-processing with Matlab, Tecplot, etc. and delegate to Graphics for X Windows Graphics 739

OutputWriter 742

ParallelConfiguration
Container class for a set of ParallelLevel list iterators that collectively identify a particular multilevel parallel configuration 743

ParallelDirectApplicInterface
Sample derived interface class for testing parallel simulator plug-ins using assign_rep() 745

ParallelLevel
Container class for the data associated with a single level of communicator partitioning 746

ParallelLibrary
Class for partitioning multiple levels of parallelism and managing message passing within these levels 749

ParamResponsePair
Container class for a variables object, a response object, and an evaluation id 758

ParamStudy
Class for vector, list, centered, and multidimensional parameter studies 762

PartialPrpEquality
Predicate for comparing ONLY the interfaceId and Vars attributes of PRPair 767

PartialPrpHash
Wrapper to delegate to the ParamResponsePair hash_value function 767

PebblBranching
Main Branching class for the PEBBL-based Minimizer 768

PebblBranchSub
Sub Branch class for the PEBBL-based Minimizer 769

PebblMinimizer
Wrapper class for experimental PebblMinimizer 770

PecosApproximation
Derived approximation class for global basis polynomials 772

ProbabilityTransformModel
Probability transformation specialization of RecastModel 777

ProblemDescDB
The database containing information parsed from the DAKOTA input file 784

ProcessApplicInterface
Derived application interface class that spawns a simulation code using a separate process and communicates with it through files 794
CHAPTER 10. CLASS INDEX

ProcessHandleApplicInterface
 Derived application interface class that spawns a simulation code using a separate process, receives a process identifier, and communicates with the spawned process through files

ProgramOptions
 ProgramOptions stores options whether from the CLH or from library user; initially valid only on worldRank = 0, but then broadcast in ParallelLibrary::push_output_tag()

PStudyDACE
 Base class for managing common aspects of parameter studies and design of experiments methods

PSUADEDesignCompExp
 Wrapper class for the PSUADE library

PythonInterface

QuesoJointPdf< V, M >
 Dakota specialization of QUESO generic joint PDF

QuesoVectorRV< V, M >
 Dakota specialization of QUESO vector-valued random variable

RandomFieldModel
 Random field model, capable of generating and then forward propagating

RecastModel
 Derived model class which provides a thin wrapper around a sub-model in order to recast the form of its inputs and/or outputs

ReducedBasis

RelaxedVarConstraints
 Derived class within the Constraints hierarchy which employs relaxation of discrete variables

RelaxedVariables
 Derived class within the Variables hierarchy which employs the relaxation of discrete variables

Response
 Container class for response functions and their derivatives. Response provides the enveloper base class

RestartWriter

ResultsDBAny

ResultsEntry< StoredType >
 Class to manage in-core vs. file database lookups

ResultsFileError
 Exception throw for other results file read error

ResultsID
 Get a globally unique 1-based execution number for a given iterator name (combination of methodName and methodID) for use in results DB. Each Iterator::run() call creates or increments this count for its string identifier

ResultsManager
 Results manager for iterator final data

ResultsNames
 List of valid names for iterator results

RichExtrapVerification
 Class for Richardson extrapolation for code and solution verification

 ScalingModel
 Scaling specialization of RecastModel


10.1. CLASS LIST

- **ScalingOptions**  
  Simple container for user-provided scaling data, possibly expanded by replicates through the models  

- **ScilabInterface**  
  

- **SensAnalysisGlobal**  
  Class for a utility class containing correlation calculations and variance-based decomposition  

- **SeqHybridMetaIterator**  
  Method for sequential hybrid iteration using multiple optimization and nonlinear least squares methods on multiple models of varying fidelity  

- **SerialDirectApplicInterface**  
  Sample derived interface class for testing serial simulator plug-ins using assign_rep()  

- **SharedApproxData**  
  Base class for the shared approximation data class hierarchy  

- **SharedPecosApproxData**  
  Derived approximation class for global basis polynomials  

- **SharedResponseData**  
  Container class encapsulating variables data that can be shared among a set of Response instances  

- **SharedResponseDataRep**  
  The representation of a SharedResponseData instance. This representation, or body, may be shared by multiple SharedResponseData handle instances  

- **SharedSurfpackApproxData**  
  Derived approximation class for Surfpack approximation classes. Interface between Surfpack and Dakota  

- **SharedVariablesData**  
  Container class encapsulating variables data that can be shared among a set of Variables instances  

- **SharedVariablesDataRep**  
  The representation of a SharedVariablesData instance. This representation, or body, may be shared by multiple SharedVariablesData handle instances  

- **SimulationModel**  
  Derived model class which utilizes a simulation-based application interface to map variables into responses  

- **SimulationResponse**  
  Container class for response functions and their derivatives. SimulationResponse provides the body class  

- **SNLLBase**  
  Base class for OPT++ optimization and least squares methods  

- **SNLLLeastSq**  
  Wrapper class for the OPT++ optimization library  

- **SNLLOptimizer**  
  Wrapper class for the OPT++ optimization library  

- **SOLBase**  
  Base class for Stanford SOL software  

- **SpawnApplicInterface**  
  Derived application interface class which spawns simulation codes using spawnvp  

- **SurfpackApproximation**  
  Derived approximation class for Surfpack approximation classes. Interface between Surfpack and Dakota  

SurrBasedGlobalMinimizer
The global surrogate-based minimizer which sequentially minimizes and updates a global surrogate model without trust region controls ........................................... 915
SurrBasedLocalMinimizer
Class for provably-convergent local surrogate-based optimization and nonlinear least squares . 917
SurrBasedMinimizer
Base class for local/global surrogate-based optimization/least squares .......................... 924
SurrogateModel
Base class for surrogate models (DataFitSurrModel and HierarchSurrModel) .................. 928
SysCallApplicInterface
Derived application interface class which spawns simulation codes using system calls ... 932
TabularDataTruncated
Exception thrown when data read truncated .............................................................. 935
TabularReader
Utility used in derived read_core to read values in tabular format .............................. 935
TabularWriter
Utility used in derived write_core to write values in tabular format ......................... 936
TANA3Approximation
Derived approximation class for TANA-3 two-point exponential approximation (a multipoint approximation) ................................................................. 936
TaylorApproximation
Derived approximation class for first- or second-order Taylor series (a local approximation) 939
TestDriverInterface .................................................................................................... 940
TrackerHTTP
TrackerHTTP: a usage tracking module that uses HTTP/HTTPS via the curl library ...... 946
UsageTracker
Lightweight class to manage conditionally active Curl-based HTTP tracker via PIMPL ... 948
Var_check
Structure for verifying bounds and initial point for string-valued vars .......................... 949
Var_rcheck
Structure for verifying bounds and initial point for real-valued vars ............................. 950
Variables
Base class for the variables class hierarchy .............................................................. 950
Verification
Base class for managing common aspects of verification studies ............................... 960
VLint
Structure for validating integer uncertain variable labels, bounds, values .................. 961
VLreal
Structure for validating real uncertain variable labels, bounds, values ....................... 962
VLstr
Structure for validating string uncertain variable labels, bounds, values ................... 962
VPSApproximation
Derived approximation class for VPS implementation ................................................. 963
WorkdirHelper .......................................................................................................... 967
Chapter 11

File Index

11.1 File List

Here is a list of all documented files with brief descriptions:

- **dakota_dll_api.cpp**
  This file contains a DakotaRunner class, which launches DAKOTA ....................................... 973

- **dakota_dll_api.h**
  API for DLL interactions ................................................................. 974

- **dakota_linear_algebra.hpp**
  Dakota linear algebra utilities .................................................... 975

- **dakota_tabular_io.hpp**
  Utility functions for reading and writing tabular data files Emerging utilities for tabular file I/O. For now, just extraction of capability from separate contexts to facilitate rework. These augment (and leverage) those in data_util.h ................................................. 975

- **dll_tester.cpp**
  Test the DLL with a DAKOTA input file ........................................... 978

- **JEGAOptimizer.cpp**
  Contains the implementation of the JEGAOptimizer class ....................... 978

- **JEGAOptimizer.hpp**
  Contains the definition of the JEGAOptimizer class ............................ 979

- **library_mode.cpp**
  File containing a mock simulator main for testing Dakota in library mode ............................................ 979

- **library_split.cpp**
  File containing a mock simulator main for testing DAKOTA in library mode on a split communicator ........................................................................... 983

- **main.cpp**
  File containing the main program for DAKOTA ..................................... 983

- **restart_util.cpp**
  File containing the DAKOTA restart utility main program .................... 984
Chapter 12

Namespace Documentation

12.1 Dakota Namespace Reference

The primary namespace for DAKOTA.

Classes

- class ActiveSubspaceModel
  
  Active subspace model for input (variable space) reduction.

- class ApplicationInterface

  Derived class within the interface class hierarchy for supporting interfaces to simulation codes.

- class ApproximationInterface

  Derived class within the interface class hierarchy for supporting approximations to simulation-based results.

- class APPSEvalMgr

  Evaluation manager class for APPSPACK.

- class APPSOptimizer

  Wrapper class for HOPSPACK.

- class BootstrapSamplerBase

  Base class/interface for the bootstrap sampler.

- class BootstrapSampler

  Actual bootstrap sampler implementation for common data types.

- class BootstrapSampler< Teuchos::SerialDenseMatrix< OrdinalType, ScalarType > >

  Bootstrap sampler that is specialized to allow for the bootstrapping of RealMatrix.

- class BootstrapSamplerWithGS

  A derived sampler to allow for user specification of the accessor methods.

- class COLINApplication

- class COLINOptimizer

  Wrapper class for optimizers defined using COLIN.

- class CollabHybridMetaIterator

  Meta-iterator for hybrid iteration using multiple collaborating optimization and nonlinear least squares methods.

- class GetLongOpt
**GetLongOpt** is a general command line utility from S. Manoharan (Advanced Computer Research Institute, Lyon, France).

- class **CommandLineHandler**
  Utility class for managing command line inputs to DAKOTA.
- class **CommandLineShell**
  Utility class which defines convenience operators for spawning processes with system calls.
- class **ConcurrentMetaIterator**
  Meta-iterator for multi-start iteration or pareto set optimization.
- class **CONMINOptimizer**
  Wrapper class for the CONMIN optimization library.
- class **FileReadException**
  base class for Dakota file read exceptions (to allow catching both tabular and general file truncation issues)
- class **TabularDataTruncated**
  exception thrown when data read truncated
- class **ResultsFileError**
  exception throw for other results file read error
- class **FunctionEvalFailure**
  exception class for function evaluation failures
- struct **BaseConstructor**
  Dummy struct for overloading letter-envelope constructors.
- struct **NoDBBaseConstructor**
  Dummy struct for overloading constructors used in on-the-fly instantiations without ProblemDescDB support.
- struct **LightWtBaseConstructor**
  Dummy struct for overloading constructors used in on-the-fly Model instantiations.
- class **ActiveSet**
  Container class for active set tracking information. Contains the active set request vector and the derivative variables vector.
- class **Analyzer**
  Base class for NonD, DACE, and ParamStudy branches of the iterator hierarchy.
- class **Approximation**
  Base class for the approximation class hierarchy.
- class **Constraints**
  Base class for the variable constraints class hierarchy.
- class **Environment**
  Base class for the environment class hierarchy.
- class **Graphics**
  The Graphics class provides a single interface to 2D (motif) and 3D (PLPLOT) graphics; there is only one instance of this OutputManager::dakotaGraphics.
- class **Interface**
  Base class for the interface class hierarchy.
- class **Iterator**
  Base class for the iterator class hierarchy.
- class **LeastSq**
  Base class for the nonlinear least squares branch of the iterator hierarchy.
• class Minimizer
  Base class for the optimizer and least squares branches of the iterator hierarchy.
• class ScalingOptions
  Simple container for user-provided scaling data, possibly expanded by replicates through the models.
• class Model
  Base class for the model class hierarchy.
• class NonD
  Base class for all nondeterministic iterators (the DAKOTA/UQ branch).
• class Optimizer
  Base class for the optimizer branch of the iterator hierarchy.
• class PStudyDACE
  Base class for managing common aspects of parameter studies and design of experiments methods.
• class Response
  Container class for response functions and their derivatives. Response provides the enveloper base class.
• class GeneralReader
  Utility used in derived read_core to read in generic format.
• class TabularReader
  Utility used in derived read_core to read values in tabular format.
• class GeneralWriter
  Utility used in derived write_core to write in generic format.
• class ApreproWriter
  Utility used in derived write_core to write in aprepro format.
• class TabularWriter
  Utility used in derived write_core to write values in tabular format.
• class LabelsWriter
  Utility used in derived write_core to write labels in tabular format.
• class Variables
  Base class for the variables class hierarchy.
• class Verification
  Base class for managing common aspects of verification studies.
• class DataEnvironmentRep
  Body class for environment specification data.
• class DataEnvironment
  Handle class for environment specification data.
• class DataFitSurrModel
  Derived model class within the surrogate model branch for managing data fit surrogates (global and local)
• class DataInterface
  Handle class for interface specification data.
• class DataMethodRep
  Body class for method specification data.
• class DataMethod
  Handle class for method specification data.
• class DataModelRep
Body class for model specification data.

- class **DataModel**
  Handle class for model specification data.

- class **DataResponsesRep**
  Body class for responses specification data.

- class **DataResponses**
  Handle class for responses specification data.

- class **DataTransformModel**
  Data transformation specialization of RecastModel.

- class **DataVariablesRep**
  Body class for variables specification data.

- class **DataVariables**
  Handle class for variables specification data.

- class **DDACEDesignCompExp**
  Wrapper class for the DDACE design of experiments library.

- class **DirectApplicInterface**
  Derived application interface class which spawns simulation codes and testers using direct procedure calls.

- class **DiscrepancyCorrection**
  Base class for discrepancy corrections.

- class **DOTOptimizer**
  Wrapper class for the DOT optimization library.

- class **EffGlobalMinimizer**
  Implementation of Efficient Global Optimization/Least Squares algorithms.

- class **EmbedHybridMetaIterator**
  Meta-iterator for closely-coupled hybrid iteration, typically involving the embedding of local search methods within global search methods.

- class **ExecutableEnvironment**
  Environment corresponding to execution as a stand-alone application.

- class **ExperimentData**
  Interpolation method for interpolating between experimental and model data. I need to work on inputs/outputs to this method. For now, this assumes interpolation of functional data.

- class **ExperimentResponse**
  Container class for response functions and their derivatives. ExperimentResponse provides the body class.

- class **ForkApplicInterface**
  Derived application interface class which spawns simulation codes using fork/execvp/waitpid.

- class **FSUDesignCompExp**
  Wrapper class for the FSUface QMC/CVT library.

- class **GaussProcApproximation**
  Derived approximation class for Gaussian Process implementation.

- class **GridApplicInterface**
  Derived application interface class which spawns simulation codes using grid services such as Condor or Globus.

- class **HierarchSurrModel**
  Derived model class within the surrogate model branch for managing hierarchical surrogates (models of varying fidelity).
12.1. DAKOTA NAMESPACE REFERENCE

- class IteratorScheduler
  This class encapsulates scheduling operations for concurrent sub-iteration within an outer level context (e.g., meta-iteration, nested models).

- class JEGAOptimizer
  A version of Dakota::Optimizer for instantiation of John Eddy’s Genetic Algorithms (JEGA).

- class LibraryEnvironment
  Environment corresponding to execution as an embedded library.

- class MatlabInterface
- class MetaIterator
  Base class for meta-iterators.

- class MixedVarConstraints
  Derived class within the Constraints hierarchy which separates continuous and discrete variables (no domain type array merging).

- class MixedVariables
  Derived class within the Variables hierarchy which separates continuous and discrete variables (no domain type array merging).

- class MPIManager
  Class MPIManager to manage Dakota’s MPI world, which may be a subset of MPI_COMM_WORLD.

- class MPIPackBuffer
  Class for packing MPI message buffers.

- class MPIUnpackBuffer
  Class for unpacking MPI message buffers.

- class NCSUOptimizer
  Wrapper class for the NCSU DIRECT optimization library.

- class NestedModel
  Derived model class which performs a complete sub-iterator execution within every evaluation of the model.

- struct Var_rcheck
  structure for verifying bounds and initial point for real-valued vars

- struct Var_icheck
  structure for verifying bounds and initial point for string-valued vars

- struct VLreal
  structure for validating real uncertain variable labels, bounds, values

- struct VLint
  structure for validating integer uncertain variable labels, bounds, values

- struct VLstr
  structure for validating string uncertain variable labels, bounds, values

- class NIDRProblemDescDB
  The derived input file database utilizing the new IDR parser.

- struct NL2Res
  Auxiliary information passed to calcr and calcj via ur.

- class NL2SOLLeastSq
  Wrapper class for the NL2SOL nonlinear least squares library.

- class NLPQLPOptimizer
  Wrapper class for the NLPQLP optimization library, Version 2.0.
• class NLSSOLLeastSq
  Wrapper class for the NLSSOL nonlinear least squares library.
• class NomadOptimizer
  Wrapper class for NOMAD Optimizer.
• class NonDAdaptImpSampling
  Class for the Adaptive Importance Sampling methods within DAKOTA.
• class NonDAdaptiveSampling
  Class for testing various Adaptively sampling methods using geometric, statistical, and topological information of the surrogate.
• class NonDBayesCalibration
  Base class for Bayesian inference: generates posterior distribution on model parameters given experimental data.
• class NonDCalibration
• class NonDCubature
  Derived nondeterministic class that generates N-dimensional numerical cubature points for evaluation of expectation integrals.
• class NonDDREAMBayesCalibration
  Bayesian inference using the DREAM approach.
• class NonDExpansion
  Base class for polynomial chaos expansions (PCE) and stochastic collocation (SC)
• class NonDGlobalEvidence
  Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ.
• class NonDGlobalInterval
  Class for using global nongradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.
• class NonDGlobalReliability
  Class for global reliability methods within DAKOTA/UQ.
• class NonDGlobalSingleInterval
  Class for using global nongradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.
• class NonDGPImpSampling
  Class for the Gaussian Process-based Importance Sampling method.
• class NonDGPMMSABayesCalibration
  Generates posterior distribution on model parameters given experiment data.
• class NonDIntegration
  Derived nondeterministic class that generates N-dimensional numerical integration points for evaluation of expectation integrals.
• class NonDInterval
  Base class for interval-based methods within DAKOTA/UQ.
• class NonDLHSEvidence
  Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ.
• class NonDLSInterval
  Class for the LHS-based interval methods within DAKOTA/UQ.
• class NonDLHSSampling
  Performs LHS and Monte Carlo sampling for uncertainty quantification.
• class NonDLHSSingleInterval
  Class for pure interval propagation using LHS.
• class NonDLocalEvidence
  Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ.
• class NonDLocalInterval
  Class for using local gradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.
• class NonDLocalReliability
  Class for the reliability methods within DAKOTA/UQ.
• class NonDLocalSingleInterval
  Class for using local gradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.
• class NonDMultilevelSampling
  Performs Multilevel Monte Carlo sampling for uncertainty quantification.
• class NonDPOFDarts
  Base class for POF Dart methods within DAKOTA/UQ.
• class NonDPolynomialChaos
  Nonintrusive polynomial chaos expansion approaches to uncertainty quantification.
• class NonDQuadrature
  Derived nondeterministic class that generates N-dimensional numerical quadrature points for evaluation of expectation integrals over uncorrelated standard normals/uniforms/exponentials/betas/gammas.
• class QuesoJointPdf
  Dakota specialization of QUESO generic joint PDF.
• class QuesoVectorRV
  Dakota specialization of QUESO vector-valued random variable.
• class NonDQUESOBayesCalibration
  Bayesian inference using the QUESO library from UT Austin.
• class NonDReliability
  Base class for the reliability methods within DAKOTA/UQ.
• class NonDRKDDBayesCalibration
  WASABI - Weighted Adaptive Surrogate Approximations for Bayesian Inference.
• class NonlinearCGOptimizer
  Nonintrusive stochastic collocation approaches to uncertainty quantification.
• class OptDartsOptimizer

• class NPSOLOptimizer
  Wrapper class for the NPSOL optimization library.
Wrapper class for OptDarts Optimizer.

- class OutputWriter
- class ConsoleRedirector
- class RestartWriter
- class OutputManager
  
  Class to manage redirection of stdout/stderr, keep track of current redir state, and manage rank 0 output. Also manage tabular data output for post-processing with Matlab, Tecplot, etc. and delegate to Graphics for X Windows Graphics.

- class ParallelLevel
  
  Container class for the data associated with a single level of communicator partitioning.

- class ParallelConfiguration
  
  Container class for a set of ParallelLevel list iterators that collectively identify a particular multilevel parallel configuration.

- class ParallelLibrary
  
  Class for partitioning multiple levels of parallelism and managing message passing within these levels.

- class ParamResponsePair
  
  Container class for a variables object, a response object, and an evaluation id.

- class ParamStudy
  
  Class for vector, list, centered, and multidimensional parameter studies.

- class PebbldBranching
  
  Main Branching class for the PEBBL-based Minimizer.

- class PebbldBranchSub
  
  Sub Branch class for the PEBBL-based Minimizer.

- class PebbldMinimizer
  
  Wrapper class for experimental PebbldMinimizer.

- class PecosApproximation
  
  Derived approximation class for global basis polynomials.

- class ProbabilityTransformModel
  
  Probability transformation specialization of RecastModel.

- class ProblemDescDB
  
  The database containing information parsed from the DAKOTA input file.

- class ProcessApplicInterface
  
  Derived application interface class that spawns a simulation code using a separate process and communicates with it through files.

- class ProcessHandleApplicInterface
  
  Derived application interface class that spawns a simulation code using a separate process, receives a process identifier, and communicates with the spawned process through files.

- class ProgramOptions
  
  ProgramOptions stores options whether from the CLH or from library user; initially valid only on worldRank = 0, but then broadcast in ParallelLibrary::push_output_tag()

- struct partial_prp_hash
  
  wrapper to delegate to the ParamResponsePair hash_value function

- struct partial_prp_equality
  
  predicate for comparing ONLY the interfaceId and Vars attributes of PRPair
• class **PSUADEDesignCompExp**
  Wrapper class for the PSUADE library.

• class **PythonInterface**

• class **RandomFieldModel**
  Random field model, capable of generating and then forward propagating.

• class **RecastModel**
  Derived model class which provides a thin wrapper around a sub-model in order to recast the form of its inputs and/or outputs.

• class **ReducedBasis**

• class **RelaxedVarConstraints**
  Derived class within the Constraints hierarchy which employs relaxation of discrete variables.

• class **RelaxedVariables**
  Derived class within the Variables hierarchy which employs the relaxation of discrete variables.

• class **ResultsDBAny**

• class **ResultsID**
  Get a globally unique 1-based execution number for a given iterator name (combination of methodName and methodID) for use in results DB. Each Iterator::run() call creates or increments this count for its string identifier.

• class **ResultsNames**
  List of valid names for iterator results.

• class **ResultsManager**
  Results manager for iterator final data.

• class **ResultsEntry**
  Class to manage in-core vs. file database lookups.

• class **RichExtrapVerification**
  Class for Richardson extrapolation for code and solution verification.

• class **ScalingModel**
  Scaling specialization of RecastModel.

• class **ScilabInterface**

• class **SensAnalysisGlobal**
  Class for a utility class containing correlation calculations and variance-based decomposition.

• class **SeqHybridMetaIterator**
  Method for sequential hybrid iteration using multiple optimization and nonlinear least squares methods on multiple models of varying fidelity.

• class **SharedApproxData**
  Base class for the shared approximation data class hierarchy.

• class **SharedPecosApproxData**
  Derived approximation class for global basis polynomials.

• class **SharedResponseDataRep**
  The representation of a SharedResponseData instance. This representation, or body, may be shared by multiple SharedResponseData handle instances.

• class **SharedResponseData**
  Container class encapsulating variables data that can be shared among a set of Response instances.

• class **SharedSurfpackApproxData**
  Derived approximation class for Surfpack approximation classes. Interface between Surfpack and Dakota.
• class SharedVariablesDataRep
  The representation of a SharedVariablesData instance. This representation, or body, may be shared by multiple
  SharedVariablesData handle instances.

• class SharedVariablesData
  Container class encapsulating variables data that can be shared among a set of Variables instances.

• class SimulationModel
  Derived model class which utilizes a simulation-based application interface to map variables into responses.

• class SimulationResponse
  Container class for response functions and their derivatives. SimulationResponse provides the body class.

• class SNLLBase
  Base class for OPT++ optimization and least squares methods.

• class SNLLLeastSq
  Wrapper class for the OPT++ optimization library.

• class SNLLOptimizer
  Wrapper class for the OPT++ optimization library.

• class SOLBase
  Base class for Stanford SOL software.

• class SpawnApplicInterface
  Derived application interface class which spawns simulation codes using spawnvp.

• class SurfpackApproximation
  Derived approximation class for Surfpack approximation classes. Interface between Surfpack and Dakota.

• class SurrBasedGlobalMinimizer
  The global surrogate-based minimizer which sequentially minimizes and updates a global surrogate model without
  trust region controls.

• class SurrBasedLocalMinimizer
  Class for provably-convergent local surrogate-based optimization and nonlinear least squares.

• class SurrBasedMinimizer
  Base class for local/global surrogate-based optimization/least squares.

• class SurrogateModel
  Base class for surrogate models (DataFitSurrModel and HierarchSurrModel).

• class SysCallApplicInterface
  Derived application interface class which spawns simulation codes using system calls.

• class TANA3Approximation
  Derived approximation class for TANA-3 two-point exponential approximation (a multipoint approximation).

• class TaylorApproximation
  Derived approximation class for first- or second-order Taylor series (a local approximation).

• class TestDriverInterface

• class TrackerHTTP
  TrackerHTTP: a usage tracking module that uses HTTP/HTTPS via the curl library.

• class UsageTracker
  Lightweight class to manage conditionally active Curl-based HTTP tracker via PIMPL.

• class VPSApproximation
  Derived approximation class for VPS implementation.
• struct MatchesWC
  Predicate that returns true when the passed path matches the wild_card with which it was configured. Currently supports * and ?.
• class WorkdirHelper

Typedefs

• typedef double Real
• typedef std::string String
• typedef
  Teuchos::SerialDenseVector
  < int, Real > RealVector
• typedef
  Teuchos::SerialDenseMatrix
  < int, Real > RealMatrix
• typedef
  Teuchos::SerialSymDenseMatrix
  < int, Real > RealSymMatrix
• typedef
  Teuchos::SerialDenseVector
  < int, int > IntVector
• typedef
  Teuchos::SerialDenseMatrix
  < int, int > IntMatrix
• typedef std::deque< bool > BoolDeque
• typedef boost::dynamic_bitset
  < unsigned long > BitArray
• typedef std::vector< BoolDeque > BoolDequeArray
• typedef std::vector< Real > RealArray
• typedef std::vector< RealArray > Real2DArray
• typedef std::vector< int > IntArray
• typedef std::vector< IntArray > Int2DArray
• typedef std::vector< short > ShortArray
• typedef std::vector< unsigned short > UShortArray
• typedef std::vector< UShortArray > UShort2DArray
• typedef std::vector< UShort2DArray > UShort3DArray
• typedef std::vector< size_t > SizetArray
• typedef std::vector< SizetArray > Sizet2DArray
• typedef std::vector< String > StringArray
• typedef std::vector< StringArray > String2DArray
• typedef
  boost::multi_array_types::index_range idx_range
• typedef boost::multi_array
  < String, 1 > StringMultiArray
• typedef boost::multi_array
  < String, 2 > StringMulti2DArray
• typedef
  StringMultiArray::array_view
  < 1 >::type StringMultiArrayView
• typedef
  StringMultiArray::const_array_view
  < 1 >::type StringMultiArrayConstView
• typedef boost::multi_array
  < unsigned short, 1 > UShortMultiArray
• typedef
  UShortMultiArray::array_view
  < 1 >::type UShortMultiArrayView
• typedef
  UShortMultiArray::const_array_view
  < 1 >::type UShortMultiArrayConstView
• typedef boost::multi_array
  < size_t, 1 > SizetMultiArray
• typedef
  SizetMultiArray::array_view
  < 1 >::type SizetMultiArrayView
• typedef
  SizetMultiArray::const_array_view
  < 1 >::type SizetMultiArrayConstView
• typedef boost::multi_array
  < Real, 1 > RealMultiArray
• typedef boost::multi_array
  < Real, 2 > RealMulti2DArray
• typedef boost::multi_array
  < Real, 3 > RealMulti3DArray
• typedef std::vector<RealVector> RealVectorArray
• typedef std::vector<RealMatrix> RealMatrixArray
• typedef std::vector<RealSymMatrix> RealSymMatrixArray
• typedef std::vector<intVector> IntVectorArray
• typedef std::vector<Variables> VariablesArray
• typedef std::vector<Response> ResponseArray
• typedef std::vector<ParamResponsePair> PRPArray
• typedef std::vector<PRPArray> PRP2DArray
• typedef std::vector<Model> ModelArray
• typedef std::vector<Iterator> IteratorArray
• typedef std::vector<RealMultiArray> BoostMAArray
• typedef std::vector<RealMulti2DArray> BoostMA2DArray
• typedef std::vector<RealMulti3DArray> BoostMA3DArray
• typedef std::list< bool > BoolList
• typedef std::list< int > IntList
• typedef std::list< size_t > SizetList
• typedef std::list< Real > RealList
• typedef std::list< RealVector > RealVectorList
• typedef std::list< String > StringList
• typedef std::list< Variables > VariablesList
• typedef std::list< Interface > InterfaceList
• typedef std::list< Response > ResponseList
• typedef std::list< Model > ModelList
• typedef std::list< Iterator > IteratorList
• typedef std::pair< int, int > IntIntPair
• typedef std::pair< size_t, size_t > SizetSizetPair
• typedef std::pair< size_t, int > SizetIntPair
• typedef std::pair< int, size_t > IntSizetPair
• typedef std::pair< int, String > IntStringPair
• typedef std::pair< Real, Real > RealRealPair
• typedef std::pair< Real, Response > RealResponsePair
• typedef std::set< Real > RealSet
• typedef std::set< int > IntSet
• typedef std::set< unsigned short > UShortSet
• typedef std::set< size_t > SizetSet
• typedef std::vector< RealSet > RealSetArray
• typedef std::vector< IntSet > IntSetArray
• typedef std::vector< StringSet > StringSetArray
• typedef std::vector< UShortSet > UShortSetArray
• typedef std::map< int, int > IntIntMap
• typedef std::map< int, short > IntShortMap
• typedef std::map< int, Real > IntRealMap
• typedef std::map< Real, Real > RealRealMap
• typedef std::map< String, Real > StringRealMap
• typedef std::multimap< Real, int > RealIntMultiMap
• typedef std::vector< RealRealPair > RealRealPairArray
• typedef std::vector< RealRealMap > RealRealMapArray
• typedef std::vector< StringRealMapArray > StringRealMapArray
• typedef std::vector< int, RealVector > IntRealVectorMap
• typedef std::vector< int, RealMatrix > IntRealMatrixMap
• typedef std::vector< int, ActiveSet > IntActiveSetMap
• typedef std::vector< int, Variables > IntVariablesMap
• typedef std::vector< int, Response > IntResponseMap
• typedef std::vector< IntArray, size_t > IntArraySizetMap
• typedef std::vector< IntIntPair, Real > IntIntPairRealMap
• typedef std::map< RealRealPair,  
   Real > RealRealPairRealMap
• typedef std::vector  
   < IntIntPairRealMap > IntIntPairRealMapArray
• typedef std::vector  
   < RealRealPairRealMap > RealRealPairRealMapArray
• typedef std::multimap  
   < RealRealPair,  
      ParamResponsePair > RealPairPRPMultiMap
• typedef IntList::iterator ILIter
• typedef IntList::const_iterator ILCIter
• typedef SizetList::iterator StLIter
• typedef SizetList::const_iterator StLCIter
• typedef RealList::iterator RLIter
• typedef RealList::const_iterator RLCIter
• typedef RealVectorList::iterator RVLIter
• typedef RealVectorList::const_iterator RVLCIter
• typedef StringList::iterator StringLIter
• typedef StringList::const_iterator StringLCIter
• typedef VariablesList::iterator VarsLIter
• typedef InterfaceList::iterator InterfLIter
• typedef ResponseList::iterator RespLIter
• typedef ModelList::iterator ModelLIter
• typedef ModelList::reverse_iterator ModelLRevIter
• typedef IteratorList::iterator IterLIter
• typedef std::list  
   < ParallelLevel >::iterator ParLevLIter
• typedef std::list  
   < ParallelConfiguration >::iterator ParConfigLIter
• typedef IntSet::iterator ISIter
• typedef IntSet::const_iterator ISCIter
• typedef StringSet::iterator SSIter
• typedef StringSet::const_iterator SSCIter
• typedef RealSet::iterator RSIter
• typedef RealSet::const_iterator RSCIter
• typedef IntIntMap::iterator IntIntMIter
• typedef IntIntMap::const_iterator IntIntMCIter
• typedef IntShortMap::iterator IntShMIter  
• typedef IntShortMap::const_iterator IntShMCIter
• typedef IntRealMap::iterator IRMIter
• typedef IntRealMap::const_iterator IRMCIter
• typedef StringRealMap::iterator SRMIter
• typedef StringRealMap::const_iterator SRMCIter
• typedef RealRealMap::iterator RRMIter
12.1. DAKOTA NAMESPACE REFERENCE

- typedef RealRealMap::const_iterator RRMCIter
- typedef IntIntPairRealMap::iterator IIPRMIter
- typedef IntIntPairRealMap::const_iterator IIPRMCIter
- typedef RealRealPairRealMap::iterator RRPRMIter
- typedef RealRealPairRealMap::const_iterator RRPRMCIter
- typedef IntRealVectorMap::iterator IntRVMIter
- typedef IntRealVectorMap::const_iterator IntRVMCIter
- typedef IntRealMatrixMap::iterator IntRMMIter
- typedef IntRealMatrixMap::const_iterator IntRMMCIter
- typedef IntActiveSetMap::iterator IntASMIter
- typedef IntVariablesMap::iterator IntVarsMIter
- typedef IntVariablesMap::const_iterator IntVarsMCIter
- typedef IntResponseMap::iterator IntRespMIter
- typedef IntResponseMap::const_iterator IntRespMCIter
- typedef boost::tuple < std::string, std::string, size_t, std::string > ResultsKeyType
  
  Data type for results key (instance name / id, unique run, label), where data_key is a valid colon-delimited string from ResultsNames tuple<method_name, method_id, execution_number, data_key>

- typedef std::string MetaDataKeyType
  
  Data type for metadata key.

- typedef std::vector < std::string > MetaDataValueType
  
  Data type for metadata value.

- typedef std::map < MetaDataKeyType, MetaDataValueType > MetaDataType
  
  A single MetaData entry is map<string, vector<string>> Example: pair( "Column labels", ["Mean", "Std Dev", "Skewness", "Kurtosis"] )

- typedef boost::tuple < std::string, std::string, size_t, std::string > StrStrSizet

  Iterator unique ID: <method_name, method_id, exec_num>

- typedef void(* dl_core_run_t)(void *, Optimizer1 *, char *)
- typedef void(* dl_destructor_t)(void **)
- typedef Teuchos::SerialDenseSolver < int, Real > RealSolver
- typedef Teuchos::SerialSpdDenseSolver < int, Real > RealSpdSolver
• typedef int(* start_grid_computing_t )(char *analysis_driver_script, char *params_file, char *results_file)
  definition of start grid computing type (function pointer)
• typedef int(* perform_analysis_t )(char *iteration_num)
  definition of perform analysis type (function pointer)
• typedef int (*)(get_jobs_completed_t )()
  definition of get completed jobs type (function pointer)
• typedef int(* stop_grid_computing_t )()
  definition of stop grid computing type (function pointer)
• typedef int MPI_Comm
• typedef void * MPI_Request
• typedef unsigned char u_char
• typedef unsigned short u_short
• typedef unsigned int u_int
• typedef unsigned long u_long
• typedef long long
• typedef unsigned long UL
• typedef int(* Calcrj ) (int *n, int *p, Real *x, int *nf, Real *r, int *ui, void *ur, Vf vf)
• typedef void(* Vf )()
• typedef void(* DbCallbackFunctionPtr )(Dakota::ProblemDescDB *db, void *data_ptr)
• typedef boost::tuple<bfs::path, bfs::path, bfs::path > PathTriple
  Triplet of filesystem paths: e.g., params, results, workdir.
• typedef bmi::multi_index_container
  < Dakota::ParamResponsePair,
    bmi::indexed_by
    < bmi::ordered_non_unique
    < bmi::tag< ordered >
    , bmi::const_mem_fun
    < Dakota::ParamResponsePair,
    const IntStringPair
    &,& Dakota::ParamResponsePair::eval_interface_ids > >,
  bmi::hashed_non_unique
  < bmi::tag< hashed >
  , bmi::identity
  < Dakota::ParamResponsePair >
  , partial_prp_hash,
  partial_prp_equality > > > PRPMultiIndexCache
  Boost Multi-Index Container for globally caching ParamResponsePairs.
• typedef PRPMultiIndexCache PRPCache
• typedef PRPCache::index_iterator
  < ordered >::type PRPCacheOIter
• typedef PRPCache::index_const_iterator
  < ordered >::type PRPCacheOCIter
12.1. DAKOTA NAMESPACE REFERENCE

- typedef PRPCache::index_iterator < hashed >::type PRPCacheHIter
- typedef PRPCache::index_const_iterator < hashed >::type PRPCacheHCIter
- typedef PRPCacheOIter PRPCacheIter
default cache iterator <0>
- typedef PRPCacheOCIter PRPCacheCIter
default cache const iterator <0>
default cache const reverse iterator <0>

- typedef boost::reverse_iterator < PRPCacheCIter > PRPCacheCRevIter
- typedef bmi::multi_index_container
  < Dakota::ParamResponsePair,
    bmi::indexed_by
    < bmi::ordered_unique
      < bmi::tag < ordered >
        , bmi::const_mem_fun
          < Dakota::ParamResponsePair,
            int,&Dakota::ParamResponsePair::eval_id >
        >
      , bmi::hashed_non_unique
        < bmi::tag < hashed >
          , bmi::identity
            < Dakota::ParamResponsePair >
              , partial_prp_hash,
              partial_prp_equality > > > PRPMultiIndexQueue

  Boost Multi-Index Container for locally queueing ParamResponsePairs.

- typedef PRPMultiIndexQueue PRPQueue
- typedef PRPQueue::index_iterator < ordered >::type PRPQueueOIter
- typedef PRPQueue::index_const_iterator < ordered >::type PRPQueueOCIter
- typedef PRPQueue::index_iterator < hashed >::type PRPQueueHIter
- typedef PRPQueue::index_const_iterator < hashed >::type PRPQueueHCIter
- typedef PRPQueueOIter PRPQueueIter
- typedef PRPQueueOCIter PRPQueueCIter
- typedef std::pair < boost::any,
    MetaDataType > ResultsValueType

Core data storage type: boost::any, with optional metadata (see other types in results_types.hpp)
CHAPTER 12. NAMESPACE DOCUMENTATION

- typedef boost::function<bool(const bfs::path &src, const bfs::path &dest, bool overwrite)> file_op_function
  
  define a function type that operates from src to dest, with option to overwrite

- typedef boost::filter_iterator<MatchesWC, bfs::directory_iterator> glob_iterator

  a glob_iterator filters a directory_iterator based on a wildcard predicate

Enumerations

- enum {
  COBYLA, DIRECT, EA, MS, PS, SW, BETA
}

- enum {
  METHOD_ERROR = -7, MODEL_ERROR = -6, IO_ERROR = -5, INTERFACE_ERROR = -4,
  CONSTRUCT_ERROR = -3, PARSE_ERROR = -2, OTHER_ERROR = -1
}

  enum for Dakota abort reasons; using negative numbers to avoid clash with signal codes 1–64 in signum.h

- enum { ABORT_EXITS, ABORT_THROWS }

  enum for dakota abort behaviors

- enum {
  TABULAR_NONE = 0, TABULAR_HEADER = 1, TABULAR_EVAL_ID = 2, TABULAR_IFACE_ID = 4,
  TABULAR_EXPER_ANNOT = TABULAR_HEADER | TABULAR_EVAL_ID, TABULAR_ANNOTATED = TABULAR_HEADER | TABULAR_EVAL_ID | TABULAR_IFACE_ID
}

  options for tabular columns

- enum { FLEXIBLE_RESULTS, LABELED_RESULTS }

  options for results file format

- enum {
  NO_MODEL_FORMAT =0, TEXT_ARCHIVE =1, BINARY_ARCHIVE =2, ALGEBRAIC_FILE =4, ALGEBRAIC_CONSOLE =8
}

  define special values for surrogateExportFormats

- enum {
  DEFAULT_INTERFACE =0, APPROX_INTERFACE, FORK_INTERFACE =PROCESS_INTERFACE_BIT, SYSTEM_INTERFACE,
  GRID_INTERFACE, TEST_INTERFACE =DIRECT_INTERFACE_BIT, MATLAB_INTERFACE, PYTHON_INTERFACE,
  SCILAB_INTERFACE
}

  special values for interface type

- enum { SYNCHRONOUS_INTERFACE, ASYNCHRONOUS_INTERFACE }

  interface synchronization types

- enum { OBJECTIVE, INEQUALITY_CONSTRAINT, EQUALITY_CONSTRAINT }
12.1. DAKOTA NAMESPACE REFERENCE

- enum {
  DEFAULT_METHOD = 0, HYBRID = (META_BIT | PARALLEL_BIT), PARETO_SET, MULTI_START,
  RICHARDSON_EXTRAP = (ANALYZER_BIT | VERIF_BIT), CENTERED_PARAMETER_STUDY = (ANALYZER_BIT | PSTUDYDACE_BIT), LIST_PARAMETER_STUDY, MULTIDIM_PARAMETER_STUDY,
  VECTOR_PARAMETER_STUDY, DACE, FSU_CVT, FSU_HALTON,
  FSU_HAMMERSLEY, PSUDE_MOAT, LOCAL_RELIABILITY = (ANALYZER_BIT | NOND_BIT), LOCAL_RELIABILITY,
  POLYNOMIAL_CHAOS, STOCH_COLLOCATION, CUBATURE_INTEGRATION, SPARSE_GRID_INTEGRATION,
  QUADRATURE_INTEGRATION, BAYES_CALIBRATION, GPAIS, POF_DARTS,
  RKD_DARTS, IMPORTANCE_SAMPLING, ADAPTIVE_SAMPLING, MULTILEVEL_SAMPLING,
  LIST_SAMPLING, RANDOM_SAMPLING, LOCAL_INTERVAL_EST, LOCAL_EVIDENCE,
  GLOBAL_INTERVAL_EST, GLOBAL_EVIDENCE, SURROGATE_BASED_LOCAL = (MINIMIZER_BIT | SURRBASED_BIT), EFFICIENT_GLOBAL, NL2SOL = (MINIMIZER_BIT | LEASTSQ_BIT), NLSSOL_SQP, OPTPP_G_NEwTON,
  ASYNCH_PATTERN_SEARCH = (MINIMIZER_BIT | OPTIMIZER_BIT), OPTPP_PDS, COLINY_BETA, COLINY_COBYLA,
  COLINY_DIRECT, COLINY_MULTI_START, COLINY_EA, COLINY_PATTERN_SEARCH,
  COLINY_SOLIS_WETS, MOGA, SOGA, NCSU_DIRECT,
  MESH_ADAPTIVE_SEARCH, GENIE_OPT_DARTS, GENIE_DIRECT, NONLINEAR_CG,
  OPTPP_CG, OPTPP_Q_NEwTON, OPTPP_FD_NEwTON, OPTPP_NEwTON,
  NPSOL_SQP, NLPRF_SQP, DOT_BFGS, DOT_FRCG,
  DOT_MMFD, DOT_SLP, DOT_SQP, CONMIN_FRCG,
  CONMIN_MFD, DL_SOLVER, BRANCH_AND_BOUND = (MINIMIZER_BIT | OPTIMIZER_BIT | LEASTSQ_BIT) }

- enum {
  SUBMETHOD_DEFAULT = 0, SUBMETHOD_NONE, SUBMETHOD_COLLABORATIVE, SUBMETHOD_EMBEDDED,
  SUBMETHODSEQUENTIAL, SUBMETHOD_LHS, SUBMETHOD_RANDOM, SUBMETHOD_BOX_BEHNKEN,
  SUBMETHOD_CENTRAL_COMPOSITE, SUBMETHOD_GRID, SUBMETHOD_OA_LHS, SUBMETHOD_OAS,
  SUBMETHOD_DREAM, SUBMETHOD_GPMSA, SUBMETHOD_QUESO, SUBMETHOD_WASABI,
  SUBMETHOD_NIP, SUBMETHOD_SQP, SUBMETHOD_EA, SUBMETHOD_EGO,
  SUBMETHOD_SBO, SUBMETHOD_CONVERGE_ORDER, SUBMETHOD_CONVERGE_QOI, SUBMETHOD_ESTIMATE_ORDER }

  Sub-methods, including sampling, inference algorithm, opt algorithm types.

- enum {
  SILENT_OUTPUT, QUIET_OUTPUT, NORMAL_OUTPUT, VERBOSE_OUTPUT,
  DEBUG_OUTPUT }
CHAPTER 12. NAMESPACE DOCUMENTATION

- enum { DEFAULT_CONFIG, PUSH_DOWN, PUSH_UP }
- enum { STD_NORMAL_U, STD_UNIFORM_U, ASKEY_U, EXTENDED_U }
- enum { DEFAULT_COVARIANCE, NO_COVARIANCE, DIAGONAL_COVARIANCE, FULL_COVARIANCE }
- enum { NO_INT_REFINE = 0, IS, AIS, MMAIS }
- enum { PROBABILITIES, RELIABILITIES, GEN_RELIABILITIES }
- enum { COMPONENT = 0, SYSTEM.Series, SYSTEM_PARALLEL }
- enum { CUMULATIVE, COMPLEMENTARY }
- enum { DEFAULT_LS = 0, SVD_LS, EQ_CON_LS }
- enum { NO_EMULATOR, PCE_EMULATOR, SC_EMULATOR, GP_EMULATOR, KRIGING_EMULATOR, VPS_EMULATOR }
- enum { CALIBRATE_NONE = 0, CALIBRATE.ONE, CALIBRATE.PER.EXPER, CALIBRATE.PER.R-ESP, CALIBRATE.BOTH }
- enum { IGNORE_RANKS, SET_RANKS, GET_RANKS, SET_GET_RANKS }
- enum { UNCERTAIN, UNCERTAIN_UNIFORM, ALEATORY_UNCERTAIN, ALEATORY_UNCERTAIN_UNIFORM, EPISTEMIC_UNCERTAIN, EPISTEMIC_UNCERTAIN_UNIFORM, ACTIVE, ACTIVE_UNIFORM, ALL, ALL_UNIFORM }
- enum { ONE_SIDED, TWO_SIDED }
- enum { MV = 0, AMV_X, AMV_U, AMV_PLUS_X, AMV_PLUS_U, TANA_X, TANA_U, NO_APPROX, EGRA_X, EGRA_U }
- enum { BREITUNG, HOHENRACK, HONG }
- enum { ORIGINAL_PRIMARY, SINGLE_OBJECTIVE, LAGRANGIAN_OBJECTIVE, AUGMENTED_LAGRANGIAN_OBJECTIVE }
- enum { NO_CONSTRAINTS, LINEARIZED_CONSTRAINTS, ORIGINAL_CONSTRAINTS }
- enum { NO_RELAX, HOMOTOPY, COMPOSITE_STEP }
- enum { PENALTY_MERIT, ADAPTIVE_PENALTY_MERIT, LAGRANGIAN_MERIT, AUGMENTED_LAGRANGIAN_MERIT }
- enum { FILTER, TR_RATIO }
- enum { SCALE_NONE, SCALE_VALUE, SCALE_LOG }
- enum { CDV, LINEAR, NONLIN, FN_LSQ }
- enum { DISALLOW, TARGET, BOUNDS }
- enum { DEFAULT_POINTS, MINIMUM_POINTS, RECOMMENDED_POINTS, TOTAL_POINTS }

define special values for pointsManagement

- enum { NO_SURROGATE = 0, UNCORRECTED_SURROGATE, AUTO_CORRECTED_SURROGATE, BYPASS_SURROGATE, MODEL_DISCREPANCY, AGGREGATED_MODELS }

define special values for SurrogateModel::responseMode
12.1. DAKOTA NAMESPACE REFERENCE

- enum { NO_CORRECTION =0, ADDITIVE_CORRECTION, MULTIPLICATIVE_CORRECTION, COMBINED_CORRECTION }
  
  define special values for approxCorrectionType

- enum { RF_KARHUNEN_LOEVE =0, RF_PCA_GP, RF_ICA }
  
  define types of random field approximations

- enum { NOCOVAR =0, EXP_L2, EXP_L1 }
  
  define types of analytic covariance functions

- enum { BASE_RESPONSE =0, SIMULATION_RESPONSE, EXPERIMENT_RESPONSE }
  
  special values for derived Response type

- enum { GENERIC_FNS =0, OBJECTIVE_FNS, CALIB_TERMS }
  
  values for primary response types

- enum { DEFAULT_DOMAIN =0, RELAXED_DOMAIN, MIXED_DOMAIN }

- enum {
    DEFAULT_VIEW =0, ALL_VIEW, DESIGN_VIEW, UNCERTAIN_VIEW, ALEATORY_uncertain_view, EPISTEMIC_uncertain_view, STATE_VIEW }

- enum {
    EMPTY_VIEW =0, RELAXED_ALL, MIXED_ALL, RELAXED_DESIGN, RELAXED_uncertain, RELAXED_ALEATORY_uncertain, RELAXED_EPISTEMIC_uncertain, RELAXED_STATE, MIXED_DESIGN, MIXED_uncertain, MIXED_ALEATORY_uncertain, MIXED_EPISTEMIC_uncertain, MIXED_STATE }

- enum {
    EMPTY_TYPE =0, CONTINUOUS_DESIGN, DISCRETE_DESIGN_Range, DISCRETE_DESIGN_SET_INT, DISCRETE_DESIGN_SET_STRING, DISCRETE_DESIGN_SET_REAL, NORMAL_uncertain, LOGNORMAL_uncertain, UNIFORM_uncertain, LOGUNIFORM_uncertain, TRIANGULAR_uncertain, EXPONENTIAL_uncertain, BETA_uncertain, GAMMA_uncertain, GUMBEL_uncertain, FRECHET_uncertain, WEIBULL_uncertain, HISTOGRAM_BIN_uncertain, POISSON_uncertain, BINOMIAL_uncertain, NEGATIVE_BINOMIAL_uncertain, GEOMETRIC_uncertain, HYPERGEOMETRIC_uncertain, HISTOGRAM_POINT_uncertain_INT, HISTOGRAM_POINT_uncertain_STRING, HISTOGRAM_POINT_uncertain_REAL, CONTINUOUS_INTERVAL_uncertain, DISCRETE_INTERVAL_uncertain, DISCRETE_uncertain_SET_INT, DISCRETE_uncertain_SET_STRING, DISCRETE_uncertain_SET_REAL, CONTINUOUS_STATE, DISCRETE_STATE_RANGE, DISCRETE_STATE_SET_INT, DISCRETE_STATE_SET_STRING, DISCRETE_STATE_SET_REAL }

- enum {
    TOTAL_CDV =0, TOTAL_ddiv, TOTAL_DSV, TOTAL_DDRV, TOTAL_CAUv, TOTAL_DAUIV, TOTAL_DAUSV, TOTAL_DAURV, TOTAL_CEuv, TOTAL_DEUIV, TOTAL_DEUSV, TOTAL_DEURV, TOTAL_CSv, TOTAL_DsIV, TOTAL_DSSV, TOTAL_DSRV, NUM_VC_TOTALS }
• enum var_t {
    VAR_x1, VAR_x2, VAR_x3, VAR_b,
    VAR_h, VAR_P, VAR_M, VAR_Y,
    VAR_w, VAR_t, VAR_R, VAR_E,
    VAR_X, VAR_Fs, VAR_P1, VAR_P2,
    VAR_P3, VAR_B, VAR_D, VAR_H,
    VAR_F0, VAR_d, VAR_MForm
}

  enumeration of possible variable types (to index to names)
• enum driver_t {
    NO_DRIVER =0, CANTILEVER_BEAM, MOD_CANTILEVER_BEAM, CYLINDER_HEAD,
    EXTENDED_ROSENBROCK, GENERALIZED_ROSENBROCK, LF_ROSENBROCK, MF_ROSE-
    NBRUCK, ROSENBRUCK, LF_POLY_PROD, POLY_PROD, GERSTNER,
    SCALABLE_GERSTNER, LOGNORMAL_RATIO, MULTIMODAL, PLUGIN_ROSENBROCK,
    PLUGIN_TEXT_BOOK, SHORT_COLUMN, LF_SHORT_COLUMN, MF_SHORT_COLUMN,
    SIDE_IMPACT_COST, SIDE_IMPACT_PERFORMANCE, SOBOL_RATIONAL, SOBOL_G_FUNCTION,
    SOBOL_ISHIGAMI, STEEL_COLUMN_COST, STEEL_COLUMN_PERFORMANCE, TEXT_BOOK,
    TEXT_BOOK1, TEXT_BOOK2, TEXT_BOOK3, TEXT_BOOK_OUU,
    SCALABLE_TEXT_BOOK, SCALABLE_MONOMIALS, MOGATEST1, MOGATEST2,
    MOGATEST3, ILLUMINATION, BARNES, BARNES_LF,
    HERBIE, SMOOTH_HerbIE, SHUBERT, SALINAS,
    MODELCENTER, GENZ, DAMPED_OSCILLATOR, ANISOTROPIC_QUADRATIC_FORM,
    BAYES_LINEAR, STEADY_STATE_DIFFUSION_1D, TRANSIENT_DIFFUSION_1D
}

  enumeration of possible direct driver types (to index to names)
• enum local_data_t { VARIABLES_MAP =1, VARIABLES_VECTOR =2 }

  enumeration for how local variables are stored (values must employ a bit representation)
• enum sigtype { NO_SIGMA, SCALAR_SIGMA, DIAGONAL_SIGMA, MATRIX_SIGMA }

  special values for sigmaType
• enum edtype { SCALAR_DATA, FUNCTIONAL_DATA }

  special values for experimental data type
• enum { SETUP_MODEL, SETUP_USERFUNC }
• enum {
    CAUVar_normal = 0, CAUVar_lognormal = 1, CAUVar_uniform = 2, CAUVar_loguniform = 3,
    CAUVar_triangular = 4, CAUVar_exponential = 5, CAUVar_beta = 6, CAUVar_gamma = 7,
    CAUVar_gumbel = 8, CAUVar_frechet = 9, CAUVar_weibull = 10, CAUVar_histogram_bin = 11,
    CAUVar_Nkinds = 12 }
• enum {
    DAUIVar_poisson = 0, DAUIVar_binomial = 1, DAUIVar_negative_binomial = 2, DAUIVar_geometric
    = 3,
    DAUIVar_hypergeometric = 4, DAUIVar_histogram_point_int = 5, DAUIVar_Nkinds = 6 }
• enum { DAUSVar_histogram_point_str = 0, DAUSVar_Nkinds = 1 }
• enum { DEUVar_interval = 0, DEUVar_set_int = 1, DEUVar_Nkinds = 2 }
• enum { DEUSVar_set_str = 0, DEUSVar_Nkinds = 1 }
12.1. DAKOTA NAMESPACE REFERENCE

- enum { DEURVar_set_real = 0, DEURVar_Nkinds = 1 }
- enum {
  DiscSetVar_design_set_int = 0, DiscSetVar_design_set_str = 1, DiscSetVar_design_set_real = 2, DiscSetVar_state_set_int = 3,
  DiscSetVar_state_set_str = 4, DiscSetVar_state_set_real = 5, DiscSetVar_Nkinds = 6 }
- enum { NUM_UNC_REAL_CONT = 4 }
  number of real-valued uncertain contiguous containers
- enum { NUM_UNC_INT_CONT = 2 }
  number of int-valued uncertain contiguous containers
- enum { NUM_UNC_STR_CONT = 2 }
  number of string-valued uncertain contiguous containers
- enum { FULL_TENSOR, FILTERED_TENSOR, RANDOM_TENSOR }
- enum CG_UPDATETYPE { CG_STEEPEST, CG_FLETCHER_REEVES, CG_POLAK_RIBIERE, CG_POLAK_RIBIERE_PLUS, CGHESTENES_STIEFEL }
  NonlinearCG update options.
- enum CG_LINESEARCHTYPE { CG_FIXED_STEP, CG_LS_SIMPLE, CG_LS_BRENT, CG_LS_WOLFE }
  NonlinearCG linesearch options.
- enum EvalType { NLFEvaluator, CONEvaluator }
  enumeration for the type of evaluator function
- enum { TH_SILENT_OUTPUT, TH_QUIET_OUTPUT, TH_NORMAL_OUTPUT, THVERBOSE_OUTPUT, TH_DEBUG_OUTPUT }
- enum { DIR_CLEAN, DIR_PERSIST, DIR_ERROR }
  define directory creation options
- enum { FILEOP_SILENT, FILEOP_WARN, FILEOP_ERROR }
  enum indicating action on failed file operation

Functions

- CommandShell & flush (CommandShell &shell)
  convenient shell manipulator function to “flush” the shell
- void read_sized_data (std::istream &s, RealVectorArray &va, size_t num_rows, int num_cols)
- void read_fixed_rowsize_data (std::istream &s, RealVectorArray &va, int num_cols, bool row_major)
- void read_unsized_data (std::istream &s, RealVectorArray &va, bool row_major)
- void read_config_vars_multifile (const std::string &basename, int num_expts, int ncv, RealVectorArray &config vars)
- void read_config_vars_singlefile (const std::string &basename, int num_expts, int ncv, RealVectorArray &config vars)
- void read_field_values (const std::string &basename, int expt_num, RealVectorArray &field_vars)
- void read_field_values (const std::string &basename, int expt_num, RealVector &field vars)
- void read_coord_values (const std::string &basename, int expt_num, RealMatrix &coords)
- void read_coord_values (const std::string &basename, RealMatrix &coords)
• void **read_covariance** (const std::string &basename, int expt_num, RealMatrix &cov_vals)

• void **read_covariance** (const std::string &basename, int expt_num, Dakota::CovarianceMatrix::FORMAT format, int num_vals, RealMatrix &cov_vals)

• bool **nearby** (const RealVector &rv1, const RealVector &rv2, Real rel_tol)

  *tolerance-based equality operator for RealVector*

• bool operator== (const ShortArray &dsa1, const ShortArray &dsa2)

  *equality operator for ShortArray*

• bool operator== (const StringArray &dsa1, const StringArray &dsa2)

  *equality operator for StringArray*

• Real **rel_change_L2** (const RealVector &curr rv, const RealVector &prev rv)

  *Computes relative change between RealVectors using Euclidean L2 norm.*

• Real **rel_change_L2** (const RealVector &curr rv1, const RealVector &prev rv1, const IntVector &curr iv, const IntVector &prev iv, const RealVector &curr rv2, const RealVector &prev rv2)

  *Computes relative change between Real/int/Real vector triples using Euclidean L2 norm.*

• bool operator== (const IntArray &dia1, const IntArray &dia2)

  *equality operator for IntArray*

• template<typename T >
  bool operator== (const std::vector<T> &vec, typename boost::multi_array<T, 1>::template const_array_view<1>::type mav)

  *equality operator for std::vector and boost::multi_array::const_array_view*

• template<typename T >
  bool operator== (typename boost::multi_array<T, 1>::template const_array_view<1>::type mav, const std::vector<T> &vec)

  *inequality operator for boost::multi_array::const_array_view and std::vector*

• template<typename T >
  bool operator== (const boost::multi_array<T, 1> &ma, typename boost::multi_array<T, 1>::template const_array_view<1>::type mav)

  *equality operator for boost::multi_array and boost::multi_array::const_array_view*

• template<typename T >
  bool operator== (typename boost::multi_array<T, 1>::template const_array_view<1>::type mav, const boost::multi_array<T, 1> &ma)

  *equality operator for boost::multi_array::const_array_view and boost::multi_array*

• bool operator!= (const IntArray &dia1, const IntArray &dia2)

  *inequality operator for IntArray*

• bool operator!= (const ShortArray &dsa1, const ShortArray &dsa2)

  *inequality operator for ShortArray*

• bool operator!= (const StringArray &dsa1, const StringArray &dsa2)

  *inequality operator for StringArray*

• template<typename T >
  bool operator!= (const std::vector<T> &vec, typename boost::multi_array<T, 1>::template const_array_view<1>::type mav)

  *inequality operator for std::vector and boost::multi_array::const_array_view*

• template<typename T >
  bool operator!= (typename boost::multi_array<T, 1>::template const_array_view<1>::type mav, const std::vector<T> &vec)
12.1. DAKOTA NAMESPACE REFERENCE

inequality operator for boost::multi_array::const_array_view and std::vector

- template<typename T>
  bool operator!= (const boost::multi_array<T, 1>& ma, typename boost::multi_array<T, 1>::template const_array_view<1>::type mav)

inequality operator for boost::multi_array and boost::multi_array::const_array_view

- template<typename T>
  bool operator!= (typename boost::multi_array<T, 1>::template const_array_view<1>::type mav, const boost::multi_array<T, 1>& ma)

inequality operator for boost::multi_array::const_array_view and boost::multi_array

- std::string strtolower (const std::string &s)
  Return lowercase copy of string s.

- bool strbegins (const std::string &input, const std::string &test)
  Return true if input string begins with string test.

- bool strends (const std::string &input, const std::string &test)
  Return true if input string ends with string test.

- bool strcontains (const std::string &input, const std::string &test)
  Return true if input string contains string test.

- void build_label (String &label, const String &root_label, size_t tag, const String &separator="")
  create a label by appending a numerical tag to the root_label, o

- void build_labels (StringArray &label_array, const String &root_label)
  create an array of labels by tagging root_label for each entry in label_array. Uses build_label().

- void build_labels (StringMultiArray &label_array, const String &root_label)
  create an array of labels by tagging root_label for each entry in label_array. Uses build_label().

- void build_labels_partial (StringArray &label_array, const String &root_label, size_t start_index, size_t num_items)
  create a partial array of labels by tagging root_label for a subset of entries in label_array. Uses build_label().

- void copy_row_vector (const RealMatrix &m, RealMatrix::ordinalType i, std::vector<Real>& row)
  Copies a row of a Teuchos_SerialDenseMatrix<int,Real> to std::vector<Real>&

- template<typename T>
  void copy_data (const std::vector<T> &vec, T *ptr, const size_t ptr_len)
  copy Array<T> to T*

- template<typename T>
  void copy_data (const T *ptr, const size_t ptr_len, std::vector<T> &vec)
  copy T* to Array<T>

- template<typename OrdinalType1, typename OrdinalType2, typename ScalarType>
  void copy_data (const std::vector<Teuchos::SerialDenseVector<OrdinalType1, ScalarType> > &va, Teuchos::SerialDenseMatrix<OrdinalType2, ScalarType> &sdm)
  copy Array<Teuchos::SerialDenseVector<OT1,ST1>> to Teuchos::SerialDenseMatrix<OT2,ST2>

- template<typename OrdinalType, typename ScalarType>
  void copy_data_transpose (const std::vector<Teuchos::SerialDenseVector<OrdinalType, ScalarType> > &sdva, Teuchos::SerialDenseMatrix<OrdinalType, ScalarType> &sdm)
  copy Array<Teuchos::SerialDenseVector<OT1,ST1>> to Teuchos::SerialDenseMatrix<OT2,ST2>
copy Array<Teuchos::SerialDenseVector<OT,ST>> to transposed Teuchos::SerialDenseMatrix<OT,ST>

- template<typename OrdinalType, typename ScalarType>
  void copy_data (const Teuchos::SerialDenseMatrix<OrdinalType, ScalarType> &sdm, std::vector<Teuchos::SerialDenseVector<OrdinalType, ScalarType>> &sdva)

- template<typename OrdinalType, typename ScalarType>
  void copy_data_transpose (const Teuchos::SerialDenseMatrix<OrdinalType, ScalarType> &sdm, Teuchos::SerialDenseMatrix<OrdinalType, ScalarType> &sdva)

- template<typename OrdinalType1, typename OrdinalType2, typename ScalarType>
  void copy_data (const Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv, Teuchos::SerialDenseMatrix<OrdinalType1, ScalarType> &sdm, OrdinalType2 nr, OrdinalType2 nc)

- template<typename T>
  void copy_data (const std::list<T> &dl, std::vector<T> &da)

- template<typename T>
  void copy_data (const std::list<T> &dl, std::vector<std::vector<T>> &d2a, size_t num_a, size_t a_len)

- template<typename T>
  void copy_data (const std::vector<std::vector<T>> &d2a, std::vector<T> &da)

- template<typename T>
  void copy_data (const Teuchos::SerialDenseVector<OrdinalType, ScalarType> &sdv, Teuchos::SerialDenseVector<OrdinalType, ScalarType> &sdv2)

- template<typename T>
  void copy_data (const_scalar_type∗ ptr, const OrdinalType2 ptr_len, Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv)

- template<typename T>
  void copy_data (const Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv, Teuchos::SerialDenseVector<OrdinalType, ScalarType> &sdv2)
• template<typename OrdinalType1, typename OrdinalType2, typename ScalarType>
  void copy_data (const Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv, std::vector<Teuchos::SerialDenseVector<OrdinalType1, ScalarType> > &sva, OrdinalType2 num_vec, OrdinalType2 vec_len)

  copy SerialDenseVector<> to Array<SerialDenseVector<> >

• template<typename OrdinalType1, typename OrdinalType2, typename ScalarType>
  void copy_data_partial (const Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv, Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sv, OrdinalType2 start_index1, OrdinalType2 num_items, Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv2, OrdinalType2 start_index2)

  copy portion of first SerialDenseVector to all of second SerialDenseVector

• template<typename OrdinalType1, typename OrdinalType2, typename ScalarType>
  void copy_data_partial (const Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv1, Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv2, OrdinalType2 start_index2)

  copy all of first SerialDenseVector to portion of second SerialDenseVector

• template<typename OrdinalType1, typename OrdinalType2, typename ScalarType>
  void copy_data_partial (const Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv1, Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv2, OrdinalType2 start_index1, OrdinalType2 num_items, Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv2, OrdinalType2 start_index2)

  copy portion of first SerialDenseVector to portion of second SerialDenseVector

• template<typename OrdinalType1, typename OrdinalType2, typename ScalarType>
  void copy_data_partial (const Teuchos::SerialDenseVector<OrdinalType1, ScalarType> &sdv1, std::vector<ScalarType> &da2, OrdinalType2 start_index2)

  copy portion of first SerialDenseVector to portion of second SerialDenseVector

• template<typename T>
  void copy_data_partial (const std::vector<T> &da1, OrdinalType index, std::vector<T> &da2, OrdinalType2 start_index1, size_t num_items, std::vector<T> &da2, OrdinalType2 start_index2)

  copy all of first Array<T> to portion of second Array<T>

• template<typename T>
  void copy_data_partial (const std::vector<T> &da1, std::vector<T> &da2, OrdinalType2 start_index2)

  copy all of first Array<T> to portion of second Array<T>

• template<typename T>
  void copy_data_partial (const std::vector<T> &da, boost::multi_array<T, 1> &bma, OrdinalType2 start_index2)

  copy all of first Array<T> to portion of boost::multi_array<T, 1>

• template<typename T>
  void copy_data_partial (const std::vector<T> &da1, OrdinalType index, size_t start_index1, size_t num_items, std::vector<T> &da2, OrdinalType2 start_index2)

  copy portion of first Array<T> to portion of second Array<T>

• void merge_data_partial (const IntVector &d_vec, RealVector &m_vec, size_t start_index_ma)
  merge a discrete integer vector into a single continuous vector

• void merge_data_partial (const IntVector &d_vec, RealArray &m_array, size_t start_index_ma)
  merge a discrete integer vector into a single continuous array

• template<typename OrdinalType, typename ScalarType>
  const ScalarType & set_index_to_value (OrdinalType index, const std::set<ScalarType> &values)

  retrieve the set value corresponding to the passed index
CHAPTER 12. NAMESPACE DOCUMENTATION

- \texttt{template<typename ScalarType >
  size_t set\_value\_to\_index (const ScalarType &value, const std::set< ScalarType > &values)}
  calculate the set index corresponding to the passed value

- \texttt{template<typename OrdinalType , typename KeyType , typename ValueTy
  const KeyType & map\_index\_to\_key (OrdinalType index, const std::map< KeyType, ValueTy &pairs)}}
  retrieve the set value corresponding to the passed index

- \texttt{template<typename OrdinalType , typename KeyType , typename ValueTy
  const ValueTy & map\_index\_to\_value (OrdinalType index, const std::map< KeyType, ValueTy &pairs)}}
  retrieve the set value corresponding to the passed index

- \texttt{template<typename KeyType , typename ValueType
  void map\_keys\_to\_set (const std::map< KeyType, ValueType > &source\_map, std::set< KeyType > &target\_set)}
  calculate the map index corresponding to the passed key

- \texttt{template<typename KeyType , typename ValueType
  size_t map\_key\_to\_index (const KeyType &key, const std::map< KeyType, ValueType > &pairs)}
  calculate the map index corresponding to the passed key

- \texttt{template<typename OrdinalType , typename ScalarType
  void x\_y\_pairs\_to\_x\_set (const Teuchos::SerialDenseVector< OrdinalType, ScalarType > &xy\_pairs, std::set< ScalarType > &x\_set)}
  convert a SerialDenseVector of head-to-tail (x,y) pairs into a std::set of (x), discarding the y values

- \texttt{template<typename ContainerType>
  size_t find\_index (const ContainerType &c, const typename ContainerType::value\_type &search\_data)}
  compute the index of an entry within a boost::multi\_array

- \texttt{size_t find\_index (SizetMultiArrayConstView bmacv, size_t search\_data)}
  compute the index of an entry within a boost::multi\_array view

- \texttt{size_t find\_index (StringMultiArrayConstView bmacv, const String &search\_data)}
  compute the index of an entry within a boost::multi\_array view

- \texttt{template<typename ListT>
  size_t find\_index (const ListT &l, const typename ListT::value\_type &val)}
  compute the index of an entry within a std::list

- \texttt{void copy\_data (SizetMultiArrayConstView ma, SizetArray &da)}
  copy boost::multi\_array view to Array

- \texttt{void copy\_data (StringMultiArrayConstView ma, StringArray &da)}
  copy boost::multi\_array view to Array

- \texttt{template<typename ListT>
  ListT::const_iterator find\_if (const ListT &l, bool(*test\_fn)(const typename ListT::value\_type &, const std::string &), const std::string &test\_fn\_data)}
  return an iterator to the first list element satisfying the predicate test\_fn w.r.t. the passed test\_fn\_data; end if not found
12.1. DAKOTA NAMESPACE REFERENCE

- template<typename DakContainerType >
  bool contains (const DakContainerType &v, const typename DakContainerType::value_type &val)
  return true if the item val appears in container v

- void abort_handler (int code)
  global function which handles serial or parallel aborts

- void abort_throw_or_exit (int code)
  throw or exit depending on abort_mode

- void register_signal_handlers ()
  Tie various signal handlers to Dakota’s abort_handler function.

- void mpi_debug_hold ()
  Global function to hold Dakota processes to help with MPI debugging.

- template<typename T >
  T abort_handler_t (int code)

- void svd (RealMatrix &matrix, RealVector &singular vals, RealMatrix &v_trans)
  Compute the SVD of an arbitrary matrix $A = USV^T$.

- int qr (RealMatrix &A)
  Compute an in-place QR factorization $A = QR$.

- int qr_rsolve (const RealMatrix &q_r, bool transpose, RealMatrix &rhs)
  Perform a multiple right-hand sides $Rinv \cdot rhs$ solve using the $R$ from a qr factorization.

- ResultsKeyType make_key (const StrStrSizet &iterator_id, const std::string &data_name)
  Make a full ResultsKey from the passed iterator_id and data_name.

- MetaDataValueType make_metadatavalue (StringMultiArrayConstView labels)
  create MetaDataValueType from the passed strings

- MetaDataValueType make_metadatavalue (StringMultiArrayConstView cv_labels, StringMultiArrayConstView div_labels, StringMultiArrayConstView drv_labels, const StringArray &resp_labels)
  create MetaDataValueType from the passed strings

- MetaDataValueType make_metadatavalue (const StringArray &resp_labels)
  create MetaDataValueType from the passed strings

- MetaDataValueType make_metadatavalue (const std::string &)
  create MetaDataValueType from the passed strings

- MetaDataValueType make_metadatavalue (const std::string &, const std::string &)
  create MetaDataValueType from the passed strings

- MetaDataValueType make_metadatavalue (const std::string &, const std::string &, const std::string &)
  create MetaDataValueType from the passed strings

- MetaDataValueType make_metadatavalue (const std::string &, const std::string &, const std::string &, const std::string &)
  create MetaDataValueType from the passed strings

- MetaDataValueType make_metadatavalue (StringMultiArrayConstView cv_labels, StringMultiArrayConstView div_labels, StringMultiArrayConstView dsv_labels, StringMultiArrayConstView drv_labels, const StringArray &resp_labels)

- std::istream & operator >> (std::istream &, ActiveSet &set)
  std::istream extraction operator for ActiveSet. Calls read(std::istream&).

- std::ostream & operator << (std::ostream &, const ActiveSet &set)
  std::ostream insertion operator for ActiveSet. Calls write(std::ostream&).
CHAPTER 12. NAMESPACE DOCUMENTATION

- **MPIUnpackBuffer & operator>> (MPIUnpackBuffer &s, ActiveSet &set)**
  
  `MPIUnpackBuffer` extraction operator for `ActiveSet`. Calls `read(MPIUnpackBuffer&)`.

- **MPIPackBuffer & operator<< (MPIPackBuffer &s, const ActiveSet &set)**
  
  `MPIPackBuffer` insertion operator for `ActiveSet`. Calls `write(MPIPackBuffer&)`.

- **bool operator!=(const ActiveSet &set1, const ActiveSet &set2)**
  
  inequality operator for `ActiveSet`

- **std::istream & operator>>(std::istream &s, Constraints &con)**
  
  `std::istream` extraction operator for `Constraints`

- **std::ostream & operator<<(std::ostream &s, const Constraints &con)**
  
  `std::ostream` insertion operator for `Constraints`

- **std::string re_match(const std::string &token, const boost::regex &re)**
  
  Global utility function to ease migration from `CtelRegExp` to `Boost.Regex`.

- **bool interface_id_compare(const Interface &interface_in, const void *id)**
  
  global comparison function for `Interface`

- **bool method_id_compare(const Iterator &iterator, const void *id)**
  
  global comparison function for `Iterator`

- **bool model_id_compare(const Model &model, const void *id)**
  
  global comparison function for `Model`

- **bool operator==(const Model &m1, const Model &m2)**
  
  equality operator for `Envelope` is true if same letter instance.

- **bool operator!=(const Model &m1, const Model &m2)**
  
  inequality operator for `Envelope` is true if different letter instance.

- **bool responses_id_compare(const Response &resp, const void *id)**
  
  global comparison function for `Response`

- **std::istream & operator>>(std::istream &s, Response &response)**
  
  `std::istream` extraction operator for `Response`. Calls `read(std::istream&)`.

- **std::ostream & operator<<(std::ostream &s, const Response &response)**
  
  `std::ostream` insertion operator for `Response`. Calls `write(std::ostream&)`.

- **MPIUnpackBuffer & operator>>(MPIUnpackBuffer &s, Response &response)**
  
  `MPIUnpackBuffer` extraction operator for `Response`. Calls `read(MPIUnpackBuffer&)`.

- **MPIPackBuffer & operator<<(MPIPackBuffer &s, const Response &response)**
  
  `MPIPackBuffer` insertion operator for `Response`. Calls `write(MPIPackBuffer&)`.

- **bool operator!=(const Response &resp1, const Response &resp2)**
  
  inequality operator for `Response`

- **bool variables_id_compare(const Variables &vars, const void *id)**
  
  global comparison function for `Variables`

- **std::istream & operator>>(std::istream &s, Variables &vars)**
  
  `std::istream` extraction operator for `Variables`.

- **std::ostream & operator<<(std::ostream &s, const Variables &vars)**
  
  `std::ostream` insertion operator for `Variables`.

- **MPIUnpackBuffer & operator>>(MPIUnpackBuffer &s, Variables &vars)**
  
  `MPIUnpackBuffer` extraction operator for `Variables`.

- **MPIPackBuffer & operator<<(MPIPackBuffer &s, const Variables &vars)**
  
  `MPIPackBuffer` insertion operator for `Variables`. 
12.1. DAKOTA NAMESPACE REFERENCE

**MPIPackBuffer** insertion operator for Variables.

- bool operator!= (const Variables &vars1, const Variables &vars2) inequality operator for Variables

- template<typename OrdinalType , typename ScalarType1 , typename ScalarType2 , typename ScalarType3 , typename ScalarType4 >
  void write_ordered (std::ostream &s, const SizetArray &comp_totals, const Teuchos::SerialDenseVector<OrdinalType, ScalarType1> &c_vector, const Teuchos::SerialDenseVector<OrdinalType, ScalarType2> &di_vector, const Teuchos::SerialDenseVector<OrdinalType, ScalarType3> &ds_vector, const Teuchos::SerialDenseVector<OrdinalType, ScalarType4> &dr_vector)

  free function to write Variables data vectors in input spec ordering

- template<typename OrdinalType , typename ScalarType1 , typename ScalarType2 , typename ScalarType3 , typename ScalarType4 >
  void write_ordered (std::ostream &s, const SizetArray &comp_totals, const Teuchos::SerialDenseVector<OrdinalType, ScalarType1> &c_vector, const Teuchos::SerialDenseVector<OrdinalType, ScalarType2> &di_vector, const boost::multi_array<ScalarType3, 1>& ds_array, const Teuchos::SerialDenseVector<OrdinalType, ScalarType4> &dr_vector)

  free function to write Variables data vectors in input spec ordering

- template<typename OrdinalType >
  void write_ordered (std::ostream &s, const SizetArray &comp_totals, const std::vector<ScalarType> &c_array, const std::vector<ScalarType> &di_array, const std::vector<ScalarType> &ds_array, const std::vector<ScalarType> &dr_array)

  free function to write Variables data vectors in input spec ordering

- MPIPackBuffer & operator<< (MPIPackBuffer &s, const DataEnvironment &data) MPIPackBuffer insertion operator for DataEnvironment.
- MPIUnpackBuffer & operator>> (MPIUnpackBuffer &s, DataEnvironment &data) MPIUnpackBuffer extraction operator for DataEnvironment.
- std::ostream & operator<< (std::ostream &s, const DataEnvironment &data) std::ostream insertion operator for DataEnvironment
- static String interface_enum_to_string (unsigned short interface_type) static String to_string function

- MPIPackBuffer & operator<< (MPIPackBuffer &s, const DataInterface &data) MPIPackBuffer insertion operator for DataInterface.
- MPIUnpackBuffer & operator>> (MPIUnpackBuffer &s, DataInterface &data) MPIUnpackBuffer extraction operator for DataInterface.
- std::ostream & operator<< (std::ostream &s, const DataInterface &data) std::ostream insertion operator for DataInterface

- MPIPackBuffer & operator<< (MPIPackBuffer &s, const DataMethod &data) MPIPackBuffer insertion operator for DataMethod.
- MPIUnpackBuffer & operator>> (MPIUnpackBuffer &s, DataMethod &data) MPIUnpackBuffer extraction operator for DataMethod.
- std::ostream & operator<< (std::ostream &s, const DataMethod &data) std::ostream insertion operator for DataMethod

- MPIPackBuffer & operator<< (MPIPackBuffer &s, const DataModel &data) MPIPackBuffer insertion operator for DataModel.
- MPIUnpackBuffer & operator>> (MPIUnpackBuffer &s, DataModel &data) MPIUnpackBuffer extraction operator for DataModel.
• std::ostream & operator<<(std::ostream &s, const DataModel &data)
  
  std::ostream insertion operator for DataModel
• MPIPackBuffer & operator<<(MPIPackBuffer &s, const DataResponses &data)

  MPIPackBuffer insertion operator for DataResponses.
• MPIUnpackBuffer & operator>>(MPIUnpackBuffer &s, DataResponses &data)

  MPIUnpackBuffer extraction operator for DataResponses.
• std::ostream & operator<<(std::ostream &s, const DataResponses &data)
  
  std::ostream insertion operator for DataResponses
• MPIPackBuffer & operator<<(MPIPackBuffer &s, const DataVariables &data)

  MPIPackBuffer insertion operator for DataVariables.
• MPIUnpackBuffer & operator>>(MPIUnpackBuffer &s, DataVariables &data)

  MPIUnpackBuffer extraction operator for DataVariables.
• std::ostream & operator<<(std::ostream &s, const DataVariables &data)
  
  std::ostream insertion operator for DataVariables
• int dlsolver_option (Opt_Info *)
• RealVector const * continuous_lower_bounds (Optimizer1 *o)
• RealVector const * continuous_upper_bounds (Optimizer1 *o)
• RealVector const * nonlinear_ineq_constraint_lower_bounds (Optimizer1 *o)
• RealVector const * nonlinear_ineq_constraint_upper_bounds (Optimizer1 *o)
• RealVector const * nonlinear_eq_constraint_targets (Optimizer1 *o)
• RealVector const * linear_ineq_constraint_lower_bounds (Optimizer1 *o)
• RealVector const * linear_ineq_constraint_upper_bounds (Optimizer1 *o)
• RealVector const * linear_eq_constraint_targets (Optimizer1 *o)
• RealMatrix const * linear_ineq_constraint_coeffs (Optimizer1 *o)
• RealMatrix const * linear_eq_constraint_coeffs (Optimizer1 *o)
• void ComputeResponses (Optimizer1 *o, int mode, int n, double *x)
• void GetFuncs (Optimizer1 *o, int m0, int m1, double *f)
• void GetGrads (Optimizer1 *o, int m0, int m1, int n, int is, int js, double *g)
• void GetContVars (Optimizer1 *o, int n, double *x)
• void SetBestContVars (Optimizer1 *o, int n, double *x)
• void SetBestRespFns (Optimizer1 *o, int n, double *x)
• void * dl_constructor (Optimizer1 *, Dakota_funcs *, dl_core_run_t *, dl Destructor_t *)
• static RealVector const * continuous_lower_bounds1 (Optimizer1 *o)
• static RealVector const * continuous_upper_bounds1 (Optimizer1 *o)
• static RealVector const * nonlinear_ineq_constraint_lower_bounds1 (Optimizer1 *o)
• static RealVector const * nonlinear_ineq_constraint_upper_bounds1 (Optimizer1 *o)
• static RealVector const * linear_ineq_constraint_lower_bounds1 (Optimizer1 *o)
• static RealVector const * linear_ineq_constraint_upper_bounds1 (Optimizer1 *o)
• static RealVector const * linear_eq_constraint_targets1 (Optimizer1 *o)
• static RealMatrix const * linear_ineq_constraint_coeffs1 (Optimizer1 *o)
• static RealMatrix const * linear_eq_constraint_coeffs1 (Optimizer1 *o)
• static void ComputeResponses1 (Optimizer1 *o, int mode, int n, double *x)
• static void GetFuncs1 (Optimizer1 *o, int m0, int m1, double *f)
• static void GetGrads1 (Optimizer1 *o, int m0, int m1, int n, int is, int js, double *g)
12.1. DAKOTA NAMESPACE REFERENCE

- static void `GetContVars1` (Optimizer1 ∗o, int n, double ∗x)
- static void `SetBestContVars1` (Optimizer1 ∗o, int n, double ∗x)
- static void `SetBestDiscVars1` (Optimizer1 ∗o, int n, int ∗x)
- static void `SetBestRespFns1` (Optimizer1 ∗o, int n, double ∗x)
- static double `Get_Real1` (Optimizer1 ∗o, const char ∗name)
- static int `Get_Int1` (Optimizer1 ∗o, const char ∗name)
- static bool `Get_Bool1` (Optimizer1 ∗o, const char ∗name)
- `DOTOptimizer ∗new_DOTOptimizer` (ProblemDescDB &problem_db)
- `DOTOptimizer ∗new_DOTOptimizer` (Model &model)
- `DOTOptimizer ∗new_DOTOptimizer` (ProblemDescDB &problem_db, Model &model)
- void `copy_field_data` (const RealVector &fn_vals, RealMatrix &fn_grad, const RealSymMatrixArray &fn_hess, size_t offset, size_t num_fns, Response &response)
- void `copy_field_data` (const RealVector &fn_vals, RealMatrix &fn_grad, const RealSymMatrixArray &fn_hess, size_t offset, size_t num_fns, short total_asv, Response &response)
- void `interpolate_simulation_field_data` (const Response &sim_resp, const RealMatrix &exp_coords, size_t field_num, short total_asv, size_t interp_resp_offset, Response &interp_resp)
- void `linear_interpolate_1d` (const RealMatrix &build_pts, const RealVector &build_vals, const RealMatrix &build_grads, const RealSymMatrixArray &build_hessians, const RealMatrix &pred_pts, RealVector &pred_vals, RealMatrix &pred_grads, RealSymMatrixArray &pred_hessians)

Returns the value of at 1D function f and its gradient and hessians (if available) at the points of vector pred_pts using linear interpolation. The vector build_pts specifies the coordinates of the underlying interval at which the values (build_vals) of the function f are known. The length of output pred_vals is equal to the length of pred_pts. This function assumes the build_pts is in ascending order.

- void `symmetric_eigenvalue_decomposition` (const RealSymMatrix &matrix, RealVector &eigenvalues, RealMatrix &eigenvectors)

Computes the eigenvalues and, optionally, eigenvectors of a real symmetric matrix A.

- void `compute_column_means` (RealMatrix &matrix, RealVector &avg_vals)

Compute the means of each column of an arbitrary matrix.

- bool `is_matrix_symmetric` (const RealMatrix &matrix)

Test if incoming matrix is symmetric.

- template<typename O , typename T>
  int `binary_search` (T target, Teuchos::SerialDenseVector<O, T> &data)

find the interval containing a target value. This function assumes the data is in ascending order.

- Real `getdist` (const RealVector &x1, const RealVector &x2)

- Real `mindist` (const RealVector &x, const RealMatrix &xset, int except)

- Real `mindistindx` (const RealVector &x, const RealMatrix &xset, const IntArray &indx)

- Real `getRmax` (const RealMatrix &xset)

- int `start_grid_computing` (char *analysis_driver_script, char *params_file, char *results_file)

- int `stop_grid_computing` ()

- int `perform_analysis` (char *iteration_num)

- template<typename T >
  string `asstring` (const T &val)

Creates a string from the argument val using an ostringstream.

- `PACKBUF` (int, MPI_INT) `PACKBUF` (int, MPI_INT) `PACKBUF` (long, MPI_LONG) `PACKBUF` (u_int, MPI_UNSIGNED)

- `PACKBUF` (long, MPI_LONG) `PACKBUF` (u_long, MPI_UNSIGNED)

- `PACKBUF` (short, MPI_SHORT) `PACKBUF` (u_short, MPI_UNSIGNED)
• MPI_UNSIGNED

MPI_UNSIGNED_LONG

MPI_UNSIGNED_SHORT

PACKBUF (char, MPI_CHAR) PACKBUF(u_char)

• MPI_UNSIGNED

MPI_UNSIGNED_LONG

MPI_UNSIGNED_SHORT

PACKBUF (double, MPI_DOUBLE) PACKBUF(float)

• UNPACKBUF 

(int, MPI_INT) UNPACKBUF(u_int)

• MPI_UNSIGNED

UNPACKBUF (long, MPI_LONG) UNPACKBUF(u_long)

• MPI_UNSIGNED

MPI_UNSIGNED_LONG

UNPACKBUF (short, MPI_SHORT) UNPACKBUF(u_short)

• MPI_UNSIGNED

MPI_UNSIGNED_SHORT

UNPACKBUF (char, MPI_CHAR) UNPACKBUF(u_char)

• MPI_UNSIGNED

MPI_UNSIGNED_LONG

MPI_UNSIGNED_SHORT

UNPACKBUF (double, MPI_DOUBLE) UNPACKBUF(float)

• PACKSIZE

(int, MPI_INT) PACKSIZE(u_int)

• MPI_UNSIGNED

PACKSIZE (long, MPI_LONG) PACKSIZE(u_long)

• MPI_UNSIGNED

MPI_UNSIGNED_LONG

PACKSIZE (short, MPI_SHORT) PACKSIZE(u_short)

• MPI_UNSIGNED

MPI_UNSIGNED_SHORT

PACKSIZE (char, MPI_CHAR) PACKSIZE(u_char)

• MPI_UNSIGNED

MPI_UNSIGNED_LONG

MPI_UNSIGNED_SHORT

MPI_UNSIGNED_CHAR

MPI_FLOAT

int MPIPackSize (const bool &data, const int num=1)

return packed size of a bool

• MPIPackBuffer & operator<< (MPIPackBuffer &buff, const int &data)

insert an int

• MPIPackBuffer & operator<< (MPIPackBuffer &buff, const u_int &data)

insert a u_int

• MPIPackBuffer & operator<< (MPIPackBuffer &buff, const long &data)

insert a long

• MPIPackBuffer & operator<< (MPIPackBuffer &buff, const u_long &data)

insert a u_long

• MPIPackBuffer & operator<< (MPIPackBuffer &buff, const short &data)

insert a short

• MPIPackBuffer & operator<< (MPIPackBuffer &buff, const u_short &data)

insert a u_short

• MPIPackBuffer & operator<< (MPIPackBuffer &buff, const char &data)

insert a char

• MPIPackBuffer & operator<< (MPIPackBuffer &buff, const u_char &data)

insert a u_char

• MPIPackBuffer & operator<< (MPIPackBuffer &buff, const double &data)

insert a double

• MPIPackBuffer & operator<< (MPIPackBuffer &buff, const float &data)
12.1. DAKOTA NAMESPACE REFERENCE

insert a float

- `MPIPackBuffer & operator<< (MPIPackBuffer &buff, const bool &data)`

insert a bool

- `MPIUnpackBuffer & operator>>(MPIUnpackBuffer &buff, int &data)`
  extract an int

- `MPIUnpackBuffer & operator>>(MPIUnpackBuffer &buff, u_int &data)`
  extract a u_int

- `MPIUnpackBuffer & operator>>(MPIUnpackBuffer &buff, long &data)`
  extract a long

- `MPIUnpackBuffer & operator>>(MPIUnpackBuffer &buff, u_long &data)`
  extract a u_long

- `MPIUnpackBuffer & operator>>(MPIUnpackBuffer &buff, short &data)`
  extract a short

- `MPIUnpackBuffer & operator>>(MPIUnpackBuffer &buff, u_short &data)`
  extract a u_short

- `MPIUnpackBuffer & operator>>(MPIUnpackBuffer &buff, char &data)`
  extract a char

- `MPIUnpackBuffer & operator>>(MPIUnpackBuffer &buff, u_char &data)`
  extract a u_char

- `MPIUnpackBuffer & operator>>(MPIUnpackBuffer &buff, double &data)`
  extract a double

- `MPIUnpackBuffer & operator>>(MPIUnpackBuffer &buff, float &data)`
  extract a float

- `MPIUnpackBuffer & operator>>(MPIUnpackBuffer &buff, bool &data)`
  extract a bool

- template<class ContainerT>
  void container_read (ContainerT &c, MPIUnpackBuffer &s)

  Read a generic container (vector<T>, list<T>) from MPIUnpackBuffer, s.

- template<class ContainerT>
  void container_write (const ContainerT &c, MPIPackBuffer &s)

  Write a generic container to MPIPackBuffer, s.

- template<typename Block, typename Allocator>
  MPIPackBuffer & operator<< (MPIPackBuffer &s, const boost::dynamic_bitset<Block, Allocator> &bs)

  stream insertion for BitArray

- template<typename Block, typename Allocator>
  MPIUnpackBuffer & operator>>(MPIUnpackBuffer &s, boost::dynamic_bitset<Block, Allocator> &bs)

  stream extraction for BitArray

- template<class ContainerT>
  MPIUnpackBuffer & operator>>(MPIUnpackBuffer &s, ContainerT &data)

  global MPIUnpackBuffer extraction operator for generic container

- template<class ContainerT>
  MPIPackBuffer & operator<<(MPIPackBuffer &s, const ContainerT &data)

  global MPIPackBuffer insertion operator for generic container
- int MPIPackSize (const int &data, const int num=1)
  return packed size of an int
- int MPIPackSize (const u_int &data, const int num=1)
  return packed size of a u_int
- int MPIPackSize (const long &data, const int num=1)
  return packed size of a long
- int MPIPackSize (const u_long &data, const int num=1)
  return packed size of a u_long
- int MPIPackSize (const short &data, const int num=1)
  return packed size of a short
- int MPIPackSize (const u_short &data, const int num=1)
  return packed size of a u_short
- int MPIPackSize (const char &data, const int num=1)
  return packed size of a char
- int MPIPackSize (const u_char &data, const int num=1)
  return packed size of a u_char
- int MPIPackSize (const double &data, const int num=1)
  return packed size of a double
- int MPIPackSize (const float &data, const int num=1)
  return packed size of a float
- int nidr_parse (const char *, FILE *)
- const char ** arg_list_adjust (const char **, void **)
- int not_executable (const char *driver_name, const char *tdir)
- static void scale_chk (StringArray &ST, RealVector &S, const char *what, const char **univ)
- static void BuildLabels (StringArray &sa, size_t nsa, size_t n1, size_t n2, const char *stub)
- static int mixed_check (IntSet &S, int n, IntArray *iv, const char *what)
- static void mixed_check2 (size_t n, IntArray *iv, const char *what)
- static int wronglen (size_t n, RealVector *V, const char *what)
- static int wronglen (size_t n, IntVector *V, const char *what)
- static void Vcopyup (RealVector *V, RealVector *M, size_t i, size_t n)
- static void Set_rv (RealVector *V, double d, size_t n)
- static void Set_iv (IntVector *V, int d, size_t n)
- static void wrong_number (const char *what, const char *kind, size_t nsv, size_t m)
- static void too_small (const char *kind)
- static void not_div (const char *kind, size_t nsv, size_t m)
- static void suppressed (const char *kind, int ndup, int *ip, String *sp, Real *rp)
- static void bad_initial_tvalue (const char *kind, int val)
- static void bad_initial_svalue (const char *kind, String val)
- static void bad_initial_rvalue (const char *kind, Real val)
- static void Vgen_ContinuousDes (DataVariablesRep *dv, size_t offset)
- static void Vgen_DiscreteDesRange (DataVariablesRep *dv, size_t offset)
- static void Vgen_ContinuousState (DataVariablesRep *dv, size_t offset)
- static void Vgen_DiscreteStateRange (DataVariablesRep *dv, size_t offset)
- static void Vchk_NormalUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_NormalUnc (DataVariablesRep *dv, size_t offset)
12.1. DAKOTA NAMESPACE REFERENCE

- static void Vchk_LognormalUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_LognormalUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_UniformUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_UniformUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_LoguniformUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_LoguniformUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_TriangularUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_TriangularUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_ExponentialUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_ExponentialUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_BetaUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_BetaUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_GammaUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_GammaUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_GumbelUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_GumbelUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_FrechetUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_FrechetUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_WeibullUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_WeibullUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_HistogramBinUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_HistogramBinUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_HistogramPointIntUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_HistogramPointIntUnc (DataVariablesRep *dv, size_t offset)
- static void Vchk_HistogramPointStrUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void Vgen_HistogramPointStrUnc (DataVariablesRep *dv, size_t offset)

Check the histogram bin input data, normalize the counts and populate the histogramUncBinPairs map data structure; map keys are guaranteed unique since the abscissas must increase.

Check the histogram point integer input data, normalize the counts and populate DataVariables::histogramUncPointIntPairs; map keys are guaranteed unique since the abscissas must increase.

Check the histogram point string input data, normalize the counts, and populate DataVariables::histogramUncPointStrPairs; map keys are guaranteed unique since the abscissas must increase (lexicographically)

Infer lower/upper bounds for histogram and set initial variable values based on initial point or moments, snapping to bounds as needed. (Histogram bin doesn’t have lower/upper bounds specification)

Use the integer-valued point histogram data to initialize the lower, upper, and initial values of the variables, using value closest to mean if no initial point.

Check the histogram point string input data, normalize the counts, and populate DataVariables::histogramUncPointStrPairs; map keys are guaranteed unique since the abscissas must increase (lexicographically)
Use the string-valued point histogram data to initialize the lower, upper, and initial values of the variables, using index closest to mean index if no initial point.

- static void Vchk_HistogramPtRealUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
  
  Check the histogram point integer real data, normalize the counts, and populate DataVariables::histogramUncPointRealPairs; map keys are guaranteed unique since the abscissas must increase.

- static void Vgen_HistogramPtRealUnc (DataVariablesRep *dv, size_t offset)
  
  Use the real-valued point histogram data to initialize the lower, upper, and initial values of the variables, using value closest to mean if no initial point.

- static void Vchk_ContinuousIntervalUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
  
  Check the continuous interval uncertain input data and populate DataVariables::continuousIntervalUncBasicProbs; map keys (real intervals) are checked for uniqueness because we don’t have a theoretically sound way to combine duplicate intervals.

- static void Vgen_ContinuousIntervalUnc (DataVariablesRep *dv, size_t offset)
  
- static void Vchk_DiscreteIntervalUnc (DataVariablesRep *dv, size_t offset, Var_Info *vi)
  
  Check the discrete interval uncertain input data and populate DataVariables::discreteIntervalUncBasicProbs; map keys (integer intervals) are checked for uniqueness because we don’t have a theoretically sound way to combine duplicate intervals.

- static void Vgen_DiscreteIntervalUnc (DataVariablesRep *dv, size_t offset)
  
- static bool check_set_keys (size_t num_v, size_t ds_len, const char *kind, IntArray *input_nsd, int &avg_num_ds)

  validate the number of set elements (values) given the number of variables and an optional apportionment with elements per variable; return the average number per variable if equally distributed

- static void Vchk_DIset (size_t num_v, const char *kind, IntArray *input_ndsi, IntVector *input_dsi, IntSetArray &dsi_all, IntVector &dsi_init_pt)

  check discrete sets of integers (design and state variables); error if a duplicate value is specified error if not ordered to prevent user confusion

- static void Vchk_DIset (size_t num_v, const char *kind, IntArray *input_ndsi, IntVector *input_dsi, RealVector *input_dsip, IntRealMapArray &dsi_vals_probs, IntVector &dsi_init_pt)

  check discrete sets of integers (uncertain variables); error if a duplicate value is specified error if not ordered to prevent user confusion

- static void Vchk_DSset (size_t num_v, const char *kind, IntArray *input_ndss, StringArray *input_dss, StringSetArray &dss_all, StringArray &dss_init_pt)

- static void Vchk_DSset (size_t num_v, const char *kind, IntArray *input_ndss, StringArray *input_dss, RealVector *input_dssp, StringRealMapArray &dss_vals_probs, StringArray &dss_init_pt)

- static void Vchk_DRset (size_t num_v, const char *kind, IntArray *input_ndsr, RealVector *input_dsr, RealSetArray &dsr_all, RealVector &dsr_init_pt)

- static void Vchk_DRset (size_t num_v, const char *kind, IntArray *input_ndsr, RealVector *input_dsr, RealVector *input_dsrp, RealRealMapArray &dsr_vals_probs, RealVector &dsr_init_pt)

- static void Vchk_Adjacency (size_t num_v, const char *kind, const IntArray &num_e, const IntVector &input_ddsa, RealMatrixArray &dda_all)

- static bool check_LUV_size (size_t num_v, IntVector &L, IntVector &U, IntVector &V, bool aggregate_L_UV, size_t offset)

- static bool check_LUV_size (size_t num_v, StringArray &L, StringArray &U, StringArray &V, bool aggregate_L_UV, size_t offset)

- static bool check_LUV_size (size_t num_v, RealVector &L, RealVector &U, RealVector &V, bool aggregate_L_UV, size_t offset)

- static void Vgen_DIset (size_t num_v, IntSetArray &sets, IntVector &L, IntVector &U, IntVector &V, bool aggregate_L_UV=false, size_t offset=0)
12.1. DAKOTA NAMESPACE REFERENCE

- static void `Vgen_DSset` (size_t num_v, StringSetArray &sets, StringArray &L, StringArray &U, StringArray &V, bool aggregate_LUV=false, size_t offset=0)
  
  generate lower, upper, and initial point for string-valued sets
- static void `Vgen_DSset` (size_t num_v, IntRealMapArray &vals_probs, IntVector &IP, IntVector &L, IntVector &U, IntVector &V, bool aggregate_LUV=false, size_t offset=0)
- static void `Vgen_DRset` (size_t num_v, RealSetArray &sets, RealVector &L, RealVector &U, RealVector &V, bool aggregate_LUV=false, size_t offset=0)
- static void `Vgen_DRset` (size_t num_v, RealRealMapArray &vals_probs, RealVector &IP, RealVector &L, RealVector &U, RealVector &V, bool aggregate_LUV=false, size_t offset=0)
- static void `Vgen_DSset` (size_t num_v, StringRealMapArray &vals, StringArray &IP, StringArray &L, StringArray &U, StringArray &V, bool aggregate_LUV=false, size_t offset=0)

For real-valued variables: verify lengths of bounds and initial point, validate bounds and adjust initial point to bounds.

- static void `Vchk_DiscreteDesSetInt` (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void `Vchk_DiscreteDesSetInt` (DataVariablesRep *dv, size_t offset)
- static void `Vchk_DiscreteDesSetStr` (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void `Vchk_DiscreteDesSetReal` (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void `Vchk_DiscreteUncSetInt` (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void `Vchk_DiscreteUncSetStr` (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void `Vchk_DiscreteUncSetReal` (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void `Vchk_DiscreteStateSetInt` (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void `Vchk_DiscreteStateSetStr` (DataVariablesRep *dv, size_t offset, Var_Info *vi)
- static void `Vchk_DiscreteStateSetReal` (DataVariablesRep *dv, size_t offset, Var_Info *vi)

For integer-valued variables: verify lengths of bounds and initial point, validate bounds and initial point against bounds.

- static void `flatten_rva` (RealVectorArray *rva, RealVector **prv)
- static void `flatten_jva` (IntVectorArray *iava, IntVector **piv)
- static void `flatten_rsm` (RealSymMatrix *rsm, RealVector **prv)
- static void `flatten_rsa` (RealSetArray *rsa, RealVector **prv)
- static void `flatten_ssa` (StringSetArray *ssa, StringArray **psa)
- static void `flatten_isa` (IntSetArray *isa, IntVector **piv)
- static void `flatten_rma_keys` (RealRealMapArray *rrma, RealVector **prv)
- static void `flatten_rma_values` (RealRealMapArray *rrma, RealVector **prv)
- static void `flattenirma_keys` (IntRealMapArray *irma, IntVector **piv)
- static void `flattenirma_values` (IntRealMapArray *irma, RealVector **prv)
static void flatten srma keys (StringRealMapArray *srma, StringArray **psa)

static void flatten srma values (StringRealMapArray *srma, RealVector **prv)

static void flatten real intervals (const RealRealPairRealMapArray &rrprma, RealVector **probs, RealVector **lb, RealVector **ub)

Flatten real-valued interval uncertain variable intervals and probabilities back into separate arrays.

static void flatten int intervals (const IntIntPairRealMapArray &iiprma, RealVector **probs, IntVector **lb, IntVector **ub)

Flatten integer-valued interval uncertain variable intervals and probabilities back into separate arrays.

static void var iulbl (const char *keyname, Values *val, VarLabel *vl)

static Iface mp Rlit MP3 (failAction, recoveryFnVals, recover)

static Iface mp ilit MP3 (failAction, retryLimit, retry)

static Iface mp ilit MP2 (failAction, abort)

static Iface mp ilit MP2 (failAction, continuation)

static Iface mp_type MP2s (analysisScheduling, MASTER_SCHEDULING)

static Iface mp_type MP2s (analysisScheduling, PEER_SCHEDULING)

static Iface mp_type MP2s (evalScheduling, MASTER_SCHEDULING)

static Iface mp_type MP2s (evalScheduling, PEER_DYNAMIC_SCHEDULING)

static Iface mp_type MP2s (evalScheduling, PEER_STATIC_SCHEDULING)

static Iface mp_type MP2s (asyncLocalEvalScheduling, DYNAMIC_SCHEDULING)

static Iface mp_type MP2s (asyncLocalEvalScheduling, STATIC_SCHEDULING)

static Iface mp_type MP2s (interfaceSynchronization, ASYNCHRONOUS_INTERFACE)

static Iface mp_type MP2s (interfaceSynchronization, SYNCHRONOUS_INTERFACE)

static Iface mp_type MP2s (interfaceType, TEST_INTERFACE)

static Iface mp_type MP2s (interfaceType, FORK_INTERFACE)

static Iface mp_type MP2s (interfaceType, GRID_INTERFACE)

static Iface mp_type MP2s (interfaceType, MATLAB_INTERFACE)

static Iface mp_type MP2s (interfaceType, PYTHON_INTERFACE)

static Iface mp_type MP2s (interfaceType, SCILAB_INTERFACE)

static Iface mp_type MP2s (interfaceType, SYSTEM_INTERFACE)

static Iface mp_type MP2s (resultsFileFormat, LABELED_RESULTS)

static String MP_ (algebraicMappings)

static String MP_ (idInterface)

static String MP_ (inputFilter)

static String MP_ (outputFilter)

static String MP_ (parametersFile)

static String MP_ (resultsFile)

static String MP_ (workDir)

static String2DArray MP_ (analysisComponents)

static StringArray MP_ (analysisDrivers)

static StringArray MP_ (copyFiles)

static StringArray MP_ (linkFiles)

static bool MP_ (activeSetVectorFlag)

static bool MP_ (allowExistingResultsFlag)

static bool MP_ (apreproFlag)

static bool MP_ (dirSave)

static bool MP_ (dirTag)
• static bool MP\_ (evalCacheFlag)
• static bool MP\_ (fileSaveFlag)
• static bool MP\_ (fileTagFlag)
• static bool MP\_ (nearbyEvalCacheFlag)
• static bool MP\_ (numpyFlag)
• static bool MP\_ (restartFileFlag)
• static bool MP\_ (templateReplace)
• static bool MP\_ (useWorkdir)
• static bool MP\_ (verbatimFlag)
• static int MP\_ (analysisServers)
• static int MP\_ (asynchLocalAnalysisConcurrency)
• static int MP\_ (asynchLocalEvalConcurrency)
• static int MP\_ (evalServers)
• static int MP\_ (procsPerAnalysis)
• static int MP\_ (procsPerEval)
• static Real MP\_ (nearbyEvalCacheTol)
• static IntVector MP\_ (primeBase)
• static IntVector MP\_ (refineSamples)
• static IntVector MP\_ (sequenceLeap)
• static IntVector MP\_ (sequenceStart)
• static IntVector MP\_ (stepsPerVariable)
• static Method mp_ilit2 MP\_3 (replacementType, numberRetained, chc)
• static Method mp_ilit2 MP\_3 (replacementType, numberRetained, elitist)
• static Method mp_ilit2z MP\_3 (crossoverType, numCrossPoints, multi_point_binary)
• static Method mp_ilit2z MP\_3 (crossoverType, numCrossPoints, multi_point_parameterized_binary)
• static Method mp_ilit2z MP\_3 (crossoverType, numCrossPoints, multi_point_real)
• static Method mp_lit MP\_2 (batchSelectionType, naive)
• static Method mp_lit MP\_2 (batchSelectionType, distance_penalty)
• static Method mp_lit MP\_2 (batchSelectionType, topology)
• static Method mp_lit MP\_2 (batchSelectionType, constant_liar)
• static Method mp_lit MP\_2 (boxDivision, all_dimensions)
• static Method mp_lit MP\_2 (boxDivision, major_dimension)
• static Method mp_lit MP\_2 (convergenceType, average_fitness_tracker)
• static Method mp_lit MP\_2 (convergenceType, best_fitness_tracker)
• static Method mp_lit MP\_2 (convergenceType, metric_tracker)
• static Method mp_lit MP\_2 (crossoverType, blend)
• static Method mp_lit MP\_2 (crossoverType, two_point)
• static Method mp_lit MP\_2 (crossoverType, uniform)
• static Method mp_lit MP\_2 (dataDistCovInputType, diagonal)
• static Method mp_lit MP\_2 (dataDistCovInputType, matrix)
• static Method mp_lit MP\_2 (evalSynchronize, blocking)
• static Method mp_lit MP\_2 (evalSynchronize, nonblocking)
• static Method mp_lit MP\_2 (expansionSampleType, incremental_lhs)
• static Method mp_lit MP\_2 (exploratoryMoves, adaptive)
• static Method mp_lit MP\_2 (exploratoryMoves, multi_step)
• static Method\textunderscore mp\_lit MP2 (exploratory\textunderscore moves, simple)
• static Method\textunderscore mp\_lit MP2 (fitness\textunderscore type, domination\textunderscore count)
• static Method\textunderscore mp\_lit MP2 (fitness\textunderscore type, layer\textunderscore rank)
• static Method\textunderscore mp\_lit MP2 (fitness\textunderscore type, linear\textunderscore rank)
• static Method\textunderscore mp\_lit MP2 (fitness\textunderscore type, merit\textunderscore function)
• static Method\textunderscore mp\_lit MP2 (fitness\textunderscore type, proportional)
• static Method\textunderscore mp\_lit MP2 (fitness\textunderscore metric\textunderscore type, predicted\textunderscore variance)
• static Method\textunderscore mp\_lit MP2 (fitness\textunderscore metric\textunderscore type, distance)
• static Method\textunderscore mp\_lit MP2 (fitness\textunderscore metric\textunderscore type, gradient)
• static Method\textunderscore mp\_lit MP2 (initialization\textunderscore type, random)
• static Method\textunderscore mp\_lit MP2 (initialization\textunderscore type, unique\textunderscore random)
• static Method\textunderscore mp\_lit MP2 (lipschitz\textunderscore type, global)
• static Method\textunderscore mp\_lit MP2 (lipschitz\textunderscore type, local)
• static Method\textunderscore mp\_lit MP2 (merit\textunderscore function, merit\textunderscore max)
• static Method\textunderscore mp\_lit MP2 (merit\textunderscore function, merit\textunderscore max\textunderscore smooth)
• static Method\textunderscore mp\_lit MP2 (merit\textunderscore function, merit\textunderscore 1)
• static Method\textunderscore mp\_lit MP2 (merit\textunderscore function, merit\textunderscore 1\textunderscore smooth)
• static Method\textunderscore mp\_lit MP2 (merit\textunderscore function, merit\textunderscore 2)
• static Method\textunderscore mp\_lit MP2 (merit\textunderscore function, merit\textunderscore 2\textunderscore smooth)
• static Method\textunderscore mp\_lit MP2 (merit\textunderscore function, merit\textunderscore 2\textunderscore squared)
• static Method\textunderscore mp\_lit MP2 (mcmc\textunderscore type, adaptive\textunderscore metropolis)
• static Method\textunderscore mp\_lit MP2 (mcmc\textunderscore type, delayed\textunderscore rejection)
• static Method\textunderscore mp\_lit MP2 (mcmc\textunderscore type, dram)
• static Method\textunderscore mp\_lit MP2 (mcmc\textunderscore type, metropolis\textunderscore hastings)
• static Method\textunderscore mp\_lit MP2 (mcmc\textunderscore type, multilevel)
• static Method\textunderscore mp\_lit MP2 (mutation\textunderscore type, bit\textunderscore random)
• static Method\textunderscore mp\_lit MP2 (mutation\textunderscore type, offset\textunderscore cauchy)
• static Method\textunderscore mp\_lit MP2 (mutation\textunderscore type, offset\textunderscore normal)
• static Method\textunderscore mp\_lit MP2 (mutation\textunderscore type, offset\textunderscore uniform)
• static Method\textunderscore mp\_lit MP2 (pattern\textunderscore basis, coordinate)
• static Method\textunderscore mp\_lit MP2 (pattern\textunderscore basis, simplex)
• static Method\textunderscore mp\_lit MP2 (point\textunderscore reuse, all)
• static Method\textunderscore mp\_lit MP2 (proposal\textunderscore cov\textunderscore input\textunderscore type, diagonal)
• static Method\textunderscore mp\_lit MP2 (proposal\textunderscore cov\textunderscore input\textunderscore type, matrix)
• static Method\textunderscore mp\_lit MP2 (proposal\textunderscore cov\textunderscore type, derivatives)
• static Method\textunderscore mp\_lit MP2 (proposal\textunderscore cov\textunderscore type, prior)
• static Method\textunderscore mp\_lit MP2 (proposal\textunderscore cov\textunderscore type, user)
• static Method\textunderscore mp\_lit MP2 (reliability\textunderscore integration, first\textunderscore order)
• static Method\textunderscore mp\_lit MP2 (reliability\textunderscore integration, second\textunderscore order)
• static Method\textunderscore mp\_lit MP2 (replacement\textunderscore type, elitist)
• static Method\textunderscore mp\_lit MP2 (replacement\textunderscore type, favor\textunderscore feasible)
• static Method\textunderscore mp\_lit MP2 (replacement\textunderscore type, roulette\textunderscore wheel)
• static Method\textunderscore mp\_lit MP2 (replacement\textunderscore type, unique\textunderscore roulette\textunderscore wheel)
• static Method\textunderscore mp\_lit MP2 (rng\textunderscore name, mt19937)
• static Method\textunderscore mp\_lit MP2 (rng\textunderscore name, nnum2)
12.1. DAKOTA NAMESPACE REFERENCE

- static Method_mp_lit MP2 (searchMethod, gradient_based_line_search)
- static Method_mp_lit MP2 (searchMethod, tr_pds)
- static Method_mp_lit MP2 (searchMethod, trust_region)
- static Method_mp_lit MP2 (searchMethod, value_based_line_search)
- static Method_mp_lit MP2 (trialType, grid)
- static Method_mp_lit MP2 (trialType, halton)
- static Method_mp_lit MP2 (trialType, random)
- static Method_mp_litc MP3 (crossoverType, crossoverRate, shuffle_random)
- static Method_mp_litc MP3 (crossoverType, crossoverRate, null_crossover)
- static Method_mp_litc MP3 (mutationType, mutationRate, null_mutation)
- static Method_mp_litc MP3 (mutationType, mutationRate, offset_cauchy)
- static Method_mp_litc MP3 (mutationType, mutationRate, offset_normal)
- static Method_mp_litc MP3 (mutationType, mutationRate, offset_uniform)
- static Method_mp_litc MP3 (replacementType, fitnessLimit, below_limit)
- static Method_mp_litrv MP3 (nichingType, nicheVector, distance)
- static Method_mp_litrv MP3 (nichingType, nicheVector, max_designs)
- static Method_mp_litrv MP3 (nichingType, nicheVector, radial)
- static Method_mp_litrv MP3 (postProcessorType, distanceVector, distance_postprocessor)
- static Method_mp_slit2 MP3 (initializationType, flatFile, flat_file)
- static Method_mp_utype_lit MP3s (methodName, dlDetails, DL_SOLVER)
- static Real MP_ (absConvTol)
- static Real MP_ (centeringParam)
- static Real MP_ (collocationRatio)
- static Real MP_ (collocRatioTermsOrder)
- static Real MP_ (constraintPenalty)
- static Real MP_ (constrPenalty)
- static Real MP_ (contractFactor)
- static Real MP_ (contractStepLength)
- static Real MP_ (convergenceTolerance)
- static Real MP_ (crossoverRate)
- static Real MP_ (falseConvTol)
- static Real MP_ (functionPrecision)
- static Real MP_ (globalBalanceParam)
- static Real MP_ (gradientTolerance)
- static Real MP_ (hybridLSProb)
- static Real MP_ (grThreshold)
- static Real MP_ (initDelta)
- static Real MP_ (initStepLength)
- static Real MP_ (initTRRadius)
- static Real MP_ (lineSearchTolerance)
- static Real MP_ (localBalanceParam)
- static Real MP_ (maxBoxSize)
- static Real MP_ (maxStep)
- static Real MP_ (minBoxSize)
- static Real MP_ (mutationRate)
• static Real MP_ (mutationScale)
• static Real MP_ (percentVarianceExplained)
• static Real MP_ (refinementRate)
• static Real MP_ (regressionL2Penalty)
• static Real MP_ (shrinkagePercent)
• static Real MP_ (singConvTol)
• static Real MP_ (singRadius)
• static Real MP_ (smoothFactor)
• static Real MP_ (slnTarget)
• static Real MP_ (stepLenToBoundary)
• static Real MP_ (surrBasedLocalTRContract)
• static Real MP_ (surrBasedLocalTRContractTrigger)
• static Real MP_ (surrBasedLocalTRExpand)
• static Real MP_ (surrBasedLocalTRExpandTrigger)
• static Real MP_ (threshDelta)
• static Real MP_ (threshStepLength)
• static Real MP_ (vbdDropTolerance)
• static Real MP_ (volBoxSize)
• static Real MP_ (vns)
• static Real MP_ (wilkConfidenceLevel)
• static Real MP_ (xConvTol)
• static RealVector MP_ (anisoDimPref)
• static RealVector MP_ (concurrentParameterSets)
• static RealVector MP_ (dataDistCovariance)
• static RealVector MP_ (dataDistMeans)
• static RealVector MP_ (finalPoint)
• static RealVector MP_ (hyperPriorAlphas)
• static RealVector MP_ (hyperPriorBetas)
• static RealVector MP_ (linearEqConstraintCoeffs)
• static RealVector MP_ (linearEqScales)
• static RealVector MP_ (linearEqTargets)
• static RealVector MP_ (linearIneqConstraintCoeffs)
• static RealVector MP_ (linearIneqLowerBnds)
• static RealVector MP_ (linearIneqUpperBnds)
• static RealVector MP_ (linearIneqScales)
• static RealVector MP_ (listOfPoints)
• static RealVector MP_ (proposalCovData)
• static RealVector MP_ (regressionNoiseTol)
• static RealVector MP_ (stepVector)
• static RealVectorArray MP_ (genReliabilityLevels)
• static RealVectorArray MP_ (probabilityLevels)
• static RealVectorArray MP_ (reliabilityLevels)
• static RealVectorArray MP_ (responseLevels)
• static unsigned short MP_ (adaptedBasisAdvancements)
12.1. DAKOTA NAMESPACE REFERENCE

- static unsigned short MP_ (cubIntOrder)
- static unsigned short MP_ (softConvLimit)
- static unsigned short MP_ (vbdOrder)
- static unsigned short MP_ (wilksOrder)
- static SizetArray MP_ (collocationPoints)
- static SizetArray MP_ (expansionSamples)
- static SizetArray MP_ (pilotSamples)
- static UShortArray MP_ (expansionOrder)
- static UShortArray MP_ (quadratureOrder)
- static UShortArray MP_ (sparseGridLevel)
- static UShortArray MP_ (tensorGridOrder)
- static UShortArray MP_ (varPartitions)
- static String MP_ (betaSolverName)
- static String MP_ (dataDistFile)
- static String MP_ (displayFormat)
- static String MP_ (exportApproxPtsFile)
- static String MP_ (exportExpansionFile)
- static String MP_ (exportMCMCPtsFile)
- static String MP_ (historyFile)
- static String MP_ (hybridGlobalMethodName)
- static String MP_ (hybridGlobalMethodPointer)
- static String MP_ (hybridGlobalModelPointer)
- static String MP_ (hybridLocalMethodName)
- static String MP_ (hybridLocalMethodPointer)
- static String MP_ (hybridLocalModelPointer)
- static String MP_ (idMethod)
- static String MP_ (importApproxPtsFile)
- static String MP_ (importBuildPtsFile)
- static String MP_ (importExpansionFile)
- static String MP_ (logFile)
- static String MP_ (modelPointer)
- static String MP_ (posteriorDensityExportFilename)
- static String MP_ (posteriorSamplesExportFilename)
- static String MP_ (posteriorSamplesImportFilename)
- static String MP_ (proposalCovFile)
- static String MP_ (pstudyFilename)
- static String MP_ (subMethodName)
- static String MP_ (subMethodPointer)
- static String MP_ (subModelPointer)
- static StringArray MP_ (hybridMethodNames)
- static StringArray MP_ (hybridMethodPointers)
- static StringArray MP_ (hybridModelPointers)
- static StringArray MP_ (linearEqScaleTypes)
- static StringArray MP_ (linearIneqScaleTypes)
- static StringArray MP_ (miscOptions)
- static bool MP_ (adaptPosteriorRefine)
• static bool MP_.(backfillFlag)
• static bool MP_.(constantPenalty)
• static bool MP_.(crossValidation)
• static bool MP_.(crossValidNoiseOnly)
• static bool MP_.(dOptimal)
• static bool MP_.(evaluatePosteriorDensity)
• static bool MP_.(expansionFlag)
• static bool MP_.(fixedSeedFlag)
• static bool MP_.(fixedSequenceFlag)
• static bool MP_.(generatePosteriorSamples)
• static bool MP_.(importApproxActive)
• static bool MP_.(importBuildActive)
• static bool MP_.(latinizeFlag)
• static bool MP_.(logitTransform)
• static bool MP_.(mainEffectsFlag)
• static bool MP_.(methodScaling)
• static bool MP_.(methodUseDerivsFlag)
• static bool MP_.(mutationAdaptive)
• static bool MP_.(normalizedCoeffs)
• static bool MP_.(pcaFlag)
• static bool MP_.(printPopFlag)
• static bool MP_.(pstudyFileActive)
• static bool MP_.(randomizeOrderFlag)
• static bool MP_.(regrassDiag)
• static bool MP_.(showAllEval)
• static bool MP_.(showMiscOptions)
• static bool MP_.(speculativeFlag)
• static bool MP_.(standardizedSpace)
• static bool MP_.(tensorGridFlag)
• static bool MP_.(surrBasedGlobalReplacePts)
• static bool MP_.(surrBasedLocalLayerBypass)
• static bool MP_.(vbdFlag)
• static bool MP_.(volQualityFlag)
• static bool MP_.(wilksFlag)
• static short MP_.(expansionType)
• static short MP_.(nestingOverride)
• static short MP_.(refinementType)
• static short MP_.(wilksSidedInterval)
• static int MP_.(buildSamples)
• static int MP_.(burnInSamples)
• static int MP_.(chainSamples)
• static int MP_.(concurrentRandomJobs)
• static int MP_.(contractAfterFail)
• static int MP_.(covarianceType)
• static int MP_.(crossoverChainPairs)
• static int MP_.(emulatorOrder)
• static int MP_ (expandAfterSuccess)
• static int MP_ (iteratorServers)
• static int MP_ (jumpStep)
• static int MP_ (maxFunctionEvaluations)
• static int MP_ (maxIterations)
• static int MP_ (mutationRange)
• static int MP_ (neighborOrder)
• static int MP_ (newSolnsGenerated)
• static int MP_ (numChains)
• static int MP_ (numCR)
• static int MP_ (numSamples)
• static int MP_ (numSteps)
• static int MP_ (numSymbols)
• static int MP_ (numTrials)
• static int MP_ (populationSize)
• static int MP_ (procsPerIterator)
• static int MP_ (proposalCovUpdates)
• static int MP_ (randomSeed)
• static int MP_ (samplesOnEmulator)
• static int MP_ (searchSchemeSize)
• static int MP_ (subSamplingPeriod)
• static int MP_ (totalPatternSize)
• static int MP_ (verifyLevel)
• static size_t MP_ (numDesigns)
• static size_t MP_ (numFinalSolutions)
• static size_t MP_ (numGenerations)
• static size_t MP_ (numOffspring)
• static size_t MP_ (numParents)
• static Method_mp_type MP2s (covarianceControl, DIAGONAL_COVARIANCE)
• static Method_mp_type MP2s (covarianceControl, FULL_COVARIANCE)
• static Method_mp_type MP2s (distributionType, COMPLEMENTARY)
• static Method_mp_type MP2s (distributionType, CUMULATIVE)
• static Method_mp_type MP2s (emulatorType, GP_EMULATOR)
• static Method_mp_type MP2s (emulatorType, KRIGING_EMULATOR)
• static Method_mp_type MP2s (emulatorType, PCE_EMULATOR)
• static Method_mp_type MP2s (emulatorType, SC_EMULATOR)
• static Method_mp_type MP2s (emulatorType, VPS_EMULATOR)
• static Method_mp_type MP2p (expansionBasisType, ADAPTED_BASIS_EXPANDING_FRONT)
• static Method_mp_type MP2p (expansionBasisType, ADAPTED_BASIS_GENERALIZED)
• static Method_mp_type MP2p (expansionBasisType, HIERARCHICAL_INTERPOLANT)
• static Method_mp_type MP2p (expansionBasisType, NODAL_INTERPOLANT)
• static Method_mp_type MP2p (expansionBasisType, TENSOR_PRODUCT_BASIS)
• static Method_mp_type MP2p (expansionBasisType, TOTAL_ORDER_BASIS)
• static Method_mp_type MP2s (expansionType, ASKEY_U)
• static Method_mp_type MP2s (expansionType, STD_NORMAL_U)
• static Method_mp_type MP2p (growthOverride, RESTRICTED)
static Method_mp_type MP2p (growthOverride, UNRESTRICTED)
static Method_mp_type MP2s (iteratorScheduling, MASTER_SCHEDULING)
static Method_mp_type MP2s (iteratorScheduling, PEER_SCHEDULING)
static Method_mp_type MP2s (lsRegressionType, EQ_CONV)
static Method_mp_type MP2s (lsRegressionType, SVD_LS)
static Method_mp_type MP2o (meritFn, ArgaezTapia)
static Method_mp_type MP2o (meritFn, NormFmu)
static Method_mp_type MP2o (meritFn, VanShanno)
static Method_mp_type MP2s (methodOutput, DEBUG_OUTPUT)
static Method_mp_type MP2s (methodOutput, NORMAL_OUTPUT)
static Method_mp_type MP2s (methodOutput, QUIET_OUTPUT)
static Method_mp_type MP2s (methodOutput, SILENT_OUTPUT)
static Method_mp_type MP2s (methodOutput, VERBOSE_OUTPUT)
static Method_mp_type MP2p (nestingOverride, NESTED)
static Method_mp_type MP2p (nestingOverride, NON_NESTED)
static Method_mp_type MP2p (refinementControl, DIMENSION_ADAPTIVE_CONTROL_GENERALIZED)
static Method_mp_type MP2p (refinementControl, DIMENSION_ADAPTIVE_CONTROL_DECAY)
static Method_mp_type MP2p (refinementControl, DIMENSION_ADAPTIVE_CONTROL_SOBOLO)
static Method_mp_type MP2p (refinementControl, LOCAL_ADAPTIVE_CONTROL)
static Method_mp_type MP2p (refinementControl, UNIFORM_CONTROL)
static Method_mp_type MP2p (refinementType, P_REFINEMENT)
static Method_mp_type MP2p (refinementType, H_REFINEMENT)
static Method_mp_type MP2p (regressionType, BASIS_Pursuit)
static Method_mp_type MP2p (regressionType, BASIS_Pursuit_DENOISING)
static Method_mp_type MP2p (regressionType, DEFAULT_LEAST_SQ_REGRESSION)
static Method_mp_type MP2p (regressionType, LASSO_REGRESSION)
static Method_mp_type MP2p (regressionType, LEAST_ANGLE_REGRESSION)
static Method_mp_type MP2p (regressionType, ORTHOG_LEAST_INTERPOLATION)
static Method_mp_type MP2p (regressionType, ORTHOG_MATCH_Pursuit)
static Method_mp_type MP2s (responseLevelTarget, GEN_RELIABILITIES)
static Method_mp_type MP2s (responseLevelTarget, PROBABILITIES)
static Method_mp_type MP2s (responseLevelTarget, RELIABILITIES)
static Method_mp_type MP2s (responseLevelTargetReduce, SYSTEM_PARALLEL)
static Method_mp_type MP2s (responseLevelTargetReduce, SYSTEM_SERIES)
static Method_mp_type MP2s (surrBasedLocalAcceptLogic, FILTER)
static Method_mp_type MP2s (surrBasedLocalAcceptLogic, TR_RATIO)
static Method_mp_type MP2s (surrBasedLocalConstrRelax, HOMOTOPY)
static Method_mp_type MP2s (surrBasedLocalMeritFn, ADAPTIVE_PENALTY_MERIT)
static Method_mp_type MP2s (surrBasedLocalMeritFn, AUGMENTED_LAGRANGIAN_MERIT)
static Method_mp_type MP2s (surrBasedLocalMeritFn, LAGRANGIAN_MERIT)
static Method_mp_type MP2s (surrBasedLocalMeritFn, PENALTY_MERIT)
static Method_mp_type MP2s (surrBasedLocalSubProbCon, LINEARIZED_CONSTRAINTS)
static Method_mp_type MP2s (surrBasedLocalSubProbCon, NO_CONSTRAINTS)
static Method_mp_type MP2s (surrBasedLocalSubProbObj, AUGMENTED_LAGRANGIAN_OBJECTIVE)
12.1. DAKOTA NAMESPACE REFERENCE

- static Method\_mp\_type MP2s (surrBasedLocalSubProbObj, LAGRANGIAN\_OBJECTIVE)
- static Method\_mp\_type MP2s (surrBasedLocalSubProbObj, ORIGINAL\_PRIMARY)
- static Method\_mp\_type MP2s (surrBasedLocalSubProbObj, SINGLE\_OBJECTIVE)
- static Method\_mp\_type MP2s (wilks\_SidedInterval, ONE\_SIDED)
- static Method\_mp\_type MP2s (wilks\_SidedInterval, TWO\_SIDED)
- static Method\_mp\_type MP2s (calibrate\_Error\_Mode, CALIBRATE\_ONE)
- static Method\_mp\_type MP2s (calibrate\_Error\_Mode, CALIBRATE\_PER\_EXPER)
- static Method\_mp\_type MP2s (calibrate\_Error\_Mode, CALIBRATE\_PER\_RESP)
- static Method\_mp\_type MP2s (calibrate\_Error\_Mode, CALIBRATE\_BOTH)
- static Method\_mp\_type MP2s (export\_Approx\_Format, TABULAR\_NONE)
- static Method\_mp\_type MP2s (export\_Approx\_Format, TABULAR\_HEADER)
- static Method\_mp\_type MP2s (export\_Approx\_Format, TABULAR\_EVAL\_ID)
- static Method\_mp\_type MP2s (export\_Approx\_Format, TABULAR\_IFACE\_ID)
- static Method\_mp\_type MP2s (export\_Approx\_Format, TABULAR\_ANNOTATED)
- static Method\_mp\_type MP2s (export\_MCMC\_Format, TABULAR\_NONE)
- static Method\_mp\_type MP2s (export\_MCMC\_Format, TABULAR\_HEADER)
- static Method\_mp\_type MP2s (export\_MCMC\_Format, TABULAR\_EVAL\_ID)
- static Method\_mp\_type MP2s (export\_MCMC\_Format, TABULAR\_IFACE\_ID)
- static Method\_mp\_type MP2s (export\_MCMC\_Format, TABULAR\_ANNOTATED)
- static Method\_mp\_type MP2s (import\_Approx\_Format, TABULAR\_NONE)
- static Method\_mp\_type MP2s (import\_Approx\_Format, TABULAR\_HEADER)
- static Method\_mp\_type MP2s (import\_Approx\_Format, TABULAR\_EVAL\_ID)
- static Method\_mp\_type MP2s (import\_Approx\_Format, TABULAR\_IFACE\_ID)
- static Method\_mp\_type MP2s (import\_Approx\_Format, TABULAR\_ANNOTATED)
- static Method\_mp\_type MP2s (import\_Build\_Format, TABULAR\_NONE)
- static Method\_mp\_type MP2s (import\_Build\_Format, TABULAR\_HEADER)
- static Method\_mp\_type MP2s (import\_Build\_Format, TABULAR\_EVAL\_ID)
- static Method\_mp\_type MP2s (import\_Build\_Format, TABULAR\_IFACE\_ID)
- static Method\_mp\_type MP2s (import\_Build\_Format, TABULAR\_ANNOTATED)
- static Method\_mp\_type MP2s (integration\_Refine, AIS)
- static Method\_mp\_type MP2s (integration\_Refine, IS)
- static Method\_mp\_type MP2s (integration\_Refine, MMAIS)
- static Method\_mp\_type MP2s (methodName, ASYNCH\_PATTERN\_SEARCH)
- static Method\_mp\_type MP2s (methodName, BRANCH\_AND\_BOUND)
- static Method\_mp\_type MP2s (methodName, COLINY\_BETA)
- static Method\_mp\_type MP2s (methodName, COLINY\_COBYLA)
- static Method\_mp\_type MP2s (methodName, COLINY\_DIRECT)
- static Method\_mp\_type MP2s (methodName, COLINY\_EA)
- static Method\_mp\_type MP2s (methodName, COLINY\_PATTERN\_SEARCH)
- static Method\_mp\_type MP2s (methodName, COLINY\_SOLIS\_WETS)
- static Method\_mp\_type MP2s (methodName, CONMIN\_FRCG)
- static Method\_mp\_type MP2s (methodName, CONMIN\_MFD)
- static Method\_mp\_type MP2s (methodName, DOT\_BFGS)
- static Method\_mp\_type MP2s (methodName, DOT\_FRCG)
- static Method\_mp\_type MP2s (methodName, DOT\_MMFD)
• static Method_mp_utype MP2s (methodName, DOT_SLP)
• static Method_mp_utype MP2s (methodName, DOT_SQP)
• static Method_mp_utype MP2s (methodName, EFFICIENT_GLOBAL)
• static Method_mp_utype MP2s (methodName, FSU_CVT)
• static Method_mp_utype MP2s (methodName, FSU_HALTON)
• static Method_mp_utype MP2s (methodName, FSU_HAMMERSLEY)
• static Method_mp_utype MP2s (methodName, HYBRID)
• static Method_mp_utype MP2s (methodName, MESH_ADAPTIVE_SEARCH)
• static Method_mp_utype MP2s (methodName, MOGA)
• static Method_mp_utype MP2s (methodName, MULTI_START)
• static Method_mp_utype MP2s (methodName, NCSU_DIRECT)
• static Method_mp_utype MP2s (methodName, NL2SOL)
• static Method_mp_utype MP2s (methodName, NLPQL_SQP)
• static Method_mp_utype MP2s (methodName, NLSSOL_SQP)
• static Method_mp_utype MP2s (methodName, ADAPTIVE_SAMPLING)
• static Method_mp_utype MP2s (methodName, BAYES_CALIBRATION)
• static Method_mp_utype MP2s (methodName, GENIE_DIRECT)
• static Method_mp_utype MP2s (methodName, GENIE_OPT_DARTS)
• static Method_mp_utype MP2s (methodName, GPAIS)
• static Method_mp_utype MP2s (methodName, GLOBAL_EVIDENCE)
• static Method_mp_utype MP2s (methodName, GLOBAL_INTERVAL_EST)
• static Method_mp_utype MP2s (methodName, GLOBAL_RELIABILITY)
• static Method_mp_utype MP2s (methodName, IMPORTANCE_SAMPLING)
• static Method_mp_utype MP2s (methodName, LOCAL_EVIDENCE)
• static Method_mp_utype MP2s (methodName, LOCAL_INTERVAL_EST)
• static Method_mp_utype MP2s (methodName, LOCAL_RELIABILITY)
• static Method_mp_utype MP2s (methodName, MULTILEVEL_SAMPLING)
• static Method_mp_utype MP2s (methodName, POF_DARTS)
• static Method_mp_utype MP2s (methodName, RKD_DARTS)
• static Method_mp_utype MP2s (methodName, POLYNOMIAL_CHAOS)
• static Method_mp_utype MP2s (methodName, RANDOM_SAMPLING)
• static Method_mp_utype MP2s (methodName, STOCH_COLLOCATION)
• static Method_mp_utype MP2s (methodName, NONLINEAR_CG)
• static Method_mp_utype MP2s (methodName, NPSOL_SQP)
• static Method_mp_utype MP2s (methodName, OPTPP_CG)
• static Method_mp_utype MP2s (methodName, OPTPP_FD/newton)
• static Method_mp_utype MP2s (methodName, OPTPP_G/newton)
• static Method_mp_utype MP2s (methodName, OPTPP_NEWTON)
• static Method_mp_utype MP2s (methodName, OPTPP_PDS)
• static Method_mp_utype MP2s (methodName, OPTPP_Q/newton)
• static Method_mp_utype MP2s (methodName, PARETO_SET)
• static Method_mp_utype MP2s (methodName, PSUADE_MOAT)
• static Method_mp_utype MP2s (methodName, RICHARDSON_EXTRAP)
• static Method_mp_utype MP2s (methodName, SOGA)
• static Method_mp_utype MP2s (methodName, SURROGATE_BASED_GLOBAL)
• static Method_mp_utype MP2s (methodName, SURROGATE_BASED_LOCAL)
• static Method\_mp\_utype MP2s (methodName, VECTOR\_PARAMETER\_STUDY)
• static Method\_mp\_utype MP2s (methodName, LIST\_PARAMETER\_STUDY)
• static Method\_mp\_utype MP2s (methodName, CENTERED\_PARAMETER\_STUDY)
• static Method\_mp\_utype MP2s (methodName, MULTIDIM\_PARAMETER\_STUDY)
• static Method\_mp\_utype MP2s (preSolveMethod, SUBMETHOD\_NIP)
• static Method\_mp\_utype MP2s (preSolveMethod, SUBMETHOD\_NONE)
• static Method\_mp\_utype MP2s (preSolveMethod, SUBMETHOD\_SQP)
• static Method\_mp\_utype MP2s (pstudyFileFormat, TABULAR\_NONE)
• static Method\_mp\_utype MP2s (pstudyFileFormat, TABULAR\_HEADER)
• static Method\_mp\_utype MP2s (pstudyFileFormat, TABULAR\_EVAL\_ID)
• static Method\_mp\_utype MP2s (pstudyFileFormat, TABULAR\_IFACE\_ID)
• static Method\_mp\_utype MP2s (pstudyFileFormat, TABULAR\_ANNOTATED)
• static Method\_mp\_utype MP2s (reliabilitySearchType, AMV\_PLUS\_U)
• static Method\_mp\_utype MP2s (reliabilitySearchType, AMV\_PLUS\_X)
• static Method\_mp\_utype MP2s (reliabilitySearchType, AMV\_U)
• static Method\_mp\_utype MP2s (reliabilitySearchType, AMV\_X)
• static Method\_mp\_utype MP2s (reliabilitySearchType, EGRA\_U)
• static Method\_mp\_utype MP2s (reliabilitySearchType, EGRA\_X)
• static Method\_mp\_utype MP2s (reliabilitySearchType, NO\_APPROX)
• static Method\_mp\_utype MP2s (reliabilitySearchType, TANA\_U)
• static Method\_mp\_utype MP2s (reliabilitySearchType, TANA\_X)
• static Method\_mp\_utype MP2s (sampleType, SUBMETHOD\_LHS)
• static Method\_mp\_utype MP2s (sampleType, SUBMETHOD\_RANDOM)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_COLLABORATIVE)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_EMBEDDED)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_SEQUENTIAL)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_DREAM)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_WASABI)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_GPMSA)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_QUESO)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_NIP)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_SQP)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_EA)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_EGO)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_SBO)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_LHS)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_RANDOM)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_OA\_LHS)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_OAS)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_BOX\_BEHNKEN)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_CENTRAL\_COMPOSITE)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_GRID)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_CONVERGE\_ORDER)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_CONVERGE\_QOI)
• static Method\_mp\_utype MP2s (subMethod, SUBMETHOD\_ESTIMATE\_ORDER)
• static IntSet MP\_ (surrogateFnIndices)
CHAPTER 12. NAMESPACE DOCUMENTATION

- static Model\_mp\_lit MP2 (approxPointReuse, all)
- static Model\_mp\_lit MP2 (approxPointReuse, none)
- static Model\_mp\_lit MP2 (approxPointReuse, region)
- static Model\_mp\_lit MP2 (marsInterpolation, linear)
- static Model\_mp\_lit MP2 (marsInterpolation, cubic)
- static Model\_mp\_lit MP2 (modelType, nested)
- static Model\_mp\_lit MP2 (modelType, random\_field)
- static Model\_mp\_lit MP2 (modelType, simulation)
- static Model\_mp\_lit MP2 (modelType, subspace)
- static Model\_mp\_lit MP2 (modelType, surrogate)
- static Model\_mp\_lit MP2 (surrogateType, hierarchical)
- static Model\_mp\_lit MP2 (surrogateType, global\_gaussian)
- static Model\_mp\_lit MP2 (surrogateType, global\_kriging)
- static Model\_mp\_lit MP2 (surrogateType, global\_mars)
- static Model\_mp\_lit MP2 (surrogateType, global\_moving\_least\_squares)
- static Model\_mp\_lit MP2 (surrogateType, global\_neural\_network)
- static Model\_mp\_lit MP2 (surrogateType, global\_polynomial)
- static Model\_mp\_lit MP2 (surrogateType, global\_radial\_basis)
- static Model\_mp\_lit MP2 (surrogateType, global\_voronoi\_surrogate)
- static Model\_mp\_lit MP2 (surrogateType, local\_taylor)
- static Model\_mp\_lit MP2 (surrogateType, multipoint\_tana)
- static Model\_mp\_lit MP2 (trendOrder, constant)
- static Model\_mp\_lit MP2 (trendOrder, linear)
- static Model\_mp\_lit MP2 (trendOrder, reduced\_quadratic)
- static Model\_mp\_lit MP2 (trendOrder, quadratic)
- static Model\_mp\_ord MP2s (approxCorrectionOrder, 0)
- static Model\_mp\_ord MP2s (approxCorrectionOrder, 1)
- static Model\_mp\_ord MP2s (approxCorrectionOrder, 2)
- static Model\_mp\_ord MP2s (polynomialOrder, 1)
- static Model\_mp\_ord MP2s (polynomialOrder, 2)
- static Model\_mp\_ord MP2s (polynomialOrder, 3)
- static Model\_mp\_type MP2s (approxCorrectionType, ADDITIVE\_CORRECTION)
- static Model\_mp\_type MP2s (approxCorrectionType, COMBINED\_CORRECTION)
- static Model\_mp\_type MP2s (approxCorrectionType, MULTIPLICATIVE\_CORRECTION)
- static Model\_mp\_type MP2s (pointsManagement, MINIMUM\_POINTS)
- static Model\_mp\_type MP2s (pointsManagement, RECOMMENDED\_POINTS)
- static Model\_mp\_type MP2s (subMethodScheduling, MASTER\_SCHEDULING)
- static Model\_mp\_type MP2s (subMethodScheduling, PEER\_SCHEDULING)
- static Model\_mp\_utype MP2s (analyticCovIdForm, EXP\_L2)
- static Model\_mp\_utype MP2s (analyticCovIdForm, EXP\_L1)
- static Model\_mp\_utype MP2s (importChallengeFormat, TABULAR\_NONE)
- static Model\_mp\_utype MP2s (importChallengeFormat, TABULAR\_HEADER)
- static Model\_mp\_utype MP2s (importChallengeFormat, TABULAR\_EVAL\_ID)
- static Model\_mp\_utype MP2s (importChallengeFormat, TABULAR\_IFACE\_ID)
- static Model\_mp\_utype MP2s (importChallengeFormat, TABULAR\_ANNOTATED)
- static Model\_mp\_utype MP2s (modelExportFormat, TEXT\_ARCHIVE)
- static Model_mp utype MP2s (modelExportFormat, BINARY_ARCHIVE)
- static Model_mp utype MP2s (modelExportFormat, ALGEBRAIC_FILE)
- static Model_mp utype MP2s (modelExportFormat, ALGEBRAIC_CONSOLE)
- static Model_mp utype MP2s (randomFieldIdForm, RF_KARHUNEN_LOEVE)
- static Model_mp utype MP2s (randomFieldIdForm, RF_PCA_GP)
- static Real MP_ (annRange)
- static Real MP_ (discontGradThresh)
- static Real MP_ (discontJumpThresh)
- static Real MP_ (krigingNugget)
- static Real MP_ (percentFold)
- static Real MP_ (truncationTolerance)
- static RealVector MP_ (krigingCorrelations)
- static RealVector MP_ (primaryRespCoeffs)
- static RealVector MP_ (secondaryRespCoeffs)
- static RealVector MP_ (solutionLevelCost)
- static String MP_ (actualModelPointer)
- static String MP_ (decompCellType)
- static String MP_ (idModel)
- static String MP_ (importChallengePtsFile)
- static String MP_ (interfacePointer)
- static String MP_ (krigingOptMethod)
- static String MP_ (modelExportPrefix)
- static String MP_ (optionalInterfRespPointer)
- static String MP_ (propagationModelPointer)
- static String MP_ (refineCVMetric)
- static String MP_ (responsesPointer)
- static String MP_ (rfDataFileName)
- static String MP_ (solutionLevelControl)
- static String MP_ (variablesPointer)
- static StringArray MP_ (diagMetrics)
- static StringArray MP_ (orderedModelPointers)
- static StringArray MP_ (primaryVarMaps)
- static StringArray MP_ (secondaryVarMaps)
- static bool MP_ (autoRefine)
- static bool MP_ (crossValidateFlag)
- static bool MP_ (decompDiscontDetect)
- static bool MP_ (exportSurrogate)
- static bool MP_ (hierarchicalTags)
- static bool MP_ (importChallengeActive)
- static bool MP_ (modelUseDerivsFlag)
- static bool MP_ (domainDecomp)
- static bool MP_ (pointSelection)
- static bool MP_ (pressFlag)
- static bool MP_ (subspaceIdBingLi)
- static bool MP_ (subspaceIdConstantine)
- static bool MP_ (subspaceIdEnergy)
• static short MP_ (annNodes)
• static short MP_ (annRandomWeight)
• static short MP_ (krigingFindNugget)
• static short MP_ (krigingMaxTrials)
• static short MP_ (marsMaxBases)
• static short MP_ (mlsWeightFunction)
• static short MP_ (polynomialOrder)
• static short MP_ (rbfBases)
• static short MP_ (rbfMaxPts)
• static short MP_ (rbfMaxSubsets)
• static short MP_ (rbfMinPartition)
• static int MP_ (decompSupportLayers)
• static int MP_ (initialSamples)
• static int MP_ (maxFunctionEvals)
• static int MP_ (numFolds)
• static int MP_ (numReplicates)
• static int MP_ (pointsTotal)
• static int MP_ (dimension)
• static int MP_ (refineCVFolds)
• static int MP_ (subMethodProcs)
• static int MP_ (subMethodServers)
• static IntSet MP_ (idAnalyticGrads)
• static IntSet MP_ (idAnalyticHessians)
• static IntSet MP_ (idNumericalGrads)
• static IntSet MP_ (idNumericalHessians)
• static IntSet MP_ (idQuasiHessians)
• static IntVector MP_ (fieldLengths)
• static IntVector MP_ (numCoordsPerField)
• static RealVector MP_ (expConfigVars)
• static RealVector MP_ (expObservations)
• static RealVector MP_ (primaryRespFnWeights)
• static RealVector MP_ (nonlinearEqTargets)
• static RealVector MP_ (nonlinearIneqLowerBnds)
• static RealVector MP_ (nonlinearIneqUpperBnds)
• static RealVector MP_ (fdGradStepSize)
• static RealVector MP_ (fdHessStepSize)
• static RealVector MP_ (primaryRespFnScales)
• static RealVector MP_ (nonlinearEqScales)
• static Resp_mp_lit MP2 (gradientType, analytic)
• static Resp_mp_lit MP2 (gradientType, mixed)
• static Resp_mp_lit MP2 (gradientType, none)
• static Resp_mp_lit MP2 (hessianType, analytic)
• static Resp_mp_lit MP2 (hessianType, mixed)
• static Resp_mp_lit MP2 (hessianType, none)
• static Resp_mp_lit MP2 (hessianType, numerical)
• static Resp_mp_lit MP2 (hessianType, quasi)
• static Resp_mp_lit MP2 (intervalType, central)
• static Resp_mp_lit MP2 (intervalType, forward)
• static Resp_mp_lit MP2 (methodSource, dakota)
• static Resp_mp_lit MP2 (methodSource, vendor)
• static Resp_mp_lit MP2 (fdGradStepType, absolute)
• static Resp_mp_lit MP2 (fdGradStepType, bounds)
• static Resp_mp_lit MP2 (fdGradStepType, relative)
• static Resp_mp_lit MP2 (fdHessStepType, absolute)
• static Resp_mp_lit MP2 (fdHessStepType, bounds)
• static Resp_mp_lit MP2 (fdHessStepType, relative)
• static Resp_mp_lit MP2 (quasiHessianType, bfgs)
• static Resp_mp_lit MP2 (quasiHessianType, damped_bfgs)
• static Resp_mp_lit MP2 (quasiHessianType, sr1)
• static String MP_ (scalarDataFileName)
• static String MP_ (idResponses)
• static StringArray MP_ (nonlinearEqScaleTypes)
• static StringArray MP_ (nonlinearIneqScaleTypes)
• static StringArray MP_ (primaryRespFnScaleTypes)
• static StringArray MP_ (primaryRespFnSense)
• static StringArray MP_ (responseLabels)
• static StringArray MP_ (varianceType)
• static bool MP_ (calibrationDataFlag)
• static bool MP_ (centralHess)
• static bool MP_ (interpolateFlag)
• static bool MP_ (ignoreBounds)
• static bool MP_ (readFieldCoords)
• static size_t MP_ (numExpConfigVars)
• static size_t MP_ (numExperiments)
• static size_t MP_ (numFieldLeastSqTerms)
• static size_t MP_ (numFieldObjectiveFunctions)
• static size_t MP_ (numFieldResponseFunctions)
• static size_t MP_ (numLeastSqTerms)
• static size_t MP_ (numNonlinearEqConstraints)
• static size_t MP_ (numNonlinearIneqConstraints)
• static size_t MP_ (numObjectiveFunctions)
• static size_t MP_ (numResponseFunctions)
• static size_t MP_ (numScalarLeastSqTerms)
• static size_t MP_ (numScalarObjectiveFunctions)
• static size_t MP_ (numScalarResponseFunctions)
• static Resp_mp_utype MP2s (scalarDataFormat, TABULAR_NONE)
• static Resp_mp_utype MP2s (scalarDataFormat, TABULAR_HEADER)
• static Resp_mp_utype MP2s (scalarDataFormat, TABULAR_EVAL_ID)
• static Resp_mp_utype MP2s (scalarDataFormat, TABULAR_EXPER.Annotation)
• static Env_mp_utype MP2s (postRunInputFormat, TABULAR_NONE)
• static Env_mp_utype MP2s (postRunInputFormat, TABULAR_HEADER)
• static Env_mp_utype MP2s (postRunInputFormat, TABULAR_EVAL_ID)
• static Env_mp_utype MP2s (postRunInputFormat, TABULAR_IFACE_ID)
• static Env_mp_utype MP2s (postRunInputFormat, TABULAR_ANNOTATED)
• static Env_mp_utype MP2s (preRunOutputFormat, TABULAR_NONE)
• static Env_mp_utype MP2s (preRunOutputFormat, TABULAR_HEADER)
• static Env_mp_utype MP2s (preRunOutputFormat, TABULAR_EVAL_ID)
• static Env_mp_utype MP2s (preRunOutputFormat, TABULAR_IFACE_ID)
• static Env_mp_utype MP2s (preRunOutputFormat, TABULAR_ANNOTATED)
• static Env_mp_utype MP2s (tabularFormat, TABULAR_NONE)
• static Env_mp_utype MP2s (tabularFormat, TABULAR_HEADER)
• static Env_mp_utype MP2s (tabularFormat, TABULAR_EVAL_ID)
• static Env_mp_utype MP2s (tabularFormat, TABULAR_IFACE_ID)
• static Env_mp_utype MP2s (tabularFormat, TABULAR_ANNOTATED)
• static String MP (errorFile)
• static String MP (outputFile)
• static String MP (postRunInput)
• static String MP (postRunOutput)
• static String MP (preRunInput)
• static String MP (preRunOutput)
• static String MP (readRestart)
• static String MP (resultsOutputFile)
• static String MP (runInput)
• static String MP (runOutput)
• static String MP (tabularDataFile)
• static String MP (topMethodPointer)
• static String MP (writeRestart)
• static bool MP (checkFlag)
• static bool MP (graphicsFlag)
• static bool MP (postRunFlag)
• static bool MP (preRunFlag)
• static bool MP (resultsOutputFlag)
• static bool MP (runFlag)
• static bool MP (tabularDataFlag)
• static int MP (outputPrecision)
• static int MP (stopRestart)
• static size_t MP (numBetaUncVars)
• static size_t MP (numBinomialUncVars)
• static size_t MP (numContinuousDesVars)
• static size_t MP (numContinuousIntervalUncVars)
• static size_t MP (numContinuousStateVars)
• static size_t MP (numDiscreteDesRangeVars)
• static size_t MP (numDiscreteDesSetIntVars)
• static size_t MP (numDiscreteDesSetStrVars)
• static size_t MP (numDiscreteDesSetRealVars)
• static size_t MP (numDiscreteIntervalUncVars)
12.1. DAKOTA NAMESPACE REFERENCE

- static size_t MP_ (numDiscreteStateRangeVars)
- static size_t MP_ (numDiscreteStateSetIntVars)
- static size_t MP_ (numDiscreteStateSetStrVars)
- static size_t MP_ (numDiscreteStateSetRealVars)
- static size_t MP_ (numDiscreteUncSetIntVars)
- static size_t MP_ (numDiscreteUncSetStrVars)
- static size_t MP_ (numDiscreteUncSetRealVars)
- static size_t MP_ (numExponentialUncVars)
- static size_t MP_ (numFrechetUncVars)
- static size_t MP_ (numGammaUncVars)
- static size_t MP_ (numGeometricUncVars)
- static size_t MP_ (numGumbelUncVars)
- static size_t MP_ (numHistogramBinUncVars)
- static size_t MP_ (numHistogramPtIntUncVars)
- static size_t MP_ (numHistogramPtStrUncVars)
- static size_t MP_ (numHistogramPtRealUncVars)
- static size_t MP_ (numHyperGeomUncVars)
- static size_t MP_ (numLognormalUncVars)
- static size_t MP_ (numLoguniformUncVars)
- static size_t MP_ (numLognormalUncVars)
- static size_t MP_ (numLoguniformUncVars)
- static size_t MP_ (numNormalUncVars)
- static size_t MP_ (numPoissonUncVars)
- static size_t MP_ (numTriangularUncVars)
- static size_t MP_ (numUniformUncVars)
- static size_t MP_ (numWeibullUncVars)
- static IntVector VP_ (ddsi)
- static IntVector VP_ (DIlb)
- static IntVector MP_ (discreteDesignRangeLowerBnds)
- static IntVector MP_ (discreteDesignRangeUpperBnds)
- static IntVector MP_ (discreteDesignRangeVars)
- static IntVector MP_ (discreteDesignSetIntVars)
- static IntVector MP_ (discreteIntervalUncVars)
- static IntVector MP_ (discreteStateRangeLowerBnds)
- static IntVector MP_ (discreteStateRangeUpperBnds)
- static IntVector MP_ (discreteStateRangeVars)
- static IntVector MP_ (discreteStateSetIntVars)
- static IntVector MP_ (discreteUncSetIntVars)
- static IntVector VP_ (DIub)
- static IntVector MP_ (histogramPointIntUncVars)
- static IntVector VP_ (hgia)
- static IntVector VP_ (dssi)
- static IntVector VP_ (ddsi)
- static IntVector VP_ (ddsa)
- static IntVector VP_ (ddsra)
- static IntVector VP_ (dusi)
- static IntArray VP_ (nddsi)
- static IntArray VP_ (nddss)
- static IntArray VP_ (nddsr)
- static IntArray VP_ (ndssi)
- static IntArray VP_ (ndsss)
- static IntArray VP_ (ndssr)
- static IntArray VP_ (ndusi)
- static IntArray VP_ (nduss)
- static IntArray VP_ (ndusr)
- static IntArray VP_ (nhbp)
- static IntArray VP_ (nhpip)
- static IntArray VP_ (nhpsp)
- static IntArray VP_ (nhrp)
- static IntArray VP_ (nCI)
- static IntArray VP_ (nDI)
- static RealVector MP_ (betaUncLowerBnds)
- static RealVector MP_ (betaUncUpperBnds)
- static RealVector MP_ (betaUncVars)
- static RealVector MP_ (binomialUncProbPerTrial)
- static RealVector MP_ (continuousDesignLowerBnds)
- static RealVector MP_ (continuousDesignUpperBnds)
- static RealVector MP_ (continuousDesignVars)
- static RealVector MP_ (continuousDesignScales)
- static RealVector MP_ (continuousIntervalUncVars)
- static RealVector MP_ (continuousStateLowerBnds)
- static RealVector MP_ (continuousStateUpperBnds)
- static RealVector MP_ (continuousStateVars)
- static RealVector MP_ (discreteDesignSetRealVars)
- static RealVector MP_ (discreteStateSetRealVars)
- static RealVector MP_ (frechetUncBetas)
- static RealVector MP_ (frechetUncVars)
- static RealVector MP_ (geometricUncBetas)
- static RealVector MP_ (gumbelUncBetas)
- static RealVector MP_ (gumbelUncVars)
- static RealVector MP_ (histogramBinUncVars)
- static RealVector MP_ (histogramPointRealUncVars)
- static RealVector MP_ (negBinomialUncProbPerTrial)
- static RealVector MP_ (normalUncLowerBnds)
- static RealVector MP_ (normalUncMeans)
- static RealVector MP_ (normalUncUpperBnds)
- static RealVector MP_ (normalUncVars)
- static RealVector MP_ (triangularUncModes)
- static RealVector MP_ (triangularUncVars)
- static RealVector MP_ (uniformUncVars)
- static RealVector MP_ (weibullUncVars)
- static RealVector VP_ (ddsr)
12.1. **DAKOTA NAMESPACE REFERENCE**

- static `RealVector VP_ (dsr)`
- static `RealVector VP_ (dssr)`
- static `RealVector VP_ (CIlb)`
- static `RealVector VP_ (CIub)`
- static `RealVector VP_ (CIp)`
- static `RealVector VP_ (DSIp)`
- static `RealVector VP_ (DSSp)`
- static `RealVector VP_ (DSRp)`
- static `RealVector VP_ (hba)`
- static `RealVector VP_ (hbo)`
- static `RealVector VP_ (hbc)`
- static `RealVector VP_ (hpic)`
- static `RealVector VP_ (hpsc)`
- static `RealVector VP_ (hpri)`
- static `RealVector VP_ (hprc)`
- static `RealVector VP_ (ucm)`
- static `String MP_ (idVariables)`
- static `StringArray MP_ (continuousDesignLabels)`
- static `StringArray MP_ (continuousDesignScaleTypes)`
- static `StringArray MP_ (continuousStateLabels)`
- static `StringArray MP_ (discreteDesignRangeLabels)`
- static `StringArray MP_ (discreteDesignSetIntLabels)`
- static `StringArray MP_ (discreteDesignSetStrLabels)`
- static `StringArray MP_ (discreteDesignSetRealLabels)`
- static `StringArray MP_ (discreteStateRangeLabels)`
- static `StringArray MP_ (discreteStateSetIntLabels)`
- static `StringArray MP_ (discreteStateSetStrLabels)`
- static `StringArray MP_ (discreteStateSetRealLabels)`
- static `StringArray MP_ (discreteUncSetIntLabels)`
- static `StringArray MP_ (discreteUncSetRealLabels)`
- static `StringArray MP_ (discreteUncSetStrVars)`
- static `StringArray MP_ (histogramPointStrUncVars)`
- static `StringArray VP_ (ddss)`
- static `StringArray VP_ (duss)`
- static `StringArray VP_ (dsss)`
- static `BitArray MP_ (discreteDesignSetIntCat)`
- static `BitArray MP_ (discreteDesignSetRealCat)`
- static `BitArray MP_ (discreteStateSetIntCat)`
- static `BitArray MP_ (discreteStateSetRealCat)`
- static `BitArray MP_ (discreteUncSetIntCat)`
- static `BitArray MP_ (discreteUncSetRealCat)`
- static `Var brv MP2s (betaUncAlphas, 0.)`
- static `Var brv MP2s (betaUncBetas, 0.)`
- static `Var brv MP2s (exponentialUncBetas, 0.)`
• static Var_brv MP2s (exponentialUncVars, 0.)
• static Var_brv MP2s (frechetUncAlphas, 2.)
• static Var_brv MP2s (gammaUncAlphas, 0.)
• static Var_brv MP2s (gammaUncBetas, 0.)
• static Var_brv MP2s (gammaUncVars, 0.)
• static Var_brv MP2s (gumbelUncAlphas, 0.)
• static Var_brv MP2s (lognormalUncErrFacts, 1.)
• static Var_brv MP2s (lognormalUncLambdas, 0.)
• static Var_brv MP2s (lognormalUncLowerBnds, 0.)
• static Var_brv MP2s (lognormalUncMeans, 0.)
• static Var_brv MP2s (lognormalUncStdDevs, 0.)
• static Var_brv MP2s (lognormalUncUpperBnds, std::numeric_limits<Real>::infinity())
• static Var_brv MP2s (lognormalUncVars, 0.)
• static Var_brv MP2s (lognormalUncZetas, 0.)
• static Var_brv MP2s (loguniformUncLowerBnds, 0.)
• static Var_brv MP2s (loguniformUncUpperBnds, std::numeric_limits<Real>::infinity())
• static Var_brv MP2s (loguniformUncVars, 0.)
• static Var_brv MP2s (normalUncStdDevs, 0.)
• static Var_brv MP2s (poissonUncLambdas, 0.)
• static Var_brv MP2s (poissonUncVars, 0.)
• static Var_brv MP2s (triangularUncLowerBnds,-std::numeric_limits<Real>::infinity())
• static Var_brv MP2s (triangularUncUpperBnds, std::numeric_limits<Real>::infinity())
• static Var_brv MP2s (uniformUncLowerBnds,-std::numeric_limits<Real>::infinity())
• static Var_brv MP2s (uniformUncUpperBnds, std::numeric_limits<Real>::infinity())
• static Var_brv MP2s (weibullUncAlphas, 0.)
• static Var_brv MP2s (weibullUncBetas, 0.)
• static Var_biv MP2s (binomialUncNumTrials, 0)
• static Var_biv MP2s (binomialUncVars, 0)
• static Var_biv MP2s (geometricUncVars, 0)
• static Var_biv MP2s (hyperGeomUncNumDrawn, 0)
• static Var_biv MP2s (hyperGeomUncSelectedPop, 0)
• static Var_biv MP2s (hyperGeomUncTotalPop, 0)
• static Var_biv MP2s (hyperGeomUncVars, 0)
• static Var_biv MP2s (negBinomialUncNumTrials, 0)
• static Var_biv MP2s (negBinomialUncVars, 0)
• static Var_biv MP2s (poissonUncVars, 0)
• static Var_mp_type Vtype (varsDomain, MIXED_DOMAIN)
• static Var_mp_type Vtype (varsDomain, RELAXED_DOMAIN)
• static Var_mp_type Vtype (varsView, ALL_VIEW)
• static Var_mp_type Vtype (varsView, DESIGN_VIEW)
• static Var_mp_type Vtype (varsView, UNCERTAIN_VIEW)
• static Var_mp_type Vtype (varsView, ALEATORY UNCERTAIN VIEW)
• static Var_mp_type Vtype (varsView, EPISTEMIC UNCERTAIN VIEW)
• static Var_mp_type Vtype (varsView, STATE VIEW)
• template<class ContainerT>
  void flatten_num_array (const std::vector< ContainerT >&input_array, IntArray **pia)
12.1. DAKOTA NAMESPACE REFERENCE

Free convenience function that flatten sizes of an array of std containers: takes an array of containers and returns an IntArray containing the sizes of each container in the input array. Note: Did not specialize for vector<RealVector> as no current use cases.

- void dn2f (int n, int p, Real *x, Calcrj, int *iv, int *lv, Real *v, int *ui, void *ur, Vf)
- void dn2fb (int n, int p, Real *x, Calcrj, int *iv, int *lv, Real *v, int *ui, void *ur, Vf)
- void dn2g (int n, int p, Real *x, Calcrj, Calcrj, int *iv, int *lv, Real *v, int *ui, void *ur, Vf)
- void dn2gb (int n, int p, Real *x, Real *b, Calcrj, Calcrj, int *iv, int *lv, Real *v, int *ui, void *ur, Vf)
- void divset (int *, int *, int *, int *, Real *)
- double dr7mdc (int *)
- static void Rswapchk (NI2Misc *q)
- static int hasnaninf (const double *, const RealVector &)
- NLPQLPOptimizer * new_NLPQLPOptimizer (ProblemDescDB &problem_db)
- NLPQLPOptimizer * new_NLPQLPOptimizer (Model &model)
- NLPQLPOptimizer * new_NLPQLPOptimizer (ProblemDescDB &problem_db, Model &model)
- NPSOLOptimizer * new_NPSOLOptimizer (ProblemDescDB &problem_db)
- NPSOLOptimizer * new_NPSOLOptimizer (Model &model)
- NPSOLOptimizer * new_NPSOLOptimizer2 (Model &model, const int &derivative_level, const Real &conv_tol)
- NPSOLOptimizer * new_NPSOLOptimizer (ProblemDescDB &problem_db, Model &model)
- NPSOLOptimizer * new_NPSOLOptimizer (Model &model)
- NPSOLOptimizer * new_NPSOLOptimizer (Model &model, const int &, const Real &)
- void start_dakota_heartbeat (int)
- void dak_sigcatch (int sig)

MPIUnpackBuffer & operator>> (MPIUnpackBuffer &s, ParallelLevel &pl)

MPIUnpackBuffer extraction operator for ParallelLevel. Calls read(MPIUnpackBuffer&).

MPIPackBuffer & operator<< (MPIPackBuffer &s, const ParallelLevel &pl)

MPIPackBuffer insertion operator for ParallelLevel. Calls write(MPIPackBuffer&).

std::istream & operator>> (std::istream &s, ParamResponsePair &pair)

std::istream extraction operator for ParamResponsePair

std::ostream & operator<< (std::ostream &s, const ParamResponsePair &pair)

std::ostream insertion operator for ParamResponsePair

MPIUnpackBuffer & operator>> (MPIUnpackBuffer &s, ParamResponsePair &pair)
MPIUnpackBuffer extraction operator for ParamResponsePair.

- MPIPackBuffer & operator<< (MPIPackBuffer &, const ParamResponsePair &pair)
  MPIPackBuffer insertion operator for ParamResponsePair.
- bool operator==(const ParamResponsePair &pair1, const ParamResponsePair &pair2)
  equality operator for ParamResponsePair
- bool operator!=(const ParamResponsePair &pair1, const ParamResponsePair &pair2)
  inequality operator for ParamResponsePair
- static void *binsearch (void *kw, size_t kwsize, size_t n, const char *key)
- static const char *Begins (const String &entry_name, const char *s)
- static void Bad_name (String entry_name, const char *where)
- static void Locked_db ()
- static void Null_rep (const char *who)
- static void Null_rep1 (const char *who)
- MPIUnpackBuffer & operator>>(MPIUnpackBuffer &, ProgramOptions &progopt)
  MPIUnpackBuffer extraction operator.
- MPIPackBuffer & operator<< (MPIPackBuffer &, const ProgramOptions &progopt)
  MPIPackBuffer insertion operator.
- bool set_compare (const ParamResponsePair &database_pr, const ActiveSet &search_set)
  search function for a particular ParamResponsePair within a PRPList based on ActiveSet content (request vector and derivative variables vector)
- bool id_vars_exact_compare (const ParamResponsePair &database_pr, const ParamResponsePair &search_pr)
  search function for a particular ParamResponsePair within a PRPMultiIndex
- std::size_t hash_value (const ParamResponsePair &prp)
  hash_value for ParamResponsePairs stored in a PRPMultiIndex
- PRPCacheHIter hashedCacheBegin (PRPCache &prp_cache)
  hashed definition of cache begin
- PRPCacheHIter hashedCacheEnd (PRPCache &prp_cache)
  hashed definition of cache end
- PRPQueueHIter hashedQueueBegin (PRPQueue &prp_queue)
  hashed definition of queue begin
- PRPQueueHIter hashedQueueEnd (PRPQueue &prp_queue)
  hashed definition of queue end
- PRPCacheHIter lookup_by_val (PRPMultiIndexCache &prp_cache, const ParamResponsePair &search_pr)
  find a ParamResponsePair based on the interface id, variables, and ActiveSet search data within search_pr
- PRPCacheHIter lookup_by_val (PRPMultiIndexCache &prp_cache, const String &search_interface_id, const Variables &search_vars, const ActiveSet &search_set)
  find a ParamResponsePair within a PRPMultiIndexCache based on the interface id, variables, and ActiveSet search data
- PRPCacheOIter lookup_by_nearby_val (PRPMultiIndexCache &prp_cache, const String &search_interface_id, const Variables &search_vars, const ActiveSet &search_set, Real tol)
- PRPCacheOIter lookup_by_ids (PRPMultiIndexCache &prp_cache, const IntStringPair &search_ids)
  find a ParamResponsePair within a PRPMultiIndexCache based on search_ids (i.e. std::pair<eval_id,interface_id>) search data
• PRPCacheOIter lookup_by_ids (PRPMultiIndexCache &prp_cache, const IntStringPair &search_ids, const ParamResponsePair &search_pr)

• PRPQueueHIter lookup_by_val (PRPMultiIndexQueue &prp_queue, const ParamResponsePair &search_pr)

  find a ParamResponsePair based on the interface id, variables, and ActiveSet search data within search_pr.

• PRPQueueHIter lookup_by_val (PRPMultiIndexQueue &prp_queue, const String &search_interface_id, const Variables &search_vars, const ActiveSet &search_set)

  find a ParamResponsePair within a PRPMultiIndexQueue based on interface id, variables, and ActiveSet search data

• PRPQueueOIter lookup_by_eval_id (PRPMultiIndexQueue &prp_queue, int search_id)

  find a ParamResponsePair within a PRPMultiIndexQueue based on search_id (i.e. integer eval_id) search data

• void print_usage (std::ostream &s)

  print restart utility help message

• void print_restart (StringArray pos_args, String print_dest)

  print a restart file

• void print_restart_pdb (StringArray pos_args, String print_dest)

  print a restart file (PDB format)

• void print_restart_tabular (StringArray pos_args, String print_dest, unsigned short tabular_format)

  print a restart file (tabular format)

• void read_neutral (StringArray pos_args)

  read a restart file (neutral file format)

• void repair_restart (StringArray pos_args, String identifier_type)

  repair a restart file by removing corrupted evaluations

• void concatenate_restart (StringArray pos_args)

  concatenate multiple restart files

• static HANDLE * wait_setup (std::map< pid_t, int > &M, size_t *pn)

• static int wait_for_one (size_t n, HANDLE *h, int req1, size_t *pi)

• void gauss_legendre_pts_wts_1D (int level, RealVector &result_0, RealVector &result_1)

• void lagrange_interpolation_1d (const RealVector &samples, const RealVector &abscissa, const RealVector &values, RealVector &result)

• void kronecker_product_2d (const RealMatrix &matrix1, const RealMatrix &matrix2, RealMatrix &matrix)

• void get_chebyshev_points (int order, RealVector &points)

• void chebyshev_derivative_matrix (int order, RealMatrix &derivative_matrix, RealVector &points)

• int salinas_main (int argc, char *argv[], MPI_Comm *comm)

  subroutine interface to SALINAS simulation code

• std::string get_cwd_str ()

• std::vector< std::string > get_pathext ()

• bool contains (const bfs::path &dir_path, const std::string &file_name, boost::filesystem::path &complete_filepath)
Variables

- **PRPCache data_pairs**
  - contains all parameter/response pairs.
- **double PI = boost::math::constants::pi<double>()**
  - constant pi
- **double HALF_LOG_2PI = std::log(2.0*PI)/2.0**
  - constant log(2*pi)/2.0
- **short abort_mode = ABORT_EXIT**
  - by default Dakota exits or calls MPI_Abort on errors
- **std::ostream *dakota_cout = &std::cout**
  - DAKOTA stdout initially points to < std::cout, but may be redirected to a tagged ofstream if there are < concurrent iterators.
- **std::ostream *dakota_cerr = &std::cerr**
  - DAKOTA stderr initially points to < std::cerr, but may be redirected to a tagged ofstream if there are < concurrent iterators.
- **ResultsManager iterator_results_db**
  - Global results database for iterator results.
- **int write_precision = 10**
  - used in ostream data output functions < (restart_util.cpp overrides default value)
- **MPIManager dummy_mpi_mgr**
  - dummy MPIManager for ref initialization
- **ProgramOptions dummy_prg_opt**
  - dummy ProgramOptions for ref initialization
- **OutputManager dummy_out_mgr**
  - dummy OutputManager for ref initialization
- **ParallelLibrary dummy_lib**
  - dummy ParallelLibrary for ref initialization
- **ProblemDescDB dummy_db**
  - dummy ProblemDescDB for ref initialization
- **int mc_ptr_int = 0**
  - global pointer for ModelCenter API
- **int dc_ptr_int = 0**
  - global pointer for ModelCenter eval DB
- **ProblemDescDB *Dak_pdddb**
  - set by ProblemDescDB, for use in parsing
- **const size_t NPOS = ~(size_t)0**
  - special value returned by index() when entry not found
- **const double BIG_REAL_BOUND = 1.0e+30**
  - bound beyond which constraints are considered inactive
- **Interface dummy_interface**
  - dummy Interface object used for mandatory < reference initialization or default virtual < function return by reference when a real < Interface instance is unavailable
- **Model dummy_model**
12.1. DAKOTA NAMESPACE REFERENCE

dummy Model object used for mandatory reference
< initialization or default virtual function < return by reference when a real Model instance < is unavailable

- Iterator dummy_iterator
dummy Iterator object used for mandatory< initialization or default virtual function return by reference when a real Iterator instance is unavailable

- Dakota_funcs * DF
- Dakota_funcs DakFuncs0
- const char * FIELD_NAMES []
- const int NUMBER_OF_FIELDS = 23
- static const int MPI_COMM_WORLD = 1
- static const int MPI_COMM_NULL = 0
- static const int MPI_ANY_TAG = -1
- static void * MPI_REQUEST_NULL = NULL
- static KeyWord kw_1 [3]
- static KeyWord kw_2 [3]
- static KeyWord kw_3 [2]
- static KeyWord kw_4 [3]
- static KeyWord kw_5 [3]
- static KeyWord kw_6 [2]
- static KeyWord kw_7 [1]
- static KeyWord kw_8 [1]
- static KeyWord kw_9 [2]
- static KeyWord kw_10 [3]
- static KeyWord kw_11 [5]
- static KeyWord kw_12 [15]
- static KeyWord kw_13 [1]
- static KeyWord kw_14 [4]
- static KeyWord kw_15 [1]
- static KeyWord kw_16 [4]
- static KeyWord kw_17 [1]
- static KeyWord kw_18 [8]
- static KeyWord kw_19 [10]
- static KeyWord kw_20 [12]
- static KeyWord kw_21 [2]
- static KeyWord kw_22 [2]
- static KeyWord kw_23 [3]
- static KeyWord kw_24 [2]
- static KeyWord kw_25 [2]
- static KeyWord kw_26 [9]
- static KeyWord kw_27 [1]
- static KeyWord kw_28 [2]
- static KeyWord kw_29 [1]
- static KeyWord kw_30 [1]
- static KeyWord kw_31 [2]
- static KeyWord kw_32 [4]
- static KeyWord kw_33 [4]
• static KeyWord kw_34 [3]
• static KeyWord kw_35 [3]
• static KeyWord kw_36 [3]
• static KeyWord kw_37 [3]
• static KeyWord kw_38 [4]
• static KeyWord kw_39 [2]
• static KeyWord kw_40 [3]
• static KeyWord kw_41 [2]
• static KeyWord kw_42 [16]
• static KeyWord kw_43 [7]
• static KeyWord kw_44 [2]
• static KeyWord kw_45 [22]
• static KeyWord kw_46 [1]
• static KeyWord kw_47 [5]
• static KeyWord kw_48 [3]
• static KeyWord kw_49 [4]
• static KeyWord kw_50 [6]
• static KeyWord kw_51 [3]
• static KeyWord kw_52 [4]
• static KeyWord kw_53 [3]
• static KeyWord kw_54 [3]
• static KeyWord kw_55 [4]
• static KeyWord kw_56 [4]
• static KeyWord kw_57 [3]
• static KeyWord kw_58 [11]
• static KeyWord kw_59 [5]
• static KeyWord kw_60 [3]
• static KeyWord kw_61 [3]
• static KeyWord kw_62 [10]
• static KeyWord kw_63 [3]
• static KeyWord kw_64 [1]
• static KeyWord kw_65 [2]
• static KeyWord kw_66 [2]
• static KeyWord kw_67 [4]
• static KeyWord kw_68 [2]
• static KeyWord kw_69 [8]
• static KeyWord kw_70 [3]
• static KeyWord kw_71 [4]
• static KeyWord kw_72 [7]
• static KeyWord kw_73 [1]
• static KeyWord kw_74 [3]
• static KeyWord kw_75 [4]
• static KeyWord kw_76 [6]
• static KeyWord kw_77 [3]
• static KeyWord kw_78 [4]
• static KeyWord kw_79 [3]
12.1. DAKOTA NAMESPACE REFERENCE

- static KeyWord kw_80 [3]
- static KeyWord kw_81 [4]
- static KeyWord kw_82 [4]
- static KeyWord kw_83 [3]
- static KeyWord kw_84 [1]
- static KeyWord kw_85 [5]
- static KeyWord kw_86 [3]
- static KeyWord kw_87 [3]
- static KeyWord kw_88 [7]
- static KeyWord kw_89 [2]
- static KeyWord kw_90 [2]
- static KeyWord kw_91 [2]
- static KeyWord kw_92 [3]
- static KeyWord kw_93 [4]
- static KeyWord kw_94 [6]
- static KeyWord kw_95 [3]
- static KeyWord kw_96 [4]
- static KeyWord kw_97 [3]
- static KeyWord kw_98 [3]
- static KeyWord kw_99 [4]
- static KeyWord kw_100 [4]
- static KeyWord kw_101 [3]
- static KeyWord kw_102 [1]
- static KeyWord kw_103 [5]
- static KeyWord kw_104 [1]
- static KeyWord kw_105 [7]
- static KeyWord kw_106 [12]
- static KeyWord kw_107 [1]
- static KeyWord kw_108 [3]
- static KeyWord kw_109 [4]
- static KeyWord kw_110 [9]
- static KeyWord kw_111 [3]
- static KeyWord kw_112 [2]
- static KeyWord kw_113 [4]
- static KeyWord kw_114 [2]
- static KeyWord kw_115 [8]
- static KeyWord kw_116 [3]
- static KeyWord kw_117 [2]
- static KeyWord kw_118 [3]
- static KeyWord kw_119 [2]
- static KeyWord kw_120 [5]
- static KeyWord kw_121 [4]
- static KeyWord kw_122 [11]
- static KeyWord kw_123 [2]
- static KeyWord kw_124 [3]
- static KeyWord kw_125 [2]
• static KeyWord kw_126 [2]
• static KeyWord kw_127 [12]
• static KeyWord kw_128 [8]
• static KeyWord kw_129 [15]
• static KeyWord kw_130 [4]
• static KeyWord kw_131 [3]
• static KeyWord kw_132 [1]
• static KeyWord kw_133 [15]
• static KeyWord kw_134 [12]
• static KeyWord kw_135 [15]
• static KeyWord kw_136 [7]
• static KeyWord kw_137 [3]
• static KeyWord kw_138 [3]
• static KeyWord kw_139 [3]
• static KeyWord kw_140 [2]
• static KeyWord kw_141 [3]
• static KeyWord kw_142 [4]
• static KeyWord kw_143 [11]
• static KeyWord kw_144 [3]
• static KeyWord kw_145 [1]
• static KeyWord kw_146 [10]
• static KeyWord kw_147 [1]
• static KeyWord kw_148 [12]
• static KeyWord kw_149 [3]
• static KeyWord kw_150 [3]
• static KeyWord kw_151 [3]
• static KeyWord kw_152 [4]
• static KeyWord kw_153 [2]
• static KeyWord kw_154 [3]
• static KeyWord kw_155 [2]
• static KeyWord kw_156 [12]
• static KeyWord kw_157 [4]
• static KeyWord kw_158 [2]
• static KeyWord kw_159 [3]
• static KeyWord kw_160 [2]
• static KeyWord kw_161 [3]
• static KeyWord kw_162 [3]
• static KeyWord kw_163 [2]
• static KeyWord kw_164 [3]
• static KeyWord kw_165 [4]
• static KeyWord kw_166 [7]
• static KeyWord kw_167 [9]
• static KeyWord kw_168 [2]
• static KeyWord kw_169 [3]
• static KeyWord kw_170 [3]
• static KeyWord kw_171 [2]
static KeyWord kw_172 [3]
static KeyWord kw_173 [4]
static KeyWord kw_174 [7]
static KeyWord kw_175 [11]
static KeyWord kw_176 [2]
static KeyWord kw_177 [1]
static KeyWord kw_178 [1]
static KeyWord kw_179 [3]
static KeyWord kw_180 [3]
static KeyWord kw_181 [3]
static KeyWord kw_182 [3]
static KeyWord kw_183 [4]
static KeyWord kw_184 [2]
static KeyWord kw_185 [3]
static KeyWord kw_186 [2]
static KeyWord kw_187 [2]
static KeyWord kw_188 [19]
static KeyWord kw_189 [2]
static KeyWord kw_190 [3]
static KeyWord kw_191 [1]
static KeyWord kw_192 [2]
static KeyWord kw_193 [1]
static KeyWord kw_194 [1]
static KeyWord kw_195 [5]
static KeyWord kw_196 [1]
static KeyWord kw_197 [2]
static KeyWord kw_198 [6]
static KeyWord kw_199 [2]
static KeyWord kw_200 [3]
static KeyWord kw_201 [2]
static KeyWord kw_202 [12]
static KeyWord kw_203 [3]
static KeyWord kw_204 [4]
static KeyWord kw_205 [3]
static KeyWord kw_206 [2]
static KeyWord kw_207 [1]
static KeyWord kw_208 [1]
static KeyWord kw_209 [2]
static KeyWord kw_210 [3]
static KeyWord kw_211 [2]
static KeyWord kw_212 [7]
static KeyWord kw_213 [4]
static KeyWord kw_214 [5]
static KeyWord kw_215 [4]
static KeyWord kw_216 [10]
static KeyWord kw_217 [1]
• static KeyWord kw_218 [2]
• static KeyWord kw_219 [4]
• static KeyWord kw_220 [2]
• static KeyWord kw_221 [7]
• static KeyWord kw_222 [11]
• static KeyWord kw_223 [2]
• static KeyWord kw_224 [5]
• static KeyWord kw_225 [3]
• static KeyWord kw_226 [1]
• static KeyWord kw_227 [6]
• static KeyWord kw_228 [8]
• static KeyWord kw_229 [3]
• static KeyWord kw_230 [2]
• static KeyWord kw_231 [1]
• static KeyWord kw_232 [3]
• static KeyWord kw_233 [1]
• static KeyWord kw_234 [2]
• static KeyWord kw_235 [4]
• static KeyWord kw_236 [19]
• static KeyWord kw_237 [1]
• static KeyWord kw_238 [1]
• static KeyWord kw_239 [5]
• static KeyWord kw_240 [2]
• static KeyWord kw_241 [2]
• static KeyWord kw_242 [7]
• static KeyWord kw_243 [9]
• static KeyWord kw_244 [15]
• static KeyWord kw_245 [14]
• static KeyWord kw_246 [2]
• static KeyWord kw_247 [2]
• static KeyWord kw_248 [3]
• static KeyWord kw_249 [2]
• static KeyWord kw_250 [8]
• static KeyWord kw_251 [1]
• static KeyWord kw_252 [2]
• static KeyWord kw_253 [4]
• static KeyWord kw_254 [2]
• static KeyWord kw_255 [2]
• static KeyWord kw_256 [3]
• static KeyWord kw_257 [4]
• static KeyWord kw_258 [2]
• static KeyWord kw_259 [2]
• static KeyWord kw_260 [3]
• static KeyWord kw_261 [1]
• static KeyWord kw_262 [1]
• static KeyWord kw_263 [1]
• static KeyWord kw_264 [2]
• static KeyWord kw_265 [2]
• static KeyWord kw_266 [1]
• static KeyWord kw_267 [17]
• static KeyWord kw_268 [3]
• static KeyWord kw_269 [6]
• static KeyWord kw_270 [3]
• static KeyWord kw_271 [3]
• static KeyWord kw_272 [3]
• static KeyWord kw_273 [4]
• static KeyWord kw_274 [1]
• static KeyWord kw_275 [6]
• static KeyWord kw_276 [3]
• static KeyWord kw_277 [2]
• static KeyWord kw_278 [4]
• static KeyWord kw_279 [3]
• static KeyWord kw_280 [2]
• static KeyWord kw_281 [3]
• static KeyWord kw_282 [2]
• static KeyWord kw_283 [31]
• static KeyWord kw_284 [2]
• static KeyWord kw_285 [2]
• static KeyWord kw_286 [3]
• static KeyWord kw_287 [2]
• static KeyWord kw_288 [8]
• static KeyWord kw_289 [1]
• static KeyWord kw_290 [1]
• static KeyWord kw_291 [4]
• static KeyWord kw_292 [1]
• static KeyWord kw_293 [4]
• static KeyWord kw_294 [14]
• static KeyWord kw_295 [3]
• static KeyWord kw_296 [3]
• static KeyWord kw_297 [2]
• static KeyWord kw_298 [3]
• static KeyWord kw_299 [3]
• static KeyWord kw_300 [4]
• static KeyWord kw_301 [2]
• static KeyWord kw_302 [2]
• static KeyWord kw_303 [4]
• static KeyWord kw_304 [2]
• static KeyWord kw_305 [4]
• static KeyWord kw_306 [2]
• static KeyWord kw_307 [29]
• static KeyWord kw_308 [5]
• static KeyWord kw_309 [18]
• static KeyWord kw_310 [3]
• static KeyWord kw_311 [16]
• static KeyWord kw_312 [3]
• static KeyWord kw_313 [6]
• static KeyWord kw_314 [3]
• static KeyWord kw_315 [4]
• static KeyWord kw_316 [6]
• static KeyWord kw_317 [5]
• static KeyWord kw_318 [2]
• static KeyWord kw_319 [1]
• static KeyWord kw_320 [8]
• static KeyWord kw_321 [4]
• static KeyWord kw_322 [7]
• static KeyWord kw_323 [2]
• static KeyWord kw_324 [2]
• static KeyWord kw_325 [2]
• static KeyWord kw_326 [2]
• static KeyWord kw_327 [4]
• static KeyWord kw_328 [17]
• static KeyWord kw_329 [4]
• static KeyWord kw_330 [8]
• static KeyWord kw_331 [2]
• static KeyWord kw_332 [7]
• static KeyWord kw_333 [1]
• static KeyWord kw_334 [4]
• static KeyWord kw_335 [6]
• static KeyWord kw_336 [16]
• static KeyWord kw_337 [4]
• static KeyWord kw_338 [87]
• static KeyWord kw_339 [1]
• static KeyWord kw_340 [2]
• static KeyWord kw_341 [7]
• static KeyWord kw_342 [2]
• static KeyWord kw_343 [2]
• static KeyWord kw_344 [3]
• static KeyWord kw_345 [2]
• static KeyWord kw_346 [5]
• static KeyWord kw_347 [1]
• static KeyWord kw_348 [2]
• static KeyWord kw_349 [1]
• static KeyWord kw_350 [3]
• static KeyWord kw_351 [5]
• static KeyWord kw_352 [3]
• static KeyWord kw_353 [4]
• static KeyWord kw_354 [6]
• static KeyWord kw_355 [1]
• static KeyWord kw_356 [4]
• static KeyWord kw_357 [1]
• static KeyWord kw_358 [2]
• static KeyWord kw_359 [2]
• static KeyWord kw_360 [2]
• static KeyWord kw_361 [3]
• static KeyWord kw_362 [3]
• static KeyWord kw_363 [3]
• static KeyWord kw_364 [3]
• static KeyWord kw_365 [2]
• static KeyWord kw_366 [4]
• static KeyWord kw_367 [2]
• static KeyWord kw_368 [4]
• static KeyWord kw_369 [7]
• static KeyWord kw_370 [2]
• static KeyWord kw_371 [3]
• static KeyWord kw_372 [4]
• static KeyWord kw_373 [2]
• static KeyWord kw_374 [2]
• static KeyWord kw_375 [2]
• static KeyWord kw_376 [3]
• static KeyWord kw_377 [2]
• static KeyWord kw_378 [2]
• static KeyWord kw_379 [4]
• static KeyWord kw_380 [4]
• static KeyWord kw_381 [2]
• static KeyWord kw_382 [5]
• static KeyWord kw_383 [4]
• static KeyWord kw_384 [2]
• static KeyWord kw_385 [5]
• static KeyWord kw_386 [4]
• static KeyWord kw_387 [2]
• static KeyWord kw_388 [5]
• static KeyWord kw_389 [3]
• static KeyWord kw_390 [26]
• static KeyWord kw_391 [6]
• static KeyWord kw_392 [3]
• static KeyWord kw_393 [1]
• static KeyWord kw_394 [2]
• static KeyWord kw_395 [2]
• static KeyWord kw_396 [5]
• static KeyWord kw_397 [10]
• static KeyWord kw_398 [2]
• static KeyWord kw_399 [3]
• static KeyWord kw_400 [5]
• static KeyWord kw_401 [2]
• static KeyWord kw_402 [6]
• static KeyWord kw_403 [3]
• static KeyWord kw_404 [6]
• static KeyWord kw_405 [8]
• static KeyWord kw_406 [18]
• static KeyWord kw_407 [4]
• static KeyWord kw_408 [8]
• static KeyWord kw_409 [3]
• static KeyWord kw_410 [2]
• static KeyWord kw_411 [1]
• static KeyWord kw_412 [2]
• static KeyWord kw_413 [8]
• static KeyWord kw_414 [3]
• static KeyWord kw_415 [6]
• static KeyWord kw_416 [8]
• static KeyWord kw_417 [15]
• static KeyWord kw_418 [3]
• static KeyWord kw_419 [4]
• static KeyWord kw_420 [7]
• static KeyWord kw_421 [1]
• static KeyWord kw_422 [2]
• static KeyWord kw_423 [19]
• static KeyWord kw_424 [6]
• static KeyWord kw_425 [11]
• static KeyWord kw_426 [5]
• static KeyWord kw_427 [12]
• static KeyWord kw_428 [10]
• static KeyWord kw_429 [8]
• static KeyWord kw_430 [8]
• static KeyWord kw_431 [1]
• static KeyWord kw_432 [7]
• static KeyWord kw_433 [1]
• static KeyWord kw_434 [7]
• static KeyWord kw_435 [7]
• static KeyWord kw_436 [3]
• static KeyWord kw_437 [9]
• static KeyWord kw_438 [8]
• static KeyWord kw_439 [7]
• static KeyWord kw_440 [7]
• static KeyWord kw_441 [6]
• static KeyWord kw_442 [3]
• static KeyWord kw_443 [9]
• static KeyWord kw_444 [9]
• static KeyWord kw_445 [8]
• static KeyWord kw_446 [3]
• static KeyWord kw_447 [5]
• static KeyWord `kw_448` [7]
• static KeyWord `kw_449` [7]
• static KeyWord `kw_450` [4]
• static KeyWord `kw_451` [7]
• static KeyWord `kw_452` [11]
• static KeyWord `kw_453` [6]
• static KeyWord `kw_454` [6]
• static KeyWord `kw_455` [6]
• static KeyWord `kw_456` [3]
• static KeyWord `kw_457` [5]
• static KeyWord `kw_458` [2]
• static KeyWord `kw_459` [4]
• static KeyWord `kw_460` [11]
• static KeyWord `kw_461` [7]
• static KeyWord `kw_462` [5]
• static KeyWord `kw_463` [11]
• static KeyWord `kw_464` [3]
• static KeyWord `kw_465` [9]
• static KeyWord `kw_466` [7]
• static KeyWord `kw_467` [7]
• static KeyWord `kw_468` [34]
• static KeyWord `kw_469` [6]

```c
FILE *nidrin
const size_t NIDR_MAX_ERROR_LEN = 8192
```

Maximum error length is roughly 100 lines at 80 char; using fixed error length instead of investing in converting to `vsnprintf` (C++11)

• static const char *aln_scaletypes[] = {"auto", "log", "none", 0}
• static Var_uinfo CAUVLbl[CAUVar_Nkinds]
• static Var_uinfo DAUVLbl[DAUVar_Nkinds]
• static Var_uinfo DAUSVLbl[DAUSVar_Nkinds]
• static Var_uinfo DAURVLbl[DAURVar_Nkinds]
• static Var_uinfo CEUVLbl[CEUVar_Nkinds]
• static Var_uinfo DEUVLbl[DEUVar_Nkinds]
• static Var_uinfo DEUSVLbl[DEUSVar_Nkinds]
• static Var_uinfo DiscSetLbl[DiscSetVar_Nkinds]
• static VarLabelChk DesignAndStateLabelsCheck[]

Variables label array designations for design and state. All non-uncertain variables need to be in this array. Used in `check_variables` node to check lengths and make_variable_defaults to build labels.

• static VLreal VLUncertainReal[NUM_UNC_REAL_CONT]

Variables labels/bounds/values check array for real-valued uncertain variables; one array entry per contiguous container. These associate the individual variables given by, e.g., CAUVLbl, with the contiguous container in which they are stored.

• static VLint VLUncertainInt[NUM_UNC_INT_CONT]

Variables labels/bounds/values check array for integer-valued uncertain variables; one array entry per contiguous container. These associate the individual variables given by, e.g., DAUVLbl, with the contiguous container in which they are stored.
CHAPTER 12. NAMESPACE DOCUMENTATION

- static VLstr VLUncertainStr [NUMUNCSTRCONT]

  Variables labels/bounds/values check array for string-valued uncertain variables; one array entry per contiguous container. These associate the individual variables given by, e.g., DAUSVLbl, with the contiguous container in which they are stored.

- static int VLR_aleatory [NUMUNCREALCONT] = { 1, 0, 1, 0 }

  which uncertain real check array containers are aleatory (true = 1)

- static int VLI_aleatory [NUMUNCINTCONT] = { 1, 0 }

  which uncertain integer check array containers are aleatory (true = 1)

- static int VLS_aleatory [NUMUNCSTRCONT] = { 1, 0 }

  which uncertain string check array containers are aleatory (true = 1)

- static Var_check_var_mp_check_cv []
- static Var_check_var_mp_check_dset []
- static Var_check_var_mp_check_cau []
- static Var_check_var_mp_check_daui []
- static Var_check_var_mp_check_daus []
- static Var_check_var_mp_check_daur []
- static Var_check_var_mp_check_ceu []
- static Var_check_var_mp_check_deui []
- static Var_check_var_mp_check_deus []
- static Var_check_var_mp_check_deur []
- static Var_recheck_var_mp_cbound []

  This is used within check_variables_node(): Var_RealBoundIPCheck() is applied to validate bounds and initial points.

- static Var_check var_mp_drange []

  This is used in check_variables_node(): Var_IntBoundIPCheck() is applied to validate bounds and initial points, and in make_variable_defaults(): Vgen_* is called to infer bounds.

- static time_t start_time
- const char * SCIFIELDNAMES []
- const int SCI_NUMBER_OF_FIELDS = 26
- const int LARGE_SCALE = 100

  a (perhaps arbitrary) definition of large scale; choose a large-scale algorithm if numVars >= LARGE_SCALE

- const double POW_Val = 1.0

  offset used textbook exponent: 1.0 is nominal, 1.4 used for B&B testing

- const String LEV_REF = "Dakota"

  levenshtein_distance computes the distance between its argument and this

12.1.1 Detailed Description

The primary namespace for DAKOTA. The Dakota namespace encapsulates the core classes of the DAKOTA framework and prevents name clashes with third-party libraries from methods and packages. The C++ source files defining these core classes reside in Dakota/src as *.cpp.

Work directory TODO
Doc: we will search for drivers in PATH, workdir (.), RUNDIR
Remove legacy utilities (once concepts migrated)

- In general review cases with race conditions such as single dir getting created / removed for each eval.
12.1. DAKOTA NAMESPACE REFERENCE

- Verify creation/removal in parallel runs (eval_comm_rank 0?): are there scenarios where we should create once ahead of time?
- Enforce tagging when async is possible
- Challenge of shared vs. distinct filesystems
- Verify template files exist at parse and that workdir parent exists
- Verify behavior when directory exists
- Allow recursive copy to descend to overwrite leaf nodes when directories already exist
- Old code setting permissions mask 0700
- Workdir with multiple analysis components (per analysis)
- Workdirs shared for each unique concurrent eval (not per eval ID)
- Evaluate environment variables
- How to manage drivers that want just param names in the work dir?!? I think arg_adjust is removing the directory args that aren’t needed.
- Consider making the class members for directories and files bfs::paths
- Behavior of file_save when directory not saved
- Error checking: directory was created directory path is a directory directory has rwx for user population worked try/catch around all fs operations
- Verify correct handling of relative vs. absolute files/dirs
- Enforce that first argument must be an executable program for all drivers; at least for fork
- Historical behaviors / features to consider Template dirs on PATH: likely no longer
  - Allowed FOO=zorch and would set that in the environment; could allow separate env var specification; otherwise likely remove
- TODO: pass environment to exec as separate pointer

TESTING NEEDS

- Allow nested quotes in driver, at least one level: analysis_driver = ‘ad.sh ”-opt foo -opt1 goo”’ p.in.1 r.out.1
- Env vars will be carried along for now, not expanded before eval; set some helpful env vars before the eval.

12.1.2 Typedef Documentation

typedef bmi::multi_index_container< Dakota::ParamResponsePair, bmi::indexed_by< bmi::ordered_non_unique< bmi::tag< ordered >, bmi::const_mem_fun< Dakota::ParamResponsePair, const IntStringPair&>, 
&Dakota::ParamResponsePair::eval_interface_ids > >, bmi::hashed_non_unique< bmi::tag< hashed >, bmi::identity< Dakota::ParamResponsePair >, partial_prp_hash, partial_prp_equality > > >
PRPMultiIndexCache

Boost Multi-Index Container for globally caching ParamResponsePairs.

  For a global cache, both evaluation and interface id’s are used for tagging ParamResponsePair records.
typedef bmi::multi_index_container<Dakota::ParamResponsePair, bmi::indexed_by<
bmi::ordered_unique<bmi::tag<ordered>>, bmi::const_mem_fun<Dakota::ParamResponsePair,
int, &Dakota::ParamResponsePair::eval_id>, bmi::hashed_non_unique<bmi::tag<hashed>>,
bmi::identity<Dakota::ParamResponsePair>, partial_prp_hash, partial_prp_equality>,
PRPMultiIndexQueue
Boost Multi-Index Container for locally queueing ParamResponsePairs.
For a local queue, interface id’s are expected to be consistent, such that evaluation id’s are sufficient for
tracking particular evaluations.

12.1.3 Enumeration Type Documentation
anonymous enum
Sub-methods, including sampling, inference algorithm, opt algorithm types.

Enumerator

  SUBMETHOD_COLLABORATIVE  Type of hybrid meta-iterator:

12.1.4 Function Documentation

CommandShell & flush ( CommandShell & shell )
convenient shell manipulator function to ”flush” the shell
  global convenience function for manipulating the shell; invokes the class member flush function.
  Referenced by SysCallApplicInterface::spawn_analysis_to_shell(), SysCallApplicInterface::spawn_evaluation_to_shell(),
  SysCallApplicInterface::spawn_input_filter_to_shell(), and SysCallApplicInterface::spawn_output_filter_to_shell().

void register_signal_handlers ()
Tie various signal handlers to Dakota’s abort_handler function.
  Global function to register signal handlers at top-level.
  Referenced by abort_handler().
  Referenced by main().

void mpi_debug_hold ()
Global function to hold Dakota processes to help with MPI debugging.
  See details in code for details, depending on MPI implementation in use.
  Referenced by main().

T Dakota::abort_handler_t ( int code )
Templatized abort_handler_t method that allows for convenient return from methods that otherwise have no sensible
return from error clauses. Usage: MyType& method() { return abort_handler<MyType&>(-1); }
  References abort_handler().
void svd ( RealMatrix & matrix, RealVector & singular vals, RealMatrix & v trans )

Compute the SVD of an arbitrary matrix $A = USV^\top$.

Uses Teuchos::LAPACK.GESVD() to compute the singular value decomposition, overwriting $A$ with the left singular vectors $U$.

References abort_handler().

Referenced by PebblBranchSub::candidateSolution(), NestedModel::ccv_index_map(), NestedModel::cdv_index_map(), ActiveSubspaceModel::compute_svd(), ActiveSubspaceModel::computeBingLiCriterion(), ActiveSubspaceModel::computeConstantineMetric(), Variables::continuous_variable_id(), Variables::continuous_variable_ids(), Variables::continuous_variable_labels(), Variables::continuous_variable_type(), Variables::continuous_variable_types(), SharedVariablesData::copy(), NestedModel::cv_index_map(), Model::discrete_int_sets(), Variables::discrete_int_variable_label(), Variables::discrete_int_variable_labels(), Variables::discrete_int_variable_type(), Variables::discrete_int_variable_types(), Variables::discrete_real_variable_label(), Variables::discrete_real_variable_labels(), Variables::discrete_real_variable_type(), Variables::discrete_real_variable_types(), Model::discrete_set_int_values(), Model::discrete_set_real_values(), Variables::discrete_string_variable_label(), Variables::discrete_string_variable_labels(), Variables::discrete_string_variable_type(), Variables::discrete_string_variable_types(), ParamStudy::distribute(), NestedModel::div_index_map(), NestedModel::drv_index_map(), NestedModel::dsv_index_map(), Variables::inactive_continuous_variable_ids(), Variables::inactive_continuous_variable_labels(), Variables::inactive_continuous_variable_types(), Variables::inactive_discrete_int_variable_labels(), Variables::inactive_discrete_int_variable_types(), Variables::inactive_discrete_real_variable_labels(), Variables::inactive_discrete_real_variable_types(), Variables::inactive_discrete_string_variable_labels(), Variables::inactive_discrete_string_variable_types(), RecastModel::init_variables(), NonD::NonD(), Optimizer::Optimizer(), SensAnalysisGlobal::partial_corr(), ParamStudy::pre_run(), ProbabilityTransformModel::ProbabilityTransformModel(), Constraints::reshape(), NonD::resize(), NonD::size(), PebblBranchSub::splitComputation(), NonD::transform_model(), ReducedBasis::update_svd(), DataTransformModel::variables_expand(), and ActiveSubspaceModel::variables_resize().

int qr ( RealMatrix & A )

Compute an in-place QR factorization $A = QR$.

Uses Teuchos::LAPACK.GEQRF() to compute the QR decomposition, overwriting $A$ with the transformations and $R$.

References abort_handler().

Referenced by SensAnalysisGlobal::partial_corr().

int qr_solve ( const RealMatrix & q,r, bool transpose, RealMatrix & rhs )

Perform a multiple right-hand sides $Rinv \cdot rhs$ solve using the $R$ from a qr factorization.

Returns info > 0 if the matrix is singular

Uses Teuchos::LAPACK.TRTRS() to perform a triangular backsolve

References abort_handler().

Referenced by SensAnalysisGlobal::partial_corr().

bool Dakota::operator!=( const ActiveSet & set1, const ActiveSet & set2 ) [inline]

inequality operator for ActiveSet

inequality operator
bool Dakota::operator== ( const Model & m1, const Model & m2 ) [inline]
equality operator for Envelope is true if same letter instance
equality operator (detect same letter instance)
References Model::modelRep.

bool Dakota::operator!=( const Model & m1, const Model & m2 ) [inline]
inequality operator for Envelope is true if different letter instance
inequality operator (detect different letter instances)
References Model::modelRep.

bool Dakota::operator!=( const Response & resp1, const Response & resp2 ) [inline]
inequality operator for Response

bool Dakota::operator!=( const Variables & vars1, const Variables & vars2 ) [inline]
inequality operator for Variables

void Dakota::write_ordered ( std::ostream & s, const SizetArray & comp_totals,
const Teuchos::SerialDenseVector< OrdinalType, ScalarType1 > & c_vector,
const Teuchos::SerialDenseVector< OrdinalType, ScalarType2 > & di_vector,
const Teuchos::SerialDenseVector< OrdinalType, ScalarType3 > & ds_vector,
const Teuchos::SerialDenseVector< OrdinalType, ScalarType4 > & dr_vector ) [inline]
free function to write Variables data vectors in input spec ordering
written for arbitrary types, but typical use will be ScalarType1 = Real, ScalarType2 = int, ScalarType3 = string,
and ScalarType4 = int or Real.
Referenced by ParamStudy::pre_run().

void Dakota::write_ordered ( std::ostream & s, const SizetArray & comp_totals,
const Teuchos::SerialDenseVector< OrdinalType, ScalarType1 > & c_vector,
const Teuchos::SerialDenseVector< OrdinalType, ScalarType2 > & di_vector,
const Teuchos::SerialDenseVector< OrdinalType, ScalarType3 > & ds_array,
const Teuchos::SerialDenseVector< OrdinalType, ScalarType4 > & dr_vector ) [inline]
free function to write Variables data vectors in input spec ordering
written for arbitrary types, but typical use will be ScalarType1 = Real, ScalarType2 = int, ScalarType3 = string,
and ScalarType4 = int or Real.

void copy_field_data ( const RealVector & fn_vals, RealMatrix & fn_grad,
const RealSymMatrixArray & fn_hess, size_t offset, size_t num_fns, Response & response )
This assumes the source gradient/Hessian are size less or equal to the destination response, and that the leading
part is to be populated.
References Response::active_set_request_vector(), Response::function_gradient_view(), Response::function_hessian_view(), and Response::function_value().
Referenced by ExperimentData::scale_residuals().
void Dakota::copy_field_data ( const RealVector & fn vals, RealMatrix & fn_grad, const RealSymMatrixArray & fn_hess, size_t offset, size_t num_fns, short total_asv, Response & response )

This assumes the source gradient/Hessian are size less or equal to the destination response, and that the leading part is to be populated.

References Response::function_gradient_view(), Response::function_hessian_view(), and Response::function_value().

void symmetric_eigenvalue_decomposition ( const RealSymMatrix & matrix, RealVector & eigenvalues, RealMatrix & eigenvectors )

Computes the eigenvalues and, optionally, eigenvectors of a real symmetric matrix A.

Eigenvalues are returned in ascending order.

References symmetric_eigenvalue_decomposition().

Referenced by NonDBayesCalibration::get_positive_definite_covariance_from_hessian(), and symmetric_eigenvalue_decomposition().

Real Dakota::getdist ( const RealVector & x1, const RealVector & x2 )

Gets the Euclidean distance between x1 and x2

Referenced by mindist(), and mindistindx().

Real Dakota::mindist ( const RealVector & x, const RealMatrix & xset, int except )

Returns the minimum distance between the point x and the points in the set xset (compares against all points in xset except point "except"): if except is not needed, pass 0.

References getdist().

Referenced by getRmax().

Real Dakota::mindistindx ( const RealVector & x, const RealMatrix & xset, const IntArray & indx )

Gets the min distance between x and points in the set xset defined by the nindx values in indx.

References getdist().

Referenced by GaussProcApproximation::pointsel_add_sel().

Real Dakota::getRmax ( const RealMatrix & xset )

Gets the maximum of the min distance between each point and the rest of the set.

References mindist().

Referenced by GaussProcApproximation::pointsel_add_sel().

int Dakota::start_grid_computing ( char * analysis_driver_script, char * params_file, char * results_file )

sample function prototype for launching grid computing

int Dakota::stop_grid_computing ( )

sample function prototype for terminating grid computing

int Dakota::perform_analysis ( char * iteration_num )

sample function prototype for submitting a grid evaluation
string Dakota::asstring ( const T & val )

Creates a string from the argument val using an ostringstream.

This only gets used in this file and is only ever called with ints so no error checking is in place.

Parameters

| val | The value of type T to convert to a string. |

Returns

The string representation of val created using an ostringstream.

Referenced by JEGAOptimizer::LoadTheConstraints().

void start_dakota_heartbeat ( int seconds )

Heartbeat function provided by dakota_filesystem_utils; pass output interval in seconds, or -1 to use $DAKOTA_HEARTBEAT

Referenced by OutputManager::OutputManager().

bool Dakota::operator== ( const ParamResponsePair & pair1, const ParamResponsePair & pair2 ) [inline]

equality operator for ParamResponsePair

equality operator

References ParamResponsePair::evalInterfaceIds, ParamResponsePair::prpResponse, and ParamResponsePair::prpVariables.

bool Dakota::operator!= ( const ParamResponsePair & pair1, const ParamResponsePair & pair2 ) [inline]

inequality operator for ParamResponsePair

inequality operator

bool Dakota::set_compare ( const ParamResponsePair & database_pr, const ActiveSet & search_set ) [inline]

search function for a particular ParamResponsePair within a PRPList based on ActiveSet content (request vector and derivative variables vector)

a global function to compare the ActiveSet of a particular database_pr (presumed to be in the global history list) with a passed in ActiveSet (search_set).

References ParamResponsePair::active_set(), ActiveSet::derivative_vector(), and ActiveSet::request_vector().

Referenced by lookup_by_val().

bool Dakota::id_vars_exact_compare ( const ParamResponsePair & database_pr, const ParamResponsePair & search_pr ) [inline]

search function for a particular ParamResponsePair within a PRPMultiIndex

a global function to compare the interface id and variables of a particular database_pr (presumed to be in the global history list) with a passed in key of interface id and variables provided by search_pr.

References ParamResponsePair::interface_id(), and ParamResponsePair::variables().

Referenced by partial_prp_equality::operator().
12.1. DAKOTA NAMESPACE REFERENCE

PRPCacheHIter Dakota::lookup_by_val ( PRPMultiIndexCache & prp_cache, const ParamResponsePair & search_pr ) [inline]

find a ParamResponsePair based on the interface id, variables, and ActiveSet search data within search_pr.

Lookup occurs in two steps: (1) PRPMultiIndexCache lookup based on strict equality in interface id and variables, and (2) set_compare() post-processing based on ActiveSet subset logic.

References ParamResponsePair::active_set(), and set_compare().

Referenced by NonDQUESOBayesCalibration::aggregate_acceptance_chain(), NonDDREAMBayesCalibration::archive_acceptance_chain(), Model::db_lookup(), ApplicationInterface::duplication_detect(), SurrBasedLocalMinimizer::find_center_approx(), Minimizer::local_recast_retrieve(), lookup_by_val(), SNLLLeastSq::post_run(), PebblIdMinimizer::print_results(), SurrBasedMinimizer::print_results(), LeastSq::print_results(), Optimizer::print_results(), Discrepancy-Correction::search_db(), and NonDLocalReliability::update_mpp_search_data().

PRPQueueHIter Dakota::lookup_by_val ( PRPMultiIndexQueue & prp_queue, const ParamResponsePair & search_pr ) [inline]

find a ParamResponsePair based on the interface id, variables, and ActiveSet search data within search_pr.

Lookup occurs in two steps: (1) PRPMultiIndexQueue lookup based on strict equality in interface id and variables, and (2) set_compare() post-processing based on ActiveSet subset logic.

References ParamResponsePair::active_set(), and set_compare().

void print_restart ( StringArray pos_args, String print_dest )

print a restart file

Usage: "dakota_restart_util print dakota.rst"
"dakota_restart_util toNeutral dakota.rst dakota.neu"

Prints all evals. in full precision to either stdout or a neutral file. The former is useful for ensuring that duplicate detection is successful in a restarted run (e.g., starting a new method from the previous best), and the latter is used for translating binary files between platforms.

References abort_handler(), ParamResponsePair::eval_id(), ParamResponsePair::write.annotated(), and write_precision.

Referenced by main().

void print_restart_pdb ( StringArray pos_args, String print_dest )

print a restart file (PDB format)

Usage: "dakota_restart_util to_pdb dakota.rst dakota.pdb"

Unrolls all data associated with a particular tag for all evaluations and then writes this data in a tabular format (e.g., to a PDB database or MATLAB/TECPLOT data file).

References abort_handler(), Variables::continuous_variables(), Variables::discrete_int_variables(), Variables::discrete_real_variables(), and Response::function.values().

Referenced by main().

void print_restart_tabular ( StringArray pos_args, String print_dest, unsigned short tabular_format )

print a restart file (tabular format)

Usage: "dakota_restart_util to.tabular dakota.rst dakota.txt"

Unrolls all data associated with a particular tag for all evaluations and then writes this data in a tabular format (e.g., to a PDB database or MATLAB/TECPLOT data file).
References abort_handler(), Variables::acv(), Variables::adiv(), Variables::adrv(), Variables::adsv(), Variables::all_continuous_variable_labels(), Variables::all_discrete_int_variable_labels(), Variables::all_discrete_real_variable_labels(), Variables::all_discrete_string_variable_labels(), Response::function_labels(), ParamResponsePair::interface_id(), ParamResponsePair::response(), ParamResponsePair::variables(), ParamResponsePair::write_tabular(), and ParamResponsePair::write_tabular_labels.

Referenced by main().

```cpp
void read_neutral ( StringArray pos_args )
```

read a restart file (neutral file format)

Usage: "dakota_restart_util from_neutral dakota.neu dakota.rst"

Reads evaluations from a neutral file. This is used for translating binary files between platforms.

References abort_handler(), and ParamResponsePair::read.annotated().

Referenced by main().

```cpp
void repair_restart ( StringArray pos_args, String identifier_type )
```

repair a restart file by removing corrupted evaluations

Usage: "dakota_restart_util remove 0.0 dakota_old.rst dakota_new.rst"
"dakota_restart_util remove_ids 2 7 13 dakota_old.rst dakota_new.rst"

Repairs a restart file by removing corrupted evaluations. The identifier for evaluation removal can be either a double precision number (all evaluations having a matching response function value are removed) or a list of integers (all evaluations with matching evaluation ids are removed).

References abort_handler(), Response::active_set.request_vector(), contains(), ParamResponsePair::eval_id(), Response::function_values(), and ParamResponsePair::response().

Referenced by main().

```cpp
void concatenate_restart ( StringArray pos_args )
```

concatenate multiple restart files

Usage: "dakota_restart_util cat dakota_1.rst ... dakota_n.rst dakota_new.rst"

Combines multiple restart files into a single restart database.

References abort_handler().

Referenced by main().

```cpp
std::vector<std::string> Dakota::get_pathext ( )
```

Utility function for executable file search algorithms

References by WorkdirHelper::which().

```cpp
bool Dakota::contains ( const bfs::path & dir_path, const std::string & file_name, boost::filesystem::path & complete_filepath ) [inline]
```

Utility function for "which" sets complete_filepath from dir_path/file_name combo

12.1.5 Variable Documentation

short abort_mode = ABORT_EXITs

by default Dakota exits or calls MPI_Abort on errors whether dakota exits/aborts or throws on errors
12.1. DAKOTA NAMESPACE REFERENCE

Referenced by abort_throw_or_exit(), Environment::exit_mode(), and PythonInterface::python_run().

Dakota_funcs DakFuncs0
Initial value:

```c
const char* FIELD_NAMES[]
Initial value:

```c
= { "numFns", "numVars", "numACV", "numADIV",
   "numADRV", "numDerivVars", "xC", "xD",
   "xDR", "xCLabels", "xDILabels",
   "xDRLabels", "directFnASV", "directFnDVV",
   "fnFlag", "gradFlag", "hessFlag",
   "fnVals", "fnGrads", "fnHessians",
   "fnLabels", "failure", "currEvalId" }
```

fields to pass to Matlab in Dakota structure

Referenced by MatlabInterface::matlab_engine_run(), and MatlabInterface::MatlabInterface().

const int NUMBER_OF_FIELDS = 23

number of fields in above structure

Referenced by MatlabInterface::matlab_engine_run(), and MatlabInterface::MatlabInterface().

KeyWord kw_1[3] [static]
Initial value:

```c
= {
   {"eval_id",8,0,2,0,0,0,0,0,N_stm(augment_utype,postRunInputFormat_TABULAR_EVAL_ID)},
   {"header",8,0,1,0,0,0,0,0,N_stm(augment_utype,postRunInputFormat_TABULAR_HEADER)},
   {"interface_id",8,0,3,0,0,0,0,0,N_stm(augment_utype,postRunInputFormat_TABULAR_IFACE_ID)}
}
```

1877 distinct keywords (plus 249 aliases)
KeyWord kw_2[3]  [static]
Initial value:
= {
    {"annotated",8,0,1,0,0,0,0,0,N_stmt(utype,postRunInputFormat,TABULAR,ANNOTATED) },
    {"custom_annotated",8,3,1,0,kw,0,0,0,0,N_stmt(utype,postRunInputFormat,TABULAR,NONE) },
    {"freeform",8,0,1,0,0,0,0,0,N_stmt(utype,postRunInputFormat,TABULAR,NONE) }
}

KeyWord kw_3[2]  [static]
Initial value:
= {
    {"input",11,3,1,0,kw,0,0,0,0,N_stmt(str,postRunInput) },
    {"output",11,0,2,0,0,0,0,0,N_stmt(str,postRunOutput) }
}

KeyWord kw_4[3]  [static]
Initial value:
= {
    {"eval_id",8,0,2,0,0,0,0,0,N_stmt(augment_utype,preRunOutputFormat,TABULAR,EVAL_ID) },
    {"header",8,0,1,0,0,0,0,0,N_stmt(augment_utype,preRunOutputFormat,TABULAR,HEADER) },
    {"interface_id",8,0,3,0,0,0,0,0,N_stmt(augment_utype,preRunOutputFormat,TABULAR,IFACE_ID) }
}

KeyWord kw_5[3]  [static]
Initial value:
= {
    {"annotated",8,0,1,0,0,0,0,0,N_stmt(utype,preRunOutputFormat,TABULAR,ANNOTATED) },
    {"custom_annotated",8,3,1,0,kw,0,0,0,0,N_stmt(utype,preRunOutputFormat,TABULAR,NONE) },
    {"freeform",8,0,1,0,0,0,0,0,N_stmt(utype,preRunOutputFormat,TABULAR,NONE) }
}

KeyWord kw_6[2]  [static]
Initial value:
= {
    {"input",11,0,1,0,0,0,0,0,N_stmt(str,preRunInput) },
    {"output",11,3,2,0,kw,5,0,0,0,N_stmt(str,preRunOutput) }
}

KeyWord kw_7[1]  [static]
Initial value:
= {
    {"stop_restart",0x29,0,1,0,0,0,0,0,N_stmt(int,stopRestart) }
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_8[1] [static]
Initial value:

= {
    "results_output_file", 11, 0, 1, 0, 0, 0, 0, 0, N_map(str, resultsOutputFile)
}

KeyWord kw_9[2] [static]
Initial value:

= {
    "input", 11, 0, 1, 0, 0, 0, 0, N_map(str, runInput),
    "output", 11, 0, 2, 0, 0, 0, 0, N_map(str, runOutput)
}

KeyWord kw_10[3] [static]
Initial value:

= {
    "eval_id", 8, 0, 2, 0, 0, 0, 0, 0, N_map(augment_utype, tabularFormat_TABULAR_EVAL_ID),
    "header", 8, 0, 1, 0, 0, 0, 0, N_map(augment_utype, tabularFormat_TABULAR_HEADER),
    "interface_id", 8, 0, 3, 0, 0, 0, 0, N_map(augment_utype, tabularFormat_TABULAR_IFACE_ID)
}

KeyWord kw_11[5] [static]
Initial value:

= {
    "annotated", 8, 0, 2, 0, 0, 0, 0, 0, N_map(utype, tabularFormat_TABULAR_ANNOTATED),
    "custom_annotated", 8, 3, 2, 0, kw_10, 0, 0, 0, N_map(utype, tabularFormat_TABULAR_NONE),
    "tabular_data_file", 11, 0, 1, 0, 0, 0, 0, N_map(str, tabularDataFile),
    "tabular_graphics_file", 3, 0, 1, 0, 0, 0, 0, -1, N_map(str, tabularDataFile)
}

KeyWord kw_12[15] [static]
Initial value:

= {
    "check", 8, 0, 1, 0, 0, 0, 0, 0, N_map(true, checkFlag),
    "error_file", 11, 0, 3, 0, 0, 0, 0, N_map(str, errorFile),
    "graphics", 8, 0, 9, 0, 0, 0, 0, N_map(true, graphicsFlag),
    "method_pointer", 3, 0, 13, 0, 0, 0, 0, 10, N_map(str, topMethodPointer),
    "output_file", 11, 0, 2, 0, 0, 0, 0, 0, N_map(str, outputFile),
    "output_precision", 8, 29, 5, 11, 0, 0, 0, 0, 0, N_map(int, outputPrecision),
    "post_run", 8, 2, 8, 0, kw_10, 0, 0, 0, N_map(true, postRunFlag),
    "pre_run", 8, 2, 6, 0, kw_6, 0, 0, 0, N_map(true, preRunFlag),
    "read_restart", 11, 1, 4, 0, kw_7, 0, 0, 0, N_map(str, readRestart),
    "results_output", 8, 1, 12, 0, kw_8, 0, 0, 0, N_map(true, resultsOutputFlag),
    "run", 8, 2, 7, 0, kw_9, 0, 0, 0, N_map(true, runFlag),
    "tabular_data", 8, 5, 10, 0, kw_11, 0, 0, 0, 0, N_map(true, tabularDataFlag),
    "tabular_graphics_data", 8, 5, 10, 0, kw_11, 0, 0, 0, -1, N_map(true, tabularDataFlag),
    "top_method_pointer", 11, 0, 13, 0, 0, 0, 0, 0, N_map(str, topMethodPointer),
    "write_restart", 11, 0, 5, 0, 0, 0, 0, 0, N_map(str, writeRestart)
}
KeyWord kw_13[1]  [static]
Initial value:
= {
   {"cache_tolerance",10,0,1,0,0,0,0,0,0,N_ifm(Real,nearbyEvalCacheTol)}
}

KeyWord kw_14[4]  [static]
Initial value:
= {
   {"active_set_vector",8,0,1,0,0,0,0,0,0,N_ifm(false,activeSetVectorFlag)},
   {"evaluation_cache",8,0,1,0,0,0,0,0,0,N_ifm(false,evalCacheFlag)},
   {"restart_file",8,0,4,0,0,0,0,0,0,N_ifm(false,restartFileFlag)},
   {"strict_cache_equality",8,1,3,0,kw_13,0,0,0,0,N_ifm(true,nearbyEvalCacheFlag)}
}

KeyWord kw_15[1]  [static]
Initial value:
= {
   {"processors_per_analysis",0x19,0,1,0,0,0,0,0,0,N_ifm(pint,procsPerAnalysis)}
}

KeyWord kw_16[4]  [static]
Initial value:
= {
   {"abort",8,0,1,1,0,0,0,0,0,N_ifm(lit,failAction_abort)},
   {"continuation",8,0,1,1,0,0,0,0,0,N_ifm(lit,failAction_continuation)},
   {"recover",14,0,1,1,0,0,0,0,0,N_ifm(Rlit,TYPE_DATA_failAction_recover)},
   {"retry",9,0,1,1,0,0,0,0,0,N_ifm(ilit,TYPE_DATA_failAction_retry)}
}

KeyWord kw_17[1]  [static]
Initial value:
= {
   {"numpy",8,0,1,0,0,0,0,0,0,N_ifm(true,numpyFlag)}
}

KeyWord kw_18[8]  [static]
Initial value:
= {
   {"copy_files",15,0,5,0,0,0,0,0,0,N_ifm(strL,copyFiles)},
   {"dir_save",8,0,1,0,0,0,0,0,0,N_ifm(true,dirSave)},
   {"dir_tag",8,0,2,0,0,0,0,0,0,N_ifm(true,dirTag)},
   {"directory_save",8,0,3,0,0,0,0,0,0,N_ifm(true,dirSave)},
   {"directory_tag",8,0,2,0,0,0,0,0,0,N_ifm(true,dirTag)},
   {"link_files",15,0,4,0,0,0,0,0,0,N_ifm(strL,linkFiles)},
   {"named",11,0,1,0,0,0,0,0,0,N_ifm(strL,workDir)},
   {"replace",8,0,6,0,0,0,0,0,0,N_ifm(true,templateReplace)}
}
KeyWord kw_19[10] [static]
Initial value:
= {
  {'allow_existing_results', 8, 0, 3, 0, 0, 0, 0, 0, N_ifm(true, allowExistingResultsFlag)},
  {'aprepro*', 0, 0, 5, 0, 0, 0, 0, -1, N_ifm(true, apreproFlag)},
  {'file_save*', 8, 0, 0, 0, 0, 0, 0, 0, N_ifm(true, fileSaveFlag)},
  {'file_tag*', 8, 0, 7, 0, 0, 0, 0, 0, N_ifm(true, fileTagFlag)},
  {'labeled*', 8, 0, 6, 0, 0, 0, 0, 0, N_ifm(type, resultsFileFormat_LABELED_RESULTS)},
  {'parameters_file*', 11, 0, 1, 0, 0, 0, 0, 0, N_ifm(true, parametersFile)}
}

KeyWord kw_20[12] [static]
Initial value:
= {
  {'analysis_components', 15, 0, 1, 0, 0, 0, 0, 0, N_ifm(str2D, analysisComponents)},
  {'deactivate*', 8, 4, 6, 0, kw_14},
  {'direct*', 8, 1, 4, 1, kw_15, 0, 0, 0, 0, N_ifm(type, interfaceType_TEST_INTERFACE)},
  {'failure_capture*', 8, 4, 5, 0, kw_16},
  {'fork*', 8, 10, 4, 1, kw_19, 0, 0, 0, 0, N_ifm(type, interfaceType_FORK_INTERFACE)},
  {'grid*', 8, 0, 4, 1, 0, 0, 0, 0, N_ifm(type, interfaceType_GRID_INTERFACE)},
  {'input_filter*', 11, 0, 2, 0, 0, 0, 0, 0, N_ifm(str, inputFilter)},
  {'matlab*', 8, 0, 6, 1, 0, 0, 0, 0, N_ifm(type, interfaceType_MATLAB_INTERFACE)},
  {'output_filter*', 11, 0, 3, 0, 0, 0, 0, 0, N_ifm(str, outputFilter)},
  {'python*', 8, 4, 1, kw_17, 0, 0, 0, 0, N_ifm(type, interfaceType_PYTHON_INTERFACE)},
  {'scilab*', 8, 0, 4, 1, 0, 0, 0, 0, N_ifm(type, interfaceType_SCILAB_INTERFACE)},
  {'system*', 8, 10, 4, 1, kw_19, 0, 0, 0, 0, N_ifm(type, interfaceType_SYSTEM_INTERFACE)}
}

KeyWord kw_21[2] [static]
Initial value:
= {
  {'master*', 8, 0, 1, 1, 0, 0, 0, 0, 0, N_ifm(type, analysisScheduling_MASTER_SCHEDULING)},
  {'peer*', 8, 0, 1, 1, 0, 0, 0, 0, 0, N_ifm(type, analysisScheduling_PEER_SCHEDULING)}
}

KeyWord kw_22[2] [static]
Initial value:
= {
  {'dynamic*', 8, 0, 1, 0, 0, 0, 0, 0, 0, N_ifm(type, asyncLocalEvalScheduling_DYNAMIC_SCHEDULING)},
  {'static*', 8, 0, 1, 1, 0, 0, 0, 0, 0, N_ifm(type, asyncLocalEvalScheduling_STATIC_SCHEDULING)}
}

KeyWord kw_23[3] [static]
Initial value:
= {
  {'analysis_concurrency*', 0x19, 0, 3, 0, 0, 0, 0, 0, 0, N_ifm(pint, asyncLocalAnalysisConcurrency)},
  {'evaluation_concurrency*', 0x19, 0, 1, 0, 0, 0, 0, 0, 0, N_ifm(pint, asyncLocalEvalConcurrency)},
  {'local_evaluation_scheduling*', 8, 2, 2, 0, kw_22}
}
KeyWord kw_24[2] [static]
Initial value:
= {
  {"dynamic",0,1,0,0,0,0,0,N ifm(type,evalScheduling_PEER_DYNAMIC_SCHEDULING)},
  {"static",0,1,0,0,0,0,N ifm(type,evalScheduling_PEER_STATIC_SCHEDULING)}
}

KeyWord kw_25[2] [static]
Initial value:
= {
  {"master",0,1,0,0,0,0,N ifm(type,evalScheduling_MASTER_SCHEDULING)},
  {"peer",0,1,2,0,0,0,N}  
}

KeyWord kw_26[9] [static]
Initial value:
= {
  {"algebraic_mappings",0,1,2,0,0,0,0,N ifm(str,algebraicMappings)},
  {"analysis_drivers",15,12,3,0,0,0,N ifm(str,analysisDrivers)},
  {"analysis_scheduling",8,1,2,0,0,0,N ifm(n,analysisScheduling)},
  {"asynchronous",0,1,3,0,0,0,0,N ifm(type,interfaceSynchronization_ASYNC)},
  {"evaluation_scheduling",0,1,2,0,0,0,N ifm(n,evaluationScheduling)},
  {"id_interface",1,0,1,0,0,0,0,N ifm(n,ifm_idInterface)},
  {"processors_per_evaluation",0,19,0,0,0,0,0,N ifm(n,procsPerEval)}
}

KeyWord kw_27[1] [static]
Initial value:
= {
  {"model_pointer",1,0,0,0,0,0,0,N ifm(n,ifm_modelPointer)}
}

KeyWord kw_28[2] [static]
Initial value:
= {
  {"complementary",0,0,0,0,0,0,0,N ifm(n,distributionType_COMPLEMENTARY)},
  {"cumulative",0,0,0,0,0,0,0,N ifm(n,distributionType_CUMULATIVE)}
}

KeyWord kw_29[1] [static]
Initial value:
= {
  {"num_gen_reliability_levels",13,0,1,0,0,0,0,N ifm(n,num_gen_reliability_levels)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_30[1] [static]
Initial value:
= {
  "num_probability_levels",13,0,1,0,0,0,0,0,N_mdm(num_resplevs,probabilityLevels)
}

KeyWord kw_31[2] [static]
Initial value:
= {
  "mt19937",8,0,1,1,0,0,0,0,N_mdm(lit,rngName_mt19937),
  "rnum2",8,0,1,1,0,0,0,0,N_mdm(lit,rngName_rnum2)
}

KeyWord kw_32[4] [static]
Initial value:
= {
  "distribution",8,2,1,0,kw_28,
  "gen_reliability_levels",14,1,3,0,kw_29,0,0,0,N_mdm(resplevs,genReliabilityLevels),
  "probability_levels",14,1,2,0,kw_30,0,0,0,N_mdm(resplevs01,probabilityLevels),
  "rng",8,2,4,0,kw_31
}

KeyWord kw_33[4] [static]
Initial value:
= {
  "constant_liar",8,0,1,1,0,0,0,0,N_mdm(lit,batchSelectionType_constant_liar),
  "distance_penalty",8,0,1,1,0,0,0,0,N_mdm(lit,batchSelectionType_distance_penalty),
  "naive",8,0,1,1,0,0,0,0,N_mdm(lit,batchSelectionType_naive),
  "topology",8,0,1,1,0,0,0,0,N_mdm(lit,batchSelectionType_topology)
}

KeyWord kw_34[3] [static]
Initial value:
= {
  "eval_id",8,0,2,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_EVAL_ID),
  "header",8,0,1,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_HEADER),
  "interface_id",8,0,3,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_IFACE_ID)
}

KeyWord kw_35[3] [static]
Initial value:
= {
  "annotated",8,0,1,0,0,0,0,0,N_mdm(utype,exportApproxFormat_TABULAR_ANNOTATED),
  "custom_annotated",8,3,1,0,kw_34,0,0,0,N_mdm(utype,exportApproxFormat_TABULAR_NONE),
  "freeform",8,0,1,0,0,0,0,0,N_mdm(utype,exportApproxFormat_TABULAR_NONE)
}
KeyWord kw_36[3] [static]
Initial value:
= {
   "distance",8,0,1,0,0,0,0,0,N,mdm(lit,fitnessMetricType,distance),
   "gradient",8,0,1,0,0,0,0,0,N,mdm(lit,fitnessMetricType,gradient),
   "predicted_variance",8,0,1,0,0,0,0,0,N,mdm(lit,fitnessMetricType,predicted_variance)
}

KeyWord kw_37[3] [static]
Initial value:
= {
   "eval_id",8,0,2,0,0,0,0,0,N,mdm(augment_utype,importBuildFormat,TABULAR,EVAL_ID),
   "header",8,0,1,0,0,0,0,0,N,mdm(augment_utype,importBuildFormat,TABULAR,HEADER),
   "interface_id",8,0,3,0,0,0,0,0,N,mdm(augment_utype,importBuildFormat,TABULAR,IFACE_ID)
}

KeyWord kw_38[4] [static]
Initial value:
= {
   "active_only",8,0,2,0,0,0,0,0,N,mdm(true,importBuildActive),
   "annotated",8,0,1,0,0,0,0,0,N,mdm(type,importBuildFormat,TABULAR,ANNOTATED),
   "custom.annotated",8,3,1,0,kw_37,0,0,0,N,mdm(type,importBuildFormat,TABULAR,NONE),
   "freeform",8,0,1,0,0,0,0,0,N,mdm(type,importBuildFormat,TABULAR,NONE)
}

KeyWord kw_39[2] [static]
Initial value:
= {
   "parallel",8,0,1,1,0,0,0,0,N,mdm(type,responseLevelTargetReduce,SYSTEM,PARALLEL),
   "series",8,0,1,1,0,0,0,0,N,mdm(type,responseLevelTargetReduce,SYSTEM,SERIES)
}

KeyWord kw_40[3] [static]
Initial value:
= {
   "gen.reliabilities",8,0,1,1,0,0,0,0,N,mdm(type,responseLevelTarget,GEN_RELIABILITIES),
   "probabilities",8,0,1,1,0,0,0,0,N,mdm(type,responseLevelTarget,PROBABILITIES),
   "system",8,2,2,0,kw_39
}

KeyWord kw_41[2] [static]
Initial value:
= {
   "compute",8,3,2,0,kw_40,
   "num_response_levels",13,0,1,0,0,0,0,0,N,mdm(num_resplevs,responseLevels)
}
12.1. DAKOTA NAMESPACE REFERENCE

**KeyWord kw\_42[16] [static]**

Initial value:

```plaintext
= {
    {0, 0, 1, 0, 0, kw_27},
    {0, 0, 4, 0, 0, kw_32},
    "batch_selection", 8, 4, 5, 0, kw_33},
    "export_approx_points_file", 11, 3, 0, 0, kw_35, 0, 0, 0, N\_mmd(str, exportApproxPtsFile),
    "export_points_file", 3, 3, 8, 0, kw_35, 0, 0, 0, 1, N\_mmd(str, exportApproxPtsFile),
    "fitness_metric", 8, 3, 0, kw_36},
    "import_build_points_file", 11, 4, 7, 0, kw_38, 0, 0, 0, 0, N\_mmd(str, importBuildPtsFile),
    "import_points_file", 3, 3, 8, 0, kw_38, 0, 0, 0, 0, N\_mmd(str, importBuildPtsFile),
    "initial_samples", 9, 0, 1, 0, 0, 0, 0, 0, N\_mmd(int, numSamples),
    "max_iterations", 0x29, 0, 1, 0, 0, 0, 0, 0, N\_mmd(int, maxIterations),
    "misc_options", 15, 0, 1, 0, 0, 0, 0, 0, N\_mmd(strL, miscOptions),
    "refinement_samples", 13, 0, 1, 0, 0, 0, 0, 0, N\_mmd(ivec, refineSamples),
    "response_levels", 14, 2, 9, 0, kw_41, 0, 0, 0, 0, N\_mmd(resplevs, responseLevels),
    "samples", 1, 0, 1, 0, 0, 0, 0, 0, N\_mmd(int, numSamples),
    "samples_on_emulator", 9, 0, 1, 0, 0, 0, 0, 0, N\_mmd(int, samplesOnEmulator),
    "seed", 0x19, 0, 2, 0, 0, 0, 0, 0, N\_mmd(pint, randomSeed)
}
```

**KeyWord kw\_43[7] [static]**

Initial value:

```plaintext
= {
    {merit1", 8, 0, 1, 1, 0, 0, 0, 0, N\_mmd(lit, meritFunction_merit1)},
    {merit1\_smooth", 8, 0, 1, 1, 0, 0, 0, 0, N\_mmd(lit, meritFunction_merit1\_smooth)},
    {merit2", 8, 0, 1, 1, 0, 0, 0, 0, N\_mmd(lit, meritFunction_merit2)},
    {merit2\_smooth", 8, 0, 1, 1, 0, 0, 0, 0, N\_mmd(lit, meritFunction_merit2\_smooth)},
    {merit2\_squared", 8, 0, 1, 1, 0, 0, 0, 0, N\_mmd(lit, meritFunction_merit2\_squared)},
    {merit\_max", 8, 0, 1, 1, 0, 0, 0, 0, N\_mmd(lit, meritFunction_merit\_max)},
    {merit\_max\_smooth", 8, 0, 1, 1, 0, 0, 0, 0, N\_mmd(lit, meritFunction_merit\_max\_smooth)}
}
```

**KeyWord kw\_44[2] [static]**

Initial value:

```plaintext
= {
    {blocking", 8, 0, 1, 1, 0, 0, 0, 0, N\_mmd(lit, evalSynchronize_blocking)},
    {nonblocking", 8, 0, 1, 1, 0, 0, 0, 0, N\_mmd(lit, evalSynchronize_nonblocking)}
}
```

**KeyWord kw\_45[22] [static]**

Initial value:

```plaintext
= {
    {0, 0, 1, 0, 0, kw_27},
    {constraint\_penalty", 10, 0, 7, 0, 0, 0, 0, 0, N\_mmd(Real, constrPenalty)},
    {constraint\_tolerance", 10, 0, 18, 0, 0, 0, 0, 0, N\_mmd(Real, constraintTolerance)},
    {contraction\_factor", 10, 0, 2, 0, 0, 0, 0, 0, N\_mmd(Real, contractStepLength)},
    {initial\_delta", 10, 0, 1, 0, 0, 0, 0, 0, N\_mmd(Real, initStepLength)},
    {linear\_equality\_constraint\_matrix", 14, 0, 14, 0, 0, 0, 0, 0, N\_mmd(RealDL, linearEqConstraintCoeffs)},
    {linear\_equality\_scale\_types", 15, 0, 16, 0, 0, 0, 0, 0, N\_mmd(strL, linearEqScaleTypes)},
    {linear\_equality\_scales", 14, 0, 17, 0, 0, 0, 0, 0, N\_mmd(RealDL, linearEqScales)},
    {linear\_equality\_targets", 14, 0, 15, 0, 0, 0, 0, 0, N\_mmd(RealDL, linearEqTargets)},
    {linear\_inequality\_constraint\_matrix", 14, 0, 16, 0, 0, 0, 0, 0, N\_mmd(RealDL, linearIneqConstraintCoeffs)},
    {linear\_inequality\_lower\_bounds", 14, 0, 10, 0, 0, 0, 0, 0, N\_mmd(RealDL, linearIneqLowerBnds)},
    {"linear\_inequality\_scale\_types", 15, 0, 16, 0, 0, 0, 0, 0, N\_mmd(strL, linearIneqScaleTypes)},
    {"linear\_inequality\_scales", 14, 0, 17, 0, 0, 0, 0, 0, N\_mmd(RealDL, linearIneqScales)},
    {"linear\_inequality\_targets", 14, 0, 15, 0, 0, 0, 0, 0, N\_mmd(RealDL, linearIneqTargets)}
}
```
KeyWord kw_46[1] [static]
Initial value:

```plaintext
= {
  "hyperprior_betas", 14, 0, 1, 0, 0, 0, 0, Nmdm(RealDL, hyperPriorBetas)
}
```

KeyWord kw_47[5] [static]
Initial value:

```plaintext
= {
  "both", 8, 0, 1, 0, 0, 0, 0, Nmdm(utype, calibrateErrorMode_CALIBRATE_BOTH),
  "hyperprior_alphas", 14, 1, 2, 0, kw_46, 0, 0, 0, Nmdm(RealDL, hyperPriorAlphas),
  "one", 8, 0, 1, 0, 0, 0, 0, Nmdm(utype, calibrateErrorMode_CALIBRATE_ONE),
  "per_experiment", 8, 0, 1, 0, 0, 0, 0, Nmdm(utype, calibrateErrorMode_CALIBRATE_PER_EXPER),
  "per_response", 8, 0, 1, 0, 0, 0, 0, Nmdm(utype, calibrateErrorMode_CALIBRATE_PER_RESP)
}
```

KeyWord kw_48[3] [static]
Initial value:

```plaintext
= {
  "eval_id", 8, 0, 2, 0, 0, 0, 0, Nmdm(augment_utype, importBuildFormat_TABULAR_EVAL_ID),
  "header", 8, 0, 1, 0, 0, 0, 0, Nmdm(augment_utype, importBuildFormat_TABULAR_HEADER),
  "interface_id", 8, 0, 3, 0, 0, 0, 0, Nmdm(augment_utype, importBuildFormat_TABULAR_IFACE_ID)
}
```

KeyWord kw_49[4] [static]
Initial value:

```plaintext
= {
  "active_only", 8, 0, 2, 0, 0, 0, 0, Nmdm(true, importBuildActive),
  "annotated", 8, 0, 1, 0, 0, 0, 0, Nmdm(utype, importBuildFormat_TABULAR_ANNOTATED),
  "custom_annotated", 8, 3, 1, kw_46, 0, 0, 0, Nmdm(utype, importBuildFormat_TABULAR_NONE),
  "freeform", 8, 0, 1, 0, 0, 0, 0, Nmdm(utype, importBuildFormat_TABULAR_NONE)
}
```
KeyWord kw_50[6]  [static]
Initial value:

```java
= {
   *
```
```java
   "build_samples",9,0,2,0,0,0,..,0,mdm(int,buildSamples)
```
```java
   "dakota",8,0,1,0,0,0,..,0,mdm(type,emulatorType_EMULATOR)
```
```java
   "import_build_points_file",11,4,0,kw,49,0,..,0,mdm(str,importBuildPtsFile)
```
```java
   "import_points_file",3,4,0,kw,49,0,..,0,mdm(str,importBuildPtsFile)
```
```java
   "posterioradaptive",8,0,3,0,0,0,..,0,mdm(true,adaptPosteriorRefine)
```
```java
   "surfpack",8,0,1,0,0,0,..,0,mdm(type,emulatorType_KRIGING_EMULATOR)
```
```java
}
```
```java
KeyWord kw_51[3]  [static]
Initial value:

```java
= {
   *
```
```java
   "evalid",8,0,2,0,0,0,..,0,mdm(augment_utype,importBuildFormat_TABULAR_EVAL_ID)
```
```java
   "header",8,0,1,0,0,0,..,0,mdm(augment_utype,importBuildFormat_TABULAR_HEADER)
```
```java
   "interface_id",8,0,3,0,0,0,..,0,mdm(augment_utype,importBuildFormat_TABULAR_IFACE_ID)
```
```java
}
```
```java
KeyWord kw_52[4]  [static]
Initial value:

```java
= {
   *
```
```java
   "activeonly",8,0,2,0,0,0,..,0,mdm(true,importBuildActive)
```
```java
   "annotated",8,0,1,0,0,0,..,0,mdm(utype,importBuildFormat_TABULAR_ANNOTATED)
```
```java
   "custom_annotated",8,3,1,0,kw,51,0,..,0,mdm(utype,importBuildFormat_TABULAR_NONE)
```
```java
   "freeform",8,0,1,0,0,0,..,0,mdm(utype,importBuildFormat_TABULAR_NONE)
```
```java
}
```
```java
KeyWord kw_53[3]  [static]
Initial value:

```java
= {
   *
```
```java
   "import_build_points_file",11,4,2,0,kw,52,0,..,0,mdm(str,importBuildPtsFile)
```
```java
   "import_points_file",3,4,2,0,kw,52,0,..,0,mdm(str,importBuildPtsFile)
```
```java
   "posterioradaptive",8,0,1,0,0,0,..,0,mdm(true,adaptPosteriorRefine)
```
```java
}
```
```java
KeyWord kw_54[3]  [static]
Initial value:

```java
= {
   *
```
```java
   "evalid",8,0,2,0,0,0,..,0,mdm(augment_utype,importBuildFormat_TABULAR_EVAL_ID)
```
```java
   "header",8,0,1,0,0,0,..,0,mdm(augment_utype,importBuildFormat_TABULAR_HEADER)
```
```java
   "interface_id",8,0,3,0,0,0,..,0,mdm(augment_utype,importBuildFormat_TABULAR_IFACE_ID)
```
```java
}
```
```java
KeyWord kw_55[4] [static]
Initial value:
= {
   {"active only",8,0,2,0,0,0,0,0,N_mdm(true,importBuildActive)},{
   "annotated",8,0,1,0,0,0,0,0,N_mdm(utype,importBuildFormat_TABULAR_ANNOTATED)},{
   "custom annotated",8,3,1,0,kw_54,0,0,0,0,N_mdm(utype,importBuildFormat_TABULAR_NONE)},{
   "freeform",8,0,1,0,0,0,0,0,0,N_mdm(utype,importBuildFormat_TABULAR_NONE)},{
   "posterior adaptive",8,0,2,0,0,0,0,0,0,N_mdm(true,adaptPosteriorRefine)},{
}

KeyWord kw_56[4] [static]
Initial value:
= {
   {"collocation ratio",10,0,1,0,0,0,0,0,0,N_mdm(Realp,collocationRatio)},{
   "import build points file",11,4,3,0,kw_55,0,0,0,0,N_mdm(str,importBuildPtsFile)},{
   "import points file",3,4,3,0,kw_55,0,0,0,0,N_mdm(str,importBuildPtsFile)},{
   "posterior adaptive",8,0,2,0,0,0,0,0,0,N_mdm(true,adaptPosteriorRefine)},{
}

KeyWord kw_57[3] [static]
Initial value:
= {
   {"collocation points sequence",13,3,1,1,kw_53,0,0,0,0,N_mdm(szarray,collocationPoints)},{
   "expansion order sequence",13,4,1,1,kw_53,0,0,0,0,N_mdm(usharray,expansionOrder)},{
   "sparse grid level sequence",13,0,1,1,0,0,0,0,0,N_mdm(usharray,sparseGridLevel)},{
}

KeyWord kw_58[1] [static]
Initial value:
= {
   {"sparse grid level sequence",13,0,1,1,0,0,0,0,0,N_mdm(usharray,sparseGridLevel)},{
}

KeyWord kw_59[5] [static]
Initial value:
= {
   {"gaussian process",8,6,1,1,kw_50},{
   "kriging",8,6,1,1,kw_50,0,0,0},{
   "pce",8,3,1,1,kw_57,0,0,0,0,N_mdm(type,emulatorType_PCE_EMULATOR)},{
   "sc",8,1,1,1,kw_58,0,0,0,0,N_mdm(type,emulatorType_SC_EMULATOR)},{
   "use derivatives",8,0,2,0,0,0,0,0,0,N_mdm(true,methodUseDerivsFlag)},{
}

KeyWord kw_60[3] [static]
Initial value:
= {
   {"eval id",8,0,2,0,0,0,0,0,0,N_mdm(augment_utype,exportMCMCFormat_TABULAR_EVAL_ID)},{
   "header",8,0,1,0,0,0,0,0,0,N_mdm(augment_utype,exportMCMCFormat_TABULAR_HEADER)},{
   "interface id",8,0,3,0,0,0,0,0,0,N_mdm(augment_utype,exportMCMCFormat_TABULAR_IFACE_ID)},{
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_61[3] [static]
Initial value:
= {
  "annotated", 0, 0, 0, 0, 0, 0, N_mdm(utable, exportMCMCFormat_TABULAR_ANNOTATED),
  "custom_annotated", 0, 0, 0, 0, 0, 0, N_mdm(utable, exportMCMCFormat_TABULAR_ANNOTATED),
  "freeform", 0, 0, 0, 0, 0, 0, N_mdm(utable, exportMCMCFormat_TABULAR.NONE)
}

KeyWord kw_62[10] [static]
Initial value:
= {
  "chain_samples", 0, 0, 0, 0, 0, 0, N_mdm(int, chainSamples),
  "crossover_chain_pairs", 0, 0, 0, 0, 0, 0, N_mdm(int, crossoverChainPairs),
  "emulator", 0, 0, 0, 0, 0, 0, N_mdm(lit, emulator),
  "export_chain_points_file", 0, 0, 0, kw_61[0], 0, 0, 0, N_mdm(str, exportMCMCPtsFile),
  "gr_threshold", 0, 0, 0, 0, 0, 0, N_mdm(Real, grThreshold),
  "jump_step", 0, 0, 0, 0, 0, 0, 0, N_mdm(int, jumpStep),
  "num_cr", 0, 0, 0, 0, 0, 0, N_mdm(int, numCR),
  "samples", 0, 0, 0, 0, 0, 0, N_mdm(int, chainSamples),
  "seed", 0, 0, 0, 0, 0, 0, 0, N_mdm(pint, randomSeed)
}

KeyWord kw_63[3] [static]
Initial value:
= {
  "nip", 0, 0, 0, 0, 0, 0, N_mdm(utable, preSolveMethod_SUBMETHOD_NIP),
  "none", 0, 0, 0, 0, 0, 0, N_mdm(utable, preSolveMethod_SUBMETHOD_NONE),
  "sqp", 0, 0, 0, 0, 0, 0, N_mdm(utable, preSolveMethod_SUBMETHOD_SQP)
}

KeyWord kw_64[1] [static]
Initial value:
= {
  "proposal_updates", 0, 0, 0, 0, 0, 0, N_mdm(int, proposalCovUpdates)
}

KeyWord kw_65[2] [static]
Initial value:
= {
  "diagonal", 0, 0, 0, 0, 0, 0, N_mdm(lit, proposalCovInputType_diagonal),
  "matrix", 0, 0, 0, 0, 0, 0, N_mdm(lit, proposalCovInputType_matrix)
}

KeyWord kw_66[2] [static]
Initial value:
= {
  "diagonal", 0, 0, 0, 0, 0, 0, N_mdm(lit, proposalCovInputType_diagonal),
  "matrix", 0, 0, 0, 0, 0, 0, N_mdm(lit, proposalCovInputType_matrix)
}
KeyWord kw_67[4]  [static]

Initial value:

= {
    {"derivatives",8,1,1,kw_64,0,0,0,N_mdm(lit,proposalCovType_derivatives)},
    {"filename",11,2,1,kw_65,0,0,0,N_mdm(str,proposalCovFile)},
    {"prior",8,0,1,0,0,0,0,N_mdm(lit,proposalCovType_prior)},
    {"values",14,2,1,kw_66,0,0,0,0,N_mdm(RealDL,proposalCovData)}
}

KeyWord kw_68[2]  [static]

Initial value:

= {
    {"mt19937",8,0,1,0,0,0,0,0,N_mdm(lit,rngName_mt19937)},
    {"rnum2",8,0,1,0,0,0,0,0,N_mdm(lit,rngName_rnum2)}
}

KeyWord kw_69[8]  [static]

Initial value:

= {
    {"adaptive_metropolis",8,0,1,0,0,0,0,0,N_mdm(lit,mcmcType_adaptive_metropolis)},
    {"delayed_rejection",8,0,1,0,0,0,0,0,N_mdm(lit,mcmcType_delayed_rejection)},
    {"dram",8,0,1,0,0,0,0,0,N_mdm(lit,mcmcType_dram)},
    {"metropolis_hastings",8,0,1,0,0,0,0,0,N_mdm(lit,mcmcType_metropolis_hastings)},
    {"multilevel",8,0,1,0,0,0,0,0,N_mdm(lit,mcmcType_multilevel)},
    {"pre_solve",8,3,3,0,kw_63},
    {"proposal_covariance",8,4,0,0,kw_67,0,0,0,N_mdm(lit,proposalCovType_user)},
    {"rng",8,2,2,0,kw_68}
}

KeyWord kw_70[3]  [static]

Initial value:

= {
    {"eval_id",8,0,2,0,0,0,0,0,N_mdm(augment_utype,importBuildFormat_TABULAR_EVAL_ID)},
    {"header",8,0,1,0,0,0,0,0,N_mdm(augment_utype,importBuildFormat_TABULAR_HEADER)},
    {"interface_id",8,0,3,0,0,0,0,0,N_mdm(augment_utype,importBuildFormat_TABULAR_IFACE_ID)}
}

KeyWord kw_71[4]  [static]

Initial value:

= {
    {"active_only",8,0,2,0,0,0,0,0,0,N_mdm(true,importBuildActive)},
    {"annotated",8,0,1,0,0,0,0,0,N_mdm(utype,importBuildFormat_TABULAR_ANNOTATED)},
    {"custom_annotated",8,3,1,0,kw_70,0,0,0,N_mdm(utype,importBuildFormat_TABULAR_NONE)},
    {"freeform",8,0,1,0,0,0,0,0,0,N_mdm(utype,importBuildFormat_TABULAR_NONE)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_72[7] [static]
Initial value:

= {
  {0,0,8,0,0,kw,69},
  {"build_samples",9,0,3,2,0,0,0,0,Nmdm(int,buildSamples)},
  {"chain_samples",9,0,1,1,0,0,0,0,Nmdm(int,chainSamples)},
  {"import_build_points_file",11,4,4,0,kw,71,0,0,0,0,Nmdm(str,importBuildPtsFile)},
  {"import_points_file",3,4,4,0,kw,74,0,0,0,-1,Nmdm(str,importBuildPtsFile)},
  {"samples",1,0,1,0,0,0,0,0,3,Nmdm(int,chainSamples)},
  {"seed",0x19,0,2,0,0,0,0,0,0,Nmdm(pint,randomSeed)}
}

KeyWord kw_73[1] [static]
Initial value:

= {
  {"num_probability_levels",13,0,1,0,0,0,0,0,Nmdm(num_resplevs,probabilityLevels)}
}

KeyWord kw_74[3] [static]
Initial value:

= {
  {"eval_id",8,0,2,0,0,0,0,0,0,Nmdm(augment_ctype,importBuildFormat_TABULAR_EVAL_ID)},
  {"header",8,0,1,0,0,0,0,0,0,Nmdm(augment_ctype,importBuildFormat_TABULAR_HEADER)},
  {"interface_id",8,0,3,0,0,0,0,0,0,Nmdm(augment_ctype,importBuildFormat_TABULAR_IFACE_ID)}
}

KeyWord kw_75[4] [static]
Initial value:

= {
  {"active_only",8,0,2,0,0,0,0,0,0,Nmdm(true,importBuildActive)},
  {"annotated",8,0,1,0,0,0,0,0,0,Nmdm(ctype,importBuildFormat_TABULAR_ANNOTATED)},
  {"custom_annotated",8,3,1,0,kw,74,0,0,0,0,Nmdm(ctype,importBuildFormat_TABULAR_NONE)},
  {"freeform",8,0,1,0,0,0,0,0,0,Nmdm(ctype,importBuildFormat_TABULAR_NONE)}
}

KeyWord kw_76[6] [static]
Initial value:

= {
  {"build_samples",9,0,2,0,0,0,0,0,0,Nmdm(int,buildSamples)},
  {"dakota",8,0,1,1,0,0,0,0,0,Nmdm(ctype,emulatorType_GP_EMULATOR)},
  {"import_build_points_file",11,4,4,0,kw,75,0,0,0,0,Nmdm(str,importBuildPtsFile)},
  {"import_points_file",3,4,4,0,kw,76,0,0,0,3,Nmdm(str,importBuildPtsFile)},
  {"posterior_adaptive",8,0,3,0,0,0,0,0,0,Nmdm(true,adaptPosteriorRefine)},
  {"surfpack",8,0,1,1,0,0,0,0,0,Nmdm(ctype,emulatorType_KRIGING_EMULATOR)}
}
KeyWord kw_77[3]  [static]
Initial value:
= {
  {"eval_id",8,0,2,0,0,0,0,0,0,N,mdm(augment,utype,importBuildFormat,TABULAR,EVAL, ID)},
  {"header",8,0,1,0,0,0,0,0,0,N,mdm(augment,utype,importBuildFormat,TABULAR,HEADER)},
  {"interface_id",8,0,3,0,0,0,0,0,0,N,mdm(augment,utype,importBuildFormat,TABULAR,FACE, ID)}
}

KeyWord kw_78[4]  [static]
Initial value:
= {
  {"active_only",8,0,2,0,0,0,0,0,0,N,mdm(true,importBuildActive)},
  {"annotated",8,0,1,0,0,0,0,0,0,N,mdm(utype,importBuildFormat,TABULAR,ANNOTATED)},
  {"custom_annotated",8,3,1,0,kw_77,0,0,0,0,N,mdm(utype,importBuildFormat,TABULAR,NONE)},
  {"freeform",8,0,1,0,0,0,0,0,0,N,mdm(utype,importBuildFormat,TABULAR,NONE)}
}

KeyWord kw_79[3]  [static]
Initial value:
= {
  {"import_build_points_file",11,4,2,0,kw_78,0,0,0,0,N,mdm(str,importBuildPtsFile)},
  {"import_points_file",3,4,2,0,kw_78,0,0,0,0,N,mdm(str,importBuildPtsFile)},
  {"posterioradaptive",8,0,1,0,0,0,0,0,0,N,mdm(true,adaptPosteriorRefine)}
}

KeyWord kw_80[3]  [static]
Initial value:
= {
  {"eval_id",8,0,2,0,0,0,0,0,0,N,mdm(augment,utype,importBuildFormat,TABULAR,EVAL, ID)},
  {"header",8,0,1,0,0,0,0,0,0,N,mdm(augment,utype,importBuildFormat,TABULAR,HEADER)},
  {"interface_id",8,0,3,0,0,0,0,0,0,N,mdm(augment,utype,importBuildFormat,TABULAR,FACE, ID)}
}

KeyWord kw_81[4]  [static]
Initial value:
= {
  {"active_only",8,0,2,0,0,0,0,0,0,N,mdm(true,importBuildActive)},
  {"annotated",8,0,1,0,0,0,0,0,0,N,mdm(utype,importBuildFormat,TABULAR,ANNOTATED)},
  {"custom_annotated",8,3,1,0,kw_80,0,0,0,0,N,mdm(utype,importBuildFormat,TABULAR,NONE)},
  {"freeform",8,0,1,0,0,0,0,0,0,N,mdm(utype,importBuildFormat,TABULAR,NONE)}
}

KeyWord kw_82[4]  [static]
Initial value:
= {
  {"collocation_ratio",10,0,1,1,0,0,0,0,0,N,mdm(Realp,collocationRatio)},
  {"import_build_points_file",11,4,3,0,kw_81,0,0,0,0,N,mdm(str,importBuildPtsFile)},
  {"import_points_file",3,4,3,0,kw_81,0,0,0,0,N,mdm(str,importBuildPtsFile)},
  {"posterioradaptive",8,0,2,0,0,0,0,0,0,N,mdm(true,adaptPosteriorRefine)}
}
KeyWord kw_83[3] [static]
Initial value:
= {
  {"collocation_points_sequence",13,3,1,1,kw_79,0.,0.,0.,0,Ndm(smarray, collocationPoints)},
  {"expansion_order_sequence",13,4,1,1,kw_82,0.,0.,0.,0,Ndm(usarray, expansionOrder)},
  {"sparse_grid_level_sequence",13,0,1,1,0.,0.,0.,0,Ndm(usarray, sparseGridLevel)}
}

KeyWord kw_84[1] [static]
Initial value:
= {
  {"sparse_grid_level_sequence",13,0,1,1,0.,0.,0.,0,Ndm(usarray, sparseGridLevel)}
}

KeyWord kw_85[5] [static]
Initial value:
= {
  {"gaussian_process",8,6,1,1,kw_76},
  {"kriging",0,6,1,1,kw_76,0.,0.,-1},
  {"pce",8,3,1,1,kw_83,0.,0.,0.,0,Ndm(type, emulatorType_PCE, EMULATOR)},
  {"zc",8,1,1,1,kw_84,0.,0.,0.,0,Ndm(type, emulatorType_ZC, EMULATOR)},
  {"use_derivatives",8,0,2,0,0.,0.,0.,0,Ndm(true, methodUseDerivsFlag)}
}

KeyWord kw_86[3] [static]
Initial value:
= {
  {"eval_id",8,0,2,0,0.,0.,0.,0,Ndm(augment_uType, exportMCMCFormat_TABULAR, EVAL_ID)},
  {"header",8,0,1,0,0.,0.,0.,0,Ndm(augment_uType, exportMCMCFormat_TABULAR, HEADER)},
  {"interface_id",8,0,3,0,0.,0.,0.,0,Ndm(augment_uType, exportMCMCFormat_TABULAR, IFACE_ID)}
}

KeyWord kw_87[3] [static]
Initial value:
= {
  {"annotated",8,0,1,0,0.,0.,0.,0,Ndm(uType, exportMCMCFormat_TABULAR, ANNOTATED)},
  {"custom_annotated",8,3,1,0,kw_86,0.,0.,0,Ndm(uType, exportMCMCFormat_TABULAR, NONE)},
  {"freeform",8,0,1,0,0.,0.,0.,0,Ndm(uType, exportMCMCFormat_TABULAR, NONE)}
}

KeyWord kw_88[7] [static]
Initial value:
= {
  {0,0,8,0,0,kw_69},
  {"chain_samples",9,0,1,1,0.,0.,0.,0,Ndm(int, chainSamples)},
  {"emulator",8,5,3,0,kw_85},
  {"export_chain_points_file",11,5,3,0,kw_87,0.,0.,0.,0,Ndm(str, exportMCMCPtsFile)},
  {"logit_transform",8,0,4,0,0.,0.,0.,0,Ndm(true, logitTransform)},
  {"samples",1,0,1,1,0.,0.,0.,-4,Ndm(int, chainSamples)},
  {"seed",0x19,0,2,0,0.,0.,0.,0,Ndm(pint, randomSeed)}
}
KeyWord kw_89[2] [static]
Initial value:
= {
    {"diagonal",8,0,1,1,0,0,0,0,N_mdm(lit, dataDistCovInputType_diagonal)},
    {"matrix",8,0,1,1,0,0,0,0,N_mdm(lit, dataDistCovInputType_matrix)}
}

KeyWord kw_90[2] [static]
Initial value:
= {
    {"covariance",14,2,2,kw_89,0,0,N_mdm(RealDL, dataDistCovariance)},
    {"means",14,0,1,1,0,0,0,0,N_mdm(RealDL, dataDistMeans)}
}

KeyWord kw_91[2] [static]
Initial value:
= {
    {"gaussian",8,2,1,1,kw_90},
    {"obs_data_filename",11,0,1,0,0,0,0,0,N_mdm(str, dataDistFile)}
}

KeyWord kw_92[3] [static]
Initial value:
= {
    {"eval_id",8,0,2,0,0,0,0,0,N_mdm(augment_utype, importBuildFormat_TABULAR_EVAL_ID)},
    {"header",8,0,1,0,0,0,0,0,N_mdm(augment_utype, importBuildFormat_TABULAR_HEADER)},
    {"interface_id",8,0,3,0,0,0,0,0,N_mdm(augment_utype, importBuildFormat_TABULAR_IFACE_ID)}
}

KeyWord kw_93[4] [static]
Initial value:
= {
    {"active_only",8,0,2,0,0,0,0,0,N_mdm(true, importBuildActive)},
    {"annotated",8,0,1,0,0,0,0,0,N_mdm(utype, importBuildFormat_TABULAR_ANNOTATED)},
    {"custom_annotated",8,3,1,0,kw_92,0,0,0,0,N_mdm(utype, importBuildFormat_TABULAR_NONE)},
    {"freeform",8,0,1,0,0,0,0,0,N_mdm(utype, importBuildFormat_TABULAR_NONE)}
}

KeyWord kw_94[6] [static]
Initial value:
= {
    {"build_samples",9,0,2,0,0,0,0,0,0,N_mdm(int, buildSamples)},
    {"dakota",8,0,1,1,0,0,0,0,0,N_mdm(type, emulatorType_GP_EMULATOR)},
    {"import_build_points_file",11,4,4,0,kw_93,0,0,0,0,0,N_mdm(str, importBuildPtsFile)},
    {"import_points_file",3,4,4,0,kw_93,0,0,0,0,0,N_mdm(str, importBuildPtsFile)},
    {"posterior_adaptive",8,0,3,0,0,0,0,0,0,N_mdm(true, adaptPosteriorRefine)},
    {"surfpack",8,0,1,1,0,0,0,0,0,N_mdm(type, emulatorType_KRIGING_EMULATOR)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_95[3] [static]
Initial value:
= {
   {*eval_id*,8,0,2,0,0,0,0,0,0,Nmdm(augment_utype,importBuildFormat_TABULAR_EVAL_ID)},
   {*header*,8,0,1,0,0,0,0,0,0,Nmdm(augment_utype,importBuildFormat_TABULAR_HEADER)},
   {*interface_id*,8,0,3,0,0,0,0,0,0,Nmdm(augment_utype,importBuildFormat_TABULAR_IFACE_ID)}
}

KeyWord kw_96[4] [static]
Initial value:
= {
   {*active_only*,8,0,2,0,0,0,0,0,0,Nmdm(true,importBuildActive)},
   {*annotated*,8,0,1,0,0,0,0,0,0,Nmdm(utype,importBuildFormat_TABULAR_ANNOTATED)},
   {*custom_annotated*,8,3,1,0,kw_95,0,0,0,0,Nmdm(utype,importBuildFormat_TABULAR_NONE)},
   {*freeform*,8,0,1,0,0,0,0,0,0,Nmdm(utype,importBuildFormat_TABULAR_NONE)}
}

KeyWord kw_97[3] [static]
Initial value:
= {
   {*import_build_points_file*,11,4,2,0,kw_96,0,0,0,0,Nmdm(str,importBuildPtsFile)},
   {*import_points_file*,3,4,2,0,kw_36,0,0,0,0,1,Nmdm(str,importBuildPtsFile)},
   {*posterior_adaptive*,8,0,1,0,0,0,0,0,0,Nmdm(true,adaptPosteriorRefine)}
}

KeyWord kw_98[3] [static]
Initial value:
= {
   {*eval_id*,8,0,2,0,0,0,0,0,0,Nmdm(augment_utype,importBuildFormat_TABULAR_EVAL_ID)},
   {*header*,8,0,1,0,0,0,0,0,0,Nmdm(augment_utype,importBuildFormat_TABULAR_HEADER)},
   {*interface_id*,8,0,3,0,0,0,0,0,0,Nmdm(augment_utype,importBuildFormat_TABULAR_IFACE_ID)}
}

KeyWord kw_99[4] [static]
Initial value:
= {
   {*active_only*,8,0,2,0,0,0,0,0,0,Nmdm(true,importBuildActive)},
   {*annotated*,8,0,1,0,0,0,0,0,0,Nmdm(utype,importBuildFormat_TABULAR_ANNOTATED)},
   {*custom_annotated*,8,3,1,0,kw_95,0,0,0,0,Nmdm(utype,importBuildFormat_TABULAR_NONE)},
   {*freeform*,8,0,1,0,0,0,0,0,0,Nmdm(utype,importBuildFormat_TABULAR_NONE)}
}

KeyWord kw_100[4] [static]
Initial value:
= {
   {*collocation_ratio*,10,0,1,1,0,0,0,0,0,Nmdm(Realp,collocationRatio)},
   {*import_build_points_file*,11,4,3,0,kw_39,0,0,0,0,Nmdm(str,importBuildPtsFile)},
   {*import_points_file*,3,4,3,0,kw_99,0,0,0,0,1,Nmdm(str,importBuildPtsFile)},
   {*posterior_adaptive*,8,0,2,0,0,0,0,0,0,Nmdm(true,adaptPosteriorRefine)}
}
KeyWord kw_101[3] [static]
Initial value:

```cpp
= {
    {"collocation_points_sequence",13,3,1,1,kw_97,0.,0.,0,N_mdm(szarray,collocationPoints)},
    {"expansion_order_sequence",13,4,1,1,kw_100,0.,0.,0,N_mdm(usharray,expansionOrder)},
    {"sparse_grid_level_sequence",13,0,1,1,0.,0.,0.,0,N_mdm(usharray,sparseGridLevel)}
}
```

KeyWord kw_102[1] [static]
Initial value:

```cpp
= {
    {"sparse_grid_level_sequence",13,0,1,1,0.,0.,0.,0,N_mdm(usharray,sparseGridLevel)}
}
```

KeyWord kw_103[5] [static]
Initial value:

```cpp
= {
    {"gaussian_process",8,6,1,1,kw_94},
    {"kriging",0,6,1,1,kw_94,0.,0.,-1},
    {"pce",8,3,1,1,kw_101,0.,0.,0,N_mdm(type,emulatorType_PCE_EMULATOR)},
    {"sc",8,1,1,1,kw_102,0.,0.,0,N_mdm(type,emulatorType_SC_EMULATOR)},
    {"use_derivatives",8,0,2,0,0.,0.,0.,0,N_mdm(true,methodUseDerivsFlag)}
}
```

KeyWord kw_104[1] [static]
Initial value:

```cpp
= {
    {"evaluate_posterior_density",8,0,1,1,0.,0.,0.,0,N_mdm(true,evaluatePosteriorDensity)}
}
```

KeyWord kw_105[7] [static]
Initial value:

```cpp
= {
    {"data_distribution",8,2,3,1,kw_91},
    {"emulator",8,5,2,0,kw_103},
    {"generate_posterior_samples",8,1,7,0,kw_104,0.,0.,0,N_mdm(true,generatePosteriorSamples)},
    {"posterior_density_export_filename",11,0,4,0,0.,0.,0,N_mdm(str,posteriorDensityExportFilename)},
    {"posterior_samples_export_filename",11,0,5,0,0.,0.,0.,0,N_mdm(str,posteriorSamplesExportFilename)},
    {"posterior_samples_import_filename",11,0,6,0,0.,0.,0.,0,N_mdm(str,posteriorSamplesImportFilename)},
    {"seed",8x9,0,1,0,0.,0.,0.,0,N_mdm(pint,randomSeed)}
}
```
KeyWord kw_106[12] [static]
Initial value:
= {
    {0,0,1,0,0,kw,27},
    {"burn_in_samples",9,0,4,0,0,0,0,0,0,N_mdm(int,burnInSamples)},
    {"calibrate_error_multipliers",8,5,3,0,kw,27},
    {"convergence_tolerance",10,0,7,0,0,0,0,0,0,N_mdm(Real,convergenceTolerance)},
    {"dream",8,10,1,1,kw,62,0,0,0,0,N_mdm(utype,subMethod,SUBMETHOD,DREAM)},
    {"gpmsa",8,6,1,1,kw,12,0,0,0,0,N_mdm(utype,subMethod,SUBMETHOD,GPMSA)},
    {"max_iterations",0x29,0,8,0,0,0,0,0,0,N_mdm(nnint,maxIterations)},
    {"probability_levels",14,1,6,0,kw,73,0,0,0,0,N_mdm(resplevs01,probabilityLevels)},
    {"queso",8,6,1,1,kw,88,0,0,0,0,N_mdm(utype,subMethod,SUBMETHOD,QUESO)},
    {"standardized_space",8,0,2,0,0,0,0,0,0,N_mdm(true,standardizedSpace)},
    {"sub_sampling_period",9,0,5,0,0,0,0,0,0,N_mdm(int,subSamplingPeriod)},
    {"wasabi",8,7,1,1,kw,105,0,0,0,0,N_mdm(utype,subMethod,SUBMETHOD,WASABI)}
}

KeyWord kw_107[1] [static]
Initial value:
= {
    {"model_pointer",11,0,0,0,0,0,0,0,0,N_mdm(str,modelPointer)}
}

KeyWord kw_108[3] [static]
Initial value:
= {
    {"method_name",11,1,1,1,kw,107,0,0,0,0,N_mdm(str,subMethodName)},
    {"method_pointer",11,0,1,1,0,0,0,0,0,N_mdm(str,subMethodPointer)},
    {"scaling",8,0,2,0,0,0,0,0,0,N_mdm(true,methodScaling)}
}

KeyWord kw_109[4] [static]
Initial value:
= {
    {0,0,1,0,0,kw,27},
    {"deltas_per_variable",5,0,2,2,0,0,0,0,0,2,N_mdm(ivec,stepsPerVariable)},
    {"step_vector",14,0,1,1,0,0,0,0,0,0,N_mdm(RealDL,stepVector)},
    {"steps_per_variable",13,0,2,2,0,0,0,0,0,0,N_mdm(ivec,stepsPerVariable)}
}

KeyWord kw_110[9] [static]
Initial value:
= {
    {"convergence_tolerance",10,0,6,0,0,0,0,0,0,N_mdm(Real,convergenceTolerance)},
    {"max_function_evaluations",0x29,0,7,0,0,0,0,0,0,N_mdm(nnint,maxFunctionEvaluations)},
    {"max_iterations",0x29,0,8,0,0,0,0,0,0,N_mdm(nnint,maxIterations)},
    {"misc_options",15,0,4,0,0,0,0,0,0,N_mdm(strL,miscOptions)},
    {"scaling",8,0,8,0,0,0,0,0,0,N_mdm(true,methodScaling)},
    {"seed",0x19,0,2,0,0,0,0,0,0,N_mdm(pint,randomSeed)},
    {"show_misc_options",8,0,3,0,0,0,0,0,0,N_mdm(true,showMiscOptions)},
    {"solution_accuracy",2,0,1,0,0,0,0,0,1,N_mdm(Real,solnTarget)},
    {"solution_target",10,0,1,0,0,0,0,0,0,N_mdm(Real,solnTarget)}
}
KeyWord kw_111[3]  [static]
Initial value:
= {
    {0,0,1,0,0,kw},
    {0,0,9,0,0,kw_110},
    {"beta_solver_name",11,0,1,0,0..0.,0.,N_mdm(str, betaSolverName)}
}

KeyWord kw_112[2]  [static]
Initial value:
= {
    {"initial_delta",10,0,1,0,0..0.,0.,0.,N_mdm(Real, initDelta)},
    {"threshold_delta",10,0,2,0,0..0.,0.,0.,N_mdm(Real, threshDelta)}
}

KeyWord kw_113[4]  [static]
Initial value:
= {
    {0,0,1,0,0,kw},
    {0,0,9,0,0,kw_110},
    {0,0,2,0,0,kw_112},
    {}*}

KeyWord kw_114[2]  [static]
Initial value:
= {
    {"all_dimensions",8,0,1,1,0,0..0.,0.,N_mdm(lit, boxDivision_all_dimensions)},
    {"major_dimension",8,0,1,1,0,0..0.,0.,N_mdm(lit, boxDivision_major_dimension)}
}

KeyWord kw_115[8]  [static]
Initial value:
= {
    {0,0,1,0,0,kw},
    {0,0,9,0,0,kw_110},
    {"constraint_penalty",10,0,6,0,0..0.,0.,0.,N_mdm(Real, constraintPenalty)},
    {"division",8,2,1,0,kw_114},
    {"global_balance_parameter",10,0,2,0,0..0.,0.,0.,N_mdm(Real, globalBalanceParam)},
    {"local_balance_parameter",10,0,3,0,0..0.,0.,0.,N_mdm(Real, localBalanceParam)},
    {"max_boxsize_limit",10,0,4,0,0..0.,0.,0.,N_mdm(Real, maxBoxSize)},
    {"min_boxsize_limit",10,0,5,0,0..0.,0.,0.,N_mdm(Real, minBoxSize)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_116[3]  [static]
Initial value:
= {
    {"blend", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(lit, crossoverType, blend)},
    {"two_point", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(lit, crossoverType, two_point)},
    {"uniform", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(lit, crossoverType, uniform)}
}

KeyWord kw_117[2]  [static]
Initial value:
= {
    {"linear_rank", 8, 0, 1, 0, 0, 0, 0, N_mdm(lit, fitnessType, linear_rank)},
    {"merit_function", 8, 0, 1, 0, 0, 0, 0, N_mdm(lit, fitnessType, proportional)}
}

KeyWord kw_118[3]  [static]
Initial value:
= {
    {"flat_file", 11, 0, 1, 0, 0, 0, 0, N_mdm(slit2, TYPE, DATA, initializationType, flat_file)},
    {"simple_random", 8, 0, 1, 0, 0, 0, 0, N_mdm(lit, initializationType, random)},
    {"unique_random", 8, 0, 1, 0, 0, 0, 0, N_mdm(lit, initializationType, unique_random)}
}

KeyWord kw_119[2]  [static]
Initial value:
= {
    {"mutation_range", 9, 0, 2, 0, 0, 0, 0, 0, N_mdm(int, mutationRange)},
    {"mutation_scale", 10, 0, 1, 0, 0, 0, 0, N_mdm(Real, mutationScale)}
}

KeyWord kw_120[5]  [static]
Initial value:
= {
    {"non_adaptive", 8, 0, 2, 0, 0, 0, 0, 0, N_mdm(false, mutationAdaptive)},
    {"offset_cauchy", 8, 2, 1, 1, kw_119, 0, 0, 0, N_mdm(lit, mutationType, offset_cauchy)},
    {"offset_normal", 8, 2, 1, 1, kw_119, 0, 0, 0, N_mdm(lit, mutationType, offset_normal)},
    {"offset_uniform", 8, 2, 1, 1, kw_119, 0, 0, 0, N_mdm(lit, mutationType, offset_uniform)},
    {"replace_uniform", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(lit, mutationType, replace_uniform)}
}

KeyWord kw_121[4]  [static]
Initial value:
= {
    {"chc", 9, 0, 1, 1, 0, 0, 0, 0, N_mdm(ilit2, TYPE, DATA, replacementType, chc)},
    {"elitist", 9, 0, 1, 1, 0, 0, 0, 0, N_mdm(ilit2, TYPE, DATA, replacementType, elitist)},
    {"new_solutions_generated", 9, 0, 2, 0, 0, 0, 0, 0, N_mdm(int, newSolnsGenerated)},
    {"random", 9, 0, 1, 1, 0, 0, 0, 0, N_mdm(ilit2, TYPE, DATA, replacementType, random)"}}
KeyWord kw_122[11]  [static]
Initial value:

    = [
        {0, 0, 1, 0, 0, kw_27},
        {0, 0, 9, 0, 0, kw_110},
        "constraint_penalty", 10, 0, 0, 0, 0, 0, N_mdm(Real, constraintPenalty),
        "crossover_rate", 10, 0, 5, 0, 0, 0, N_mdm(Real, crossoverRate),
        "crossover_type", 8, 3, 0, 0, kw_116},
        "fitness_type", 8, 2, 3, 0, kw_117},
        "initialization_type", 8, 3, 2, 0, kw_118},
        "mutation_rate", 10, 0, 7, 0, 0, 0, 0, N_mdm(Real, mutationRate),
        "mutation_type", 8, 5, 0, 0, kw_120},
        "population_size", 0x19, 0, 1, 0, 0, 0, 0, N_mdm(pint, populationSize),
        "replacement_type", 8, 4, 4, 0, kw_121}
    ]

KeyWord kw_123[2]  [static]
Initial value:

    = [
        "constraint_penalty", 10, 0, 2, 0, 0, 0, 0, 0, N_mdm(Real, constraintPenalty),
        "contraction_factor", 10, 0, 1, 0, 0, 0, 0, 0, N_mdm(Real, contractFactor),
    ]

KeyWord kw_124[3]  [static]
Initial value:

    = [
        "adaptive_pattern", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(lit, exploratoryMoves_adaptive),
        "basic_pattern", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(lit, exploratoryMoves_simple),
        "multi_step", 8, 0, 1, 0, 0, 0, 0, 0, N_mdm(lit, exploratoryMoves_multi_step),
    ]

KeyWord kw_125[2]  [static]
Initial value:

    = [
        "coordinate", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(lit, patternBasis_coordinate),
        "simplex", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(lit, patternBasis_simplex),
    ]

KeyWord kw_126[2]  [static]
Initial value:

    = [
        "blocking", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(lit, evalSynchronize_blocking),
        "nonblocking", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(lit, evalSynchronize_nonblocking),
    ]
12.1. DAKOTA NAMESPACE REFERENCE

**KeyWord kw\_127[12] [static]**

Initial value:
```plaintext
= {
    {0, 0, 1, 0, 0, kw\_27},
    {0, 0, 9, 0, 0, kw\_110},
    {0, 0, 2, 0, 0, kw\_112},
    {0, 0, 2, 0, 0, kw\_123},
    "constant\_penalty", 8, 0, 1, 0, 0, 0, 0, 0, N\_mdm(true, constantPenalty),
    "expand\_after\_success", 9, 0, 3, 0, 0, 0, 0, 0, N\_mdm(int, expandAfterSuccess),
    "exploratory\_moves", 8, 3, 7, 0, kw\_124},
    "no\_expansion", 8, 0, 2, 0, 0, 0, 0, 0, N\_mdm(false, expansionFlag),
    "pattern\_basis", 8, 2, 4, 0, kw\_125},
    "stochastic", 8, 0, 5, 0, 0, 0, 0, 0, N\_mdm(true, randomizeOrderFlag),
    "synchronization", 8, 0, 2, 0, 0, 0, 0, 0, N\_mdm(false, expansionFlag)}
```

**KeyWord kw\_128[8] [static]**

Initial value:
```plaintext
= {
    {0, 0, 1, 0, 0, kw\_27},
    {0, 0, 9, 0, 0, kw\_110},
    {0, 0, 2, 0, 0, kw\_112},
    {0, 0, 2, 0, 0, kw\_123},
    "contract\_after\_failure", 9, 0, 1, 0, 0, 0, 0, 0, N\_mdm(int, contractAfterFail),
    "expand\_after\_success", 9, 0, 3, 0, 0, 0, 0, 0, N\_mdm(int, expandAfterSuccess),
    "no\_expansion", 8, 0, 2, 0, 0, 0, 0, 0, N\_mdm(false, expansionFlag)}
```

**KeyWord kw\_129[15] [static]**

Initial value:
```plaintext
= {
    "constraint\_tolerance", 10, 0, 3, 0, 0, 0, 0, 0, N\_mdm(Real, constraintTolerance),
    "convergence\_tolerance", 10, 0, 2, 0, 0, 0, 0, 0, N\_mdm(Real, convergenceTolerance),
    "linear\_equality\_constraint\_matrix", 14, 0, 12, 0, 0, 0, 0, 0, N\_mdm(RealDL, linearEqConstraintCoeffs),
    "linear\_equality\_scale\_types", 15, 0, 14, 0, 0, 0, 0, 0, N\_mdm(strL, linearEqScaleTypes),
    "linear\_equality\_scales", 14, 0, 15, 0, 0, 0, 0, 0, N\_mdm(RealDL, linearEqScales),
    "linear\_equality\_targets", 14, 0, 13, 0, 0, 0, 0, 0, N\_mdm(RealDL, linearEqTargets),
    "linear\_inequality\_constraint\_matrix", 14, 0, 7, 0, 0, 0, 0, 0, N\_mdm(RealDL, linearIneqConstraintCoeffs),
    "linear\_inequality\_lower\_bounds", 14, 0, 8, 0, 0, 0, 0, 0, N\_mdm(RealDL, linearIneqLowerBnds),
    "linear\_inequality\_scale\_types", 15, 0, 10, 0, 0, 0, 0, 0, N\_mdm(strL, linearIneqScaleTypes),
    "linear\_inequality\_upper\_bounds", 14, 0, 9, 0, 0, 0, 0, 0, N\_mdm(RealDL, linearIneqUpperBnds),
    "max\_function\_evaluations", 0x29, 0, 5, 0, 0, 0, 0, 0, N\_mdm(nnint, maxFunctionEvaluations),
    "max\_iterations", 0x29, 0, 1, 0, 0, 0, 0, 0, N\_mdm(nnint, maxIterations),
    "scaling", 8, 0, 6, 0, 0, 0, 0, 0, N\_mdm(true, methodScaling),
    "speculative", 8, 0, 4, 0, 0, 0, 0, 0, N\_mdm(true, speculativeFlag)}
```

**KeyWord kw\_130[4] [static]**

Initial value:
```plaintext
= {
    {0, 0, 1, 0, 0, kw\_27},
    {0, 0, 15, 0, 0, kw\_129},
    "frcg", 8, 0, 1, 1, 0, 0, 0, 0, N\_mdm(utype, methodName\_CONMIN\_FRCG),
    "mfd", 8, 0, 1, 1, 0, 0, 0, 0, N\_mdm(utype, methodName\_CONMIN\_MFD)}
```
KeyWord kw_131[3]  [static]
Initial value:
= {
    {0,0,1,0,0,kw_27},
    {0,0,15,0,0,kw_129},
    {""
}
}

KeyWord kw_132[1]  [static]
Initial value:
= {
    "drop.tolerance",10,0,1,0,0,,0,0,N_mdm(Real,vbdDropTolerance)}
}

KeyWord kw_133[15]  [static]
Initial value:
= {
    {0,0,1,0,0,kw_27},
    {"box_behnken",8,0,1,0,0,,0,0,N_mdm(utype,subMethod_SUBMETHOD_BOX_BEHNKEN)},
    {"central_composite",8,0,1,0,0,,0,0,N_mdm(utype,subMethod_SUBMETHOD_CENTRAL_COMPOSITE)},
    {"fixed_seed",8,0,7,0,0,,0,0,N_mdm(true,fixedSeedFlag)},
    {"grid",8,0,1,0,0,,0,0,N_mdm(utype,subMethod_SUBMETHOD_GRID)},
    {"main_effects",8,0,1,0,0,,0,0,N_mdm(true,mainEffectsFlag)},
    {"oa_lhs",8,0,1,0,0,,0,0,N_mdm(utype,subMethod_SUBMETHOD_OA_LHS)},
    {"quality_metrics",8,0,1,0,0,,0,0,N_mdm(true,volQualityFlag)},
    {"random",8,0,1,0,0,,0,0,N_mdm(utype,subMethod_SUBMETHOD_RANDOM)},
    {"samples",9,0,2,0,0,,0,0,N_mdm(int,numSamples)},
    {"seed",0x19,0,1,0,0,,0,0,N_mdm(pint,randomSeed)},
    {"symbols",9,0,8,0,0,,0,0,N_mdm(int,numSymbols)},
    {"variance_based_decomp",8,1,6,0,kw_132,0,,0,0,N_mdm(true,vbdFlag)}
}

KeyWord kw_134[12]  [static]
Initial value:
= {
    {0,0,1,0,0,kw_27},
    {"linear_equality_constraint_matrix",14,0,6,0,0,0,,0,0,N_mdm(RealDL, linearEqConstraintCoeffs)},
    {"linear_equality_scale_types",15,0,6,0,0,0,0,,0,N_mdm(strL,linearEqScaleTypes)},
    {"linear_equality_scales",14,0,9,0,0,0,0,,0,N_mdm(RealDL,linearEqScales)},
    {"linear_equality_targets",14,0,7,0,0,0,0,,0,N_mdm(RealDL,linearEqTargets)},
    {"linear_equality_constraint_matrix",14,0,1,0,0,0,0,,0,N_mdm(RealDL, linearIneqConstraintCoeffs)},
    {"linear_equality_scale_types",15,0,6,0,0,0,0,,0,N_mdm(strL,linearIneqScaleTypes)},
    {"linear_equality_scales",14,0,5,0,0,0,0,,0,N_mdm(RealDL,linearIneqScales)},
    {"linear_equality_upper_bounds",14,0,3,0,0,0,0,,0,N_mdm(RealDL,linearIneqUpperBnds)},
    {"max_function_evaluations",0x29,0,1,0,0,,0,0,0,N_mdm(nnint,maxFunctionEvaluations)},
    {"scaling",8,0,11,0,0,0,0,,0,N_mdm(true,methodScaling)}
}
KeyWord kw_135[15] [static]

Initial value:

```c
= {
    "constraint_tolerance",10,0,3,0,0,0,0,0,N_mdmd(Real,constraintTolerance),
    "convergence_tolerance",10,0,2,0,0,0,0,0,N_mdmd(Real,convergenceTolerance),
    "linear_equality_constraint_matrix",14,0,12,0,0,0,0,0,N_mdmd(RealDL,
    linearEqConstraintCoeffs),
    "linear_equality_scale_types",15,0,14,0,0,0,0,0,N_mdmd(strL,linearEqScaleTypes),
    "linear_equality_scales",14,0,15,0,0,0,0,0,N_mdmd(RealDL,linearEqScales),
    "linear_equality_targets",14,0,13,0,0,0,0,0,N_mdmd(RealDL,linearEqTargets),
    "linear_inequality_constraint_matrix",14,0,7,0,0,0,0,0,N_mdmd(RealDL,
    linearIneqConstraintCoeffs),
    "linear_inequality_lower_bounds",14,0,8,0,0,0,0,0,N_mdmd(RealDL,linearIneqLowerBnds),
    "linear_inequality_scale_types",15,0,10,0,0,0,0,0,N_mdmd(strL,linearIneqScaleTypes),
    "linear_inequality_upper_bounds",14,0,9,0,0,0,0,0,N_mdmd(RealDL,linearIneqUpperBnds),
    "max_function_evaluations",0x29,0,5,0,0,0,0,0,N_mdmd(nnint,maxFunctionEvaluations),
    "max_iterations",0x29,0,1,0,0,0,0,0,N_mdmd(nnint,maxIterations),
    "scaling",8,0,6,0,0,0,0,0,N_mdmd(true,methodScaling),
    "speculative",8,0,4,0,0,0,0,0,N_mdmd(true,speculativeFlag)
} }
```

KeyWord kw_136[7] [static]

Initial value:

```c
= {
    {0,0,1,0,0,kw_27},
    {0,0,15,0,kw_135},
    "bfgs",8,0,1,1,0,0,0,0,N_mdmd(utype,methodName_DOT_BFGS),
    "frcg",8,0,1,1,0,0,0,0,N_mdmd(utype,methodName_DOT_FRCG),
    "nmfd",8,0,1,1,0,0,0,0,N_mdmd(utype,methodName_DOT_NMFD),
    "slp",8,0,1,1,0,0,0,0,N_mdmd(utype,methodName_DOT_SLP),
    "sqp",8,0,1,1,0,0,0,0,N_mdmd(utype,methodName_DOT_SQP)
} }
```

KeyWord kw_137[3] [static]

Initial value:

```c
= {
    {0,0,1,0,0,kw_27},
    {0,0,15,0,kw_135},
    "eval_id",8,0,2,0,0,0,0,0,N_mdmd(augment_utype,exportApproxFormat_TABULAR_EVAL_ID),
    "header",8,0,1,0,0,0,0,0,N_mdmd(augment_utype,exportApproxFormat_TABULAR_HEADER),
    "interface_id",8,0,3,0,0,0,0,0,N_mdmd(augment_utype,exportApproxFormat_TABULAR_IFACE_ID)
} }
```
CHAPTER 12. NAMESPACE DOCUMENTATION

KeyWord kw_139[3]  [static]
Initial value:

```cpp
= {
    "annotated", 8, 0, 1, 0, 0, 0, 0, N_userdata(utype, exportApproxFormat_TABULAR_ANNOTATED)
}
```

KeyWord kw_140[2]  [static]
Initial value:

```cpp
= {
    "dakota", 8, 0, 1, 0, 0, 0, 0, N_userdata(type, emulatorType_GP_EMULATOR)
    "surfpack", 8, 0, 1, 0, 0, 0, 0, N_userdata(type, emulatorType_KRIGING_EMULATOR)
}
```

KeyWord kw_141[3]  [static]
Initial value:

```cpp
= {
    "eval_id", 8, 0, 2, 0, 0, 0, 0, N_userdata(augment_utype, importBuildFormat_TABULAR_EVAL_ID)
    "header", 8, 0, 1, 0, 0, 0, 0, N_userdata(augment_utype, importBuildFormat_TABULAR_HEADER)
    "interface_id", 8, 0, 3, 0, 0, 0, 0, N_userdata(augment_utype, importBuildFormat_TABULAR_IFACE_ID)
}
```

KeyWord kw_142[4]  [static]
Initial value:

```cpp
= {
    "active_only", 8, 0, 2, 0, 0, 0, 0, N_userdata(true, importBuildActive)
    "annotated", 8, 0, 1, 0, 0, 0, 0, N_userdata(utype, importBuildFormat_TABULAR_ANNOTATED)
    "custom_annotated", 8, 3, 1, 0, kw_138, 0, 0, 0, N_userdata(utype, importBuildFormat_TABULAR_NONE)
    "freeform", 8, 0, 1, 0, 0, 0, 0, N_userdata(utype, importBuildFormat_TABULAR_NONE)
}
```

KeyWord kw_143[11]  [static]
Initial value:

```cpp
= {
    0, 0, 1, 0, 0, kw_27,
    "export_approx_points_file", 11, 3, 7, 0, kw_139, 0, 0, 0, N_userdata(str, exportApproxPtsFile)
    "import_build_points_file", 11, 4, 6, 0, kw_142, 0, 0, 0, N_userdata(str, importBuildPtsFile)
    "initial_samples", 9, 0, 1, 0, 0, 0, 0, N_userdata(int, numSamples)
    "gaussian_process", 8, 2, 4, 0, kw_140
    "max_iterations", 0x29, 0, 3, 0, 0, 0, 0, N_userdata(nnint, maxIterations)
    "seed", 0x19, 0, 2, 0, 0, 0, 0, 0, N_userdata(pint, randomSeed)
    "use_derivatives", 8, 0, 5, 0, 0, 0, 0, N_userdata(true, methodUseDerivsFlag)
}
```
KeyWord kw_144[3]  [static]
Initial value:
= {
   {"grid", 8, 0, 1, 0, 0, 0, 0, N, mdm(lit, trialType, grid)},
   {"halton", 8, 0, 1, 0, 0, 0, 0, N, mdm(lit, trialType, halton)},
   {"random", 8, 0, 1, 0, 0, 0, 0, N, mdm(lit, trialType, random)}
}

KeyWord kw_145[1]  [static]
Initial value:
= {
   {"drop_tolerance", 10, 0, 1, 0, 0, 0, 0, N, mdm(Real, vbdDropTolerance)}
}

KeyWord kw_146[10]  [static]
Initial value:
= {
   {0, 0, 1, 0, 0, kw_27},
   {"fixed_seed", 8, 0, 6, 0, 0, 0, 0, 0, N, mdm(true, fixedSeedFlag)},
   {"latinize", 8, 0, 3, 0, 0, 0, 0, 0, N, mdm(true, latinizeFlag)},
   {"max_iterations", 0x29, 0, 9, 0, 0, 0, 0, 0, N, mdm(nnint, maxIterations)},
   {"num_trials", 9, 0, 8, 0, 0, 0, 0, 0, N, mdm(int, numTrials)},
   {"quality_metrics", 8, 0, 4, 0, 0, 0, 0, 0, N, mdm(true, volQualityFlag)},
   {"samples", 9, 0, 1, 0, 0, 0, 0, 0, N, mdm(int, numSamples)},
   {"seed", 0x19, 0, 12, 0, 0, 0, 0, 0, N, mdm(pint, randomSeed)},
   {"trial_type", 8, 3, 7, 0, kw_144},
   {"variance_based_decomp", 8, 1, 5, 0, kw_145, 0, 0, 0, N, mdm(true, vbdFlag)}
}

KeyWord kw_147[1]  [static]
Initial value:
= {
   {"drop_tolerance", 10, 0, 1, 0, 0, 0, 0, N, mdm(Real, vbdDropTolerance)}
}

KeyWord kw_148[12]  [static]
Initial value:
= {
   {0, 0, 1, 0, 0, kw_27},
   {"fixed_sequence", 8, 0, 6, 0, 0, 0, 0, 0, N, mdm(true, fixedSequenceFlag)},
   {"halton", 8, 0, 1, 0, 0, 0, 0, 0, N, mdm(utype, methodName, FSU_HALTON)},
   {"hammersley", 8, 0, 1, 0, 0, 0, 0, 0, N, mdm(utype, methodName, FSU_HAMMERSLEY)},
   {"latinize", 8, 0, 2, 0, 0, 0, 0, 0, N, mdm(true, latinizeFlag)},
   {"max_iterations", 0x29, 0, 10, 0, 0, 0, 0, 0, N, mdm(nnint, maxIterations)},
   {"prime_base", 13, 0, 9, 0, 0, 0, 0, 0, N, mdm(ivec, primeBase)},
   {"quality_metrics", 8, 0, 3, 0, 0, 0, 0, 0, N, mdm(true, volQualityFlag)},
   {"samples", 9, 0, 5, 0, 0, 0, 0, 0, N, mdm(int, numSamples)},
   {"sequence_leap", 13, 0, 8, 0, 0, 0, 0, 0, N, mdm(ivec, sequenceLeap)},
   {"sequence_start", 13, 0, 7, 0, 0, 0, 0, 0, N, mdm(ivec, sequenceStart)},
   {"variance_based_decomp", 8, 1, 4, 0, kw_147, 0, 0, 0, 0, N, mdm(true, vbdFlag)}
}
KeyWord kw.149[3]  [static]
Initial value:
= {
    \{"eval_id",8,0,2,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_EVAL_ID)\},
    \{"header",8,0,1,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_HEADER)\},
    \{"interface_id",8,0,3,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_IFACE_ID)\}
}

KeyWord kw.150[3]  [static]
Initial value:
= {
    \{"annotated",8,0,1,0,0,0,0,0,N_mdm(utype,exportApproxFormat_TABULAR_ANNOTATED)\},
    \{"custom_annotated",8,0,1,0,0,0,0,0,N_mdm(utype,exportApproxFormat_TABULAR_NONE)\},
    \{"freeform",8,0,1,0,0,0,0,0,N_mdm(utype,exportApproxFormat_TABULAR_NONE)\}
}

KeyWord kw.151[3]  [static]
Initial value:
= {
    \{"eval_id",8,0,2,0,0,0,0,0,N_mdm(augment_utype,importBuildFormat_TABULAR_EVAL_ID)\},
    \{"header",8,0,1,0,0,0,0,0,N_mdm(augment_utype,importBuildFormat_TABULAR_HEADER)\},
    \{"interface_id",8,0,3,0,0,0,0,0,N_mdm(augment_utype,importBuildFormat_TABULAR_IFACE_ID)\}
}

KeyWord kw.152[4]  [static]
Initial value:
= {
    \{"active_only",8,0,2,0,0,0,0,0,N_mdm(true,importBuildActive)\},
    \{"annotated",8,0,1,0,0,0,0,0,N_mdm(utype,importBuildFormat_TABULAR_ANNOTATED)\},
    \{"custom_annotated",8,0,1,0,kw.149,0,0,0,N_mdm(utype,importBuildFormat_TABULAR_NONE)\},
    \{"freeform",8,0,1,0,0,0,0,0,N_mdm(utype,importBuildFormat_TABULAR_NONE)\}
}

KeyWord kw.153[2]  [static]
Initial value:
= {
    \{"parallel",8,0,1,1,0,0,0,0,N_mdm(type,responseLevelTargetReduce_SYSTEM_PARALLEL)\},
    \{"series",8,0,1,1,0,0,0,0,N_mdm(type,responseLevelTargetReduce_SYSTEM_SERIES)\}
}

KeyWord kw.154[3]  [static]
Initial value:
= {
    \{"gen_reliabilities",8,0,1,1,0,0,0,0,N_mdm(type,responseLevelTarget_GEN_RELIABILITIES)\},
    \{"probabilities",8,0,1,1,0,0,0,0,N_mdm(type,responseLevelTarget_PROBABILITIES)\},
    \{"system",8,2,2,0,kw.153\}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw.155[2]  [static]
Initial value:
```cpp
= {
    {*compute*, 8, 3, 2, 0, kw.154},
    {*num_response_levels*, 13, 0, 0, 0, 0, 0, N, mdm(num_resplevs, responseLevels)}
}
```

KeyWord kw.156[12]  [static]
Initial value:
```cpp
= {
    {0, 0, 1, 0, 0, kw.27},
    {0, 0, 4, 0, 0, kw.33},
    {*build_samples*, 9, 0, 1, 0, 0, 0, 0, N, mdm(int, buildSamples)},
    {*export_approx_points_file*, 11, 3, 5, 0, kw.150, 0, 0, 0, N, mdm(str, exportApproxPtsFile)},
    {*export_points_file*, 3, 3, 5, 0, kw.150, 0, 0, 0, N, mdm(str, exportApproxPtsFile)},
    {*import_build_points_file*, 11, 4, 4, 0, kw.152, 0, 0, 0, N, mdm(str, importBuildPtsFile)},
    {*import_points_file*, 3, 4, 4, 0, kw.152, 0, 0, 0, N, mdm(str, importBuildPtsFile)},
    {*max_iterations*, 0x29, 0, 7, 0, 0, 0, 0, 0, N, mdm(nnint, maxIterations)},
    {*response_levels*, 14, 2, 6, 0, kw.155, 0, 0, 0, N, mdm(resplevs, responseLevels)},
    {*samples_on_emulator*, 9, 0, 3, 0, 0, 0, 0, N, mdm(int, samplesOnEmulator)},
    {*seed*, 0x19, 0, 2, 0, 0, 0, 0, 0, N, mdm(pint, randomSeed)}
}
```

KeyWord kw.157[4]  [static]
Initial value:
```cpp
= {
    {0, 0, 1, 0, 0, kw.27},
    {*max_function_evaluations*, 0x29, 0, 2, 0, 0, 0, 0, 0, N, mdm(nnint, maxFunctionEvaluations)},
    {*scaling*, 8, 0, 3, 0, 0, 0, 0, 0, N, mdm(true, methodScaling)},
    {*seed*, 0x19, 0, 1, 0, 0, 0, 0, 0, N, mdm(pint, randomSeed)}
}
```

KeyWord kw.158[2]  [static]
Initial value:
```cpp
= {
    {*parallel*, 8, 0, 1, 0, 0, 0, 0, 0, N, mdm(type, responseLevelTargetReduce_SYSTEM_PARALLEL)},
    {*series*, 8, 0, 1, 0, 0, 0, 0, 0, N, mdm(type, responseLevelTargetReduce_SYSTEM_SERIES)}
}
```

KeyWord kw.159[3]  [static]
Initial value:
```cpp
= {
    {*gen_reliabilities*, 8, 0, 1, 1, 0, 0, 0, 0, 0, N, mdm(type, responseLevelTarget_GEN_RELIABILITIES)},
    {*probabilities*, 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(type, responseLevelTarget_PROBABILITIES)},
    {*system*, 8, 0, 2, 0, kw.156}
}
```
KeyWord kw_160[2]  [static]
Initial value:
= {
    {"compute",8,3,2,0,kw.159},
    {"num_response_levels",13,0,1,0,0,,0,0,Nmdm(num_reslevs,responseLevels)}
}

KeyWord kw_161[3]  [static]
Initial value:
= {
    {"eval_id",8,0,2,0,0,,0,0,Nmdm(augment_utype,exportApproxFormat_TABULAR_EVAL_ID)},
    {"header",8,0,1,0,0,,0,0,Nmdm(augment_utype,exportApproxFormat_TABULAR_HEADER)},
    {"interface_id",8,0,3,0,0,,0,0,Nmdm(augment_utype,exportApproxFormat_TABULAR_IFACE_ID)}
}

KeyWord kw_162[3]  [static]
Initial value:
= {
    {"annotated",8,0,1,0,0,,0,0,Nmdm(utype,exportApproxFormat_TABULAR_ANNOTATED)},
    {"custom_annotated",8,3,1,0,kw_161,0,,0,0,Nmdm(utype,exportApproxFormat_TABULAR_NONE)},
    {"freeform",8,0,1,0,0,,0,0,Nmdm(utype,exportApproxFormat_TABULAR_NONE)}
}

KeyWord kw_163[2]  [static]
Initial value:
= {
    {"dakota",8,0,1,1,0,0,,0,0,Nmdm(type,emulatorType_GP_EMULATOR)},
    {"surfpack",8,0,1,1,0,0,,0,0,Nmdm(type,emulatorType_KRIGING_EMULATOR)}
}

KeyWord kw_164[3]  [static]
Initial value:
= {
    {"eval_id",8,0,2,0,0,,0,0,Nmdm(augment_utype,importBuildFormat_TABULAR_EVAL_ID)},
    {"header",8,0,1,0,0,,0,0,Nmdm(augment_utype,importBuildFormat_TABULAR_HEADER)},
    {"interface_id",8,0,3,0,0,,0,0,Nmdm(augment_utype,importBuildFormat_TABULAR_IFACE_ID)}
}

KeyWord kw_165[4]  [static]
Initial value:
= {
    {"active_only",8,0,2,0,0,,0,0,Nmdm(true,importBuildActive)},
    {"annotated",8,0,1,0,0,,0,0,Nmdm(utype,importBuildFormat_TABULAR_ANNOTATED)},
    {"custom_annotated",8,3,1,0,kw_164,0,,0,0,Nmdm(utype,importBuildFormat_TABULAR_NONE)},
    {"freeform",8,0,1,0,0,,0,0,Nmdm(utype,importBuildFormat_TABULAR_NONE)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_166[7] [static]
Initial value:

= {
    {"export_approx_points_file":11,3,4,0,kw_162,0,0,0,0,N_mdm(str,exportApproxPtsFile)},
    {"export_points_file":3,3,4,0,kw_162,0,0,0,0,N_mdm(str,exportApproxPtsFile)},
    {"gaussian_process":8,2,1,0,kw_163},
    {"import_build_points_file":11,4,3,0,kw_165,0,0,0,0,N_mdm(str,importBuildPtsFile)},
    {"import_points_file":3,4,3,0,kw_165,0,0,0,0,N_mdm(str,importBuildPtsFile)},
    {"kriging":0,2,1,0,kw_163,0,0,0,0,N_mdm(true,methodUseDerivsFlag)}
}

KeyWord kw_167[9] [static]
Initial value:

= {
    {0,0,1,0,0,0,kw_27},
    {0,0,4,0,0,kw_32},
    {"ea":8,0,3,0,0,0,0,0,0,N_mdm(utype,subMethod_SUBMETHOD_EA)},
    {"ego":8,3,0,0,0,0,0,0,0,N_mdm(utype,subMethod_SUBMETHOD_EGO)},
    {"lhs":8,0,3,0,0,0,0,0,0,N_mdm(utype,subMethod_SUBMETHOD_LHS)},
    {"response_levels":14,2,4,0,kw_160,0,0,0,0,N_mdm(resplevels,responseLevels)},
    {"samples":9,0,1,0,0,0,0,0,0,N_mdm(int,numSamples)},
    {"sbo":8,3,1,0,kw_166,0,0,0,0,N_mdm(utype,subMethod_SUBMETHOD_SBO)},
    {"seed":0x19,0,2,0,0,0,0,0,0,N_mdm(pint,randomSeed)}
}

KeyWord kw_168[2] [static]
Initial value:

= {
    {"mt19937":8,0,1,0,0,0,0,0,0,N_mdm(lit,rngName_mt19937)},
    {"rnum2":8,0,1,0,0,0,0,0,0,N_mdm(lit,rngName_rnum2)}
}

KeyWord kw_169[3] [static]
Initial value:

= {
    {"eval_id":8,0,2,0,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_EVAL_ID)},
    {"header":8,0,1,0,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_HEADER)},
    {"interface_id":8,0,3,0,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_IFACE_ID)}
}

KeyWord kw_170[3] [static]
Initial value:

= {
    {"annotated":8,0,1,0,0,0,0,0,0,N_mdm(utype,exportApproxFormat_TABULAR_ANNOTATED)},
    {"custom_annotated":8,3,1,0,kw_169,0,0,0,0,N_mdm(utype,exportApproxFormat_TABULAR_NONE)},
    {"freeform":8,0,1,0,0,0,0,0,0,N_mdm(utype,exportApproxFormat_TABULAR_NONE)}
}
KeyWord kw_171[2]  [static]
Initial value:
= {
  {"dakota",8,0,1,0,0,0,0,N_mdm(type,emulatorType,GP_EMULATOR)},
  {"surfpack",8,0,1,0,0,0,0,N_mdm(type,emulatorType,KRIGING_EMULATOR)}
}

KeyWord kw_172[3]  [static]
Initial value:
= {
  {"eval_id",8,0,2,0,0,0,0,0,N_mdm(augment_utype,importBuildFormat,TABULAR_EVAL_ID)},
  {"interface_id",8,0,3,0,0,0,0,0,N_mdm(augment_utype,importBuildFormat,INTERFACE_ID)}
}

KeyWord kw_173[4]  [static]
Initial value:
= {
  {"active_only",8,0,2,0,0,0,0,0,N_mdm(true,importBuildActive)},
  {"annotated",8,0,1,0,0,0,0,0,N_mdm(utype,importBuildFormat,TABULAR_ANNOTATED)},
  {"custom_annotated",8,3,1,0,kw_172,0,0,0,N_mdm(utype,importBuildFormat,TABULAR_NONE)},
  {"freeform",8,0,1,0,0,0,0,0,N_mdm(utype,importBuildFormat,TABULAR_NONE)}
}

KeyWord kw_174[7]  [static]
Initial value:
= {
  {"export_approx_points_file",11,3,4,0,kw_170,0,0,0,0,N_mdm(str,exportApproxPtsFile)},
  {"export_points_file",3,3,4,0,kw_170,0,0,0,0,N_mdm(str,exportPtsFile)},
  {"gaussian_process",8,2,1,0,kw_171},
  {"import_build_points_file",11,4,3,0,kw_173,0,0,0,0,N_mdm(str,importBuildPtsFile)},
  {"import_points_file",3,4,3,0,kw_173,0,0,0,0,N_mdm(str,importBuildPtsFile)},
  {"kriging",3,2,1,0,kw_171,0,0,0,0,N_mdm(str,importBuildPtsFile)},
  {"use_derivatives",8,0,2,0,0,0,0,0,N_mdm(true,methodUseDerivsFlag)}
}

KeyWord kw_175[11]  [static]
Initial value:
= {
  {"convergence_tolerance",10,0,4,0,0,0,0,0,0,N_mdm(Real,convergenceTolerance)},
  {"ea",8,0,6,0,0,0,0,0,0,N_mdm(utype,subMethod,SUBMETHOD_EA)},
  {"ego",8,7,6,0,kw_174,0,0,0,0,N_mdm(utype,subMethod,SUBMETHOD_EGO)},
  {"lhs",8,0,6,0,0,0,0,0,0,N_mdm(utype,subMethod,SUBMETHOD_LHS)},
  {"max_function_evaluations",0x29,0,5,0,0,0,0,0,0,N_mdm(nnint,maxFunctionEvaluations)},
  {"max_iterations",0x29,0,3,0,0,0,0,0,0,N_mdm(nnint,maxIterations)},
  {"rng",8,2,7,0,kw_168},
  {"samples",9,0,1,0,0,0,0,0,0,N_mdm(int,numSamples)},
  {"sbo",11,5,0,kw_174,0,0,0,0,N_mdm(utype,subMethod,SUBMETHOD_SBO)},
  {"seed",5x19,0,2,0,0,0,0,0,0,N_mdm(pint,randomSeed)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw\_176[2] [static]
Initial value:
= {
    "complementary", 8, 0, 1, 0, 0, 0, 0, N\_mdm(type, distributionType, COMPLEMENTARY),
    "cumulative", 8, 0, 1, 0, 0, 0, 0, N\_mdm(type, distributionType, CUMULATIVE)
}

KeyWord kw\_177[1] [static]
Initial value:
= {
    "num\_gen\_reliability\_levels", 13, 0, 1, 0, 0, 0, N\_mdm(num\_resplevs, genReliabilityLevels)
}

KeyWord kw\_178[1] [static]
Initial value:
= {
    "num\_probability\_levels", 13, 0, 1, 0, 0, 0, N\_mdm(num\_resplevs, probabilityLevels)
}

KeyWord kw\_179[3] [static]
Initial value:
= {
    "distribution", 8, 2, 1, 0, kw\_176,
    "gen\_reliability\_levels", 14, 1, 3, 0, kw\_177, 0, 0, 0, N\_mdm(resplevs, genReliabilityLevels),
    "probability\_levels", 14, 1, 2, 0, kw\_178, 0, 0, 0, N\_mdm(resplevs01, probabilityLevels)
}

KeyWord kw\_180[3] [static]
Initial value:
= {
    "eval\_id", 8, 0, 2, 0, 0, 0, 0, 0, N\_mdm(augment\_utype, exportApproxFormat, TABULAR, EVAL, ID),
    "header", 8, 0, 1, 0, 0, 0, 0, N\_mdm(augment\_utype, exportApproxFormat, TABULAR, HEADER),
    "interface\_id", 8, 0, 3, 0, 0, 0, 0, 0, N\_mdm(augment\_utype, exportApproxFormat, TABULAR, IFACE, ID)
}

KeyWord kw\_181[3] [static]
Initial value:
= {
    "annotated", 8, 0, 1, 0, 0, 0, 0, 0, N\_mdm(utype, exportApproxFormat, TABULAR, ANNOTATED),
    "custom\_annotated", 8, 3, 1, 0, kw\_180, 0, 0, 0, N\_mdm(utype, exportApproxFormat, TABULAR, NONE),
    "freeform", 8, 0, 1, 0, 0, 0, 0, 0, N\_mdm(utype, exportApproxFormat, TABULAR, NONE)
}
KeyWord kw_182[3] [static]
Initial value:
= {
    {"eval_id",8,0,2,0,0,0.,0.,0.,0.,N_mdm(augment_utype,importBuildFormat_TABULAR_EVAL_ID)},
    {"header",8,0,1,0,0,0.,0.,0.,0.,N_mdm(augment_utype,importBuildFormat_TABULAR_HEADER)},
    {"interface_id",8,0,3,0,0,0.,0.,0.,0.,N_mdm(augment_utype,importBuildFormat_TABULAR_INTERFACE_ID)}
}

KeyWord kw_183[4] [static]
Initial value:
= {
    {"active_only",8,0,2,0,0,0.,0.,0.,0.,N_mdm(true,importBuildActive)},
    {"annotated",8,0,1,0,0,0.,0.,0.,0.,N_mdm(utype,importBuildFormat_TABULAR_ANNOTATED)},
    {"custom_annotated",8,3,1,0,0,0.,0.,0.,0.,0.,N_mdm(utype,importBuildFormat_TABULAR_ANNOTATED)},
    {"freeform",8,0,1,0,0,0.,0.,0.,0.,N_mdm(utype,importBuildFormat_TABULAR_NONE)}
}

KeyWord kw_184[2] [static]
Initial value:
= {
    {"parallel",8,0,1,1,0,0,0.,0.,0.,0.,N_mdm(type,responseLevelTargetReduce_SYSTEM_PARALLEL)}
    {"series",8,0,1,1,0,0,0.,0.,0.,0.,N_mdm(type,responseLevelTargetReduce_SYSTEM SERIES)}
}

KeyWord kw_185[3] [static]
Initial value:
= {
    {"gen_reliabilities",8,0,1,1,0,0,0.,0.,0.,0.,N_mdm(type,responseLevelTarget_GEN_RELIABILITIES)},
    {"probabilities",8,0,1,1,0,0,0.,0.,0.,0.,N_mdm(type,responseLevelTarget_PROBABILITIES)},
    {"system",8,2,2,0,kw_184}
}

KeyWord kw_186[2] [static]
Initial value:
= {
    {"compute",8,3,2,0,kw_185},
    {"num_response_levels",13,0,1,0,0,0.,0.,0.,0.,N_mdm(num_resplevs, responseLevels)}
}

KeyWord kw_187[2] [static]
Initial value:
= {
    {"mt19937",8,0,1,1,0,0,0.,0.,0.,0.,N_mdm(lit,rngName_mt19937)},
    {"rnum2",8,0,1,1,0,0,0.,0.,0.,0.,N_mdm(lit,rngName_rnum2)}
}
KeyWord kw_188[19]  [static]
Initial value:
= {
  {0,0,1,0,0,kw.27},
  {0,0,3,0,0,kw.179},
  "convergence_tolerance",10,0,11,0,0,.0,0,0,N,mdm(Real,convergenceTolerance),
  "dakota",8,0,3,0,0,.0,0,0,0,N,mdm(type,emulatorType_GP_EMULATOR),
  "export_approx_points_file",11,3,5,0,kw.181,0,.0,0,0,N,mdm(str,exportApproxPtsFile),
  "export_points_file",3,3,5,0,kw.181,0,.0,.0,0,N,mdm(str,exportPointsFile),
  "import_build_points_file",11,4,4,0,kw.183,0,.0,0,0,N,mdm(str,importBuildPntsFile),
  "import_points_file",3,4,4,0,kw.183,0,.0,.0,0,N,mdm(str,importPointsFile),
  "initial_samples",9,0,1,0,0,.0,0,0,0,N,mdm(int,numSamples),
  "max_iterations",0x29,0,10,0,0,.0,0,0,0,N,mdm(nnint,maxIterations),
  "response_levels",14,2,9,0,kw.186,0,.0,.0,0,N,mdm(resplevs,responseLevels),
  "seed",0x19,0,7,0,0,.0,0,0,0,N,mdm(pint,randomSeed),
  "surfpack",8,0,2,0,0,.0,0,0,0,N,mdm(type,emulatorType_KRIGING_EMULATOR),
  "u_gaussian_process",8,0,2,1,0,0,.0,.0,.0,0,N,mdm(utype,reliabilitySearchType_EGRA_U),
  "u_kriging",8,0,2,1,0,0,.0,.0,.0,0,N,mdm(utype,reliabilitySearchType_EGRA_U),
  "use_derivatives",8,0,0,6,0,0,.0,.0,.0,0,N,mdm(true,methodUseDerivsFlag),
  "x_gaussian_process",8,0,2,1,0,0,.0,.0,0,0,N,mdm(type,emulatorType_KRIGING_EMULATOR),
  "x_kriging",8,0,2,1,0,0,.0,.0,.0,0,N,mdm(type,emulatorType_KRIGING_EMULATOR)
}

KeyWord kw_189[2]  [static]
Initial value:
= {
  "master",8,0,1,0,0,.0,0,0,0,N,mdm(type,iteratorScheduling_MASTER_SCHEDULING),
  "peer",8,0,1,0,0,.0,0,0,0,N,mdm(type,iteratorScheduling_PEER_SCHEDULING)
}

KeyWord kw_190[3]  [static]
Initial value:
= {
  "iterator_scheduling",8,2,2,0,kw.189,
  "iterator_servers",0x19,0,1,0,0,.0,0,0,0,N,mdm(pint,iteratorServers),
  "processors_per_iterator",0x19,0,3,0,0,.0,0,0,0,N,mdm(pint,procsPerIterator)
}

KeyWord kw_191[1]  [static]
Initial value:
= {
  "model_pointer_list",11,0,1,0,0,.0,.0,0,0,N,mdm(strL,hybridModelPointers)
}

KeyWord kw_192[2]  [static]
Initial value:
= {
  "method_name_list",15,1,1,1,kw.191,0,.0,0,0,N,mdm(strL,hybridMethodNames),
  "method_pointer_list",15,0,1,1,0,0,.0,0,0,N,mdm(strL,hybridMethodPointers)
}
KeyWord kw_193[1]  [static]
Initial value:
= {
    "global_model_pointer", 11, 0, 1, 0, 0, 0, 0, 0, Nmdm(str, hybridGlobalModelPointer)
}

KeyWord kw_194[1]  [static]
Initial value:
= {
    "local_model_pointer", 11, 0, 1, 0, 0, 0, 0, 0, Nmdm(str, hybridLocalModelPointer)
}

KeyWord kw_195[5]  [static]
Initial value:
= {
    "global_method_name", 11, 1, 1, kw_193, 0, 0, 0, 0, Nmdm(str, hybridGlobalMethodName),
    "global_method_pointer", 11, 0, 1, 0, 0, 0, 0, 0, Nmdm(str, hybridGlobalMethodPointer),
    "local_method_name", 11, 1, 2, kw_194, 0, 0, 0, 0, Nmdm(str, hybridLocalMethodName),
    "local_method_pointer", 11, 0, 2, 2, 0, 0, 0, 0, Nmdm(str, hybridLocalMethodPointer),
    "local_search_probability", 10, 0, 3, 0, 0, 0, 0, 0, Nmdm(Real, hybridLSProb)
}

KeyWord kw_196[1]  [static]
Initial value:
= {
    "model_pointer_list", 11, 0, 0, 0, 0, 0, 0, 0, Nmdm(strL, hybridModelPointers)
}

KeyWord kw_197[2]  [static]
Initial value:
= {
    "method_name_list", 15, 1, 1, kw_196, 0, 0, 0, 0, Nmdm(strL, hybridMethodNames),
    "method_pointer_list", 15, 0, 1, 0, 0, 0, 0, 0, Nmdm(strL, hybridMethodPointers)
}

KeyWord kw_198[6]  [static]
Initial value:
= {
    0, 0, 3, 0, 0, kw_190,
    "collaborative", 8, 2, 1, kw_192, 0, 0, 0, 0, Nmdm(utype, subMethod_SUBMETHOD_COLLABORATIVE),
    "coupled", 0, 5, 1, 1, kw_195, 0, 0, 1, Nmdm(utype, subMethod_SUBMETHOD_EMBEDDED),
    "embedded", 8, 5, 1, 1, kw_195, 0, 0, 0, 0, Nmdm(utype, subMethod_SUBMETHOD_EMBEDDED),
    "sequential", 8, 2, 1, kw_197, 0, 0, 0, 0, Nmdm(utype, subMethod_SUBMETHOD_SEQUENTIAL),
    "uncoupled", 0, 2, 1, 1, kw_197, 0, 0, -1, Nmdm(utype, subMethod_SUBMETHOD_SEQUENTIAL)
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_199[2] [static]
Initial value:

```csharp
    = {
        {"parallel", 8, 0, 1, 1, 0, 0, 0, 0, 0, N_mdm(type, responseLevelTargetReduce_SYSTEM_PARALLEL)},
        {"series", 8, 0, 1, 1, 0, 0, 0, 0, 0, N_mdm(type, responseLevelTargetReduce_SYSTEM_SERIES)}
    }
```

KeyWord kw_200[3] [static]
Initial value:

```csharp
    = {
        {"gen_reliabilities", 8, 0, 1, 1, 0, 0, 0, 0, 0, N_mdm(type, responseLevelTarget_GEN_RELIABILITIES)},
        {"probabilities", 8, 0, 1, 1, 0, 0, 0, 0, 0, N_mdm(type, responseLevelTarget_PROBABILITIES)},
        {"system", 8, 2, 2, 0, kw_199}
    }
```

KeyWord kw_201[2] [static]
Initial value:

```csharp
    = {
        {"compute", 8, 3, 2, 0, kw_200},
        {"num_response_levels", 13, 0, 1, 0, 0, 0, 0, 0, N_mdm(num_resplevs, responseLevels)}
    }
```

KeyWord kw_202[12] [static]
Initial value:

```csharp
    = {
        {0, 0, 1, 0, 0, kw_27},
        {0, 0, 4, 0, kw_32},
        {"adapt_import", 8, 0, 3, 1, 0, 0, 0, 0, 0, N_mdm(utype, integrationRefine_AIS)},
        {"convergence_tolerance", 10, 0, 7, 0, 0, 0, 0, 0, N_mdm(Real, convergenceTolerance)},
        {"import", 8, 0, 3, 1, 0, 0, 0, 0, 0, N_mdm(utype, integrationRefine_AIS)},
        {"initial_samples", 1, 0, 1, 0, 0, 0, 0, 5, N_mdm(int, numSamples)},
        {"max_iterations", 0x29, 0, 6, 0, 0, 0, 0, 0, N_mdm(nnint, maxIterations)},
        {"mm_adapt_import", 8, 0, 3, 1, 0, 0, 0, 0, 0, N_mdm(utype, integrationRefine_MM_AIS)},
        {"refinement_samples", 13, 0, 4, 0, 0, 0, 0, 0, N_mdm(ivec, refineSamples)},
        {"response_levels", 14, 2, 5, 0, kw_201, 0, 0, 0, 0, N_mdm(resplevs, responseLevels)},
        {"samples", 9, 0, 1, 0, 0, 0, 0, 0, N_mdm(int, numSamples)},
        {"seed", 0x19, 0, 2, 0, 0, 0, 0, 0, N_mdm(pint, randomSeed)}
    }
```

KeyWord kw_203[3] [static]
Initial value:

```csharp
    = {
        {"eval_id", 8, 0, 2, 0, 0, 0, 0, 0, 0, N_mdm(augment_utype, pstudyFileFormat_TABULAR_EVAL_ID)},
        {"header", 8, 0, 1, 0, 0, 0, 0, 0, 0, N_mdm(augment_utype, pstudyFileFormat_TABULAR_HEADER)},
        {"interface_id", 8, 0, 3, 0, 0, 0, 0, 0, 0, N_mdm(augment_utype, pstudyFileFormat_TABULAR_IFACE_ID)}
    }
```
KeyWord kw_204[4] [static]
Initial value:

```c
= {
  "active_only", 8, 0, 2, 0, 0, 0, 0, 0, N_mdm(true, pstudyFileActive),
  "annotated", 8, 0, 1, 0, 0, 0, 0, N_mdm(type, pstudyFileFormat_TABULAR_ANNOTATED),
  "custom_annotated", 8, 3, 1, kw_203, 0, 0, 0, N_mdm(utype, pstudyFileFormat_TABULAR_NONE),
  "freeform", 8, 0, 1, 0, 0, 0, 0, N_mdm(utype, pstudyFileFormat_TABULAR_NONE)
}
```

KeyWord kw_205[3] [static]
Initial value:

```c
= {
  0, 0, 1, 0, 0, kw_27},
  "import_points_file", 11, 4, 1, 1, kw_204, 0, 0, 0, N_mdm(str, pstudyFilename),
  "list_of_points", 14, 0, 1, 0, 0, 0, 0, N_mdm(RealDL, listOfPoints)
}
```

KeyWord kw_206[2] [static]
Initial value:

```c
= {
  "complementary", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, distributionType_COMPLEMENTARY),
  "cumulative", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, distributionType_CUMULATIVE)
}
```

KeyWord kw_207[1] [static]
Initial value:

```c
= {
  "num_gen_reliability_levels", 13, 0, 1, 0, 0, 0, 0, 0, N_mdm(num_resplevs, genReliabilityLevels)
}
```

KeyWord kw_208[1] [static]
Initial value:

```c
= {
  "num_probability_levels", 13, 0, 1, 0, 0, 0, 0, 0, N_mdm(num_resplevs, probabilityLevels)
}
```

KeyWord kw_209[2] [static]
Initial value:

```c
= {
  "parallel", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, responseLevelTargetReduce_SYSTEM_PARALLEL),
  "series", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, responseLevelTargetReduce_SYSTEM_SERIES)
}
```
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_210[3] [static]
Initial value:

```plaintext
= {
    "gen_reliabilities",8,0,1,1,0,0,0,0,0,N_mdm(type,responseLevelTarget,GEN_RELIABILITIES),
    "probabilities",8,0,1,1,0,0,0,0,0,N_mdm(type,responseLevelTarget,PROBABILITIES),
    "system",8,2,2,0,kw_209,
}
```

KeyWord kw_211[2] [static]
Initial value:

```plaintext
= {
    "compute",8,3,2,0,kw_210,
    "num_response_levels",13,0,1,0,0,0,0,0,N_mdm(num_resplevs, responseLevels),
}
```

KeyWord kw_212[7] [static]
Initial value:

```plaintext
= {
    0,0,1,0,0,kw_27,
    "distribution",8,2,5,0,kw_206,
    "gen_reliability_levels",14,1,4,0,kw_207,0,0,0,0,N_mdm(resplevs, genReliabilityLevels),
    "nip",8,0,1,0,0,0,0,0,N_mdm(utype, subMethod, SUBMETHOD, HIP),
    "probability_levels",14,1,3,0,kw_208,0,0,0,0,N_mdm(resplevs01, probabilityLevels),
    "response_levels",14,2,2,0,kw_211,0,0,0,0,N_mdm(resplevs, responseLevels),
    "sqp",8,0,1,0,0,0,0,0,N_mdm(utype, subMethod, SUBMETHOD, SQP),
}
```

KeyWord kw_213[4] [static]
Initial value:

```plaintext
= {
    0,0,1,0,0,kw_27,
    "convergence_tolerance",10,0,2,0,0,0,0,0,N_mdm(Real, convergenceTolerance),
    "nip",8,0,1,0,0,0,0,0,N_mdm(utype, subMethod, SUBMETHOD, HIP),
    "sqp",8,0,1,0,0,0,0,0,N_mdm(utype, subMethod, SUBMETHOD, SQP),
}
```

KeyWord kw_214[5] [static]
Initial value:

```plaintext
= {
    "adapt_import",8,0,1,1,0,0,0,0,0,N_mdm(utype, integrationRefine, AIS),
    "import",8,0,1,1,0,0,0,0,0,N_mdm(utype, integrationRefine, IS),
    "mm_adapt_import",8,0,1,1,0,0,0,0,0,N_mdm(utype, integrationRefine, MMAIS),
    "refinement_samples",13,0,2,0,0,0,0,0,N_mdm(ivec, refineSamples),
    "seed",0x19,0,1,0,0,0,0,0,0,N_mdm(pint, randomSeed),
```
KeyWord kw_215[4]  [static]
Initial value:

```c
= {
    {"first_order",8,0,1,0,0.,0.,N,mdm(lit,reliabilityIntegration_first_order)},
    {"probability_refinement",8,5,2,0,kw_214},
    {"sample_refinement",0,5,2,0,kw_214,0.,0.,0.,-1},
    {"second_order",8,0,1,0,0.,0.,0,N,mdm(lit,reliabilityIntegration_second_order)}
}
```

KeyWord kw_216[10]  [static]
Initial value:

```c
= {
    {"integration",8,4,3,0,kw_215},
    {"nip",8,0,2,0,0.,0.,0.,N,mdm(utype,subMethod_SUBMETHOD_NIP)},
    {"no_approx",8,0,1,0,0.,0.,0.,N,mdm(utype,reliabilitySearchType_NO_APPROX)},
    {"sqp",8,0,2,0,0.,0.,0.,0,N,mdm(utype,subMethod_SUBMETHOD_SQP)},
    {"u_taylor_mean",8,0,1,1,0,0.,0.,0.,N,mdm(utype,reliabilitySearchType_AMV_U)},
    {"u_taylor_mpp",8,0,1,0,0.,0.,0.,N,mdm(utype,reliabilitySearchType_AMV_PLUS_U)},
    {"x_taylor_mean",8,0,1,1,0,0.,0.,0.,N,mdm(utype,reliabilitySearchType_AMV_X)},
    {"u_two_point",8,0,1,1,0,0.,0.,0.,N,mdm(utype,reliabilitySearchType_TANA_U)},
    {"x_two_point",8,0,1,1,0,0.,0.,0.,N,mdm(utype,reliabilitySearchType_TANA_X)}
}
```

KeyWord kw_217[1]  [static]
Initial value:

```c
= {
    {"num_reliability_levels",13,0,1,0,0.,0.,0.,N,mdm(num,resplevs,reliabilityLevels)}
}
```

KeyWord kw_218[2]  [static]
Initial value:

```c
= {
    {"parallel",8,0,1,1,0,0.,0.,0.,N,mdm(type,responseLevelTargetReduce_SYSTEM_PARALLEL)},
    {"series",8,0,1,1,0,0.,0.,0.,N,mdm(type,responseLevelTargetReduce_SYSTEM_SERIES)}
}
```

KeyWord kw_219[4]  [static]
Initial value:

```c
= {
    {"gen_reliabilities",8,0,1,1,0,0.,0.,0.,N,mdm(type,responseLevelTarget_GEN_RELIABILITIES)},
    {"probabilities",8,0,1,1,0,0.,0.,0.,N,mdm(type,responseLevelTarget_PROBABILITIES)},
    {"reliabilities",8,0,1,1,0,0.,0.,0.,N,mdm(type,responseLevelTarget_RELIABILITIES)},
    {"system",8,2,2,0,kw_218}
}
```
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_220[2] [static]
Initial value:
= {
    {"compute",8,4,2,0,kw_219},
    {"num_response_levels",13,0,1,0,0,0,0,0,N_mdm(num_resplevs,responseLevels)}
}

KeyWord kw_221[7] [static]
Initial value:
= {
    {0,0,1,0,0,0,0,0,kw_27},
    {0,0,3,0,0,kw_179},
    {"convergence_tolerance",10,0,5,0,0,0,0,0,N_mdm(Real,convergenceTolerance)},
    {"max_iterations",0x29,0,4,0,0,0,0,0,N_mdm(nnint,maxIterations)},
    {"mpp_search",8,10,1,0,kw_216},
    {"reliability_levels",14,1,3,0,0,0,0,0,N_mdm(resplevs,reliabilityLevels)},
    {"response_levels",14,2,2,0,kw_220,0,0,0,0,N_mdm(resplevs,responseLevels)}
}

KeyWord kw_222[11] [static]
Initial value:
= {
    {0,0,1,0,0,0,0,0,kw_27},
    {"display_all_evaluations",8,0,7,0,0,0,0,0,N_mdm(true,showAllEval)},
    {"display_format",11,0,4,0,0,0,0,0,N_mdm(str,displayFormat)},
    {"function_precision",10,0,1,0,0,0,0,0,N_mdm(Real,functionPrecision)},
    {"history_file",11,0,3,0,0,0,0,0,N_mdm(str,historyFile)},
    {"max_function_evaluations",0x29,0,9,0,0,0,0,0,N_mdm(nnint,maxFunctionEvaluations)},
    {"max_iterations",0x29,0,8,0,0,0,0,0,N_mdm(nnint,maxIterations)},
    {"neighbor_order",0x19,0,6,0,0,0,0,0,N_mdm(pint,neighborOrder)},
    {"scaling",8,0,10,0,0,0,0,0,N_mdm(true,methodScaling)},
    {"seed",0x19,0,2,0,0,0,0,0,N_mdm(pint,randomSeed)},
    {"variable_neighborhood_search",10,0,5,0,0,0,0,0,N_mdm(Real,vns)}
}

KeyWord kw_223[2] [static]
Initial value:
= {
    {"num_offspring",0x19,0,2,0,0,0,0,0,N_mdm(pintz,numOffspring)},
    {"num_parents",0x19,0,1,0,0,0,0,0,N_mdm(pintz,numParents)}
}

KeyWord kw_224[5] [static]
Initial value:
= {
    {"crossover_rate",10,0,2,0,0,0,0,0,N_mdm(litz,TYPE_DATA_crossoverType,null.crossover)},
    {"multi_point_binary",9,0,1,0,0,0,0,0,N_mdm(ilit2p,TYPE_DATA_crossoverType.multi_point_binary)},
    {"multi_point_parameterized_binary",9,0,1,1,0,0,0,0,N_mdm(ilit2p,TYPE_DATA_crossoverType.multi_point_parameterized_binary)},
    {"multi_point_real",9,0,1,1,0,0,0,0,N_mdm(ilit2p,TYPE_DATA_crossoverType.multi_point_real)},
    {"shuffle_random",8,2,1,1,kw_223,0,0,0,0,N_mdm(litz,TYPE_DATA_crossoverType_shuffle_random)}
}
KeyWord kw_225[3]  [static]
Initial value:

    = {
        {"flat_file",11,0,1,0,0,0,0,N_mdm(slit2,TYPE_DATA,initializationType,flat_file)},
        {"simple_random",8,0,1,1,0,0,0,0,N_mdm(lit,initializationType,random)},
        {"unique_random",8,0,1,1,0,0,0,0,N_mdm(lit,initializationType,unique_random)}
    }

KeyWord kw_226[1]  [static]
Initial value:

    = {
        {"mutation_scale",10,0,1,0,0,0,0,0,N_mdm(Real01,mutationScale)}
    }

KeyWord kw_227[6]  [static]
Initial value:

    = {
        {"bit_random",8,0,1,0,0,0,0,0,N_mdm(lit,mutationType,bit_random)},
        {"mutation_rate",10,0,2,0,0,0,0,0,N_mdm(litz,TYPE_DATA,mutationType,null_mutation)},
        {"offset_cauchy",8,1,1,kw_226,0,0,0,0,N_mdm(litc,TYPE_DATA,mutationType,offset_cauchy)},
        {"offset_normal",8,1,1,kw_226,0,0,0,0,N_mdm(litc,TYPE_DATA,mutationType,offset_normal)},
        {"offset_uniform",8,1,1,kw_226,0,0,0,0,N_mdm(litc,TYPE_DATA,mutationType,offset_uniform)},
        {"replace_uniform",8,0,1,1,0,0,0,0,N_mdm(lit,mutationType,replace_uniform)}
    }

KeyWord kw_228[8]  [static]
Initial value:

    = {
        {"convergence_tolerance",10,0,8,0,0,0,0,0,N_mdm(Real,convergenceTolerance)},
        {"crossover_type",8,5,5,kw_224},
        {"initialization_type",8,3,4,kw_225},
        {"log_file",11,0,2,0,0,0,0,0,N_mdm(str,logFile)},
        {"mutation_type",8,6,6,kw_227},
        {"population_size",8x29,0,1,0,0,0,0,0,N_mdm(nnint,populationSize)},
        {"print_each_pop",8,0,3,0,0,0,0,0,N_mdm(true,printPopFlag)},
        {"seed",8x19,0,7,0,0,0,0,0,N_mdm(pint,randomSeed)}
    }

KeyWord kw_229[3]  [static]
Initial value:

    = {
        {"metric_tracker",8,0,1,1,0,0,0,0,N_mdm(lit,convergenceType,metric_tracker)},
        {"num_generations",8x29,0,3,0,0,0,0,0,N_mdm(sizet,numGenerations)},
        {"percent_change",10,0,2,0,0,0,0,0,N_mdm(Realz,convergenceTolerance)}
    }
12.1. DAKOTA NAMESPACE REFERENCE

**KeyWord kw_230[2]**  
[static]  
Initial value:  
= {  
  {"domination_count",8,0,1,0,0,0,0,0,Nmdm(lit,fitnessType,domination_count)},  
  {"layer_rank",8,0,1,0,0,0,0,0,Nmdm(lit,fitnessType,layer_rank)}  
}

**KeyWord kw_231[1]**  
[static]  
Initial value:  
= {  
  {"num_designs",0x29,0,1,0,0,2,0,0,0,Nmdm(pintz,numDesigns)}  
}

**KeyWord kw_232[3]**  
[static]  
Initial value:  
= {  
  {"distance",14,0,1,0,0,0,0,0,0,Nmdm(Reallit,TYPE_DATA,nichingType,distance)},  
  {"max_designs",14,1,1,kw_231,0,0,0,0,Nmdm(Reallit,TYPE_DATA,nichingType,max_designs)},  
  {"radial",14,0,1,0,0,0,0,0,0,Nmdm(Reallit,TYPE_DATA,nichingType_radial)}  
}

**KeyWord kw_233[1]**  
[static]  
Initial value:  
= {  
  {"orthogonal_distance",14,0,1,0,0,0,0,0,0,Nmdm(Reallit,TYPE_DATA,postProcessorType,distance,postprocessor)}  
}

**KeyWord kw_234[2]**  
[static]  
Initial value:  
= {  
  {"shrinkage_fraction",10,0,1,0,0,0,0,0,0,Nmdm(Real101,shrinkagePercent)},  
  {"shrinkage_percentage",2,0,1,0,0,0,0,-1,0,Nmdm(Real101,shrinkagePercent)}  
}

**KeyWord kw_235[4]**  
[static]  
Initial value:  
= {  
  {"below_limit",10,2,1,1,kw_234,0,0,0,0,Nmdm(litp,TYPE_DATA,replacementType,below_limit)},  
  {"elitist",8,0,1,0,0,0,0,0,Nmdm(lit,replacementType,elitist)},  
  {"roulette_wheel",8,0,1,0,0,0,0,0,Nmdm(lit,replacementType,roulette_wheel)},  
  {"unique_roulette_wheel",8,0,1,0,0,0,0,0,Nmdm(lit,replacementType,unique_roulette_wheel)}  
}
KeyWord kw_236[19] [static]
Initial value:
= {
    {0,0,1,0,0,kw_27},
    {0,0,8,0,0,kw_229},
    {"convergence_type",8,3,0,0,kw_229},
    {"fitness_type",8,2,1,0,kw_230},
    {"linear_equality_constraint_matrix",14,0,12,0,0,0,0,0,N_mdm(RealDL, linearEqConstraintCoeffs)},
    {"linear_equality_scales",14,0,15,0,0,0,0,0,N_mdm(RealDL,linearEqScales)},
    {"linear_equality_targets",14,0,13,0,0,0,0,0,N_mdm(RealDL,linearEqTargets)},
    {"max_function_evaluations",0,0,16,0,0,0,0,0,N_mdm(nnint,maxFunctionEvaluations)},
    {"max_iterations",0,0,6,0,0,0,0,0,N_mdm(nnint,maxIterations)},
    {"method_name",11,1,1,0,kw_237},
    {"method_pointer",11,0,1,1,0,0,0,0,N_mdm(str,subMethodName)},
    {"partitions",13,0,1,1,0,0,0,0,N_mdm(usharray,varPartitions)},
    {"replacement_type",8,1,5,0,kw_233},
    {"scaling",8,5,17,0,0,0,0,0,N_mdm(true,methodScaling)}
}

KeyWord kw_237[1] [static]
Initial value:
= {
    {"model_pointer",11,0,1,0,0,0,0,0,N_mdm(str,subModelPointer)}
}

KeyWord kw_238[1] [static]
Initial value:
= {
    {"seed",9,0,1,0,0,0,0,0,N_mdm(int,randomSeed)}
}

KeyWord kw_239[5] [static]
Initial value:
= {
    {0,0,3,0,0,kw_190},
    {"method_name",11,1,1,kw_237},
    {"method_pointer",11,0,1,0,0,0,0,0,N_mdm(str,subMethodName)},
    {"partitions",13,0,1,1,0,0,0,0,N_mdm(usharray,varPartitions)},
    {"random_starts",9,1,2,0,kw_238},
    {"starting_points",14,0,5,0,0,0,0,0,N_mdm(RealDL,concurrentParameterSets)}
}

KeyWord kw_240[2] [static]
Initial value:
= {
    {0,0,1,0,0,kw_27},
    {"partitions",13,0,1,1,0,0,0,0,N_mdm(usharray,varPartitions)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_241[2] [static]
Initial value:

= {
  "lhs", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(utype, sampleType_SUBMETHOD_LHS),
  "random", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(utype, sampleType_SUBMETHOD_RANDOM) |

KeyWord kw_242[7] [static]
Initial value:

= {
  0, 0, 1, 0, k, kw_27,
  0, 0, 4, 0, k, kw_32,
  "convergence_tolerance", 10, 0, 5, 0, 0, 0, 0, 0, N_mdm(Real, convergenceTolerance),
  "max_iterations", 0x29, 0, 4, 0, 0, 0, 0, 0, N_mdm(nnint, maxIterations),
  "pilot_samples", 13, 0, 2, 0, 0, 0, 0, 0, N_mdm(szarray, pilotSamples),
  "sample_type", 8, 2, 3, k, kw_241,
  "seed", 0x19, 0, 1, 0, 0, 0, 0, 0, N_mdm(pint, randomSeed)
}

KeyWord kw_243[9] [static]
Initial value:

= {
  0, 0, 1, 0, k, kw_27,
  "convergence_tolerance", 10, 0, 4, 0, 0, 0, 0, 0, N_mdm(Real, convergenceTolerance),
  "max_function_evaluations", 0x29, 0, 6, 0, 0, 0, 0, 0, N_mdm(nnint, maxFunctionEvaluations),
  "min_boxsize_limit", 10, 0, 2, 0, 0, 0, 0, 0, N_mdm(Real, minBoxSize),
  "scaling", 8, 0, 7, 0, 0, 0, 0, 0, N_mdm(true, methodScaling),
  "solution_accuracy", 2, 0, 1, 0, 0, 0, 0, 1, N_mdm(Real, solnTarget),
  "solution_target", 10, 0, 1, 0, 0, 0, 0, 0, N_mdm(Real, solnTarget),
  "volume_boxsize_limit", 10, 0, 3, 0, 0, 0, 0, 0, N_mdm(Real, volBoxSize)
}

KeyWord kw_244[15] [static]
Initial value:

= {
  0, 0, 1, 0, k, kw_27,
  "absolute_conv_tol", 10, 0, 2, 0, 0, 0, 0, 0, N_mdm(Real, absConvTol),
  "covariance", 9, 0, 8, 0, 0, 0, 0, 0, N_mdm(int, covarianceType),
  "false_conv_tol", 10, 0, 6, 0, 0, 0, 0, 0, N_mdm(Real, falseConvTol),
  "function_precision", 10, 0, 1, 0, 0, 0, 0, 0, N_mdm(Real, functionPrecision),
  "initial_tr_radius", 10, 0, 7, 0, 0, 0, 0, 0, N_mdm(Real, initTRadius),
  "max_function_evaluations", 0x29, 0, 13, 0, 0, 0, 0, 0, N_mdm(nnint, maxFunctionEvaluations),
  "max_iterations", 0x29, 0, 11, 0, 0, 0, 0, 0, N_mdm(nnint, maxIterations),
  "regression_diagnostics", 8, 0, 9, 0, 0, 0, 0, 0, N_mdm(true, regressDiag),
  "scaling", 8, 0, 14, 0, 0, 0, 0, 0, N_mdm(true, methodScaling),
  "singular_conv_tol", 10, 0, 4, 0, 0, 0, 0, 0, N_mdm(Real, singConvTol),
  "singular_radius", 10, 0, 5, 0, 0, 0, 0, 0, N_mdm(Real, singRadius),
  "speculative", 8, 0, 12, 0, 0, 0, 0, 0, N_mdm(true, speculativeFlag),
  "x_conv_tol", 10, 0, 3, 0, 0, 0, 0, 0, N_mdm(Real, xConvTol)
}
KeyWord kw_245[14]  [static]
Initial value:
= {
  {0,0,1,0,0,kw_27},
  {"convergence_tolerance",10,0,2,0,0,0,0,0,N_mdm(Real,convergenceTolerance)},
  {"linear_inequality_constraint_matrix",14,0,8,0,0,0,0,0,N_mdm(RealDL,
    linearEqConstraintCoeffs)},
  {"linear_inequality_scale_types",15,0,10,0,0,0,0,0,N_mdm(strL,linearEqScaleTypes)},
  {"linear_inequality_scales",14,0,11,0,0,0,0,0,N_mdm(RealDL,linearEqTargets)},
  {"linear_inequality_targets",14,0,9,0,0,0,0,0,N_mdm(RealDL,linearEqTargets)},
  {"max_iterations",0x29,0,1,0,0,0,0,0,N_mdm(nnint,maxFunctionEvaluations)},
  {"max_function_evaluations",0x29,0,12,0,0,0,0,0,N_mdm(nnint,maxFunctionEvaluations)},
  {"methodScaling",true,methodScaling}}

KeyWord kw_246[2]  [static]
Initial value:
= {
  {"global",8,0,1,0,0,0,0,0,N_mdm(lit,lipschitzType_global)},
  {"local",8,0,1,0,0,0,0,0,N_mdm(lit,lipschitzType_local)}}

KeyWord kw_247[2]  [static]
Initial value:
= {
  {"parallel",8,0,1,0,0,0,0,0,N_mdm(type,responseLevelTargetReduce_SYSTEM_PARALLEL)},
  {"series",8,0,1,0,0,0,0,0,N_mdm(type,responseLevelTargetReduce_SYSTEM_SERIES)}}

KeyWord kw_248[3]  [static]
Initial value:
= {
  {"gen_reliabilities",8,0,1,0,0,0,0,0,N_mdm(type,responseLevelTarget_JEN_RELIABILITIES)},
  {"probabilities",8,0,1,0,0,0,0,0,N_mdm(type,responseLevelTarget_PROBABILITIES)},
  {"system",8,2,2,0,kw_247}}

KeyWord kw_249[2]  [static]
Initial value:
= {
  {"compute",8,3,2,0,kw_248},
  {"num_response_levels",13,0,1,0,0,0,0,0,N_mdm(num_resplevs,responseLevels)}}
KeyWord kw_250[8] [static]
Initial value:
= {
    {0,0,1,0,0,kw,27},
    {0,0,4,0,0,kw,32},
    {"build_samples",9,0,1,0,0.,0.,0.,0,mdm(int,buildSamples)},
    {"lipschitz",8,2,3,0,kw,246},
    {"response_levels",14,2,5,0,kw,249,0.,0.,0.,0,mdm(resplevs,responseLevels)},
    {"samples",1,0,1,0,0.,0.,0.,0.,0,mdm(int,buildSamples)},
    {"samples_on_emulator",9,0,4,0,0.,0.,0.,0,mdm(int,samplesOnEmulator)},
    {"seed",0x19,0,2,0,0.,0.,0.,0,N,mdm(pint,randomSeed)}
}

KeyWord kw_251[1] [static]
Initial value:
= {
    {"num_reliability_levels",13,0,1,0,0.,0.,0.,0,mdm(num_resplevs,reliabilityLevels)}
}

KeyWord kw_252[2] [static]
Initial value:
= {
    {"parallel",8,0,1,1,0,0.,0.,0.,0,mdm(type,responseLevelTargetReduce_SYSTEM_PARALLEL)},
    {"series",8,0,1,1,0,0.,0.,0.,0,mdm(type,responseLevelTargetReduce_SYSTEM_SERIES)}
}

KeyWord kw_253[4] [static]
Initial value:
= {
    {"gen_reliabilities",8,0,1,1,0,0.,0.,0.,0,mdm(type,responseLevelTarget_GEN_RELIABILITIES)},
    {"probabilities",8,0,1,1,0,0.,0.,0.,0,mdm(type,responseLevelTarget_PROBABILITIES)},
    {"reliabilities",8,0,1,1,0,0.,0.,0.,0,mdm(type,responseLevelTarget_RELIABILITIES)},
    {"system",8,2,2,0,kw,252}
}

KeyWord kw_254[2] [static]
Initial value:
= {
    {"compute",8,4,2,0,kw,253},
    {"num_response_levels",13,0,1,0,0.,0.,0.,0,mdm(num_resplevs,responseLevels)}
}

KeyWord kw_255[2] [static]
Initial value:
= {
    {"reliability_levels",14,1,1,0,kw,251,0.,0.,0.,0,mdm(resplevs,reliabilityLevels)},
    {"response_levels",14,2,2,0,kw,254,0.,0.,0,mdm(resplevs,responseLevels)}
}
KeyWord kw_256[3]  [static]
Initial value:
= {
  {"eval_id",8,0,2,0,0,0,0,0,N_mdm(augment_ute,importBuildFormat_TABULAR_EVAL_ID)},
  {"header",8,0,1,0,0,0,0,0,N_mdm(augment_ute,importBuildFormat_TABULAR_HEADER)},
  {"interface_id",8,0,3,0,0,0,0,0,N_mdm(augment_ute,importBuildFormat_TABULAR_INTERFACE_ID)}
}

KeyWord kw_257[4]  [static]
Initial value:
= {
  {"active_only",8,0,2,0,0,0,0,0,N_mdm(true,importBuildActive)},
  {"annotated",8,0,1,0,0,0,0,0,N_mdm(ute,importBuildFormat_TABULAR_ANNOTATED)},
  {"custom_annotated",8,3,1,0,kw_256,0.,0.,0,N_mdm(ute,importBuildFormat_TABULAR_NONE)},
  {"freeform",8,0,1,0,0,0,0,0,N_mdm(ute,importBuildFormat_TABULAR_NONE)}
}

KeyWord kw_258[2]  [static]
Initial value:
= {
  {"import_build_points_file",11,4,1,0,kw_257,0.,0,0,N_mdm(str,importBuildPtsFile)},
  {"import_points_file",3,4,1,0,kw_257,0.,0,0,N_mdm(str,importBuildPtsFile)}
}

KeyWord kw_259[2]  [static]
Initial value:
= {
  {"advancements",9,0,1,0,0,0,0,0,N_mdm(ushint,adaptedBasisAdvancements)},
  {"soft_convergence_limit",9,0,2,0,0,0,0,0,N_mdm(ushint,softConvLimit)}
}

KeyWord kw_260[3]  [static]
Initial value:
= {
  {"adapted",8,2,1,1,kw_259,0.,0,0,N_mdm(type,expansionBasisType_ADAPTED_BASIS_EXPANDING_FRONT)},
  {"tensor_product",8,0,1,1,0,0,0,0,N_mdm(type,expansionBasisType_TENSOR_PRODUCT_BASIS)},
  {"total_order",8,0,1,1,0,0,0,0,N_mdm(type,expansionBasisType_TOTAL_ORDER_BASIS)}
}

KeyWord kw_261[1]  [static]
Initial value:
= {
  {"noise_tolerance",14,0,1,0,0,0,0,0,N_mdm(RealDL,regressionNoiseTol)}
}
KeyWord kw_262[1]  [static]
Initial value:
= {
  {"noise_only","8,0,1,0,0,,0,0,N\text{mdm}(true,\text{crossValidNoiseOnly})"}
}

KeyWord kw_263[1]  [static]
Initial value:
= {
  {"noise\_tolerance","14,0,1,0,0,,0,0,N\text{mdm}(\text{RealDL,regressionNoiseTol})"}
}

KeyWord kw_264[2]  [static]
Initial value:
= {
  {"\text{l2\_penalty","10,0,2,0,0,0,,0,0,N\text{mdm}(\text{Real,regressionL2Penalty})"}},
  {"noise\_tolerance","14,0,1,0,0,,0,0,N\text{mdm}(\text{RealDL,regressionNoiseTol})"}
}

KeyWord kw_265[2]  [static]
Initial value:
= {
  {"\text{equality\_constrained","8,0,1,0,0,,0,0,N\text{mdm}(\text{lsRegressionType_EQ\_CON\_LS})"}},
  {"\text{svd","8,0,1,0,0,,0,0,N\text{mdm}(\text{lsRegressionType\_SV\_LS})"}}
}

KeyWord kw_266[1]  [static]
Initial value:
= {
  {"noise\_tolerance","14,0,1,0,0,,0,0,N\text{mdm}(\text{RealDL,regressionNoiseTol})"}
}

KeyWord kw_267[17]  [static]
Initial value:
= {
  {"\text{basis\_pursuit","8,0,2,0,0,0,,0,0,N\text{mdm}(type,\text{regressionType\_BASIS\_PURSUIT})"},
   {"\text{basis\_pursuit\_denoising","8,1,2,0,kw\_261,0,,0,0,N\text{mdm}(type,\text{regressionType\_BASIS\_PURSUIT\_DENOISING})"}},
   {"\text{bp","0,0,2,0,0,0,,0,0,0,0,0,N\text{mdm}(type,\text{regressionType\_BASIS\_PURSUIT\_DENOISING})"}},
   {"\text{bpdn","0,1,2,0,kw\_261,0,,0,0,0,0,0,N\text{mdm}(type,\text{regressionType\_BASIS\_PURSUIT\_DENOISING})"}},
   {"\text{cross\_validation","8,1,3,0,kw\_262,0,,0,0,0,N\text{mdm}(true,\text{crossValidation})"}},
   {"\text{lars","0,1,2,0,kw\_263,0,,0,0,0,0,N\text{mdm}(type,\text{regressionType\_LEAST\_ANGLE\_REGRESSION})"}},
   {"\text{lasso","0,2,2,0,kw\_264,0,,0,0,0,0,N\text{mdm}(type,\text{regressionType\_LASSO\_REGRESSION})"}},
   {"\text{least\_absolute\_shrinkage","8,2,2,0,kw\_264,0,,0,0,0,0,N\text{mdm}(type,\text{regressionType\_LEAST\_ANGLE\_REGRESSION})"}},

CHAPTER 12. NAMESPACE DOCUMENTATION

```
{"least_squares",8,2,2,0,kw265,0,0,0,Nmdm(type,
regressionTypeDEFAULT_LEAST_SQ_REGRESSION)},
{"omp",0,1,2,0,kw266,0,0,0,1,Nmdm(type,
regressionTypeORTHOG_MATCH_Pursuit)},
{"orthogonal_matching_pursuit",8,1,2,0,kw266,0,0,0,0,Nmdm(type,
regressionTypeORTHOGMATCH_Pursuit)},
{"reuse_points",8,0,6,0,0,0,0,0,Nmdm(lit,pointReuse_all)},
{"reuse_samples",0,0,6,0,0,0,0,-1,Nmdm(lit,pointReuse_all)},
{"tensor_grid",8,0,5,0,0,0,0,0,Nmdm(true,tensorGridFlag)},
{"use_derivatives",8,0,4,0,0,0,0,0,Nmdm(true,methodUseDerivsFlag)}
```

**KeyWord kw_268[3]** [static]
Initial value:

```
= {
  {
    "incremental_lhs",8,0,2,0,0,0,0,0,Nmdm(lit,expansionSampleType.incremental_lhs)},
  {"reuse_points",8,0,1,0,0,0,0,0,Nmdm(lit,pointReuse_all)},{
  {"reuse_samples",0,0,1,0,0,0,0,0,Nmdm(lit,pointReuse_all)},{
  
```

**KeyWord kw_269[6]** [static]
Initial value:

```
= {
  {0,0,2,0,0,kw258},
    {"basis_type",8,3,2,0,kw260},
    {"collocation_points_sequence",13,17,3,1,kw267,0,0,0,0,Nmdm(szarray,collocationPoints)},
    {"collocation_ratio",10,17,3,1,kw267,0,0,0,0,Nmdm(Rea1p,colnLocationRatio)},
    {"dimension_preference",14,0,1,0,0,0,0,0,Nmdm(RealDL,anisoDimPref)},{
    {"expansion_samples_sequence",13,3,3,1,kw268,0,0,0,0,Nmdm(szarray,expansionSamples)'''
```

**KeyWord kw_270[3]** [static]
Initial value:

```
= {
  {"eval_id",8,0,2,0,0,0,0,0,Nmdm(augment_utype,exportApproxFormat_TABULAR_EVAL_ID)},{
  {"header",8,0,1,0,0,0,0,0,Nmdm(augment_utype,exportApproxFormat_TABULAR_HEADER)},
  {"interface_id",8,0,3,0,0,0,0,0,Nmdm(augment_utype,exportApproxFormat_TABULAR_IFACE_ID)'''
```

**KeyWord kw_271[3]** [static]
Initial value:

```
= {
  {"annotated",8,0,1,0,0,0,0,0,Nmdm(utype,exportApproxFormat_TABULAR_ANNOTATED)},{
  {"custom.annotated",8,3,1,0,kw270,0,0,0,0,Nmdm(utype,exportApproxFormat_TABULAR_NONE)},
  {"freeform",8,0,1,0,0,0,0,0,Nmdm(utype,exportApproxFormat_TABULAR_NONE)'''
```
KeyWord kw_272[3]  [static]
Initial value:
  = {
    {*eval_id*,8,0,2,0,0,0,0,0,Nmdm(augment_utype,importApproxFormat_TABULAR_EVAL_ID)},
    {*interface_id*,8,0,3,0,0,0,0,0,Nmdm(augment_utype,importApproxFormat_TABULAR_IFACE_ID)}
  }

KeyWord kw_273[4]  [static]
Initial value:
  = {
    {*active_only*,8,0,2,0,0,0,0,0,Nmdm(true,importApproxActive)},
    {*annotated*,8,0,1,0,0,0,0,0,Nmdm(utype,importApproxFormat_TABULAR_ANNOTATED)},
    {*custom_annotated*,8,1,1,0,kw_272,0,0,0,Nmdm(utype,importApproxFormat_TABULAR_NONE)},
    {*freeform*,8,0,1,0,0,0,0,0,Nmdm(utype,importApproxFormat_TABULAR_NONE)}
  }

KeyWord kw_274[1]  [static]
Initial value:
  = {
    {*noise_only*,8,0,1,0,0,0,0,0,Nmdm(true,crossValidNoiseOnly)}
  }

KeyWord kw_275[6]  [static]
Initial value:
  = {
    {0,0,2,0,0,kw_258},
    {*collocation_points_sequence*,13,0,1,1,0,0,0,0,Nmdm(szarray,collocationPoints)},
    {*cross_validation*,8,1,2,0,kw_274,0,0,0,Nmdm(true,crossValidation)},
    {*reuse_points*,8,0,4,0,0,0,0,0,Nmdm(lit,pointReuse_all)},
    {*reuse_samples*,0,0,4,0,0,0,0,0,1,Nmdm(lit,pointReuse_all)},
    {*tensor.grid*,13,0,3,0,0,0,0,0,0,Nmdm(usharray,tensorGridOrder)}
  }

KeyWord kw_276[3]  [static]
Initial value:
  = {
    {*decay*,8,0,1,1,0,0,0,0,Nmdm(type,refinementControl_DIMENSION_ADAPTIVE_CONTROL_DECAY)},
    {*generalized*,8,0,1,1,0,0,0,0,Nmdm(type,refinementControl_DIMENSION_ADAPTIVE_CONTROL_GENERALIZED)},
    {*sobol*,8,0,1,1,0,0,0,0,Nmdm(type,refinementControl_DIMENSION_ADAPTIVE_CONTROL_SOBOLO}]
  }

KeyWord kw_277[2]  [static]
Initial value:
  = {
    {*dimension_adaptive*,8,3,1,1,kw_276},
    {*uniform*,8,0,1,1,0,0,0,0,Nmdm(type,refinementControl_UNIFORMCONTROL)}
  }
CHAPTER 12. NAMESPACE DOCUMENTATION

KeyWord kw_278[4]  [static]
Initial value:
= {
    {"adapt_import",8,0,1,0,0,0,0,N_mdm(utype,integrationRefine,AIS)}},
    {"import",8,0,1,0,0,0,0,N_mdm(utype,integrationRefine,IS)}},
    {"mm_adapt_import",8,0,1,0,0,0,0,N_mdm(utype,integrationRefine,MMAIS)}},
    {"refinement_samples",13,0,2,0,0,0,0,0,N_mdm(ivec,refineSamples)}
}

KeyWord kw_279[3]  [static]
Initial value:
= {
    {"dimension_preference",14,0,1,0,0,0,0,N_mdm(RealDL,anisoDimPref)},
    {"nested",8,0,2,0,0,0,0,0,N_mdm(type,nestingOverride,NESTED)},
    {"non_nested",8,0,2,0,0,0,0,0,N_mdm(type,nestingOverride,NON_NESTED)}
}

KeyWord kw_280[2]  [static]
Initial value:
= {
    {"lhs",8,0,1,0,0,0,0,0,N_mdm(utype,sampleType,SUBMETHOD,LHS)}},
    {"random",8,0,1,0,0,0,0,0,N_mdm(utype,sampleType,SUBMETHOD,RANDOM)}
}

KeyWord kw_281[3]  [static]
Initial value:
= {
    {0,0,3,0,0,0,kw_279},
    {"restricted",8,0,1,0,0,0,0,0,N_mdm(type,growthOverride,RESTRICTED)},
    {"unrestricted",8,0,1,0,0,0,0,0,N_mdm(type,growthOverride,UNRESTRICTED)}
}

KeyWord kw_282[2]  [static]
Initial value:
= {
    {"drop_tolerance",10,0,2,0,0,0,0,0,N_mdm(Real,vbdDropTolerance)},
    {"interaction_order",0x19,0,1,0,0,0,0,0,N_mdm(ushint,vbdOrder)}
}

KeyWord kw_284[2]  [static]
Initial value:
= {
    {"global",8,0,1,0,0,0,0,0,N_mdm(lit,lipschitzType,global)}},
KeyWord kw_285[2] [static]
Initial value:
= {
  "parallel", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, responseLevelTarget Reduce_SYSTEM_PARALLEL),
  "series", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, responseLevelTarget Reduce_SYSTEM_SERIES)
}

KeyWord kw_286[3] [static]
Initial value:
= {
  "gen_reliabilities", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, responseLevelTarget GEN RELIABILITIES),
  "probabilities", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, responseLevelTarget PROBABILITIES),
  "system", 8, 2, 2, 0, kw_285
}

KeyWord kw_287[2] [static]
Initial value:
= {
  "compute", 8, 3, 2, 0, kw_286,
  "num_response_levels", 13, 0, 1, 0, 0, 0, 0, 0, N_mdm(num_resplevs, responseLevels)
}

KeyWord kw_288[8] [static]
Initial value:
= {
  0, 0, 1, 0, 0, kw_27,
  0, 0, 4, 0, 0, kw_32,
  "build_samples", 9, 0, 1, 1, 0, 0, 0, 0, N_mdm(int, buildSamples),
  "lipschitz", 8, 2, 1, 0, kw_284,
  "response_levels", 14, 2, 5, 0, kw_287, 0, 0, 0, 0, N_mdm(resplevs, responseLevels),
  "samples", 1, 0, 1, 1, 0, 0, 0, 0, N_mdm(int, buildSamples),
  "samples_on_emulator", 9, 0, 4, 0, 0, 0, 0, 0, N_mdm(int, samplesOnEmulator),
  "seed", 0x19, 0, 0, 0, 0, 0, 0, 0, N_mdm(pint, randomSeed)
}

KeyWord kw_289[1] [static]
Initial value:
= {
  "oversample_ratio", 10, 0, 1, 0, 0, 0, 0, 0, N_mdm(Real, collocationRatio)
}

KeyWord kw_290[1] [static]
Initial value:
= {
  "percent_variance_explained", 10, 0, 1, 0, 0, 0, 0, 0, N_mdm(Real, percentVarianceExplained)
}
KeyWord kw_291[4]  [static]
Initial value:
= {
    "incremental_lhs",8,0,1,0,0,0,0,N_mdm(utype,sampleType_SUBMETHOD_LHS) },
    "incremental_random",8,0,1,0,0,0,0,N_mdm(utype,sampleType_SUBMETHOD_LHS) },
    "random",8,0,1,0,0,0,0,N_mdm(utype,sampleType_SUBMETHOD_RANDOM) }
}

KeyWord kw_292[1]  [static]
Initial value:
= {
    "drop_tolerance",10,0,1,0,0,0,0,N_mdm(Real,vbdDropTolerance) }
}

KeyWord kw_293[4]  [static]
Initial value:
= {
    "confidence_level",10,0,2,0,0,0,0,N_mdm(Real,wilksConfidenceLevel) },
    "order",9,0,1,0,0,0,0,0,N_mdm(ushint,wilksOrder) },
    "two_sided",8,0,4,0,0,0,0,0,N_mdm(type,wilksSidedInterval_TWOSIDED) }
}

KeyWord kw_294[14]  [static]
Initial value:
= {
    0,0,1,0,0,kw_27,0,0,4,0,0,kw_32,0,0,2,0,0,kw_255,
    "backfill",8,0,8,0,0,0,0,0,N_mdm(true,backfillFlag) },
    "d_optimal",8,1,6,0,kw_289,0,0,0,0,N_mdm(true,dOptimal) },
    "fixed_seed",8,0,3,0,0,0,0,0,N_mdm(true,fixedSeedFlag) },
    "initial_samples",1,0,1,0,0,0,0,0,N_mdm(int,numSamples) },
    "principal_components",8,1,9,0,kw_290,0,0,0,0,N_mdm(true,pcaFlag) },
    "variance_based_decomp",8,1,7,0,kw_292,0,0,0,0,N_mdm(true,vbdFlag) },
    "wilks",8,4,10,0,kw_293,0,0,0,0,N_mdm(true,wilksFlag) }
}

KeyWord kw_295[3]  [static]
Initial value:
= {
    "eval_id",8,0,2,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_EVAL_ID) },
    "header",8,0,1,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_HEADER) },
    "interface_id",8,0,3,0,0,0,0,0,N_mdm(augment_utype,exportApproxFormat_TABULAR_IFACE_ID) }
}
KeyWord kw_296[3] [static]
Initial value:

```csharp
{ "annotated", 8, 0, 1, 0, 0, 0, 0, 0, N_mdm(utype, exportApproxFormat_TABULAR_ANNOTATED) },
{ "custom_annotated", 8, 3, 1, 0, kw_295[0], 0, 0, 0, N_mdm(utype, exportApproxFormat_TABULAR_ANNOTATED) },
{ "freeform", 8, 0, 1, 0, 0, 0, 0, 0, N_mdm(utype, exportApproxFormat_TABULAR_NONE) }
```

KeyWord kw_297[2] [static]
Initial value:

```csharp
{ "generalized", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, refinementControl_DIMENSION_ADAPTIVE_CONTROL_GENERALIZED) },
{ "sobol", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, refinementControl_DIMENSION_ADAPTIVE_CONTROL_SOBOL) }
```

KeyWord kw_298[3] [static]
Initial value:

```csharp
{ "dimension_adaptive", 8, 2, 1, 1, kw_297 },
{ "local_adaptive", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, refinementControl_LOCAL_ADAPTIVE_CONTROL) },
{ "uniform", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, refinementControl_UNIFORM_CONTROL) }
```

KeyWord kw_299[3] [static]
Initial value:

```csharp
{ "eval_id", 8, 0, 2, 0, 0, 0, 0, 0, N_mdm(augment_utype, importApproxFormat_TABULAR_EVAL_ID) },
{ "header", 8, 0, 1, 0, 0, 0, 0, 0, N_mdm(augment_utype, importApproxFormat_TABULAR_HEADER) },
{ "interface_id", 8, 0, 3, 0, 0, 0, 0, 0, N_mdm(augment_utype, importApproxFormat_TABULAR_IFACE_ID) }
```

KeyWord kw_300[4] [static]
Initial value:

```csharp
{ "active_only", 8, 0, 2, 0, 0, 0, 0, 0, N_mdm(true, importApproxActive) },
{ "annotated", 8, 0, 1, 0, 0, 0, 0, 0, N_mdm(utype, importApproxFormat_TABULAR_ANNOTATED) },
{ "custom_annotated", 8, 3, 1, 0, kw_299[0], 0, 0, 0, N_mdm(utype, importApproxFormat_TABULAR_ANNOTATED) },
{ "freeform", 8, 0, 1, 0, 0, 0, 0, 0, N_mdm(utype, importApproxFormat_TABULAR_NONE) }
```

KeyWord kw_301[2] [static]
Initial value:

```csharp
{ "generalized", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, refinementControl_DIMENSION_ADAPTIVE_CONTROL_GENERALIZED) },
{ "sobol", 8, 0, 1, 1, 0, 0, 0, 0, N_mdm(type, refinementControl_DIMENSION_ADAPTIVE_CONTROL_SOBOL) }
```
KeyWord kw_302[2] [static]
Initial value:
= {
    {"dimension_adaptive", 8, 2, 1, 1, kw_301},
    {"uniform", 8, 0, 1, 1, 0, 0, 0, 0, Nmdm(type, refinementControl, UNIFORM_CONTROL)}
}

KeyWord kw_303[4] [static]
Initial value:
= {
    {"adapt_import", 8, 0, 1, 1, 0, 0, 0, 0, Nmdm(type, integrationRefine, AIS)},
    {"import", 8, 0, 1, 1, 0, 0, 0, 0, Nmdm(type, integrationRefine, IS)},
    {"mm_adapt_import", 8, 0, 1, 1, 0, 0, 0, 0, Nmdm(type, integrationRefine, MMais)},
    {"refinement_samples", 13, 0, 2, 0, 0, 0, 0, 0, Nmdm(ivec, refineSamples)}
}

KeyWord kw_304[2] [static]
Initial value:
= {
    {"lhs", 8, 0, 1, 1, 0, 0, 0, 0, Nmdm(type, sampleType, SUBMETHOD_LHS)},
    {"random", 8, 0, 1, 1, 0, 0, 0, 0, Nmdm(type, sampleType, SUBMETHOD_RANDOM)}
}

KeyWord kw_305[4] [static]
Initial value:
= {
    {"hierarchical", 8, 0, 2, 0, 0, 0, 0, 0, Nmdm(type, expansionBasisType, HIERARCHICAL_INTERPOLANT)},
    {"nodal", 8, 0, 2, 0, 0, 0, 0, 0, Nmdm(type, expansionBasisType, NODAL_INTERPOLANT)},
    {"restricted", 8, 0, 1, 0, 0, 0, 0, 0, Nmdm(type, growthOverride, RESTRICTED)},
    {"unrestricted", 8, 0, 1, 0, 0, 0, 0, 0, Nmdm(type, growthOverride, UNRESTRICTED)}
}

KeyWord kw_306[2] [static]
Initial value:
= {
    {"drop_tolerance", 10, 0, 2, 0, 0, 0, 0, 0, Nmdm(Real, vbdDropTolerance)},
    {"interaction_order", 0x19, 0, 1, 0, 0, 0, 0, 0, Nmdm(ushint, vbdOrder)}
}

KeyWord kw_308[5] [static]
Initial value:
= {
    {0, 0, 1, 0, 0, kw_27},
    {"convergence_tolerance", 10, 0, 2, 0, 0, 0, 0, 0, 0, Nmdm(Real, convergenceTolerance)},
    {"max_iterations", 0x29, 0, 3, 0, 0, 0, 0, 0, Nmdm(nnint, maxiterations)},
    {"misc_options", 15, 0, 1, 0, 0, 0, 0, 0, Nmdm(strL, miscOptions)},
    {"scaling", 8, 5, 4, 0, 0, 0, 0, 0, Nmdm(true, methodScaling)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_309[18] [static]

Initial value:

```plaintext
= {
    "constraint_tolerance", 10.0, 6.0, 0.0, 0.0, 0.0, 0.0, N_mdm(Real, constraintTolerance),
    "convergence_tolerance", 10.0, 4.0, 0.0, 0.0, 0.0, 0.0, N_mdm(Real, convergenceTolerance),
    "function_precision", 10.0, 2.0, 0.0, 0.0, 0.0, 0.0, N_mdm(Real, functionPrecision),
    "linear_equality_constraint_matrix", 14.0, 15.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL,
        linearEqConstraintCoeffs),
    "linear_equality_scale_types", 15.0, 17.0, 0.0, 0.0, 0.0, 0.0, N_mdm(strL, linearEqScaleTypes),
    "linear_equality_scales", 14.0, 16.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL, linearEqScales),
    "linear_equality_targets", 14.0, 16.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL, linearEqTargets),
    "linear_inequality_constraint_matrix", 14.0, 10.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL,
        linearIneqConstraintCoeffs),
    "linear_inequality_lower_bounds", 14.0, 11.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL, linearIneqLowerBnds),
    "linear_inequality_scale_types", 15.0, 14.0, 0.0, 0.0, 0.0, 0.0, N_mdm(strL, linearIneqScaleTypes),
    "linear_inequality_scales", 14.0, 13.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL, linearIneqScales),
    "linear_inequality_upper_bounds", 14.0, 12.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL, linearIneqUpperBnds),
    "linesearch_tolerance", 10.0, 3.0, 0.0, 0.0, 0.0, 0.0, N_mdm(Real, lineSearchTolerance),
    "max_function_evaluations", 0x29.0, 8.0, 0.0, 0.0, 0.0, N_mdm(nnint, maxFunctionEvaluations),
    "max_iterations", 0x29.0, 5.0, 0.0, 0.0, 0.0, 0.0, N_mdm(nnint, maxIterations),
    "scaling", 8.0, 9.0, 0.0, 0.0, 0.0, 0.0, N_mdm(true, methodScaling),
    "speculative", 8.0, 7.0, 0.0, 0.0, 0.0, 0.0, N_mdm(true, speculativeFlag),
    "verify_level", 9.0, 1.0, 0.0, 0.0, 0.0, 0.0, N_mdm(int, verifyLevel)
}
```

KeyWord kw_310[3] [static]

Initial value:

```plaintext
= {
    {0, 0, 1, 0, 0, kw_27},
    {0, 0, 18, 0, 0, kw_309},
    {""}
}
```

KeyWord kw_311[16] [static]

Initial value:

```plaintext
= {
    "convergence_tolerance", 10.0, 4.0, 0.0, 0.0, 0.0, 0.0, N_mdm(Real, convergenceTolerance),
    "gradient_tolerance", 10.0, 2.0, 0.0, 0.0, 0.0, 0.0, N_mdm(Real, gradientTolerance),
    "linear_equality_constraint_matrix", 14.0, 13.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL,
        linearEqConstraintCoeffs),
    "linear_equality_scale_types", 15.0, 15.0, 0.0, 0.0, 0.0, 0.0, N_mdm(strL, linearEqScaleTypes),
    "linear_equality_scales", 14.0, 14.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL, linearEqScales),
    "linear_equality_targets", 14.0, 14.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL, linearEqTargets),
    "linear_inequality_constraint_matrix", 14.0, 8.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL,
        linearIneqConstraintCoeffs),
    "linear_inequality_lower_bounds", 14.0, 9.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL, linearIneqLowerBnds),
    "linear_inequality_scale_types", 15.0, 11.0, 0.0, 0.0, 0.0, 0.0, N_mdm(strL, linearIneqScaleTypes),
    "linear_inequality_scales", 14.0, 12.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL, linearIneqScales),
    "linear_inequality_upper_bounds", 14.0, 10.0, 0.0, 0.0, 0.0, 0.0, N_mdm(RealDL, linearIneqUpperBnds),
    "max_function_evaluations", 0x29.0, 8.0, 0.0, 0.0, 0.0, N_mdm(nnint, maxFunctionEvaluations),
    "max_iterations", 0x29.0, 5.0, 0.0, 0.0, 0.0, 0.0, N_mdm(nnint, maxIterations),
    "max_step", 10.0, 1.0, 0.0, 0.0, 0.0, 0.0, N_mdm(Real, maxStep),
    "scaling", 8.0, 7.0, 0.0, 0.0, 0.0, 0.0, N_mdm(true, methodScaling),
    "speculative", 8.0, 5.0, 0.0, 0.0, 0.0, 0.0, N_mdm(true, speculativeFlag)
}
```
KeyWord kw_312[3]  [static]
Initial value:
= {
    {0,0,1,0,0,kw_27},
    {0,0,16,0,0,kw_311},
    {""}
}

KeyWord kw_313[6]  [static]
Initial value:
= {
    {0,0,1,0,0,kw_27},
    {"convergence_tolerance",10,0,3,0,0.,0.,0.,0.,N_mdm(Real,convergenceTolerance)},
    {"max_function_evaluations",0x29,0,4,0,0.,0.,0.,0.,N_mdm(nnint,maxFunctionEvaluations)},
    {"max_iterations",0x29,0,2,0,0.,0.,0.,0.,N_mdm(nnint,maxIterations)},
    {"scaling",8,0,5,0,0.,0.,0.,0.,N_mdm(true,methodScaling)},
    {"search_scheme_size",9,0,1,0,0.,0.,0.,0.,N_mdm(int,searchSchemeSize)}
}

KeyWord kw_314[3]  [static]
Initial value:
= {
    {"argaez_tapia",8,0,1,1,0.,0.,0.,0.,N_mdm(type,meritFn_ArgaezTapia)},
    {"el_bakry",8,0,1,1,0.,0.,0.,0.,N_mdm(type,meritFn_NormFmu)},
    {"van_shanno",8,0,1,1,0.,0.,0.,0.,N_mdm(type,meritFn_VanShanno)}
}

KeyWord kw_315[4]  [static]
Initial value:
= {
    {"gradient_based_line_search",8,0,1,1,0.,0.,0.,0.,N_mdm(lit,searchMethod_gradient_based_line_search)},
    {"tr_pds",8,0,1,1,0.,0.,0.,0.,N_mdm(lit,searchMethod_tr_pds)},
    {"trust_region",8,0,1,1,0.,0.,0.,0.,N_mdm(lit,searchMethod_trust_region)},
    {"value_based_line_search",8,0,1,1,0.,0.,0.,0.,N_mdm(lit,searchMethod_value_based_line_search)}
}

KeyWord kw_316[6]  [static]
Initial value:
= {
    {0,0,1,0,0,kw_27},
    {0,0,16,0,0,kw_311},
    {"centering_parameter",10,0,4,0,0.,0.,0.,0.,0.,N_mdm(Real,centeringParam)},
    {"merit_function",8,3,2,0,kw_314},
    {"search_method",8,4,1,0,kw_315},
    {"step_length_to_boundary",10,0,3,0,0.,0.,0.,0.,N_mdm(Real,stepLenToBoundary)}
}
KeyWord kw_317[5] [static]
Initial value:

= {
    {*debug*,8,0,1,1,0,0,0,0,Nmdm(type,methodOutput,DEBUG_OUTPUT)},{
    {*normal*,8,0,1,1,0,0,0,0,Nmdm(type,methodOutput,NORMAL_OUTPUT)},{
    {*quiet*,8,0,1,1,0,0,0,0,Nmdm(type,methodOutput,QUIET_OUTPUT)},{
    {*silent*,8,0,1,1,0,0,0,0,Nmdm(type,methodOutput,SILENT_OUTPUT)},{
    {*verbose*,8,0,1,1,0,0,0,0,Nmdm(type,methodOutput,VERBOSE_OUTPUT)},{

KeyWord kw_318[2] [static]
Initial value:

= {
    {*model_pointer*,11,0,1,0,0,0,0,0,Nmdm(str,subModelPointer)},{
    {*opt_model_pointer*,3,0,1,0,0,0,0,-1,Nmdm(str,subModelPointer)},{

KeyWord kw_319[1] [static]
Initial value:

= {
    {*seed*,9,0,1,0,0,0,0,0,Nmdm(int,randomSeed)},{

KeyWord kw_320[8] [static]
Initial value:

= {
    {0,0,3,0,0,kw 190},{
    {*method_name*,11,0,1,1,kw_318,0,0,0,0,Nmdm(str,subMethodName)},{
    {*method_pointer*,11,0,1,1,0,0,0,0,Nmdm(str,subMethodPointer)},{
    {*multi_objective_weight_sets*,6,0,3,0,0,0,0,0,0,4,Nmdm(RealDL,concurrentParameterSets)},{
    {*opt_method_name*,3,2,1,1,kw_318,0,0,0,-3,Nmdm(str,subMethodName)},{
    {*opt_method_pointer*,3,0,1,1,0,0,0,0,-3,Nmdm(str,subMethodPointer)},{
    {*random_weight_sets*,9,1,2,0,kw_319,0,0,0,0,Nmdm(int,concurrentRandomJobs)},{
    {*weight_sets*,14,0,3,0,0,0,0,0,0,Nmdm(RealDL,concurrentParameterSets)},{

KeyWord kw_321[4] [static]
Initial value:

= {
    {0,0,1,0,0,kw 27},{
    {*partitions*,13,0,1,0,0,0,0,0,0,Nmdm(usharray, varPartitions)},{
    {*samples*,9,0,2,0,0,0,0,0,Nmdm(int,numSamples)},{
    {*seed*,0x19,0,3,0,0,0,0,0,0,Nmdm(point,randomSeed)},{

KeyWord kw_322[7] [static]
Initial value:
= {
    {0, 0, 1, 0, 0, kw_27},
    {"converge_order", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(utype, subMethod, SUBMETHOD, CONVERGE_ORDER)},
    {"converge_qoi", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(utype, subMethod, SUBMETHOD, CONVERGE_QOI)},
    {"convergence_tolerance", 10, 0, 0, 3, 0, 0, 0, 0, N, mdm(Real, convergenceTolerance)},
    {"estimate_order", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(utype, subMethod, SUBMETHOD, ESTIMATE_ORDER)},
    {"max_iterations", 0x29, 0, 4, 0, 0, 0, 0, 0, N, mdm(nnint, maxIterations)},
    {"refinement_rate", 10, 0, 2, 0, 0, 0, 0, 0, N, mdm(Real, refinementRate)}
}

KeyWord kw_323[2] [static]
Initial value:
= {
    {"num_generations", 0x29, 0, 2, 0, 0, 0, 0, 0, N, mdm(sizet, numGenerations)},
    {"percent_change", 10, 0, 1, 0, 0, 0, 0, 0, N, mdm(Realz, convergenceTolerance)}
}

KeyWord kw_324[2] [static]
Initial value:
= {
    {"num_generations", 0x29, 0, 2, 0, 0, 0, 0, 0, N, mdm(sizet, numGenerations)},
    {"percent_change", 10, 0, 1, 0, 0, 0, 0, 0, N, mdm(Realz, convergenceTolerance)}
}

KeyWord kw_325[2] [static]
Initial value:
= {
    {"average_fitness_tracker", 8, 2, 1, 1, kw_323, 0, 0, 0, N, mdm(lit, convergenceType, average_fitness_tracker)},
    {"best_fitness_tracker", 8, 2, 1, 1, kw_324, 0, 0, 0, N, mdm(lit, convergenceType, best_fitness_tracker)}
}

KeyWord kw_326[2] [static]
Initial value:
= {
    {"constraint_penalty", 10, 0, 2, 0, 0, 0, 0, 0, N, mdm(Realp, constraintTolerance)},
    {"merit_function", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(lit, fitnessType, merit_function)}
}

KeyWord kw_327[4] [static]
Initial value:
= {
    {"elitist", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(lit, replacementType, elitist)},
    {"favor_feasible", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(lit, replacementType, favor_feasible)},
    {"roulette_wheel", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(lit, replacementType, roulette_wheel)},
    {"unique_roulette_wheel", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(lit, replacementType, unique_roulette_wheel)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_328[17] [static]

Initial value:

```csharp
= {
    {0,0,1,0,0,kw},
    {0,0,8,0,0,kw},
    {"convergence_type",8,2,3,0,kw},
    {"fitness_type",8,2,1,0,kw},
    {"linear_equality_constraint_matrix",14,0,10,0,0,0,0,N,mdm(RealDL,linearEqConstraintCoeffs)},
    {"linear_equality_scale_types",15,0,12,0,0,0,0,0,N,mdm(strL,linearEqScaleTypes)},
    {"linear_equality_targets",14,0,11,0,0,0,0,0,N,mdm(RealDL,linearEqTargets)},
    {"linear_inequality_constraint_matrix",14,0,5,0,0,0,0,0,N,mdm(RealDL,linearIneqConstraintCoeffs)},
    {"linear_inequality_lower_bounds",14,0,6,0,0,0,0,0,N,mdm(RealDL,linearIneqLowerBnds)},
    {"linear_inequality_scale_types",14,0,9,0,0,0,0,0,N,mdm(strL,linearIneqScaleTypes)},
    {"linear_inequality_scales",14,0,7,0,0,0,0,0,N,mdm(RealDL,linearIneqScales)},
    {"linear_inequality_upper_bounds",14,0,8,0,0,0,0,0,N,mdm(RealDL,linearIneqUpperBnds)},
    {"max_function_evaluations",0x29,0,14,0,0,0,0,0,N,mdm(nnint,maxFunctionEvaluations)},
    {"max_iterations",0x29,0,4,0,0,0,0,0,N,mdm(nnint,maxIterations)},
    {"replacement_type",8,4,2,0,kw},
    {"scaling",8,0,15,0,0,0,0,0,N,mdm(true,methodScaling)}
}
```

KeyWord kw_329[4] [static]

Initial value:

```csharp
= {
    {0,0,1,0,0,kw},
    {0,0,18,0,0,kw},
    {"nlssol",8,0,1,1,0,0,0,0,N,mdm(utype,methodName,NLSSOL,SQP)},
    {"npsol",8,0,1,1,0,0,0,0,N,mdm(utype,methodName,NPSOL,SQP)}
}
```

KeyWord kw_330[8] [static]

Initial value:

```csharp
= {
    {"approx_method_name",3,0,1,1,0,0,0,0,4,N,mdm(str,subMethodName)},
    {"approx_method_pointer",3,0,1,1,0,0,0,0,4,N,mdm(str,subMethodPointer)},
    {"approx_model_pointer",3,0,2,2,0,0,0,0,4,N,mdm(str,subModelPointer)},
    {"max_iterations",0x29,0,4,0,0,0,0,0,N,mdm(nnint,maxIterations)},
    {"method_name",11,0,1,1,0,0,0,0,0,N,mdm(str,subMethodName)},
    {"method_pointer",11,0,1,1,0,0,0,0,0,N,mdm(str,subMethodPointer)},
    {"model_pointer",11,0,2,2,0,0,0,0,0,N,mdm(str,subModelPointer)},
    {"replace_points",8,0,3,0,0,0,0,0,N,mdm(true,surrBasedGlobalReplacePts)}
}
```

KeyWord kw_331[2] [static]

Initial value:

```csharp
= {
    {"filter",8,0,1,1,0,0,0,0,0,N,mdm(type,surrBasedLocalAcceptLogic,FILTER)},
    {"tr_ratio",8,0,1,1,0,0,0,0,0,N,mdm(type,surrBasedLocalAcceptLogic,TR_RATIO)}
}
```
KeyWord kw_332[7] [static]

Initial value:

```c
= {
    "augmented_lagrangian_objective", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalSubProbObject_AUGMENTED_LAGRANGIAN_OBJECTIVE)
```

```
    "lagrangian_objective", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalSubProbObject_LAGRANGIAN_OBJECTIVE)
```

```
    "linearized_constraints", 8, 0, 2, 0, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalSubProbCon_LINEARIZED_CONSTRAINTS)
```

```
    "no_constraints", 8, 0, 2, 0, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalSubProbCon_NO_CONSTRAINTS)
```

```
    "original_constraints", 8, 0, 2, 0, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalSubProbCon_ORIGINAL_CONSTRAINTS)
```

```
    "original_primary", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalSubProbObject_ORIGINAL_PRIMARY)
```

```
    "single_objective", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalSubProbObject_SINGLE_OBJECTIVE)
```

} 
```

KeyWord kw_333[1] [static]

Initial value:

```c
= {
    "homotopy", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalConstrRelax_HOMOTOPY)
```

} 
```

KeyWord kw_334[4] [static]

Initial value:

```c
= {
    "adaptive_penalty_merit", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalMeritFn_ADAPTIVE_PENALTY_MERIT)
```

```
    "augmented_lagrangian_merit", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalMeritFn_AUGMENTED_LAGRANGIAN_MERIT)
```

```
    "lagrangian_merit", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalMeritFn_LAGRANGIAN_MERIT)
```

```
    "penalty_merit", 8, 0, 1, 1, 0, 0, 0, 0, N, mdm(type,
    surrBasedLocalMeritFn_PENALTY_MERIT)
```

} 
```

KeyWord kw_335[6] [static]

Initial value:

```c
= {
    "contract_threshold", 10, 0, 3, 0, 0, 0, 0, 0, N, mdm(Real,
    surrBasedLocalTRContractTrigger)
```

```
    "contraction_factor", 10, 0, 5, 0, 0, 0, 0, 0, N, mdm(Real,
    surrBasedLocalTRContract)
```

```
    "expand_threshold", 10, 0, 4, 0, 0, 0, 0, 0, N, mdm(Real,
    surrBasedLocalTRExpandTrigger)
```

```
    "expansion_factor", 10, 0, 6, 0, 0, 0, 0, 0, N, mdm(Real,
    surrBasedLocalTRExpand)
```

```
    "initial_size", 10, 0, 1, 0, 0, 0, 0, 0, N, mdm(Real,
    surrBasedLocalTRInitSize)
```

```
    "minimum_size", 10, 0, 2, 0, 0, 0, 0, 0, N, mdm(Real,
    surrBasedLocalTRMinSize)
```

} 
```
```
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_336[16] [static]

Initial value:
= {
  {"acceptance_logic",8,2,8,0,kw_331},
  {"approx_method_name",3,0,1,1,0,0,0,0,9,N_mdm(str,subMethodName)},
  {"approx_method_pointer",3,0,1,1,0,0,0,0,9,N_mdm(str,subMethodPointer)},
  {"approx_model_pointer",3,0,2,2,0,0,0,0,9,N_mdm(str,modelPointer)},
  {"approx_subproblem",8,7,6,0,kw_332},
  {"constraint_relax",8,1,9,0,kw_333},
  {"constraint_tolerance",10,0,1,9,0,0,0,0,0,N_mdm(Real,constraintTolerance)},
  {"convergence_tolerance",10,0,1,0,0,0,0,0,0,N_mdm(Real,convergenceTolerance)},
  {"max_iterations",0x29,0,10,0,0,0,0,0,0,N_mdm(nnint,maxIterations)},
  {"merit_function",8,4,7,0,kw_334},
  {"method_name",11,0,1,1,0,0,0,0,0,N_mdm(str,subMethodName)},
  {"method_pointer",11,0,1,1,0,0,0,0,0,N_mdm(str,subMethodPointer)},
  {"model_pointer",11,0,2,2,0,0,0,0,0,N_mdm(str,modelPointer)},
  {"soft_convergence_limit",9,0,3,0,0,0,0,0,0,N_mdm(ushint,softConvLimit)},
  {"trust_region",8,6,5,0,kw_335,0,0,0,0,0,NIDRProblemDescDB::method_tr_final},
  {"truth_surrogate_bypass",8,0,4,0,0,0,0,0,0,N_mdm(true,surrBasedLocalLayerBypass)}
}

KeyWord kw_337[4] [static]

Initial value:
= {
  0,0,1,0,0,0,kw_27],
  {"final_point",14,0,1,1,0,0,0,0,0,N_mdm(Real_DL,finalPoint)},
  {"num_steps",9,0,2,2,0,0,0,0,0,N_mdm(int,numSteps)},
  {"step_vector",14,0,1,1,0,0,0,0,0,N_mdm(Real_DL,stepVector)}
}

KeyWord kw_339[1] [static]

Initial value:
= {
  {"optional_interface_responses_pointer",11,0,1,0,0,0,0,0,0,N_mom(str,
  optionalInterfRespPointer)}
}

KeyWord kw_340[2] [static]

Initial value:
= {
  {"master",8,0,1,1,0,0,0,0,0,N_mom(type,subMethodScheduling\_MASTER\_SCHEDULING)},
  {"peer",8,0,1,1,0,0,0,0,0,N_mom(type,subMethodScheduling\_PEER\_SCHEDULING)}
}

KeyWord kw_341[7] [static]

Initial value:
= {
  {"iterator_scheduling",8,2,2,0,kw_340},
  {"iterator_servers",0x19,0,1,0,0,0,0,0,0,N_mom(pint,subMethodServers)},
  {"primary_response_mapping",14,0,6,0,0,0,0,0,0,N_mom(Real_DL,primaryRespCoeffs)},
  {"primary_variable_mapping",15,0,4,0,0,0,0,0,0,N_mom(strL,primaryVarMaps)},
  {"processors_per_iterator",0x19,0,3,0,0,0,0,0,0,N_mom(pint,subMethodProcs)},
  {"secondary_response_mapping",14,0,7,0,0,0,0,0,0,N_mom(Real_DL,secondaryRespCoeffs)},
  {"secondary_variable_mapping",15,0,5,0,0,0,0,0,0,N_mom(strL,secondaryVarMaps)}
}
KeyWord kw_342[2] [static]
Initial value:

```cpp
= {
    "optional_interface_pointer",11,1,0,kw_339,0,0,0,0,mom(str,interfacePointer),
    "sub_method_pointer",11,7,2,1,kw_341,0,0,0,0,mom(str,subMethodPointer)
}
```

KeyWord kw_343[2] [static]
Initial value:

```cpp
= {
    "exponential",8,0,1,1,0,0,0,0,0,mom(utype,analyticCovForm_EXP_L1)),
    "squared_exponential",8,0,1,1,0,0,0,0,0,mom(utype,analyticCovForm_EXP_L2))
}
```

KeyWord kw_344[3] [static]
Initial value:

```cpp
= {
    "analytic_covariance",8,2,1,1,kw_343),
    "dace_method_pointer",11,0,1,1,0,0,0,0,0,mom(str,subMethodPointer),
    "rf_data_file",11,0,1,1,0,0,0,0,0,mom(str,rfDataFileName)
}
```

KeyWord kw_345[2] [static]
Initial value:

```cpp
= {
    "karhunen_loeve",8,0,1,1,0,0,0,0,0,mom(utype,randomFieldIdForm_RF_KARHUNEN_LOEVE}),
    "principal_components",8,0,1,1,0,0,0,0,0,mom(utype,randomFieldIdForm_RF_PCA_GP)
}
```

KeyWord kw_346[5] [static]
Initial value:

```cpp
= {
    "build_source",8,3,1,0,kw_344),
    "expansion_bases",9,0,3,0,0,0,0,0,mom(int,domension),
    "expansion_form",8,2,2,0,kw_345),
    "propagation_model_pointer",11,0,5,1,0,0,0,0,mom(str,propagationModelPointer),
    "truncation_tolerance",10,0,4,0,0,0,0,0,mom(Real,truncationTolerance)
}
```

KeyWord kw_347[1] [static]
Initial value:

```cpp
= {
    "solution_level_cost",14,0,1,1,0,0,0,0,0,mom(RealDL,solutionLevelCost)
}
```
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_348[2] [static]
Initial value:
= {
  "interface_pointer",11,0,1,0,0,0,0,0,Nmom(str,interfacePointer),
  "solution_level.control",11,1,3,0,kw_347,0,0,0,Nmom(str,solutionLevelControl)
}

KeyWord kw_349[1] [static]
Initial value:
= {
  "truncation_tolerance",10,0,1,0,0,0,0,0,Nmom(Real,truncationTolerance)
}

KeyWord kw_350[3] [static]
Initial value:
= {
  "bing.li",8,0,1,0,0,0,0,0,Nmom(true,subspaceIdBingLi),
  "constantine",8,0,2,0,0,0,0,0,Nmom(true,subspaceIdConstantine),
  "energy",8,1,3,0,kw_349,0,0,0,Nmom(true,subspaceIdEnergy)
}

KeyWord kw_351[5] [static]
Initial value:
= {
  "actual_model_pointer",11,0,1,0,0,0,0,0,Nmom(str,actualModelPointer),
  "bootstrap_samples",9,0,5,0,0,0,0,0,Nmom(int,numReplicates),
  "dimension",9,0,4,0,0,0,0,0,Nmom(int,dimension),
  "initial_samples",9,0,2,0,0,0,0,0,Nmom(int,initialSamples),
  "truncation_method",8,3,3,0,kw_350
}

KeyWord kw_352[3] [static]
Initial value:
= {
  "eval_id",8,0,2,0,0,0,0,0,Nmom(augment_utype,importChallengeFormat_TABULAR_EVAL_ID),
  "header",8,0,1,0,0,0,0,0,Nmom(augment_utype,importChallengeFormat_TABULAR_HEADER),
  "interface_id",8,0,3,0,0,0,0,0,Nmom(augment_utype,importChallengeFormat_TABULAR_IFACE_ID)
}

KeyWord kw_353[4] [static]
Initial value:
= {
  "active_only",8,0,2,0,0,0,0,0,Nmom(true,importChallengeActive),
  "annotated",8,0,1,0,0,0,0,0,Nmom(utype,importChallengeFormat_TABULAR_ANNOTATED),
  "custom_annotated",8,3,1,0,kw_352,0,0,0,0,Nmom(utype,importChallengeFormat_TABULAR_JNONE),
  "freeform",8,0,1,0,0,0,0,0,Nmom(utype,importChallengeFormat_TABULAR_JNONE)
}
KeyWord kw_354[6] [static]

Initial value:

```c
={
    {"additive",8,0,2,0,0,0,0,Nmom(type,approxCorrectionType_ADDITIVE_CORRECTION)},
    {"combined",8,0,2,0,0,0,0,Nmom(type,approxCorrectionType_COMBINED_CORRECTION)},
    {"first_order",8,0,1,1,0,0,0,Nmom(order,approxCorrectionOrder_1)},
    {"multiplicative",8,0,2,0,0,0,0,Nmom(type,
        approxCorrectionType_MULTIPLICATIVE_CORRECTION)},
    {"second_order",8,0,1,1,0,0,0,Nmom(order,approxCorrectionOrder_2)},
    {"zeroth_order",8,0,1,1,0,0,0,Nmom(order,approxCorrectionOrder_2)}
}
```

KeyWord kw_355[1] [static]

Initial value:

```c
={
    {"folds",0x19,0,0,0,0,0,Nmom(int,refineCVFolds)}
}
```

KeyWord kw_356[4] [static]

Initial value:

```c
={
    {"convergence_tolerance",10,0,3,0,0,0,0,Nmom(Real,convergenceTolerance)},
    {"cross_validation_metric",11,1,4,0,kw_355,0,0,Nmom(str,refineCVMetric)},
    {"max_function_evaluations",0x19,0,2,0,0,0,0,Nmom(int,maxFunctionEvals)},
    {"max_iterations",0x19,0,1,0,0,0,0,Nmom(int,maxIterations)}
}
```

KeyWord kw_357[1] [static]

Initial value:

```c
={
    {"auto_refinement",8,4,1,0,kw_356,0,0,0,Nmom(true,autoRefine)}
}
```

KeyWord kw_358[2] [static]

Initial value:

```c
={
    {"folds",9,0,1,0,0,0,0,0,Nmom(int,numFolds)},
    {"percent",10,0,1,0,0,0,0,0,Nmom(Real,percentFold)}
}
```

KeyWord kw_359[2] [static]

Initial value:

```c
={
    {"cross_validation",8,2,1,0,kw_358,0,0,0,Nmom(true,crossValidateFlag)},
    {"press",8,0,2,0,0,0,0,0,Nmom(true,pressFlag)}
}
```
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_360[2] [static]
Initial value:
= {
    {"gradient_threshold",10,0,1,0,0,0,0,0,Nmom(Real,discontGradThresh)},
    {"jump_threshold",10,0,1,0,0,0,0,0,Nmom(Real,discontJumpThresh)}
}

KeyWord kw_361[3] [static]
Initial value:
= {
    {"cell_type",11,0,1,0,0,0,0,0,Nmom(str,decompCellType)},
    {"discontinuity_detection",8,2,3,0,kw_360,0,0,0,Nmom(true,decompDiscontDetect)},
    {"support_layers",9,0,2,0,0,0,0,0,Nmom(int,decompSupportLayers)}
}

KeyWord kw_362[3] [static]
Initial value:
= {
    {"eval_id",8,0,2,0,0,0,0,0,Nmom(augment_utype,exportApproxFormat_TABULAR_EVAL_ID)},
    {"header",8,0,1,0,0,0,0,0,Nmom(augment_utype,exportApproxFormat_TABULAR_HEADER)},
    {"interface_id",8,0,1,0,0,0,0,0,Nmom(augment_utype,exportApproxFormat_TABULAR_IFACE_ID)}
}

KeyWord kw_363[3] [static]
Initial value:
= {
    {"annotated",8,0,1,0,0,0,0,0,Nmom(utype,exportApproxFormat_TABULAR_ANNOTATED)},
    {"custom_annotated",8,3,1,kw_362,0,0,0,Nmom(utype,exportApproxFormat_TABULAR_NONE)},
    {"freeform",8,0,1,0,0,0,0,0,Nmom(utype,exportApproxFormat_TABULAR_NONE)}
}

KeyWord kw_364[3] [static]
Initial value:
= {
    {"constant",8,0,1,1,0,0,0,0,Nmom(lit,trendOrder_constant)},
    {"linear",8,0,1,1,0,0,0,0,Nmom(lit,trendOrder_linear)},
    {"reduced_quadratic",8,0,1,1,0,0,0,0,Nmom(lit,trendOrder_reduced_quadratic)}
}

KeyWord kw_365[2] [static]
Initial value:
= {
    {"point_selection",8,0,1,0,0,0,0,0,Nmom(true,pointSelection)},
    {"trend",8,3,2,0,kw_364}
}
KeyWord kw_366[4]  [static]
Initial value:

= {
  {"algebraic_console", 8, 0, 4, 0, 0, 0, 0, 0, Nmom(augment_type, modelExportFormat_ALGEBRAIC_CONSOLE)},
  {"algebraic_file", 8, 0, 3, 0, 0, 0, 0, 0, Nmom(augment_type, modelExportFormat_ALGEBRAIC_FILE)},
  {"binary_archive", 8, 0, 2, 0, 0, 0, 0, 0, Nmom(augment_type, modelExportFormat_BINARY_ARCHIVE)},
  {"text_archive", 8, 0, 1, 0, 0, 0, 0, 0, Nmom(augment_type, modelExportFormat_TEXT_ARCHIVE)}
}

KeyWord kw_367[2]  [static]
Initial value:

= {
  {"filename_prefix", 11, 0, 1, 0, 0, 0, 0, 0, Nmom(str, modelExportPrefix)},
  {"formats", 8, 4, 2, 1, kw_366}
}

KeyWord kw_368[4]  [static]
Initial value:

= {
  {"constant", 8, 0, 1, 1, 0, 0, 0, 0, Nmom(lit, trendOrder_constant)},
  {"linear", 8, 0, 1, 1, 0, 0, 0, 0, Nmom(lit, trendOrder_linear)},
  {"quadratic", 8, 0, 1, 1, 0, 0, 0, 0, Nmom(lit, trendOrder_quadratic)},
  {"reduced_quadratic", 8, 0, 1, 1, 0, 0, 0, 0, Nmom(lit, trendOrder_reduced_quadratic)}
}

KeyWord kw_369[7]  [static]
Initial value:

= {
  {"correlation_lengths", 14, 0, 5, 0, 0, 0, 0, 0, Nmom(RealDL, krigingCorrelations)},
  {"export_model", 8, 2, 6, 0, kw_367, 0, 0, 0, Nmom(true, exportSurrogate)},
  {"find_nugget", 9, 0, 4, 0, 0, 0, 0, 0, Nmom(shint, krigingFindNugget)},
  {"max_trials", 0x19, 0, 0, 0, 0, 0, 0, 0, Nmom(Real, krigingMaxTrials)},
  {"nugget", 0x1a, 0, 4, 0, 0, 0, 0, 0, Nmom(Real, krigingNugget)},
  {"optimization_method", 11, 0, 2, 0, 0, 0, 0, 0, Nmom(str, krigingOptMethod)},
  {"trend", 8, 4, 1, 0, kw_368}
}

KeyWord kw_370[2]  [static]
Initial value:

= {
  {"dakota", 8, 2, 1, 1, kw_365, 0, 0, 0, Nmom(lit, surrogateType_global_gaussian)},
  {"surfpack", 8, 7, 1, 1, kw_369, 0, 0, 0, Nmom(lit, surrogateType_global_kriging)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_371[3] [static]
Initial value:

```plaintext
= {
  "eval_id", 8, 2, 0, 0, 0, 0, 0, 0, Nmom(augment_utype, importBuildFormat_TABULAR_EVAL_ID),
  "header", 8, 1, 0, 0, 0, 0, 0, Nmom(augment_utype, importBuildFormat_TABULAR_HEADER),
  "interface_id", 8, 3, 0, 0, 0, 0, 0, Nmom(augment_utype, importBuildFormat_TABULAR_INTERFACE_ID)
}
```

KeyWord kw_372[4] [static]
Initial value:

```plaintext
= {
  "active_only", 8, 2, 0, 0, 0, 0, 0, 0, Nmom(true, importBuildActive),
  "annotated", 8, 1, 0, 0, 0, 0, 0, Nmom(utype, importBuildFormat_TABULAR_ANNOTATED),
  "custom_annotated", 8, 3, 1, 0, kw_371, 0, 0, 0, Nmom(utype, importBuildFormat_TABULAR_NONE),
  "freeform", 8, 0, 1, 0, 0, 0, 0, 0, Nmom(utype, importBuildFormat_TABULAR_NONE)
}
```

KeyWord kw_373[2] [static]
Initial value:

```plaintext
= {
  "binary_archive", 8, 2, 0, 0, 0, 0, 0, 0, Nmom(augment_utype, modelExportFormat_BINARY_ARCHIVE),
  "text_archive", 8, 0, 1, 0, 0, 0, 0, 0, Nmom(augment_utype, modelExportFormat_TEXT_ARCHIVE)
}
```

KeyWord kw_374[2] [static]
Initial value:

```plaintext
= {
  "filename_prefix", 11, 0, 1, 0, 0, 0, 0, 0, Nmom(str, modelExportPrefix),
  "formats", 8, 2, 2, 1, kw_373
}
```

KeyWord kw_375[2] [static]
Initial value:

```plaintext
= {
  "cubic", 0, 1, 1, 0, 0, 0, 0, 0, Nmom(lit, marsInterpolation_cubic),
  "linear", 0, 1, 1, 0, 0, 0, 0, 0, Nmom(lit, marsInterpolation_linear)
}
```

KeyWord kw_376[3] [static]
Initial value:

```plaintext
= {
  "export_model", 8, 2, 3, 0, kw_374, 0, 0, 0, Nmom(true, exportSurrogate),
  "interpolation", 8, 2, 2, 0, kw_375,
  "max_bases", 9, 0, 1, 0, 0, 0, 0, 0, Nmom(shint, marsMaxBases)
}
```
KeyWord kw_377[2] [static]
Initial value:
= {
  {"binary_archive",8,0,2,0,0,0,0,0,0,N,mom(augment_utype,modelExportFormat_BINARY_ARCHIVE)},
  {"text_archive",8,0,1,0,0,0,0,0,0,N,mom(augment_utype,modelExportFormat_TEXT_ARCHIVE)}
}

KeyWord kw_378[2] [static]
Initial value:
= {
  {"filename_prefix",11,0,1,0,0,0,0,0,0,N,mom(str,modelExportPrefix)},
  {"formats",8,2,2,1,kw_377}
}

KeyWord kw_379[4] [static]
Initial value:
= {
  {"basis_order",0x29,0,1,0,0,0,0,0,0,N,mom(shint,polynomialOrder)},
  {"poly_order",0x21,0,1,0,0,0,0,0,0,N,mom(shint,polynomialOrder)},
  {"weight_function",9,0,2,0,0,0,0,0,0,N,mom(shint,mlsWeightFunction)}
}

KeyWord kw_380[4] [static]
Initial value:
= {
  {"algebraic_console",8,0,4,0,0,0,0,0,0,N,mom(augment_utype,
      modelExportFormat_ALGEBRAIC_CONSOLE)},
  {"algebraic_file",8,0,3,0,0,0,0,0,0,N,mom(augment_utype,modelExportFormat_ALGEBRAIC_FILE)},
  {"binary_archive",8,0,2,0,0,0,0,0,0,N,mom(augment_utype,modelExportFormat_BINARY_ARCHIVE)},
  {"text_archive",8,0,1,0,0,0,0,0,0,N,mom(augment_utype,modelExportFormat_TEXT_ARCHIVE)}
}

KeyWord kw_381[2] [static]
Initial value:
= {
  {"filename_prefix",11,0,1,0,0,0,0,0,0,N,mom(str,modelExportPrefix)},
  {"formats",8,4,2,1,kw_380}
}

KeyWord kw_382[5] [static]
Initial value:
= {
  {"export_model",8,2,4,0,kw_381,0,0,0,0,0,N,mom(true,exportSurrogate)},
  {"max_nodes",9,0,1,0,0,0,0,0,0,N,mom(shint,annNodes)},
  {"nodes",1,0,1,0,0,0,0,0,0,N,mom(shint,annNodes)},
  {"random_weight",9,0,3,0,0,0,0,0,0,N,mom(shint,annRandomWeight)},
  {"range",10,0,2,0,0,0,0,0,0,N,mom(Real,annRange)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_383[4]  [static]
Initial value:

= {
    {"algebraic_console", 8, 0, 4, 0, 0, 0, 0, 0, N_mom(augment_utype, modelExportFormat_ALGEBRAIC_CONSOLE),
     "algebraic_file", 8, 0, 3, 0, 0, 0, 0, 0, N_mom(augment_utype, modelExportFormat_ALGEBRAIC_FILE),
     "binary_archive", 8, 0, 2, 0, 0, 0, 0, 0, N_mom(augment_utype, modelExportFormat_BINARY_ARCHIVE),
     "text_archive", 8, 0, 1, 0, 0, 0, 0, 0, N_mom(augment_utype, modelExportFormat_TEXT_ARCHIVE)
}

KeyWord kw_384[2]  [static]
Initial value:

= {
    {"filename_prefix", 11, 0, 1, 0, 0, 0, 0, 0, N_mom(str, modelExportPrefix),
     "formats", 8, 4, 2, 1, kw_383}
}

KeyWord kw_385[5]  [static]
Initial value:

= {
    {"basis_order", 0x29, 0, 1, 0, 0, 0, 0, 0, N_mom(shint, polynomialOrder),
     "cubic", 8, 0, 1, 1, 0, 0, 0, 0, N_mom(order, polynomialOrder_3),
     "export_model", 8, 0, 2, 0, kw_384, 0, 0, 0, N_mom(true, exportSurrogate),
     "linear", 8, 0, 1, 1, 0, 0, 0, 0, N_mom(order, polynomialOrder_1),
     "quadratic", 8, 0, 1, 1, 0, 0, 0, 0, N_mom(order, polynomialOrder_2)}
}

KeyWord kw_386[4]  [static]
Initial value:

= {
    {"algebraic_console", 8, 0, 4, 0, 0, 0, 0, 0, N_mom(augment_utype, modelExportFormat_ALGEBRAICConsole),
     "algebraic_file", 8, 0, 3, 0, 0, 0, 0, 0, N_mom(augment_utype, modelExportFormat_ALGEBRAIC_FILE),
     "binary_archive", 8, 0, 2, 0, 0, 0, 0, 0, N_mom(augment_utype, modelExportFormat_BINARY_ARCHIVE),
     "text_archive", 8, 0, 1, 0, 0, 0, 0, 0, N_mom(augment_utype, modelExportFormat_TEXT_ARCHIVE)
}

KeyWord kw_387[2]  [static]
Initial value:

= {
    {"filename_prefix", 11, 0, 1, 0, 0, 0, 0, 0, N_mom(str, modelExportPrefix),
     "formats", 8, 4, 2, 1, kw_386}
}
CHAPTER 12. NAMESPACE DOCUMENTATION

KeyWord kw_388[5]  [static]
Initial value:

= {
  "bases", 9, 0, 1, 0, 0, 0, 0, 0, N, mom(shint, rbfBases),
  "export_model", 8, 2, 5, 0, kw_387, 0, 0, 0, N, mom(true, exportSurrogate),
  "max_pts", 9, 0, 2, 0, 0, 0, 0, 0, N, mom(shint, rbfMaxPts),
  "max_subsets", 9, 0, 4, 0, 0, 0, 0, 0, N, mom(shint, rbfMaxSubsets),
  "min_partition", 9, 0, 3, 0, 0, 0, 0, 0, N, mom(shint, rbfMinPartition)}

KeyWord kw_389[3]  [static]
Initial value:

= {
  "all", 8, 0, 1, 0, 0, 0, 0, 0, N, mom(lit, approxPointReuse_all),
  "none", 8, 0, 1, 0, 0, 0, 0, 0, N, mom(lit, approxPointReuse_none),
  "region", 8, 0, 1, 0, 0, 0, 0, 0, N, mom(lit, approxPointReuse_region)}

KeyWord kw_390[26]  [static]
Initial value:

= {
  "actual_model_pointer", 11, 4, 0, 0, 0, 0, 0, N, mom(str, actualModelPointer),
  "challenge_points_file", 3, 4, 11, 0, kw_353, 0, 0, 0, N, mom(str, importChallengePtsFile),
  "correction", 8, 6, 9, 0, kw_354,
  "dace_method_pointer", 11, 1, 4, 0, kw_357, 0, 0, 0, N, mom(str, subMethodPointer),
  "diagnostics", 7, 2, 10, 0, kw_359, 0, 0, 0, N, mom(str, diagMetrics),
  "domain_decomposition", 8, 1, 2, 0, kw_361, 0, 0, 0, N, mom(true, domainDecomp),
  "export_approx_points_file", 11, 3, 7, 0, kw_363, 0, 0, 0, N, mom(str, exportApproxPtsFile),
  "gaussian_process", 8, 2, 1, 1, kw_370,
  "import_build_points_file", 11, 4, 6, 0, kw_372, 0, 0, 0, N, mom(str, importBuildPtsFile),
  "import_challenge_points_file", 11, 4, 11, 0, kw_353, 0, 0, 0, N, mom(str, importChallengePtsFile),
  "import_points_file", 3, 4, 6, 0, kw_372, 0, 0, 0, 2, N, mom(str, importBuildPtsFile),
  "kriging", 0, 2, 1, 1, kw_370, 0, 0, 0, N, mom(str, importBuildPtsFile),
  "mars", 8, 3, 1, 1, kw_376, 0, 0, 0, N, mom(lit, surrogateType_global_mars),
  "metrics", 15, 2, 10, 0, kw_359, 0, 0, 0, N, mom(str, diagMetrics),
  "minimum_points", 8, 0, 3, 0, 0, 0, 0, 0, N, mom(type, pointsManagement_MINIMUM_POINTS),
  "moving_least_squares", 8, 4, 1, 1, kw_379, 0, 0, 0, N, mom(lit, surrogateType_global_moving_least_squares),
  "neural_network", 8, 5, 1, 1, kw_382, 0, 0, 0, N, mom(lit, surrogateType_global_neural_network),
  "polynomial", 8, 5, 1, 1, kw_385, 0, 0, 0, N, mom(lit, surrogateType_global_polynomial),
  "radial_basis", 8, 5, 1, 1, kw_388, 0, 0, 0, N, mom(lit, surrogateType_global_radial_basis),
  "recommended_points", 8, 0, 3, 0, 0, 0, 0, 0, N, mom(type, pointsManagement_RECOMMENDED_POINTS),
  "reuse_points", 8, 3, 5, 0, kw_389,
  "samples_file", 3, 4, 6, 0, kw_372, 0, 0, 0, 14, N, mom(str, importBuildPtsFile),
  "total_points", 9, 0, 3, 0, 0, 0, 0, 0, 0, mom(int, pointsTotal),
  "use_derivatives", 8, 0, 8, 0, 0, 0, 0, 0, N, mom(true, modelUseDerivsFlag)}

KeyWord kw_391[6]  [static]
Initial value:
12.1. DAKOTA NAMESPACE REFERENCE

= {
  "additive", 8, 0, 2, 0, 0, 0, 0, Nmom(type, approxCorrectionType_ADDITIVE_CORRECTION),
  "combined", 8, 0, 2, 0, 0, 0, 0, Nmom(type, approxCorrectionType_COMBINED_CORRECTION),
  "first_order", 8, 0, 1, 0, 0, 0, 0, Nmom(order, approxCorrectionOrder_1),
  "multiplicative", 8, 0, 2, 0, 0, 0, 0, Nmom(type, approxCorrectionType_MULTIPLICATIVE_CORRECTION),
  "second_order", 8, 0, 1, 0, 0, 0, 0, Nmom(order, approxCorrectionOrder_2),
  "zeroth_order", 8, 0, 1, 0, 0, 0, 0, Nmom(order, approxCorrectionOrder_0)
}

KeyWord kw_392[3] [static]
Initial value:

= {
  "correction", 8, 6, 2, 2, kw_391,
  "model_fidelity_sequence", 7, 0, 1, 1, 0, 0, 0, 1, Nmom(strL, orderedModelPointers),
  "ordered_model_fidelities", 15, 0, 1, 1, 0, 0, 0, 0, Nmom(strL, orderedModelPointers)
}

KeyWord kw_393[1] [static]
Initial value:

= {
  "actual_model_pointer", 11, 0, 1, 1, 0, 0, 0, 0, Nmom(str, actualModelPointer)
}

KeyWord kw_394[2] [static]
Initial value:

= {
  0, 0, 1, 0, 0, kw_393,
  "taylor_series", 8, 0, 1, 1
}

KeyWord kw_395[2] [static]
Initial value:

= {
  0, 0, 1, 0, 0, kw_393,
  "tana", 8, 0, 1, 1
}

KeyWord kw_396[5] [static]
Initial value:

= {
  "global", 8, 26, 2, 1, kw_390,
  "hierarchical", 8, 3, 2, 1, kw_392, 0, 0, 0, Nmom(lit, surrogateType_hierarchical),
  "id_surrogates", 13, 0, 1, 0, 0, 0, 0, 0, Nmom(intsetm1, surrogateFnIndices),
  "local", 8, 1, 2, 1, kw_394, 0, 0, 0, Nmom(lit, surrogateType_local_taylor),
  "multipoint", 8, 1, 2, 1, kw_395, 0, 0, 0, Nmom(lit, surrogateType_multipoint_tana)
}
KeyWord kw_397[10] [static]
Initial value:

```csharp
= {
    {"hierarchical_tagging", 8, 0, 4, 0, 0, 0, 0, 0, 0, mom(true, hierarchicalTags)},
    {"id_model", 11, 0, 1, 0, 0, 0, 0, 0, mom(str, idModel)},
    {"nested", 8, 2, 1, kw_342, 0, 0, 0, 0, mom(lit, modelType_nested)},
    {"random_field", 8, 5, 1, kw_346, 0, 0, 0, 0, mom(lit, modelType_random_field)},
    {"responses_pointer", 11, 0, 5, 0, 0, 0, 0, 0, mom(str, responsesPointer)},
    {"simulation", 0, 2, 1, kw_348, 0, 0, 1, 0, mom(lit, modelType_simulation)},
    {"single", 8, 2, 1, kw_348, 0, 0, 0, 0, mom(lit, modelType_simulation)},
    {"subspace", 8, 5, 1, kw_351, 0, 0, 0, 0, mom(lit, modelType_subspace)},
    {"surrogate", 8, 5, 1, kw_396, 0, 0, 0, 0, mom(lit, modelType_surrogate)},
    {"variables_pointer", 11, 0, 2, 0, 0, 0, 0, 0, mom(str, variablesPointer)}
}
```

KeyWord kw_398[2] [static]
Initial value:

```csharp
= {
    {"exp_id", 8, 0, 2, 0, 0, 0, 0, 0, 0, mom(augment_utype, scalarDataFormat_TABULAR_EVAL_ID)},
    {"header", 8, 0, 1, 0, 0, 0, 0, 0, mom(augment_utype, scalarDataFormat_TABULAR_HEADER)}
}
```

KeyWord kw_399[3] [static]
Initial value:

```csharp
= {
    {"annotated", 8, 0, 1, 0, 0, 0, 0, 0, 0, mom(utype, scalarDataFormat_TABULAR_EXPER_ANNOT)},
    {"custom.annotated", 8, 2, 1, 0, kw_398, 0, 0, 0, 0, mom(utype, scalarDataFormat_TABULAR_NONE)},
    {"freeform", 8, 0, 1, 0, 0, 0, 0, 0, 0, mom(utype, scalarDataFormat_TABULAR_NONE)}
}
```

KeyWord kw_400[5] [static]
Initial value:

```csharp
= {
    {"interpolate", 8, 0, 5, 0, 0, 0, 0, 0, 0, mom(true, interpolateFlag)},
    {"num_config_variables", 0x29, 0, 2, 0, 0, 0, 0, 0, 0, mom(sizet, numExpConfigVars)},
    {"num_experiments", 0x29, 0, 1, 0, 0, 0, 0, 0, 0, mom(sizet, numExperiments)},
    {"scalar_data_file", 11, 3, 4, 0, kw_399, 0, 0, 0, 0, mom(str, scalarDataFileName)},
    {"variance_type", 0x80f, 0, 3, 0, 0, 0, 0, 0, 0, mom(str, varianceType)}
}
```

KeyWord kw_401[2] [static]
Initial value:

```csharp
= {
    {"exp_id", 8, 0, 2, 0, 0, 0, 0, 0, 0, mom(augment_utype, scalarDataFormat_TABULAR_EVAL_ID)},
    {"header", 8, 0, 1, 0, 0, 0, 0, 0, 0, mom(augment_utype, scalarDataFormat_TABULAR_HEADER)}
}
```
KeyWord kw_402[6]  [static]
Initial value:

= {
  "annotated", 8, 0, 1, 0, 0, 0, 0, 0, N_rem(utype, scalarDataFormat_TABULAR_EXPER,ANNOT),
  "custom_annotated", 8, 2, 1, kw_401, 0, 0, 0, 0, N_rem(utype, scalarDataFormat_TABULAR_NONE),
  "freeform", 8, 0, 1, 0, 0, 0, 0, 0, N_rem(utype, scalarDataFormat_TABULAR_NONE),
  "num_config_variables", 0x29, 0, 3, 0, 0, 0, 0, 0, N_rem(sizet, numExpConfigVars),
  "num_experiments", 0x29, 0, 2, 0, 0, 0, 0, 0, N_rem(sizet, numExperiments),
  "variance_type", 0x80f, 0, 4, 0, 0, 0, 0, 0, N_rem(strL, varianceType)
}

KeyWord kw_403[3]  [static]
Initial value:

= {
  "lengths", 13, 0, 1, 1, 0, 0, 0, 0, N_rem(ivec, fieldLengths),
  "num_coordinates_per_field", 13, 0, 2, 0, 0, 0, 0, 0, N_rem(ivec, numCoordsPerField),
  "read_field_coordinates", 8, 0, 1, 0, 0, 0, 0, 0, N_rem(true, readFieldCoords)
}

KeyWord kw_404[6]  [static]
Initial value:

= {
  "nonlinear_inequality_scale_types", 0x807, 0, 2, 0, 0, 0, 0, 0, 3, N_rem(strL, nonlinearEqScaleTypes),
  "nonlinear_inequality_scales", 0x806, 0, 3, 0, 0, 0, 0, 0, 3, N_rem(RealDL, nonlinearEqScales),
  "nonlinear_inequality_targets", 6, 0, 1, 0, 0, 0, 0, 0, 3, N_rem(RealDL, nonlinearEqTargets),
  "scale_types", 0x80f, 0, 2, 0, 0, 0, 0, 0, 0, N_rem(strL, nonlinearEqScaleTypes),
  "scales", 0x80e, 0, 3, 0, 0, 0, 0, 0, 0, N_rem(RealDL, nonlinearEqScales),
  "targets", 14, 0, 1, 0, 0, 0, 0, 0, 0, N_rem(RealDL, nonlinearEqTargets)
}

KeyWord kw_405[8]  [static]
Initial value:

= {
  "lower_bounds", 14, 0, 1, 0, 0, 0, 0, 0, N_rem(RealDL, nonlinearIneqLowerBnds),
  "nonlinear_inequality_lower_bounds", 6, 0, 1, 0, 0, 0, 0, 0, -1, N_rem(RealDL, nonlinearIneqLowerBnds),
  "nonlinear_inequality_scale_types", 0x807, 0, 3, 0, 0, 0, 0, 0, 3, N_rem(strL, nonlinearIneqScaleTypes),
  "nonlinear_inequality_scales", 0x806, 0, 4, 0, 0, 0, 0, 0, 3, N_rem(RealDL, nonlinearIneqScales),
  "nonlinear_inequality_upper_bounds", 6, 0, 2, 0, 0, 0, 0, 0, 3, N_rem(RealDL, nonlinearIneqUpperBnds),
  "scale_types", 0x80f, 0, 3, 0, 0, 0, 0, 0, 0, N_rem(strL, nonlinearIneqScaleTypes),
  "scales", 0x80e, 0, 4, 0, 0, 0, 0, 0, 0, N_rem(RealDL, nonlinearIneqScales),
  "upper_bounds", 14, 0, 2, 0, 0, 0, 0, 0, 0, N_rem(RealDL, nonlinearIneqUpperBnds)
}
KeyWord kw_406[18] [static]
Initial value:

```plaintext
= {
    {"calibration_data", 8, 5, 6, 0, kw_400, 0, 0, 0, 0, N_rem(true, calibrationDataFlag)},
    {"calibration_term_scale_types", 0x807, 0, 0, 0, 0, 0, 0, 0, 12, N_rem(true, primaryRespFnScaleTypes)}
    ,
    {"field_calibration_terms", 0x29, 3, 2, 0, kw_403, 0, 0, 0, 0, N_rem(sizet, numFieldLeastSqTerms)},
    {"least_squares_data_file", 3, 6, 0, kw_402, 0, 0, -5, N_rem(str, scalarDataFileName)},
    {"least_squares_term_scale_types", 0x807, 0, 0, 0, 0, 0, 0, 0, 7, N_rem(strl, primaryRespFnScaleTypes)},
    {"least_squares_term_scales", 0x806, 0, 4, 0, 0, 0, 0, 0, 7, N_rem(RealDL, primaryRespFnScales)},
    {"least_squares_weights", 6, 0, 5, 0, 0, 0, 0, 0, 8, N_rem(RealDL, primaryRespFnWeights)},
    {"nonlinear_equality_constraints", 0x21, 6, 8, 0, kw_404, 0, 0, 0, 0, N_rem(sizet, numNonlinearEqConstraints)},
    {"nonlinear_inequality_constraints", 0x29, 8, 0, 0, 0, 0, 0, 0, 7, N_rem(RealDL, primaryRespFnScaleTypes)},
    {"scalar_calibration_terms", 0x29, 0, 1, 0, 0, 0, 0, 0, 0, N_rem(sizet, numScalarLeastSqTerms)},
    {"weights", 14, 0, 5, 0, 0, 0, 0, 0, 0, N_rem(RealDL, primaryRespFnWeights)}
}
```

KeyWord kw_407[4] [static]
Initial value:

```plaintext
= {
    {"absolute", 8, 0, 2, 0, 0, 0, 0, 0, 0, N_rem(lit, fdGradStepType_absolute)},
    {"bounds", 8, 0, 2, 0, 0, 0, 0, 0, 0, N_rem(lit, fdGradStepType_bounds)},
    {"ignore_bounds", 8, 0, 1, 0, 0, 0, 0, 0, 0, N_rem(true, ignoreBounds)},
    {"relative", 8, 0, 2, 0, 0, 0, 0, 0, 0, N_rem(lit, fdGradStepType_relative)}
}
```

KeyWord kw_408[8] [static]
Initial value:

```plaintext
= {
    {"central", 8, 4, 0, 0, 0, 0, 0, 0, 0, N_rem(lit, intervalType_central)},
    {"dakota", 8, 4, 2, 0, kw_407, 0, 0, 0, 0, N_rem(lit, methodSource_dakota)},
    {"fd_step_size", 6, 0, 5, 0, 0, 0, 0, 0, 1, N_rem(RealL, fdGradStepSize)},
    {"fd_step_size", 14, 0, 5, 0, 0, 0, 0, 0, 0, N_rem(RealL, fdGradStepSize)},
    {"forward", 8, 0, 4, 0, 0, 0, 0, 0, 0, N_rem(lit, intervalType_forward)},
    {"interval_type", 8, 0, 3},
    {"method_source", 8, 0, 1},
    {"vendor", 8, 0, 2, 0, 0, 0, 0, 0, 0, N_rem(lit, methodSource_vendor)}
}
```

KeyWord kw_409[3] [static]
Initial value:

```plaintext
= {
    {0, 0, 8, 0, 0, kw_408},
    {"id_analytic_gradients", 13, 0, 2, 2, 0, 0, 0, 0, 0, N_rem(intset, idAnalyticGrads)},
    {"id_numerical_gradients", 13, 0, 1, 1, 0, 0, 0, 0, 0, N_rem(intset, idNumericalGrads)}
}
```
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_410[2]  [static]
Initial value:
= {
  "fdhessian_step_size", 6, 0, 1, 0, 0, 0, 0, 1, N_rem(RealL, fdHessStepSize),
  "fd_step_size", 14, 0, 1, 0, 0, 0, 0, N_rem(RealL, fdHessStepSize),
}

KeyWord kw_411[1]  [static]
Initial value:
= {
  "damped", 8, 0, 1, 0, 0, 0, 0, 0, N_rem(lit, quasiHessianType_damped_bfgs),
}

KeyWord kw_412[2]  [static]
Initial value:
= {
  "bfgs", 8, 1, 1, 1, kw_411, 0, 0, 0, N_rem(lit, quasiHessianType_bfgs),
  "sr1", 8, 0, 1, 1, 0, 0, 0, 0, N_rem(lit, quasiHessianType_sr1),
}

KeyWord kw_413[8]  [static]
Initial value:
= {
  "absolute", 8, 0, 2, 0, 0, 0, 0, 0, N_rem(lit, fdHessStepType_absolute),
  "bounds", 8, 0, 2, 0, 0, 0, 0, 0, N_rem(lit, fdHessStepType_bounds),
  "central", 8, 0, 3, 0, 0, 0, 0, 0, N_rem(true, centralHess),
  "forward", 8, 0, 3, 0, 0, 0, 0, 0, N_rem(false, centralHess),
  "id_analytic_hessians", 13, 0, 5, 0, 0, 0, 0, 0, N_rem(intset, idAnalyticHessians),
  "id_numerical_hessians", 13, 2, 4, 0, kw_410, 0, 0, 0, N_rem(intset, idNumericalHessians),
  "relative", 8, 0, 2, 0, 0, 0, 0, 0, N_rem(lit, fdHessStepType_relative),
}

KeyWord kw_414[3]  [static]
Initial value:
= {
  "lengths", 13, 0, 1, 1, 0, 0, 0, 0, N_rem(ivec, fieldLengths),
  "num_coordinates_per_field", 13, 0, 2, 0, 0, 0, 0, 0, N_rem(ivec, numCoordsPerField),
  "read_field_coordinates", 8, 0, 3, 0, 0, 0, 0, 0, N_rem(true, readFieldCoords),
}

KeyWord kw_415[6]  [static]
Initial value:
= {
  "nonlinear_equality_scale_types", 0x807, 0, 2, 0, 0, 0, 0, 3, N_rem(strL, nonlinearEqScaleTypes),
  "nonlinear_equality_scales", 0x806, 0, 3, 0, 0, 0, 0, 3, N_rem(RealDL, nonlinearEqScales),
  "nonlinear_equality_targets", 6, 0, 1, 0, 0, 0, 0, 3, N_rem(RealDL, nonlinearEqTargets),
  "scale_types", 0x805, 0, 2, 0, 0, 0, 0, 0, N_rem(strL, nonlinearEqScaleTypes),
  "scales", 0x804, 0, 3, 0, 0, 0, 0, 0, N_rem(RealDL, nonlinearEqScales),
  "targets", 14, 0, 1, 0, 0, 0, 0, 0, N_rem(RealDL, nonlinearEqTargets),
}
KeyWord kw_416[8]  [static]
Initial value:
= {
    {"lower_bounds",14,0,1,0,0,0,0,0,0,N,rem(RealDL,nonlinearIneqLowerBnds),  
     "nonlinear_inequality_lower_bounds",5,0,1,0,0,0,0,-1,N,rem(RealDL,nonlinearIneqLowerBnds)},
    {"nonlinear_inequality_scale_types",0x807,0,3,0,0,0,0,3,N,rem(strL,nonlinearIneqScaleTypes)},
    {"nonlinear_inequality_scales",0x806,0,4,0,0,0,0,3,N,rem(RealDL,nonlinearIneqScales)},
    {"nonlinear_inequality_upper_bounds",6,0,2,0,0,0,0,3,N,rem(RealDL,nonlinearIneqUpperBnds)},
    {"scale_types",0x80f,0,3,0,0,0,0,N,rem(strL,nonlinearIneqScaleTypes)},
    {"scales",0x80e,0,4,0,0,0,0,N,rem(RealDL,nonlinearIneqScales)},
    {"upper_bounds",14,0,2,0,0,0,0,0,N,rem(RealDL,nonlinearIneqUpperBnds)}
}

KeyWord kw_417[15]  [static]
Initial value:
= {
    {"field_objectives",0x29,3,8,0,kw_414,0.,0.,0,N,rem(sizet,numFieldObjectiveFunctions)},
    {"multi_objective_weights",5,0,4,0,0,0,0,13,N,rem(RealDL,primaryRespFnWeights)},
    {"nonlinear_equality_constraints",5,0,6,0,1,kw_415,0.,0.,0,N,rem(sizet,numNonlinearEqConstraints)},
    {"nonlinear_inequality_constraints",5,0,8,0,1,kw_416,0.,0.,0,N,rem(sizet,numNonlinearIneqConstraints)},
    {"num_field_objectives",5,0,7,0,0,0,0,-4,N,rem(sizet,numFieldObjectiveFunctions)},
    {"num_nonlinear_equality_constraints",5,0,6,0,0,0,0,-3,N,rem(sizet,numNonlinearEqConstraints)},
    {"num_nonlinear_inequality_constraints",5,0,8,0,0,0,0,-3,N,rem(sizet,numNonlinearIneqConstraints)},
    {"objective_function_scale_types",13,0,4,0,0,0,0,0,N,rem(strL,primaryRespFnScaleTypes)},
    {"objective_function_scales",5,0,4,0,0,0,0,2,N,rem(RealDL,primaryRespFnScales)},
    {"primary_scale_types",5,0,2,0,0,0,0,0,N,rem(strL,primaryRespFnScaleTypes)},
    {"primary_scales",5,0,3,0,0,0,0,0,N,rem(RealDL,primaryRespFnScales)},
    {"scalar_objectives",5,0,7,0,0,0,0,0,N,rem(sizet,numScalarObjectiveFunctions)},
    {"sense",5,0,1,0,0,0,0,0,N,rem(strL,primaryRespFnSense)},
    {"weights",14,0,4,0,0,0,0,0,N,rem(RealDL,primaryRespFnWeights)}
}

KeyWord kw_418[3]  [static]
Initial value:
= {
    {"lengths",13,0,1,1,0,0,0,0,0,N,rem(ivec,fieldLengths)},
    {"num_coordinates_per_field",13,0,2,0,0,0,0,0,N,rem(ivec,numCoordsPerField)},
    {"read_field_coordinates",8,0,3,0,0,0,0,0,N,rem(true,readFieldCoords)}
}

KeyWord kw_419[4]  [static]
Initial value:
= {
    {"field_responses",5,0,3,2,0,kw_418,0,0,0,0,N,rem(sizet,numFieldResponseFunctions)},
    {"num_field_responses",5,0,3,2,0,kw_418,0,0,0,0,N,rem(sizet,numFieldResponseFunctions)},
    {"num_scalar_responses",5,0,1,0,0,0,0,1,N,rem(sizet,numScalarResponseFunctions)},
    {"scalar_responses",5,0,1,0,0,0,0,0,N,rem(sizet,numScalarResponseFunctions)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_420[7]  [static]

Initial value:

= {
    {"absolute", 8, 0, 2, 0, 0, 0, 0, 0, N, rem(lit, fdHessStepType, absolute)},
    {"bounds", 8, 0, 2, 0, 0, 0, 0, 0, N, rem(lit, fdHessStepType, bounds)},
    {"central", 8, 0, 3, 0, 0, 0, 0, 0, N, rem(true, centralHess)},
    {"fd_hessian_step_size", 6, 0, 1, 0, 0, 0, 0, 1, N, rem(RealL, fdHessStepSize)},
    {"fd_step_size", 14, 0, 1, 0, 0, 0, 0, 0, N, rem(RealL, fdHessStepSize)},
    {"relative", 8, 0, 2, 0, 0, 0, 0, 0, N, rem(lit, fdHessStepType, relative)}
}

KeyWord kw_421[1]  [static]

Initial value:

= {
    {"damped", 8, 0, 1, 0, 0, 0, 0, 0, N, rem(lit, quasiHessianType, damped, bfgs)}
}

KeyWord kw_422[2]  [static]

Initial value:

= {
    {"bfgs", 8, 1, 1, 1, kw, 421, 0, 0, 0, N, rem(lit, quasiHessianType, bfgs)},
    {"sr1", 8, 0, 1, 1, 0, 0, 0, 0, N, rem(lit, quasiHessianType, sr1)}
}

KeyWord kw_423[19]  [static]

Initial value:

= {
    {"analytic_gradients", 8, 0, 4, 2, 0, 0, 0, 0, 0, N, rem(lit, gradientType, analytic)},
    {"analytic_hessians", 8, 0, 5, 3, 0, 0, 0, 0, N, rem(lit, hessianType, analytic)},
    {"calibration_terms", 0x29, 18, 3, 1, kw, 406, 0, 0, 0, N, rem(sizet, numLeastSqTerms)},
    {"descriptors", 15, 0, 2, 0, 0, 0, 0, 0, N, rem(strL, responseLabels)},
    {"id_responses", 11, 0, 1, 0, 0, 0, 0, 0, N, rem(str, idResponses)},
    {"least_squares_terms", 0x21, 18, 3, 1, kw, 406, 0, 0, 0, 3, N, rem(sizet, numLeastSqTerms)},
    {"mixed_gradients", 8, 2, 4, 2, kw, 409, 0, 0, 0, 0, N, rem(lit, gradientType, mixed)},
    {"mixed_hessians", 8, 8, 5, 3, kw, 413, 0, 0, 0, N, rem(lit, hessianType, mixed)},
    {"no_gradients", 8, 0, 4, 2, 0, 0, 0, 0, 0, N, rem(lit, gradientType, none)},
    {"no_hessians", 8, 0, 5, 3, 0, 0, 0, 0, 0, N, rem(lit, hessianType, none)},
    {"num_least_squares_terms", 0x29, 18, 3, 1, kw, 406, 0, 0, 0, 0, N, rem(sizet, numLeastSqTerms)},
    {"num_objective_functions", 0x21, 15, 3, 1, kw, 417, 0, 0, 0, 4, N, rem(sizet, numObjectiveFunctions)},
    {"num_response_functions", 0x21, 4, 3, 1, kw, 419, 0, 0, 0, 6, N, rem(sizet, numResponseFunctions)},
    {"numerical_gradients", 8, 8, 4, 2, kw, 408, 0, 0, 0, N, rem(lit, gradientType, numerical)},
    {"numerical_hessians", 8, 8, 5, 3, kw, 409, 0, 0, 0, N, rem(lit, hessianType, numerical)},
    {"objective_functions", 0x29, 15, 3, 1, kw, 417, 0, 0, 0, N, rem(sizet, numObjectiveFunctions)},
    {"quasi_hessians", 8, 2, 5, 3, kw, 422, 0, 0, 0, N, rem(lit, hessianType, quasi)},
    {"response_descriptors", 7, 0, 2, 0, 0, 0, 0, 0, N, rem(strL, responseLabels)},
    {"response_functions", 0x29, 4, 3, 1, kw, 419, 0, 0, 0, N, rem(sizet, numResponseFunctions)}
}
KeyWord kw_424[6]  [static]
Initial value:

= {
  {"aleatory", 8, 0, 1, 1, 0, 0, 0, 0, 0, N_vam(type, varsView_Aleatory, UncertainView)},
  {"all", 8, 0, 1, 1, 0, 0, 0, 0, N_vam(type, varsView_AllView)},
  {"design", 8, 0, 1, 1, 0, 0, 0, 0, N_vam(type, varsView_DesignView)},
  {"epistemic", 8, 0, 1, 1, 0, 0, 0, 0, N_vam(type, varsView_Epistemic, UncertainView)},
  {"state", 8, 0, 1, 1, 0, 0, 0, 0, N_vam(type, varsView_StateView)},
  {"uncertain", 8, 0, 1, 1, 0, 0, 0, 0, N_vam(type, varsView_UncertainView)}
}

KeyWord kw_425[11]  [static]
Initial value:

= {
  {"alphas", 14, 0, 1, 1, 0, 0, 0, 0, N_vam(RealLb, betaUncAlphas)},
  {"betas", 14, 0, 2, 2, 0, 0, 0, 0, N_vam(RealLb, betaUncBetas)},
  {"buv_alphas", 6, 0, 1, 1, 0, 0, 0, -2, N_vam(rvec, betaUncLowerBnds)},
  {"buv_betas", 6, 0, 2, 2, 0, 0, 0, -2, N_vam(rvec, betaUncUpperBnds)},
  {"buv_descriptors", 7, 0, 6, 0, 0, 0, 0, 3, N_vam(caulbl, CAUVar_beta)},
  {"buv_lower_bounds", 6, 0, 3, 3, 0, 0, 0, 4, N_vam(rvec, betaUncLowerBnds)},
  {"buv_upper_bounds", 6, 0, 4, 4, 0, 0, 0, 4, N_vam(rvec, betaUncUpperBnds)},
  {"descriptors", 15, 0, 6, 0, 0, 0, 0, 0, N_vam(caulbl, CAUVar_beta)},
  {"initial_point", 14, 0, 5, 0, 0, 0, 0, 0, N_vam(rvec, betaUncVars)},
  {"lower_bounds", 14, 0, 3, 3, 0, 0, 0, 0, N_vam(rvec, betaUncLowerBnds)},
  {"upper_bounds", 14, 0, 4, 4, 0, 0, 0, 0, N_vam(rvec, betaUncUpperBnds)}
}

KeyWord kw_426[5]  [static]
Initial value:

= {
  {"descriptors", 15, 0, 4, 0, 0, 0, 0, 0, N_vam(dautilbl, DAUVar_binomial)},
  {"initial_point", 13, 0, 3, 0, 0, 0, 0, 0, N_vam(intlb, binomialUncNumTrials)},
  {"num_trials", 13, 0, 2, 2, 0, 0, 0, 0, N_vam(intlb, binomialUncNumTrials)},
  {"prob_per_trial", 6, 0, 1, 1, 0, 0, 0, 1, N_vam(rvec, binomialUncProbPerTrial)},
  {"probability_per_trial", 14, 0, 1, 1, 0, 0, 0, 0, N_vam(rvec, binomialUncProbPerTrial)}
}

KeyWord kw_427[12]  [static]
Initial value:

= {
  {"cdv_descriptors", 7, 0, 6, 0, 0, 0, 0, 0, 6, N_vam(strl, continuousDesignLabels)},
  {"cdv_initial_point", 6, 0, 1, 0, 0, 0, 0, 0, 6, N_vam(rvec, continuousDesignVars)},
  {"cdv_lower_bounds", 6, 0, 2, 0, 0, 0, 0, 0, 6, N_vam(rvec, continuousDesignLowerBnds)},
  {"cdv_scales", 0x806, 0, 5, 0, 0, 0, 0, 6, N_vam(rvec, continuousDesignScales)},
  {"cdv_upper_bounds", 6, 0, 3, 0, 0, 0, 0, 0, 6, N_vam(rvec, continuousDesignUpperBnds)},
  {"descriptors", 15, 0, 6, 0, 0, 0, 0, 0, N_vam(strl, continuousDesignScaleTypes)},
  {"initial_point", 14, 0, 1, 0, 0, 0, 0, 0, N_vam(rvec, continuousDesignVars)},
  {"lower_bounds", 14, 0, 2, 0, 0, 0, 0, 0, N_vam(rvec, continuousDesignLowerBnds)},
  {"scales", 0x80f, 0, 4, 0, 0, 0, 0, 0, N_vam(strl, continuousDesignScaleTypes)},
  {"upper_bounds", 14, 0, 3, 0, 0, 0, 0, 0, N_vam(rvec, continuousDesignUpperBnds)}
}
KeyWord kw_428[10] [static]
Initial value:

= {
    *descriptors*, 15, 0, 6, 0, 0, 0, 0, 0, N, vam (ceulbl, CEUVar_interval),
    *interval_probabilities*, 14, 0, 2, 0, 0, 0, 0, 0, N, vam (newrvec, Var_Info_CIp),
    *interval_probs*, 6, 0, 2, 0, 0, 0, 0, 0, N, vam (newrvec, Var_Info_CIp),
    *iuv_descriptors*, 7, 0, 6, 0, 0, 0, 0, 0, N, vam (ceulbl, CEUVar_interval),
    *iuv_interval_probs*, 6, 0, 2, 0, 0, 0, 0, 0, -5, N, vam (newrvec, Var_Info_CIp),
    *iuv_num_intervals*, 5, 0, 1, 0, 0, 0, 0, 0, 2, N, vam (newiarray, Var_Info_CI),
    *lower_bounds*, 14, 0, 3, 1, 0, 0, 0, 0, N, vam (newrvec, Var_Info_CIlb),
    *num_intervals*, 13, 0, 1, 0, 0, 0, 0, 0, N, vam (newiarray, Var_Info_CI),
    *upper_bounds*, 14, 0, 4, 2, 0, 0, 0, 0, N, vam (newrvec, Var_Info_CUlb)
}

KeyWord kw_429[8] [static]
Initial value:

= {
    *csv_descriptors*, 7, 0, 4, 0, 0, 0, 0, 0, 4, N, vam (strL, continuousStateLabels),
    *csv_initial_state*, 6, 0, 1, 0, 0, 0, 0, 0, 4, N, vam (rvec, continuousStateVars),
    *csv_lower_bounds*, 6, 0, 2, 0, 0, 0, 0, 0, 4, N, vam (rvec, continuousStateLowerBnds),
    *csv_upper_bounds*, 6, 0, 3, 0, 0, 0, 0, 0, 4, N, vam (rvec, continuousStateUpperBnds),
    *descriptors*, 15, 0, 4, 0, 0, 0, 0, 0, 0, N, vam (strL, continuousStateLabels),
    *initial_point*, 13, 0, 1, 0, 0, 0, 0, 0, 0, N, vam (ivec, discreteDesignRangeVars),
    *lower_bounds*, 13, 0, 2, 0, 0, 0, 0, 0, 0, N, vam (ivec, discreteDesignRangeLowerBnds),
    *upper_bounds*, 13, 0, 3, 0, 0, 0, 0, 0, 0, N, vam (ivec, discreteDesignRangeUpperBnds)
}

KeyWord kw_430[8] [static]
Initial value:

= {
    *ddv_descriptors*, 7, 0, 4, 0, 0, 0, 0, 0, 4, N, vam (strL, discreteDesignRangeLabels),
    *ddv_initial_point*, 5, 0, 1, 0, 0, 0, 0, 0, 4, N, vam (ivec, discreteDesignRangeVars),
    *ddv_lower_bounds*, 5, 0, 2, 0, 0, 0, 0, 0, 4, N, vam (ivec, discreteDesignRangeLowerBnds),
    *ddv_upper_bounds*, 5, 0, 3, 0, 0, 0, 0, 0, 4, N, vam (ivec, discreteDesignRangeUpperBnds),
    *descriptors*, 15, 0, 4, 0, 0, 0, 0, 0, 0, N, vam (strL, discreteDesignRangeLabels),
    *initial_point*, 13, 0, 1, 0, 0, 0, 0, 0, 0, N, vam (ivec, discreteDesignRangeVars),
    *lower_bounds*, 13, 0, 2, 0, 0, 0, 0, 0, 0, N, vam (ivec, discreteDesignRangeLowerBnds),
    *upper_bounds*, 13, 0, 3, 0, 0, 0, 0, 0, 0, N, vam (ivec, discreteDesignRangeUpperBnds)
}

KeyWord kw_431[1] [static]
Initial value:

= {
    *adjacency_matrix*, 13, 0, 1, 0, 0, 0, 0, 0, 0, N, vam (newivec, Var_Info_4dsia)
KeyWord kw_432[7] [static]
Initial value:

```plaintext
= {
    {"categorical",15,1,3,0,kw_431,0.,0.,0.,0.,N_vam(categorical,discreteDesignSetIntCat)},
    {"descriptors",15,0,5,0,0.,0.,0.,0.,N_vam(strL,discreteDesignSetIntLabels)},
    {"elements",13,0,2,1,0.,0.,0.,0.,0.,N_vam(newivec,Var_Info_ddssi)},
    {"elements_per_variable",0x80d,0,1,0,0.,0.,0.,0.,0.,N_vam(newiarray,Var_Info_ddssi)},
    {"initial_point",13,0,4,0,0.,0.,0.,0.,0.,N_vam(ivec,discreteDesignSetIntVars)},
    {"num_set_values",0x805,0,1,0,0.,0.,0.,-2,N_vam(newiarray,Var_Info_ddssi)},
    {"set_values",5,0,2,1,0.,0.,0.,-4,N_vam(newivec,Var_Info_ddssi)}
}
```

KeyWord kw_433[1] [static]
Initial value:

```plaintext
= {
    {"adjacency_matrix",13,0,1,0,0.,0.,0.,0.,0.,N_vam(newivec,Var_Info_ddsra)}
}
```

KeyWord kw_434[7] [static]
Initial value:

```plaintext
= {
    {"categorical",15,1,3,0,kw_433,0.,0.,0.,0.,N_vam(categorical,discreteDesignSetRealCat)},
    {"descriptors",15,0,5,0,0.,0.,0.,0.,N_vam(strL,discreteDesignSetRealLabels)},
    {"elements",14,0,2,1,0.,0.,0.,0.,0.,0.,0.,N_vam(newrvec,Var_Info_ddsr)},
    {"elements_per_variable",0x80d,0,1,0,0.,0.,0.,0.,0.,N_vam(newiarray,Var_Info_ddsr)},
    {"initial_point",14,0,4,0,0.,0.,0.,0.,0.,N_vam(rvec,discreteDesignSetRealVars)},
    {"num_set_values",0x805,0,1,0,0.,0.,0.,-2,N_vam(newiarray,Var_Info_ddsr)},
    {"set_values",6,0,2,1,0.,0.,0.,-4,N_vam(newrvec,Var_Info_ddsr)}
}
```

KeyWord kw_435[7] [static]
Initial value:

```plaintext
= {
    {"adjacency_matrix",13,0,3,0,0.,0.,0.,0.,0.,0.,N_vam(newswire,Var_Info_ddss)},
    {"descriptors",15,0,5,0,0.,0.,0.,0.,0.,N_vam(strL,discreteDesignSetStrLabels)},
    {"elements",15,0,2,1,0.,0.,0.,0.,0.,0.,0.,N_vam(newarray,Var_Info_ddss)},
    {"elements_per_variable",0x80d,0,1,0,0.,0.,0.,0.,0.,N_vam(newiarray,Var_Info_ddss)},
    {"initial_point",15,0,4,0,0.,0.,0.,0.,0.,N_vam(array,discreteDesignSetStrVars)},
    {"num_set_values",0x805,0,1,0,0.,0.,0.,-2,N_vam(newiarray,Var_Info_ddss)},
    {"set_values",7,0,2,1,0.,0.,0.,-4,N_vam(newarray,Var_Info_ddss)}
}
```

KeyWord kw_436[3] [static]
Initial value:

```plaintext
= {
    {"integer",0x19,7,1,0,kw_432,0.,0.,0.,0.,N_vam(pintz,numDiscreteDesSetIntVars)},
    {"real",0x19,7,1,0,kw_434,0.,0.,0.,0.,N_vam(pintz,numDiscreteDesSetRealVars)},
    {"string",0x19,7,2,0,kw_435,0.,0.,0.,0.,N_vam(pintz,numDiscreteDesSetStrVars)}
}
```
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_437[9]  [static]

Initial value:

\[
= \{ \\
\{ \text{"descriptors"}, 15, 0, 6, 0, 0, \ldots, 0, N_{\text{vam}}(\text{desktop}, \text{DEUVar}, \text{interval}) \}, \\
\{ \text{"initial_point"}, 13, 0, 5, 0, 0, \ldots, 0, N_{\text{vam}}(\text{newvec}, \text{Var}, \text{Info}, \text{DIlb}) \}, \\
\{ \text{"interval_probabilities"}, 14, 0, 2, 0, 0, \ldots, 0, N_{\text{vam}}(\text{newrvec}, \text{Var}, \text{Info}, \text{DIp}) \}, \\
\{ \text{"interval_probs"}, 6, 0, 2, 0, 0, \ldots, -1, N_{\text{vam}}(\text{newrvec}, \text{Var}, \text{Info}, \text{DIp}) \}, \\
\{ \text{"lower_bounds"}, 13, 0, 3, 1, 0, \ldots, 0, N_{\text{vam}}(\text{newivec}, \text{Var}, \text{Info}, \text{DIlb}) \}, \\
\{ \text{"num_intervals"}, 13, 0, 1, 0, 0, \ldots, 0, N_{\text{vam}}(\text{newiarray}, \text{Var}, \text{Info}, \text{nDI}) \}, \\
\{ \text{"range_probabilities"}, 6, 0, 2, 0, 0, \ldots, -4, N_{\text{vam}}(\text{newrvec}, \text{Var}, \text{Info}, \text{DIp}) \}, \\
\{ \text{"range_probs"}, 6, 0, 2, 0, 0, \ldots, -5, N_{\text{vam}}(\text{newrvec}, \text{Var}, \text{Info}, \text{DIp}) \}, \\
\{ \text{"upper_bounds"}, 13, 0, 4, 2, 0, \ldots, 0, N_{\text{vam}}(\text{newivec}, \text{Var}, \text{Info}, \text{DIub}) \} \\
\} \\
\}
\]

KeyWord kw_438[8]  [static]

Initial value:

\[
= \{ \\
\{ \text{"descriptors"}, 15, 0, 4, 0, 0, \ldots, 0, N_{\text{vam}}(\text{strl}, \text{discreteStateRangeLabels}) \}, \\
\{ \text{"dsv_descriptors"}, 7, 0, 4, 0, 0, \ldots, -1, N_{\text{vam}}(\text{strl}, \text{discreteStateRangeLabels}) \}, \\
\{ \text{"dsv_initial_state"}, 5, 0, 2, 0, 0, \ldots, 3, N_{\text{vam}}(\text{ivec}, \text{discreteStateRangeVars}) \}, \\
\{ \text{"dsv_lower_bounds"}, 5, 0, 3, 0, 0, \ldots, 3, N_{\text{vam}}(\text{ivec}, \text{discreteStateRangeLowerBnds}) \}, \\
\{ \text{"dsv_upper_bounds"}, 5, 0, 3, 0, 0, \ldots, 3, N_{\text{vam}}(\text{ivec}, \text{discreteStateRangeUpperBnds}) \}, \\
\{ \text{"initial_state"}, 13, 0, 4, 2, 0, \ldots, 0, N_{\text{vam}}(\text{ivec}, \text{discreteStateRangeVars}) \}, \\
\{ \text{"lower_bounds"}, 13, 0, 2, 0, 0, \ldots, 3, N_{\text{vam}}(\text{ivec}, \text{discreteStateRangeLowerBnds}) \}, \\
\{ \text{"upper_bounds"}, 13, 0, 3, 0, 0, \ldots, 0, N_{\text{vam}}(\text{ivec}, \text{discreteStateRangeUpperBnds}) \} \\
\} \\
\]

KeyWord kw_439[7]  [static]

Initial value:

\[
= \{ \\
\{ \text{"categorical"}, 15, 0, 3, 0, 0, \ldots, 0, N_{\text{vam}}(\text{categorical}, \text{discreteStateSetIntCat}) \}, \\
\{ \text{"descriptors"}, 15, 0, 5, 0, 0, \ldots, 0, N_{\text{vam}}(\text{strl}, \text{discreteStateSetIntLabels}) \}, \\
\{ \text{"elements"}, 13, 0, 2, 1, 0, \ldots, 0, N_{\text{vam}}(\text{newivec}, \text{Var}, \text{Info}, \text{dssi}) \}, \\
\{ \text{"elements_per_variable"}, 5x80d, 0, 1, 0, 0, \ldots, 3, N_{\text{vam}}(\text{newiarray}, \text{Var}, \text{Info}, \text{ndssi}) \}, \\
\{ \text{"initial_state"}, 13, 0, 4, 0, 0, \ldots, 0, N_{\text{vam}}(\text{ivec}, \text{discreteStateSetIntVars}) \}, \\
\{ \text{"num_set_values"}, 5x805, 0, 1, 0, 0, \ldots, -2, N_{\text{vam}}(\text{newiarray}, \text{Var}, \text{Info}, \text{ndssi}) \}, \\
\{ \text{"set_values"}, 5, 0, 2, 1, 0, \ldots, -4, N_{\text{vam}}(\text{newrvec}, \text{Var}, \text{Info}, \text{dssr}) \} \\
\} \\
\]

KeyWord kw_440[7]  [static]

Initial value:

\[
= \{ \\
\{ \text{"categorical"}, 15, 0, 3, 0, 0, \ldots, 0, N_{\text{vam}}(\text{categorical}, \text{discreteStateSetRealCat}) \}, \\
\{ \text{"descriptors"}, 15, 0, 5, 0, 0, \ldots, 0, N_{\text{vam}}(\text{strl}, \text{discreteStateSetRealLabels}) \}, \\
\{ \text{"elements_per_variable"}, 5x80d, 0, 1, 0, 0, \ldots, 3, N_{\text{vam}}(\text{newiarray}, \text{Var}, \text{Info}, \text{ndssr}) \}, \\
\{ \text{"initial_state"}, 13, 0, 4, 0, 0, \ldots, 0, N_{\text{vam}}(\text{rvec}, \text{discreteStateSetRealVars}) \}, \\
\{ \text{"num_set_values"}, 5x805, 0, 1, 0, 0, \ldots, -2, N_{\text{vam}}(\text{newiarray}, \text{Var}, \text{Info}, \text{ndssr}) \}, \\
\{ \text{"set_values"}, 5, 0, 2, 1, 0, \ldots, -4, N_{\text{vam}}(\text{newrvec}, \text{Var}, \text{Info}, \text{dssr}) \} \\
\} \\
\]
CHAPTER 12. NAMESPACE DOCUMENTATION

KeyWord kw_
441[6]  [static]
Initial value:

= {
  {"descriptors",15,0,4,0,0,0,0,0,N_vam(strl, discreteStateSetStrLabels)},
  {"elements",15,0,2,1,0,0,0,0,0,0,N_vam(newarray, Var_Info_dssn)},
  {"initial_state",15,0,3,0,0,0,0,0,0,N_vam(strl, discreteStateSetStrVars)},
  {"num_set_values",0x805,0,1,0,0,0,0,0,-2,N_vam(newarray, Var_Info_dssn)},
  {"set_values",7,0,2,1,0,0,0,0,-4,N_vam(newarray, Var_Info_dssn)}
}

KeyWord kw_
442[3]  [static]
Initial value:

= {
  {"integer",0x19,7,1,0,kw_439,0.,0.,0,N_vam(pintz, numDiscreteStateSetIntVars)},
  {"real",0x19,7,3,0,kw_440,0.,0.,0,N_vam(pintz, numDiscreteStateSetRealVars)},
  {"string",0x19,6,2,0,kw_441,0.,0.,0,N_vam(pintz, numDiscreteStateSetStrVars)}
}

KeyWord kw_
443[9]  [static]
Initial value:

= {
  {"categorical",15,0,4,0,0,0,0,0,N_vam(categorical, discreteUncSetIntCat)},
  {"descriptors",15,0,6,0,0,0,0,0,N_vae(deuilbl, DEUIVar_set_int)},
  {"elements",13,0,2,1,0,0,0,0,0,N_vam(newivec, Var_Info_dusi)},
  {"elements_per_variable",13,0,1,0,0,0,0,0,0,N_vam(newiarray, Var_Info_ndu}),
  {"initial_point",13,0,5,0,0,0,0,0,0,N_vam(ivec, discreteUncSetIntVars)},
  {"num_set_values",5,0,1,0,0,0,0,0,-2,N_vam(newiarray, Var_Info_ndu)},
  {"set_probabilities",14,0,3,0,0,0,0,0,0,N_vam(newrvec, Var_Info_DSIp)},
  {"set_probs",6,0,3,0,0,0,0,0,-1,N_vam(newrvec, Var_Info_DSIp)},{"set_values",5,0,2,1,0,0,0,0,-6,N_vam(newiarray, Var_Info_ndu)}
}

KeyWord kw_
444[9]  [static]
Initial value:

= {
  {"categorical",15,0,4,0,0,0,0,0,N_vam(categorical, discreteUncSetRealCat)},
  {"descriptors",15,0,6,0,0,0,0,0,N_vae(deurlbl, DEURVar_set_real)},
  {"elements",14,0,2,1,0,0,0,0,0,N_vam(newrvec, Var_Info_dusr)},
  {"elements_per_variable",13,0,1,0,0,0,0,0,0,N_vam(newiarray, Var_Info_ndu)},
  {"initial_point",14,0,5,0,0,0,0,0,0,N_vam(rvec, discreteUncSetRealVars)},
  {"num_set_values",5,0,1,0,0,0,0,0,-2,N_vam(newiarray, Var_Info_ndu)},
  {"set_probabilities",14,0,3,0,0,0,0,0,0,N_vam(newrvec, Var_Info_DSRp)},
  {"set_probs",6,0,3,0,0,0,0,0,-1,N_vam(newrvec, Var_Info_DSRp)},{"set_values",6,0,2,1,0,0,0,0,-6,N_vam(newrvec, Var_Info_dusr)}
}
KeyWord kw.445[8] [static]
Initial value:
   = {
      {'descriptors', 15, 0, 3, 0, 0, 0, 0, 0, str, (deuslbl, DEUSVar, set, str)},
      {'elements', 15, 0, 3, 1, 0, 0, 0, 0, 0, (newarray, Var, Info, nduss)},
      {'initial_point', 15, 0, 4, 0, 0, 0, 0, 0, (newarray, Var, Info, nduss)},
      {'num_set_values', 5, 0, 1, 0, 0, 0, 0, -2, (newarray, Var, Info, nduss)},
      {'set_probabilities', 14, 0, 3, 0, 0, 0, 0, 0, (newarray, Var, Info, nduss)},
      {'set_probs', 6, 0, 3, 0, 0, 0, 0, -1, (newarray, Var, Info, nduss)},
      {'set_values', 7, 0, 2, 0, 0, 0, 0, -6, (newarray, Var, Info, nduss)}
   }

KeyWord kw.446[3] [static]
Initial value:
   = {
      {'integer', 0x19, 9, 1, 0, kw.443, 0, 0, 0, N, (pintz, numDiscreteUncSetIntVars)},
      {'real', 0x19, 9, 3, 0, kw.444, 0, 0, 0, N, (pintz, numDiscreteUncSetRealVars)},
      {'string', 0x19, 8, 2, 0, kw.445, 0, 0, 0, N, (pintz, numDiscreteUncSetStrVars)}
   }

KeyWord kw.447[5] [static]
Initial value:
   = {
      {'betas', 14, 0, 1, 1, 0, 0, 0, 0, N, (RealLb, exponentialUncBetas)},
      {'descriptors', 15, 0, 3, 0, 0, 0, 0, 0, str, (caulbl, CAUVar, exponential)},
      {'euv_betas', 6, 0, 1, 1, 0, 0, 0, -2, N, (RealLb, exponentialUncBetas)},
      {'euv_descriptors', 7, 0, 3, 0, 0, 0, -2, (caulbl, CAUVar, exponential)},
      {'initial_point', 14, 0, 2, 0, 0, 0, 0, 0, (RealLb, exponentialUncVars)}
   }

KeyWord kw.448[7] [static]
Initial value:
   = {
      {'alphas', 14, 0, 1, 1, 0, 0, 0, 0, N, (RealLb, frechetUncAlphas)},
      {'betas', 14, 0, 2, 2, 0, 0, 0, 0, 0, N, (rvec, frechetUncBetas)},
      {'descriptors', 15, 0, 4, 0, 0, 0, 0, 0, str, (caulbl, CAUVar, frechet)},
      {'fuv_alphas', 6, 0, 1, 1, 0, 0, 0, -3, N, (RealLb, frechetUncAlphas)},
      {'fuv_betas', 6, 0, 2, 2, 0, 0, 0, -3, N, (rvec, frechetUncBetas)},
      {'fuv_descriptors', 7, 0, 4, 0, 0, 0, -3, (caulbl, CAUVar, frechet)},
      {'initial_point', 14, 0, 3, 0, 0, 0, 0, 0, (RealLb, frechetUncVars)}
   }

KeyWord kw.449[7] [static]
Initial value:
   = {
      {'alphas', 14, 0, 1, 1, 0, 0, 0, 0, N, (RealLb, gammaUncAlphas)},
      {'betas', 14, 0, 2, 2, 0, 0, 0, 0, 0, N, (RealLb, gammaUncBetas)},
      {'descriptors', 15, 0, 4, 0, 0, 0, 0, 0, str, (caulbl, CAUVar, gamma)},
      {'gauv_alphas', 6, 0, 1, 1, 0, 0, 0, -3, N, (RealLb, gammaUncAlphas)},
      {'gauv_betas', 6, 0, 2, 2, 0, 0, 0, -3, N, (RealLb, gammaUncBetas)},
      {'gauv_descriptors', 7, 0, 4, 0, 0, 0, -3, (caulbl, CAUVar, gamma)},
      {'initial_point', 14, 0, 3, 0, 0, 0, 0, 0, (RealLb, gammaUncVars)}
   }
KeyWord kw_450[4]  [static]
Initial value:
= {
    \{"descriptors":15,0,3,0,0,0,0,0,N_vae(dauilbl,DAUIVar \text{geometric})},
    \{"prob_per_trial":6,0,1,1,0,0,0,0,1,N_vam(vec,geometricUncProbPerTrial)},
    \{"probability_per_trial":14,0,1,1,0,0,0,0,0,N_vam(rvec,geometricUncProbPerTrial)}
}

KeyWord kw_451[7]  [static]
Initial value:
= {
    \{"alphas":14,0,1,1,0,0,0,0,N_vam(RealLb,gumbelUncAlphas)},
    \{"betas":14,0,2,2,0,0,0,0,N_vam(rvec,gumbelUncBetas)},
    \{"guuv_alphas":6,0,1,0,0,0,0,-3,N_vam(RealLb,gumbelUncAlphas)},
    \{"guuv_betas":6,0,2,2,0,0,0,-3,N_vam(rvec,gumbelUncBetas)},
    \{"guuv_descriptors":7,0,4,0,0,0,0,-3,N_vae(caulbl,CAUVar \text{gumbel})},
    \{"initial_point":14,0,3,0,0,0,0,0,N_vam(rvec,gumbelUncVars)}
}

KeyWord kw_452[11]  [static]
Initial value:
= {
    \{"abscissas":14,0,2,1,0,0,0,0,0,N_vam(newrvec,Var Info hba)},
    \{"counts":14,0,3,2,0,0,0,0,0,N_vam(newrvec,Var Info hbc)},
    \{"huv_bin_abscissas":6,0,2,0,0,0,0,-3,N_vam(newrvec,Var Info hba)},
    \{"huv_bin_counts":6,0,3,2,0,0,0,0,-3,N_vam(newrvec,Var Info hbc)},
    \{"huv_bin_descriptors":7,0,5,0,0,0,0,-3,N_vae(caulbl,CAUVar \text{histogram_bin})},
    \{"huv_bin_ordinates":6,0,3,2,0,0,0,0,-3,N_vam(newrvec,Var Info hbo)},
    \{"huv_bin_pairs":5,0,1,0,0,0,0,2,N_vam(newiarray,Var Info nhbp)},
    \{"ordinates":14,0,3,2,0,0,0,0,N_vam(newrvec,Var Info hbo)},
    \{"pairs_per_variable":13,0,1,0,0,0,0,0,N_vam(newiarray,Var Info nhbp)}
}

KeyWord kw_453[6]  [static]
Initial value:
= {
    \{"abscissas":13,0,2,1,0,0,0,0,0,N_vam(newrvec,Var Info hpia)},
    \{"counts":14,0,3,2,0,0,0,0,0,N_vam(newrvec,Var Info hpic)},
    \{"descriptors":15,0,5,0,0,0,0,0,N_vae(dauilbl,DAUIVar \text{histogram_point_int})},
    \{"initial_point":13,0,4,0,0,0,0,0,N_vam(ivec,histogramPointIntUncVars)},
    \{"num_pairs":5,0,1,0,0,0,0,1,N_vam(newiarray,Var Info nhpip)},
    \{"pairs_per_variable":13,0,1,0,0,0,0,0,N_vam(newiarray,Var Info nhnip)}
}
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw_454[6] [static]
Initial value:

```c
KeyWord kw_454[6] [static]
Initial value:
```

```c
= {
    {'abscissas*','14,0,2,1,0,0.,0.,0,N,vam(newrvec,Var_Info_hpra)},
    {'counts*','14,0,3,2,0,0.,0.,0,N,vam(newrvec,Var_Info_hprc)},
    {'descriptors*','15,0,5,0,0,0,0,0,N,vaes(DAUIVar,DAUIVar_histogram_point_str)},
    {'initial_point*','14,0,4,0,0,0,0,0,0,N,vam(rvec.histogramPointRealUncVars)},
    {'num_pairs*','5,0,1,0,0,0,0,1,N,vam(newiarray,Var_Info_nhprp)},
    {'pairs_per_variable*','13,0,1,0,0,0,0,0,N,vam(newiarray,Var_Info_nhprp)}
}
```

KeyWord kw_455[6] [static]
Initial value:

```c
KeyWord kw_455[6] [static]
Initial value:
```

```c
= {
    {'abscissas*','15,0,2,1,0,0,0,0,N,vam(newrvec,Var_Info_hpsa)},
    {'counts*','14,0,3,2,0,0,0,0,N,vam(newrvec,Var_Info_hpsc)},
    {'descriptors*','15,0,5,0,0,0,0,0,N,vaes(DAUSVar,DAUSVar_histogram_point_str)},
    {'initial_point*','15,0,4,0,0,0,0,0,N,vam(strL,hyperGeomUncVars)},
    {'num_pairs*','5,0,1,0,0,0,0,1,N,vam(newiarray,Var_Info_nhpsp)},
    {'pairs_per_variable*','13,0,1,0,0,0,0,0,N,vam(newiarray,Var_Info_nhpsp)}
}
```

KeyWord kw_456[3] [static]
Initial value:

```c
KeyWord kw_456[3] [static]
Initial value:
```

```c
= {
    {'integer*','0x19,6,1,0,kw_453,0,0,0,N,vam(pintz,numHistogramPtIntUncVars)},
    {'real*','0x19,6,3,0,kw_454,0,0,0,N,vam(pintz,numHistogramPtRealUncVars)},
    {'string*','0x19,6,2,0,kw_455,0,0,0,N,vam(pintz,numHistogramPtStrUncVars)}
}
```

KeyWord kw_457[5] [static]
Initial value:

```c
KeyWord kw_457[5] [static]
Initial value:
```

```c
= {
    {'descriptors*','15,0,5,0,0,0,0,0,N,vaes(DAUSlbl,DAUSVar_hypergeometric)},
    {'initial_point*','15,0,4,0,0,0,0,0,N,vam(IntLb,hyperGeomUncVars)},
    {'num_drawn*','13,0,3,0,0,0,0,0,N,vam(IntLb,hyperGeomUncNumDrawn)},
    {'selected_population*','13,0,2,2,0,0,0,0,N,vam(IntLb,hyperGeomUncSelectedPop)},
    {'total_population*','13,0,1,1,0,0,0,0,N,vam(IntLb,hyperGeomUncTotalPop)}
}
```

KeyWord kw_458[2] [static]
Initial value:

```c
KeyWord kw_458[2] [static]
Initial value:
```

```c
= {
    {'lnuv_zetas*','6,0,1,1,0,0,0,1,N,vam(RealLb,lognormalUncZetas)},
    {'zetas*','14,0,1,1,0,0,0,0,N,vam(RealLb,lognormalUncZetas)}
}
```
KeyWord kw_459[4]  [static]
Initial value:

```c
{"error_factors",14,0,1,1,0,0,0,0,0,0,N_vam(RealLb,lognormalUncErrFacts)},
{"lnuv_std_deviations",6,0,1,1,0,0,0,0,1,N_vam(RealLb,lognormalUncStdDevs)},
{"std_deviations",14,0,1,1,0,0,0,0,0,N_vam(RealLb,lognormalUncStdDevs)}
```

KeyWord kw_460[11]  [static]
Initial value:

```c
{"descriptors",15,0,5,0,0,0,0,0,0,N_vae(caulbl,CAUVar_lognormal)},
{"initial_point",14,0,4,0,0,0,0,0,0,N_vam(RealLb,lognormalUncVars)},
{"lambda",14,2,1,1,kw_458,0,0,0,0,0,N_vam(RealLb,lognormalUncLambdas)},
{"lnuv_descriptors",7,0,5,0,0,0,0,0,0,0,N_vae(caulbl,CAUVar_lognormal)},
{"lnuv_initial_point",6,0,2,0,0,0,0,0,0,0,N_vam(RealLb,lognormalUncLowerBnds)},
{"lnuv_lambdas",6,4,1,1,kw_459,0,0,0,0,0,N_vam(RealLb,lognormalUncMeans)},
{"lnuv_lower_bounds",6,0,2,0,0,0,0,0,0,0,N_vam(RealLb,lognormalUncMeans)},
{"lnuv_means",14,0,3,0,0,0,0,0,0,0,N_vam(RealLb,lognormalUncLowerBnds)},
{"lnuv_upper_bounds",14,0,3,0,0,0,0,0,0,0,N_vam(RealLb,lognormalUncUpperBnds)}
```

KeyWord kw_461[7]  [static]
Initial value:

```c
{"descriptors",15,0,4,0,0,0,0,0,0,N_vae(dauilbl,DAUIVar_negative_binomial)},
{"initial_point",13,0,3,0,0,0,0,0,0,N_vam(IntLb,negBinomialUncVars)},
{"num_trials",13,0,2,2,0,0,0,0,0,0,N_vam(IntLb,negBinomialUncNumTrials)},
{"prob_per_trial",6,0,1,1,0,0,0,0,0,1,N_vam(rvec,negBinomialUncProbPerTrial)},
{"probability_per_trial",14,0,1,1,0,0,0,0,0,0,N_vam(rvec,negBinomialUncProbPerTrial)}
```

KeyWord kw_462[5]  [static]
Initial value:

```c
{"descriptors",15,0,4,0,0,0,0,0,0,N_vae(dauilbl,DAUIVar_negative_binomial)},
{"initial_point",13,0,3,0,0,0,0,0,0,N_vam(IntLb,negBinomialUncVars)},
{"num_trials",13,0,2,2,0,0,0,0,0,0,N_vam(IntLb,negBinomialUncNumTrials)},
{"prob_per_trial",6,0,1,1,0,0,0,0,0,1,N_vam(rvec,negBinomialUncProbPerTrial)},
{"probability_per_trial",14,0,1,1,0,0,0,0,0,0,N_vam(rvec,negBinomialUncProbPerTrial)}
```
12.1. DAKOTA NAMESPACE REFERENCE

KeyWord kw\_463[11] [static]
Initial value:

```plaintext
= {
  "descriptors",15,0,6,0,0,0,0,0,N_vae(caulbl,CAUVar\_normal),
  "initial_point",14,0,5,0,0,0,0,0,N_vam(rvec,normalUncVars),
  "lower_bound",14,0,3,0,0,0,0,0,N_vam(rvec,normalUncLowerBnds),
  "means",14,0,1,0,0,0,0,0,N_vam(rvec,normalUncMeans),
  "nuv\_descriptors",7,0,6,0,0,0,0,0,N_vae(caulbl,CAUVar\_normal),
  "nuv\_lower_bound",6,0,3,0,0,0,0,0,-3,N_vam(rvec,normalUncLowerBnds),
  "nuv\_means",6,0,1,1,0,0,0,0,-3,N_vam(rvec,normalUncMeans),
  "nuv\_std\_deviations",6,0,2,2,0,0,0,0,2,N_vam(RealLb,normalUncStdDevs),
  "nuv\_upper_bound",6,0,4,0,0,0,0,0,3,N_vam(rvec,normalUncUpperBnds),
  "std\_deviations",14,0,2,2,0,0,0,0,0,N_vam(RealLb,normalUncStdDevs),
  "upper_bound",14,0,4,0,0,0,0,0,0,N_vam(rvec,normalUncUpperBnds)
}
```

KeyWord kw\_464[3] [static]
Initial value:

```plaintext
= {
  "descriptors",15,0,3,0,0,0,0,0,N_vae(dauilbl,DAUIVar\_poisson),
  "initial_point",13,0,2,0,0,0,0,0,N_vam(IntLb,poissonUncVars),
  "lambdas",14,0,1,1,0,0,0,0,0,N_vam(RealLb,poissonUncLambdas)
}
```

KeyWord kw\_465[9] [static]
Initial value:

```plaintext
= {
  "descriptors",15,0,5,0,0,0,0,0,N_vae(caulbl,CAUVar\_triangular),
  "initial_point",14,0,4,0,0,0,0,0,N_vam(rvec,triangularUncVars),
  "lower_bound",14,0,2,2,0,0,0,0,0,N_vam(rvec,triangularUncLowerBnds),
  "modes",14,0,1,1,0,0,0,0,0,N_vam(rvec,triangularUncModes),
  "nuv\_lower_bound",6,0,2,2,0,0,0,0,0,N_vam(rvec,triangularUncLowerBnds),
  "nuv\_modes",6,0,1,1,0,0,0,0,0,N_vam(rvec,triangularUncModes),
  "nuv\_upper_bound",6,0,3,3,0,0,0,0,1,N_vam(rvec,triangularUncUpperBnds),
  "upper_bound",14,0,3,3,0,0,0,0,0,N_vam(RealUb,triangularUncUpperBnds)
}
```

KeyWord kw\_466[7] [static]
Initial value:

```plaintext
= {
  "descriptors",15,0,4,0,0,0,0,0,N_vae(caulbl,CAUVar\_uniform),
  "initial_point",14,0,3,0,0,0,0,0,N_vam(rvec,uniformUncVars),
  "lower_bound",14,0,1,1,0,0,0,0,0,N_vam(RealLb,uniformUncLowerBnds),
  "upper_bound",14,0,2,2,0,0,0,0,0,N_vam(RealUb,uniformUncUpperBnds),
  "uuv\_descriptors",7,0,4,0,0,0,0,0,4,N_vae(caulbl,CAUVar\_uniform),
  "uuv\_lower_bound",6,0,1,1,0,0,0,0,0,-3,N_vam(rvec,uniformUncLowerBnds),
  "uuv\_upper_bound",6,0,2,2,0,0,0,0,0,-3,N_vam(rvec,uniformUncUpperBnds)
}
```
KeyWord kw_467[7]  [static]

Initial value:

```cpp
= {
    {"alphas",14,0,1,1,0,0,0,0,N_vam(RealLb,weibullUncAlphas)},
    {"betas",14,0,2,2,0,0,0,0,N_vam(RealLb,weibullUncBetas)},
    {"descriptors",15,0,4,0,0,0,0,N_vae(cairo,CAUVar_weibull)},
    {"initial_point",14,0,3,0,0,0,0,0,N_vam(RealLb,weibullUncVars)},
    {"wuv_alpha",6,0,1,1,0,0,0,0,-4,N_vam(RealLb,weibullUncAlphas)},
    {"wuv_betas",6,0,2,2,0,0,0,0,-4,N_vam(RealLb,weibullUncBetas)},
    {"wuv_descriptors",7,0,4,0,0,0,0,0,-4,N_vae(cairo,CAUVar_weibull)}
}
```

KeyWord kw_469[6]  [static]

Initial value:

```cpp
= {
    {"environment",0x108,15,1,kw_12,0,0,0,NIDRProblemDescDB::env_start},
    {"interface",0x308,9,5,5,kw_26,0,0,0,N_ifm3(start,0,stop)},
    {"method",0x308,87,2,2,kw_338,0,0,0,N_mdm3(start,0,stop)},
    {"model",8,10,3,3,kw_397,0,0,0,N_mom3(start,0,stop)},
    {"responses",0x308,19,6,6,kw_423,0,0,0,N_rem3(start,0,stop)},
    {"variables",0x308,34,4,4,kw_468,0,0,0,N_vam3(start,0,stop)}
}
```

Var_uinfo CAUVlbl[CAUVar_Nkinds]  [static]

Initial value:

```cpp
= {
    VarLabelInfo(nuv_, NormalUnc),
    VarLabelInfo(lnuv_, LognormalUnc),
    VarLabelInfo(uuv_, UniformUnc),
    VarLabelInfo(luuv_, LoguniformUnc),
    VarLabelInfo(tuv_, TriangularUnc),
    VarLabelInfo(euv_, ExponentialUnc),
    VarLabelInfo(beuv_, BetaUnc),
    VarLabelInfo(gauv_, GammaUnc),
    VarLabelInfo(guuv_, GumbelUnc),
    VarLabelInfo(fuv_, FrechetUnc),
    VarLabelInfo(wuv_, WeibullUnc),
    VarLabelInfo(hbuv_, HistogramBinUnc)
}
```

Var_uinfo DAUVlbl[DAUVar_Nkinds]  [static]

Initial value:

```cpp
= {
    VarLabelInfo(puv_, PoissonUnc),
    VarLabelInfo(biuv_, BinomialUnc),
    VarLabelInfo(nbuv_, NegBinomialUnc),
    VarLabelInfo(ggeuv_, GeometricUnc),
    VarLabelInfo(hgauv_, HyperGeometricUnc),
    VarLabelInfo(hpiuv_, HistogramPtIntUnc)
}
```
12.1. DAKOTA NAMESPACE REFERENCE

Var\_uinfo DAUSVLbl[DAUSVar\_Nkinds]  [static]
Initial value:

```cpp
= \{ 
  VarLabelInfo(hpsuv, HistogramPtStrUnc) 
\}
```

Var\_uinfo DAURVLbl[DAURVar\_Nkinds]  [static]
Initial value:

```cpp
= \{ 
  VarLabelInfo(hpruv, HistogramPtRealUnc) 
\}
```

Var\_uinfo CEUVLbl[CEUVar\_Nkinds]  [static]
Initial value:

```cpp
= \{ 
  VarLabelInfo(ciuv, ContinuousIntervalUnc) 
\}
```

Var\_uinfo DEUIVLbl[DEUIVar\_Nkinds]  [static]
Initial value:

```cpp
= \{ 
  VarLabelInfo(diuv, DiscreteIntervalUnc), 
  VarLabelInfo(dusiv, DiscreteUncSetInt) 
\}
```

Var\_uinfo DEUSVLbl[DEUSVar\_Nkinds]  [static]
Initial value:

```cpp
= \{ 
  VarLabelInfo(dussv, DiscreteUncSetStr) 
\}
```

Var\_uinfo DEURVLbl[DEURVar\_Nkinds]  [static]
Initial value:

```cpp
= \{ 
  VarLabelInfo(dusrv, DiscreteUncSetReal) 
\}
```
Var_uinfo DiscSetLbl[DiscSetVar_Nkinds] [static]

Initial value:

```cpp
= {
    VarLabelInfo(ddsiV, DiscreteDesSetInt),
    VarLabelInfo(ddssV, DiscreteDesSetStr),
    VarLabelInfo(ddsrV, DiscreteDesSetReal),
    VarLabelInfo(dssiV, DiscreteStateSetInt),
    VarLabelInfo(dsssv, DiscreteStateSetStr),
    VarLabelInfo(dssrv, DiscreteStateSetReal)
}
```

VarLabelChk DesignAndStateLabelsCheck[ ] [static]

Initial value:

```cpp
= {
    { AVI numContinuousDesVars, AVI continuousDesignLabels, "cdv", "cdv_descriptors" },
    { AVI numDiscreteDesRangeVars, AVI discreteDesignRangeLabels, "ddriv", "ddriv_descriptors" },
    { AVI numDiscreteDesSetIntVars, AVI discreteDesignSetIntLabels, "ddsiv", "ddsiv_descriptors" },
    { AVI numDiscreteDesSetStrVars, AVI discreteDesignSetStrLabels, "ddssv", "ddssv_descriptors" },
    { AVI numDiscreteDesSetRealVars, AVI discreteDesignSetRealLabels, "ddsrv", "ddsrv_descriptors" },
    { AVI numContinuousStateVars, AVI continuousStateLabels, "csv", "csv_descriptors" },
    { AVI numDiscreteStateRangeVars, AVI discreteStateRangeLabels, "dsriv", "dsriv_descriptors" },
    { AVI numDiscreteStateSetIntVars, AVI discreteStateSetIntLabels, "dssiv", "dssiv_descriptors" },
    { AVI numDiscreteStateSetStrVars, AVI discreteStateSetStrLabels, "dsssv", "dsssv_descriptors" },
    { AVI numDiscreteStateSetRealVars, AVI discreteStateSetRealLabels, "dssrv", "dssrv_descriptors" }
}
```

Variables label array designations for design and state. All non-uncertain variables need to be in this array. Used in check_variables_node to check lengths and make variable defaults to build labels.

Referenced by NIDRProblemDescDB::check_variables_node(), and NIDRProblemDescDB::make_variable_defaults().

VLreal VLUncertainReal[NUM_UNC_REAL_CONT] [static]

Initial value:

```cpp
=
{CAUVar_Nkinds, AVI CAUV, CAUVlbl,
    DVR continuousAleatoryUncLabels,
    DVR continuousAleatoryUncLowerBnds,
    DVR continuousAleatoryUncUpperBnds,
    DVR continuousAleatoryUncVars},
{CEUVar_Nkinds, AVI CEUV, CEUVlbl,
    DVR continuousEpistemicUncLabels,
    DVR continuousEpistemicUncLowerBnds,
    DVR continuousEpistemicUncUpperBnds,
    DVR continuousEpistemicUncVars},
{DAURVar_Nkinds, AVI DAURv, DAURVlbl,
    DVR discreteRealAleatoryUncLabels,
    DVR discreteRealAleatoryUncLowerBnds,
    DVR discreteRealAleatoryUncUpperBnds,
    DVR discreteRealAleatoryUncVars},
{DEURVar_Nkinds, AVI DEURv, DEURVlbl,
    DVR discreteRealEpistemicUncLabels,
    DVR discreteRealEpistemicUncLowerBnds,
    DVR discreteRealEpistemicUncUpperBnds,
    DVR discreteRealEpistemicUncVars}
```

Variables labels/bounds/values check array for real-valued uncertain variables; one array entry per contiguous container. These associate the individual variables given by, e.g., CAUVlbl, with the contiguous container in which they are stored.

Referenced by NIDRProblemDescDB::check_variables_node(), and NIDRProblemDescDB::make_variable_defaults().
12.1. DAKOTA NAMESPACE REFERENCE

**VLInt VLUncertainInt[NUM_UNC_INT_CONT]**  
**[static]**

Initial value:

```c
= {
  {DAUIVar_Nkinds, AVI DAUIv, DAUIVLbl, 
   DVR discreteIntAleatoryUncLabels, 
   DVR discreteIntAleatoryUncLowerBnds, 
   DVR discreteIntAleatoryUncUpperBnds, 
   DVR discreteIntAleatoryUncVars},
  {DEUIVar_Nkinds, AVI DEUIv, DEUIVLbl, 
   DVR discreteIntEpistemicUncLabels, 
   DVR discreteIntEpistemicUncLowerBnds, 
   DVR discreteIntEpistemicUncUpperBnds, 
   DVR discreteIntEpistemicUncVars}}
```

**Variables** labels/bounds/values check array for integer-valued uncertain variables; one array entry per contiguous container. These associate the individual variables given by, e.g., DAUIVLbl, with the contiguous container in which they are stored.

Referenced by NIDRProblemDescDB::check_variables_node(), and NIDRProblemDescDB::make_variable_defaults().

**VLstr VLUncertainStr[NUM_UNC_STR_CONT]**  
**[static]**

Initial value:

```c
= {
  {DAUSVar_Nkinds, AVI DAUSv, DAUSVLbl, 
   DVR discreteStrAleatoryUncLabels, 
   DVR discreteStrAleatoryUncLowerBnds, 
   DVR discreteStrAleatoryUncUpperBnds, 
   DVR discreteStrAleatoryUncVars},
  {DEUSVar_Nkinds, AVI DEUSv, DEUSVLbl, 
   DVR discreteStrEpistemicUncLabels, 
   DVR discreteStrEpistemicUncLowerBnds, 
   DVR discreteStrEpistemicUncUpperBnds, 
   DVR discreteStrEpistemicUncVars}}
```

**Variables** labels/bounds/values check array for string-valued uncertain variables; one array entry per contiguous container. These associate the individual variables given by, e.g., DAUSVLbl, with the contiguous container in which they are stored.

Referenced by NIDRProblemDescDB::check_variables_node(), and NIDRProblemDescDB::make_variable_defaults().

**Var_check var_mp_check_cv[]**  
**[static]**

Initial value:

```c
= {
  Vchk3(continuous_design,ContinuousDes), 
  Vchk3(continuous_state,ContinuousState) }
```

**Var_check var_mp_check_dset[]**  
**[static]**

Initial value:

```c
= {
  Vchk3(discrete_design_set_integer,DiscreteDesSetInt),
  Vchk3(discrete_design_set_string,DiscreteDesSetStr),
  Vchk3(discrete_state_set_integer,DiscreteStateSetInt),
  Vchk3(discrete_state_set_string,DiscreteStateSetStr),
  Vchk3(discrete_state_set_real,DiscreteStateSetReal) }
```
Var_check var_mp_check_cau[] [static]
Initial value:
= {
  Vchk_3(normal_uncertain,NormalUnc),
  Vchk_3(lognormal_uncertain,LognormalUnc),
  Vchk_3(uniform_uncertain,UniformUnc),
  Vchk_3(loguniform_uncertain,LoguniformUnc),
  Vchk_3(triangular_uncertain,TriangularUnc),
  Vchk_3(exponential_uncertain,ExponentialUnc),
  Vchk_3(beta_uncertain,BetaUnc),
  Vchk_3(gamma_uncertain,GammaUnc),
  Vchk_3(gumbel_uncertain,GumbelUnc),
  Vchk_3(frechet_uncertain,FrechetUnc),
  Vchk_3(weibull_uncertain,WeibullUnc),
  Vchk_3(histogram_bin_uncertain,HistogramBinUnc) }

Var_check var_mp_check_dauli[] [static]
Initial value:
= {
  Vchk_3(poisson_uncertain,PoissonUnc),
  Vchk_3(binomial_uncertain,BinomialUnc),
  Vchk_3(negative_binomial_uncertain,NegBinomialUnc),
  Vchk_3(geometric_uncertain,GeometricUnc),
  Vchk_3(hypergeometric_uncertain,HyperGeomUnc),
  Vchk_3(histogram_point_int_uncertain,HistogramPtIntUnc) }

Var_check var_mp_check_daus[] [static]
Initial value:
= {
  Vchk_3(histogram_point_str_uncertain,HistogramPtStrUnc) }

Var_check var_mp_check_dausr[] [static]
Initial value:
= {
  Vchk_3(histogram_point_real_uncertain,HistogramPtRealUnc) }

Var_check var_mp_check_ceu[] [static]
Initial value:
= {
  Vchk_3(continuous_interval_uncertain,ContinuousIntervalUnc) }

Var_check var_mp_check_deui[] [static]
Initial value:
= {
  Vchk_3(discrete_interval_uncertain,DiscreteIntervalUnc),
  Vchk_3(discrete_uncertain_set_integer,DiscreteUncSetInt) }
12.1. DAKOTA NAMESPACE REFERENCE

Var_check var_mp_check_deus[] [static]
Initial value:
= { Vchk3(discrete_uncertain_set_string, DiscreteUncSetStr) }

Var_check var_mp_check_deur[] [static]
Initial value:
= { Vchk3(discrete_uncertain_set_real, DiscreteUncSetReal) }

Var_rcheck var_mp_cbound[] [static]
Initial value:
= {
  Vchk7(continuous_design, ContinuousDes, continuousDesign),
  Vchk7(continuous_state, ContinuousState, continuousState),
  Vchk5(normal_uncertain, NormalUnc, normalUnc),
  Vchk5(lognormal_uncertain, LognormalUnc, lognormalUnc),
  Vchk5(uniform_uncertain, UniformUnc, uniformUnc),
  Vchk5(loguniform_uncertain, LoguniformUnc, loguniformUnc),
  Vchk5(triangular_uncertain, TriangularUnc, triangularUnc),
  Vchk5(beta_uncertain, BetaUnc, betaUnc) }

This is used within check_variables_node(): Var_RealBoundIPCheck() is applied to validate bounds and initial points.
  Referenced by NIDRProblemDescDB::check_variables_node().

Var_iCHECK var_mp_drange[] [static]
Initial value:
= {
  Vchk7(discrete_design_range, DiscreteDesRange, discreteDesignRange),
  Vchk7(discrete_state_range, DiscreteStateRange, discreteStateRange) }

This is used in check_variables_node(): Var_IntBoundIPCheck() is applied to validate bounds and initial points, and in make_variable_defaults(): Vgen_* is called to infer bounds.
  Referenced by NIDRProblemDescDB::check_variables_node(), and NIDRProblemDescDB::make_variable_defaults().

const char* SCI_FIELD_NAMES[]
Initial value:
= { "dakota_type", "numFns", "numVars", "numACV", "numADIV",
    "numADRV", "numDerivVars", "xC", "xDI",
    "xDV", "xLabels", "xDILabels",
    "xDRLabels", "directFnASV", "directFnASM",
    "directFnDVV", "directFnDVVBool",
    "fnFlag", "gradFlag", "hessFlag",
    "fnVals", "fnGrads", "fnHessians",
    "fnLabels", "failure", "currEvalId" }

fields to pass to Scilab in Dakota structure
  Referenced by ScilabInterface::scilab_engine_run().
const int SCI_NUMBER_OF_FIELDS = 26

number of fields in above structure
Referenced by ScilabInterface::scilab_engine_run().

12.2 SIM Namespace Reference

A sample namespace for derived classes that use assign_rep() to plug facilities into DAKOTA.

Classes

- class ParallelDirectApplicInterface
  
  Sample derived interface class for testing parallel simulator plug-ins using assign_rep().

- class SerialDirectApplicInterface
  
  Sample derived interface class for testing serial simulator plug-ins using assign_rep().

12.2.1 Detailed Description

A sample namespace for derived classes that use assign_rep() to plug facilities into DAKOTA. A typical use of plug-ins with assign_rep() is to publish a simulation interface for use in library mode. See Interfacing with Dakota as a Library for more information.
Chapter 13

Class Documentation

13.1 ActiveSet Class Reference

Container class for active set tracking information. Contains the active set request vector and the derivative variables vector.

Public Member Functions

- **ActiveSet ()**
  
  default constructor
- **ActiveSet (size_t num_fns, size_t num_deriv_vars)**
  
  standard constructor
- **ActiveSet (size_t num_fns)**
  
  partial constructor
- **ActiveSet (const ShortArray &asv, const SizetArray &dvv)**
  
  alt constructor
- **ActiveSet (const ActiveSet &set)**
  
  copy constructor
- **~ActiveSet ()**
  
  destructor
- **ActiveSet & operator= (const ActiveSet &set)**
  
  assignment operator
- **void reshape (size_t num_fns, size_t num_deriv_vars)**
  
  reshape requestVector and derivVarsVector
- **void reshape (size_t num_fns)**
  
  reshape requestVector
- **const ShortArray & request_vector () const**
  
  return the request vector
- **void request_vector (const ShortArray &rv)**
  
  set the request vector
- **void request_values (const short rv_val)**
  
  set all request vector values
CHAPTER 13. CLASS DOCUMENTATION

- short request_value (const size_t index) const
  get the value of an entry in the request vector
- void request_value (const short rv_val, const size_t index)
  set the value of an entry in the request vector
- const SizetArray & derivative_vector () const
  return the derivative variables vector
- void derivative_vector (const SizetArray &dvv)
  set the derivative variables vector from a SizetArray
- void derivative_vector (SizetMultiArrayConstView dvv)
  set the derivative variables vector from a SizetMultiArrayConstView
- void derivative_start_value (size_t dvv_start_val)
  set the derivative variables vector values
- void read (std::<iostream &s)
  read an active set object from an std::<istream
- void write (std::<ostream &s) const
  write an active set object to an std::<ostream
- void write.annotated (std::<ostream &s) const
  write an active set object to an std::<ostream in annotated format
- void read (MPIUnpackBuffer &s)
  read an active set object from a packed MPI buffer
- void write (MPIPackBuffer &s) const
  write an active set object to a packed MPI buffer

Private Member Functions

- template<class Archive>
  void serialize (Archive &ar, const unsigned int version)
  implementation of Boost serialize for ActiveSet

Private Attributes

- ShortArray requestVector
  the vector of response requests
- SizetArray derivVarsVector
  the vector of variable ids used for computing derivatives

Friends

- class boost::serialization::access
- bool operator== (const ActiveSet &set1, const ActiveSet &set2)
  equality operator
- bool operator!=(const ActiveSet &set1, const ActiveSet &set2)
  inequality operator
13.1.1 Detailed Description

Container class for active set tracking information. Contains the active set request vector and the derivative variables vector.

The ActiveSet class is a small class whose initial design function is to avoid having to pass the ASV and D-VV separately. It is not part of a class hierarchy and does not employ reference-counting/representation-sharing idioms (e.g., handle-body).

13.1.2 Member Data Documentation

ShortArray requestVector [private]
the vector of response requests
It uses a 0 value for inactive functions and sums 1 (value), 2 (gradient), and 4 (Hessian) for active functions.
Referenced by ActiveSet::ActiveSet(), ActiveSet::operator=(), ActiveSet::read(), ActiveSet::request_value(), ActiveSet::request_values(), ActiveSet::request_vector(), ActiveSet::reshape(), ActiveSet::write(), and ActiveSet::write_annotated().

SizetArray derivVarsVector [private]
the vector of variable ids used for computing derivatives
These ids will generally identify either the active continuous variables or the inactive continuous variables.
Referenced by ActiveSet::ActiveSet(), ActiveSet::derivative_start_value(), ActiveSet::derivative_vector(), ActiveSet::operator=(), ActiveSet::read(), ActiveSet::reshape(), ActiveSet::write(), and ActiveSet::write_annotated().

The documentation for this class was generated from the following file:

• DakotaActiveSet.hpp

13.2 ActiveSubspaceModel Class Reference

Active subspace model for input (variable space) reduction.

Inheritance diagram for ActiveSubspaceModel:

```
Model
   |
   |
RecastModel
   |
   |
ActiveSubspaceModel
```

Public Member Functions

• ActiveSubspaceModel (ProblemDescDB &problem_db)
  Problem database constructor.
• ActiveSubspaceModel (const Model &sub_model, int random_seed, int initial_samples, double conv_tol, size_t max_evals, unsigned short subspace_id_method)
  Lightweight constructor
• ~ActiveSubspaceModel ()
CHAPTER 13. CLASS DOCUMENTATION

destructor

• bool initialize_mapping (ParLevLIter pl_iter)
• bool finalize_mapping ()
  finalize model mapping, returns true if the variables size has changed
• bool mapping_initialized ()
  return true if mapping has been fully initialized, false otherwise.
• void stop_init_mapping (ParLevLIter pl_iter)
  called from IteratorScheduler::init_iterator() for iteratorComm rank 0 to terminate serve_init_mapping() on other iteratorComm processors
• int serve_init_mapping (ParLevLIter pl_iter)
  called from IteratorScheduler::init_iterator() for iteratorComm rank != 0 to balance resize() calls on iteratorComm rank 0

Protected Member Functions

• void derived_init_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag)
  portion of set_communicators() specific to derived model classes
• void derived_set_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag)
  portion of set_communicators() specific to derived model classes
• void derived_free_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag)
  portion of free_communicators() specific to derived model classes
• void derived_evaluate (const ActiveSet &set)
  portion of evaluate() specific to derived model classes
• void derived_evaluate_nowait (const ActiveSet &set)
  portion of evaluate_nowait() specific to derived model classes
• const IntResponseMap & derived_synchronize ()
  portion of synchronize() specific to derived model classes
• const IntResponseMap & derived_synchronize_nowait ()
  portion of synchronize_nowait() specific to derived model classes
• void component_parallel_mode (short mode)
  update component parallel mode for supporting parallelism in the offline and online phases
• void serve_run (ParLevLIter pl_iter, int max_eval_concurrency)
  Service the offline and online phase job requests received from the master; completes when termination message received from stop_servers().
• void stop_servers ()
  Executed by the master to terminate the offline and online phase server operations when iteration on the ActiveSubspaceModel is complete.
• Model get_sub_model (ProblemDescDB &problem_db)
  retrieve the sub-Model from the DB to pass up the constructor chain
• void init_fullspace_sampler ()
  initialize the native problem space Monte Carlo sampler
• void validate_inputs ()
  validate the build controls and set defaults
• void identify_subspace ()
• void expand_basis ()
generate fullspace samples, append to matrix, and factor, returning whether tolerance met

- unsigned int calculate_fullspace_samples ()
  determine the number of full space samples for next iteration, based on batchSize, limiting by remaining function evaluation budget

- void generate_fullspace_samples (unsigned int diff_samples)
  sample the derivative at diff_samples points and leave temporary in dace_iterator

- void append_sample_matrices (unsigned int diff_samples)
  append the fullspaceSampler samples to the derivative and vars matrices

- void compute_svd ()
  factor the derivative matrix and analyze singular values, assessing convergence and rank, returning whether tolerance met

- double computeBingLiCriterion (RealVector &singular_values)
  compute Bing Li's criterion to identify the active subspace

- double computeConstantineMetric (RealVector &singular_values)
  compute Constantine's metric to identify the active subspace

- double computeEnergyCriterion (RealVector &singular_values)
  Compute active subspace size based on eigenvalue energy. Compatible with other truncation methods.

- void initialize_recast ()
  Initialize the base class RecastModel with reduced space variable sizes.

- SizetArray variables.resize ()
  Create a variables components totals array with the reduced space size for continuous variables.

- void uncertain_vars_to_subspace ()
  translate the characterization of uncertain variables in the native_model to the reduced space of the transformed model

- void update_linear_constraints ()
  transform the original bounded domain (and any existing linear constraints) into linear constraints in the reduced space

- void update_var_labels ()
  update variable labels

**Static Protected Member Functions**

- static void vars_mapping (const Variables &recast_xi_vars, Variables &sub_model_x_vars)
  map the active continuous recast variables to the active submodel variables (linear transformation)

- static void set_mapping (const Variables &recast_vars, const ActiveSet &recast_set, ActiveSet &sub_model_set)
  map the inbound ActiveSet to the sub-model (map derivative variables)

- static void response_mapping (const Variables &recast_y_vars, const Variables &sub_model_x_vars, const Response &sub_model_resp, Response &recastResp)
  map responses from the sub-model to the recast model
Protected Attributes

- int randomSeed
  seed controlling all samplers
- int initialSamples
  initial number of samples at which to query the truth model
- int maxFunctionEvals
  maximum number of build evaluations
- bool subspaceIdBingLi
  Boolean flag signaling use of Bing Li criterion to identify active subspace dimension.
- bool subspaceIdConstantine
  Boolean flag signaling use of Constantine criterion to identify active subspace dimension.
- bool subspaceIdEnergy
  Boolean flag signaling use of eigenvalue energy criterion to identify active subspace dimension.
- size_t numReplicates
  Number of bootstrap samples for subspace identification.
- bool transformVars
  boolean flag to determine if variables should be transformed to u-space before active subspace initialization
- size_t numFullspaceVars
  max bases to retain
- size_t numFunctions
- unsigned int totalSamples
  total construction samples evaluated so far
- unsigned int totalEvals
  total evaluations of model (accounting for UQ phase)
- bool subspaceInitialized
  boolean flag to determine if mapping has been fully initialized
- unsigned int reducedRank
  current approximation of system rank
- RealMatrix activeBasis
  basis for the reduced subspace
- RealMatrix inactiveBasis
  basis for the inactive subspace
- RealVector inactiveVars
  current inactive variables
- RealMatrix derivativeMatrix
  matrix of derivative data with numFunctions columns per fullspace sample; each column contains the gradient of one function at one sample point, so total matrix size is numContinuousVars * (numFunctions + numSamples) [ D1 | D2 | ... | Dnum_samples ] [ dy1/dx(k=1) | dy2/dx(k=1) | ... | dyM/dx(k=1) | k=2 | ... | k=n_samples ]
- RealMatrix leftSingularVectors
  matrix of the left singular vectors of derivativeMatrix
- RealMatrix varsMatrix
  matrix of fullspace variable points samples size numContinuousVars * (numSamples)
- RealArray gradientScaleFactors
13.2. ACTIVESUBSPACEMODEL CLASS REFERENCE

Gradient scaling factors to make multiple response function gradients similar orders of magnitude.

- Real \texttt{truncationTolerance}
  
  Truncation tolerance for eigenvalue energy subspace identification.

- 
  \texttt{Iterator fullspaceSampler}

  Monte Carlo sampler for the full parameter space.

- \texttt{size_t miPLIndex}

  the index of the active metaiterator-iterator parallelism level (corresponding to \texttt{ParallelConfiguration::miPLIters}) used at runtime

- \texttt{int onlineEvalConcurrency}

  Concurrency to use once subspace has been built.

- \texttt{int offlineEvalConcurrency}

  Concurrency to use when building subspace.

**Static Protected Attributes**

- \texttt{static ActiveSubspaceModel * asmInstance}

  static pointer to this class for use in static callbacks

13.2.1 Detailed Description

Active subspace model for input (variable space) reduction.

Specialization of a \texttt{RecastModel} that identifies an active subspace during build phase and creates a \texttt{RecastModel} in the reduced space

13.2.2 Constructor & Destructor Documentation

\texttt{ActiveSubspaceModel ( const Model & submodel, int random_seed, int initial_samples, double conv_fol, size_t max_evals, unsigned short subspace_id_method )}

lightweight constructor

An \texttt{ActiveSubspaceModel} will be built over all functions, without differentiating primary vs. secondary constraints. However the associated \texttt{RecastModel} has to differentiate. Currently identifies subspace for continuous variables only, but carries other active variables along for the ride.

References \texttt{ActiveSubspaceModel::asmInstance, Model::componentParallelMode, Model::derivative_concurrency()}, \texttt{ActiveSubspaceModel::init_fullspace_sampler()}, \texttt{ActiveSubspaceModel::initialSamples, Model::modelType, ActiveSubspaceModel::offlineEvalConcurrency, ActiveSubspaceModel::randomSeed, and RecastModel::subModel}.

13.2.3 Member Function Documentation

\texttt{bool initialize_mapping ( ParLevLIter pl_iter ) [virtual]}

May eventually take on init_comms and related operations. Also may want ide of build/update like \texttt{DataFitSurrModel}, eventually.

Reimplemented from \texttt{Model}.

References \texttt{ActiveSubspaceModel::component_parallel_mode(), Model::initialize_mapping(), ActiveSubspaceModel::initialize_recast(), ActiveSubspaceModel::miPLIndex, Model::modelPCIter, ActiveSubspaceModel::num_FullspaceVars, Model::outputLevel, ActiveSubspaceModel::reducedRank, RecastModel::subModel, ActiveSubspaceModel::subspaceInitialized, Model::supportsEstimDerivs, ActiveSubspaceModel::uncertain_vars_to_subspace(), ActiveSubspaceModel::update_linear_constraints(), and ActiveSubspaceModel::update_var_labels().}
void derived_init_communicators ( ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag )
[protected], [virtual]

This specialization is because the model is used in multiple contexts in this iterator, depending on build phase.
Note that this overrides the default behavior at Iterator which recurses into any submodels.
Reimplemented from Model.
References ActiveSubspaceModel::fullspaceSampler, Iterator::init_communicators(), Model::init_communicators(),
ActiveSubspaceModel::mapping_initialized(), ActiveSubspaceModel::onlineEvalConcurrency, and RecastModel-::subModel.

void initialize_recast ( ) [protected]
Initialize the base class RecastModel with reduced space variable sizes.
Initialize the recast model based on the reduced space, with no response function mapping (for now). TODO:
use a surrogate model over the inactive dimension.
References Model::current_response(), Model::cv(), Model::div(), Model::drv(), Model::dsv(),
Response::function_gradients(), Response::function_hessians(), RecastModel::init_maps(),
RecastModel::init_sizes(), Model::num_functions(), Model::num_nonlinear_ineq_constraints(),
Model::num_primary_fns(), ActiveSubspaceModel::reduced-Rank, ActiveSubspaceModel::response_mapping(),
ActiveSubspaceModel::set_mapping(), RecastModel::subModel,
ActiveSubspaceModel::variables_resize(), and ActiveSubspaceModel::vars_mapping().
Referenced by ActiveSubspaceModel::initialize_mapping().

void uncertain_vars_to_subspace ( ) [protected]
translate the characterization of uncertain variables in the native_model to the reduced space of the transformed model
transform and set the distribution parameters in the reduced model
Convert the user-specified normal random variables to the appropriate reduced space variables, based on the orthogonal transformation.
TODO: Generalize to convert other random variable types (non-normal)
TODO: The translation of the correlations from full to reduced space is likely wrong for rank correlations;
should be correct for covariance.
Referenced by ActiveSubspaceModel::initialize_mapping().

void vars_mapping ( const Variables & recast_y_vars, Variables & sub_model_x_vars ) [static],
[protected]
map the active continuous recast variables to the active submodel variables (linear transformation)
Perform the variables mapping from recast reduced dimension variables y to original model x variables via
linear transformation. Maps only continuous variables.
References ActiveSubspaceModel::activeBasis, ActiveSubspaceModel::asmInstance, Variables::continuous_vars(),
Dakota::copy_data(), ActiveSubspaceModel::inactiveBasis, ActiveSubspaceModel::inactiveVars, and
Model::outputLevel.
Referenced by ActiveSubspaceModel::initialize_recast().

void set_mapping ( const Variables & recast_vars, const ActiveSet & recast_set,
ActiveSet & sub_model_set ) [static], [protected]
map the inbound ActiveSet to the sub-model (map derivative variables)
Simplified derivative variables mapping where all continuous depend on all others. TODO: Could instead rely
on a richer default in RecastModel based on varsMapIndices.
References ActiveSubspaceModel::asmInstance, Variables::cv(), Model::cv(), ActiveSet::derivative_vector(), and RecastModel::subModel.
Referred by ActiveSubspaceModel::initialize_recast().

```c++
void response_mapping ( const Variables & recast_y_vars, const Variables & sub_model_x_vars, const Response & sub_model_resp, Response & recast_resp ) [static], [protected]
```
Map responses from the sub-model to the recast model
- Perform the response mapping from submodel to recast response
- References ActiveSubspaceModel::activeBasis, ActiveSubspaceModel::asmInstance, Response::function_gradients(), Response::function_hessians(), and Response::function_values().
Referred by ActiveSubspaceModel::initialize_recast().

### 13.2.4 Member Data Documentation

**ActiveSubspaceModel * asmInstance [static], [protected]**

static pointer to this class for use in static callbacks
- initialization of static needed by RecastModel
Referred by ActiveSubspaceModel::ActiveSubspaceModel(), ActiveSubspaceModel::response_mapping(), ActiveSubspaceModel::set_mapping(), and ActiveSubspaceModel::vars_mapping().
The documentation for this class was generated from the following files:
- ActiveSubspaceModel.hpp
- ActiveSubspaceModel.cpp

### 13.3 Analyzer Class Reference

Base class for NonD, DACE, and ParamStudy branches of the iterator hierarchy.
Inheritance diagram for Analyzer:

```
Analyzer
  Iterator
  NonD
    NonDCalibration
    NonD Expansion
    NonD Integration
    NonD Interval
    NonDPOFDarts
    NonDReliability
    NonDRKDDarts
    NonDSampling
  PStudyDACE
    DDACEDesignCompExp
    FSUDesignCompExp
    ParamStudy
    PSUADesignCompExp
    RichExtrapVerification
```
Public Member Functions

- const VariablesArray & all_variables ()
  return the complete set of evaluated variables
- const RealMatrix & all_samples ()
  return the complete set of evaluated samples
- const IntResponseMap & all_responses () const
  return the complete set of computed responses
- bool resize ()
  reinitializes iterator based on new variable size
- int num_samples () const
- virtual void vary_pattern (bool pattern_flag)
  sets varyPattern in derived classes that support it

Protected Member Functions

- Analyzer ()
  default constructor
- Analyzer (ProblemDescDB &problem_db, Model &model)
  standard constructor
- Analyzer (unsigned short method_name, Model &model)
  alternate constructor for instantiations "on the fly" with a Model
- Analyzer (unsigned short method_name)
  alternate constructor for instantiations "on the fly" without a Model
- ~Analyzer ()
  destructor
- virtual void get_parameter_sets (Model &model)
  Returns one block of samples (ndim * num_samples)
- virtual void update_model_from_sample (Model &model, const Real *sample_vars)
  update model's current variables with data from sample
- virtual void update_model_from_variables (Model &model, const Variables &vars)
  update model's current variables with data from vars
- virtual void sample_to_variables (const Real *sample_vars, Variables &vars)
  convert column of samples array to variables; derived classes may reimplement for more than active continuous variables
- void update_from_model (const Model &model)
  set inherited data attributes based on extractions from incoming model
- void initialize_run ()
  utility function to perform common operations prior to pre_run(); typically memory initialization; setting of instance pointers
- void pre_run ()
  pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori
- void post_run (std::ostream &s)
post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way

- **void finalize_run()**
  utility function to perform common operations following `post_run()`; deallocation and resetting of instance pointers

- **void pre_output()**

- **void print_results(std::ostream &s)**
  print the final iterator results

- **const Model & algorithm_space_model() const**

- **const Variables & variables_results() const**
  return a single final iterator solution (variables)

- **const Response & response_results() const**
  return a single final iterator solution (response)

- **const VariablesArray & variables_array_results()**
  return multiple final iterator solutions (variables). This should only be used if `returns_multiple_points()` returns true.

- **const ResponseArray & response_array_results()**
  return multiple final iterator solutions (response). This should only be used if `returns_multiple_points()` returns true.

- **void response_results_active_set(const ActiveSet &set)**
  set the requested data for the final iterator response results

- **bool compact_mode() const**
  returns Analyzer::compactMode

- **bool returns_multiple_points() const**
  indicates if this iterator returns multiple final points. Default return is false. Override to return true if appropriate.

- **void evaluate_parameter_sets(Model &model, bool log_resp_flag, bool log_best_flag)**
  perform function evaluations to map parameter sets (allVariables) into response sets (allResponses)

- **void variance_based_decomp(int ncont, int ndiscint, int ndiscreal, int num_samples)**

- **void read_variables_responses(int num_evals, size_t num_vars)**
  convenience function for reading variables/responses (used in derived classes post_input)

- **void print_sobol_indices(std::ostream &s) const**
  Printing of VBD results.

- **void samples_to_variables_array(const RealMatrix &sample_matrix, VariablesArray &vars_array)**
  convert samples array to variables array; e.g., allSamples to allVariables

- **virtual void variables_to_sample(const Variables &vars, Real *sample_c_vars)**
  convert the active continuous variables into a column of allSamples

- **void variables_array_to_samples(const VariablesArray &vars_array, RealMatrix &sample_matrix)**
  convert variables array to samples array; e.g., allVariables to allSamples

**Protected Attributes**

- **size_t numFunctions**
  number of response functions

- **size_t numContinuousVars**
  number of active continuous vars

- **size_t numDiscreteIntVars**
number of active discrete integer vars

• size_t numDiscreteStringVars

number of active discrete string vars

• size_t numDiscreteRealVars

number of active discrete real vars

• bool compactMode

switch for allSamples (compact mode) instead of allVariables (normal mode)

VariablesArray allVariables

array of all variables to be evaluated in evaluate_parameter_sets()

• RealMatrix allSamples

compact alternative to allVariables

• IntResponseMap allResponses

array of all responses to be computed in evaluate_parameter_sets()

• StringArray allHeaders

array of headers to insert into output while evaluating allVariables

• size_t numObjFns

number of objective functions

• size_t numLSqTerms

number of least squares terms

• RealPairPRPMultiMap bestVarsRespMap

map which stores best set of solutions

Private Member Functions

• void compute_best_metrics (const Response &response, std::pair<Real, Real> &metrics)

compares current evaluation to best evaluation and updates best

• void update_best (const Variables &vars, int eval_id, const Response &response)

compares current evaluation to best evaluation and updates best

• void update_best (const Real *sample_c_vars, int eval_id, const Response &response)

compares current evaluation to best evaluation and updates best

Private Attributes

• int writePrecision

write precision as specified by the user

• Real vbdDropTol

tolerance for omitting output of small VBD indices

• RealVectorArray S4

VBD main effect indices.

• RealVectorArray T4

VBD total effect indices.
13.3. ANALYZER CLASS REFERENCE

Additional Inherited Members

13.3.1 Detailed Description

Base class for NonD, DACE, and ParamStudy branches of the iterator hierarchy.

The Analyzer class provides common data and functionality for various types of systems analysis, including nondeterministic analysis, design of experiments, and parameter studies.

13.3.2 Member Function Documentation

int num_samples ( ) const [inline], [virtual]

Return current number of evaluation points. Since the calculation of samples, collocation points, etc. might be costly, provide a default implementation here that backs out from the maxEvalConcurrency.

Reimplemented from Iterator.

Reimplemented in NonDSampling, NonDQuadrature, NonDSParseGrid, NonDCubature, DDACEDesignCompExp, FSUDesignCompExp, and PSUADEDesignCompExp.

References Model::derivative_concurrency(), Iterator::iteratedModel, and Iterator::maxEvalConcurrency.

Referenced by NonDDREAMBayesCalibration::archive_acceptance_chain(), NonDDREAMBayesCalibration::cache_chain(), NonDBayesCalibration::compute_statistics(), NonDBayesCalibration::filter_chain(), NonDGlobalReliability::get_best_sample(), NonDPolynomialChaos::ratio_samples_to_order(), Analyzer::samples_to_variables_array(), Analyzer::variables_array_to_samples(), and Analyzer::variance_based_decomp().

void sample_to_variables ( const Real * sample_c_vars, Variables & vars ) [protected], [virtual]

convert column of samples array to variables; derived classes may reimplement for more than active continuous variables

Default mapping that maps into continuous part of Variables only

Reimplemented in NonDSampling.

References Variables::adiv(), Variables::adriv(), Variables::all_discrete_int_variables(), Variables::all_discrete_real_variables(), Variables::continuous_variable(), Model::current_variables(), Variables::inactive_continuous_variables(), Variables::is_null(), Iterator::iteratedModel, Analyzer::numContinuousVars, and Variables::shared_data().

Referenced by NonDLHSEvidence::post_process_samples(), Analyzer::pre_output(), Analyzer::samples_to_variables_array(), and Analyzer::update_best().

void initialize_run ( ) [protected], [virtual]

utility function to perform common operations prior to pre_run(); typically memory initialization; setting of instance pointers

Perform initialization phases of run sequence, like allocating memory and setting instance pointers. Commonly used in sub-iterator executions. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s initialize_run(), typically before performing its own implementation steps.

Reimplemented from Iterator.

Reimplemented in NonD.

References Model::initialize_mapping(), Model::is_null(), Iterator::iteratedModel, Model::mapping_initialized(), Iterator::methodPCIter, Analyzer::resize(), Model::set_evaluation_reference(), and Iterator::summaryOutputFlag.

Referenced by NonD::initialize_run().
void pre_run() [protected], [virtual]

pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori

pre-run phase, which a derived iterator may optionally reimplement; when not present, pre-run is likely integrated into the derived run function. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s pre_run(), if implemented, typically before performing its own implementation steps.

Reimplemented from Iterator.
Reimplemented in NonDLHSSampling, DDACEDesignCompExp, NonDRKDDarts, FSUDesignCompExp, ParamStudy, NonDMultilevelSampling, and PSUADesignCompExp.

References Analyzer::bestVarsRespMap.

Referenced by NonDMultilevelSampling::pre_run(), PSUADesignCompExp::pre_run(), ParamStudy::pre_run(), NonDRKDDarts::pre_run(), DDACEDesignCompExp::pre_run(), and NonDLHSSampling::pre_run().

void post_run (std::ostream & s) [protected], [virtual]

post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way

Post-run phase, which a derived iterator may optionally reimplement; when not present, post-run is likely integrated into run. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s post_run(), typically after performing its own implementation steps.

Reimplemented from Iterator.

References Model::is_null(), Iterator::iteratedModel, Model::print_evaluation_summary(), Analyzer::print_results(), Iterator::resultsDB, Iterator::summaryOutputFlag, and ResultsManager::write_databases().

Referenced by NonDMultilevelSampling::post_run(), PSUADesignCompExp::post_run(), NonDRKDDarts::post_run(), DDACEDesignCompExp::post_run(), NonDLHSSampling::post_run(), and NonDRKDDarts::post_run().

void finalize_run() [inline], [protected], [virtual]

utility function to perform common operations following post_run(); deallocation and resetting of instance pointers

Optional: perform finalization phases of run sequence, like deallocating memory and resetting instance pointers. Commonly used in sub-iterator executions. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s finalize_run(), typically after performing its own implementation steps.

Reimplemented from Iterator.
Reimplemented in NonD.

References Iterator::finalize_run().

void pre_output() [protected], [virtual]

Generate tabular output with active variables (compactMode) or all variables with their labels and response labels, with no data. Variables are sequenced {cv, div, drv}

Reimplemented from Iterator.

References Analyzer::allSamples, Analyzer::allVariables, ParallelLibrary::command_line_pre_run_output(), ParallelLibrary::command_line_user_modes(), Analyzer::compactMode, Variables::copy(), Model::current_response(), Model::current_variables(), Model::interface_id(), Iterator::iteratedModel, Iterator::outputLevel, Iterator::parallelLib, ProgramOptions::pre_run_output_format(), ParallelLibrary::program_options(), Analyzer::sample_to_variables(), Dakota::write_precision, Variables::write_tabular(), and Analyzer::writePrecision.
void print_results ( std::ostream & s ) [protected], [virtual]

print the final iterator results

This virtual function provides additional iterator-specific final results outputs beyond the function evaluation
summary printed in finalize_run().

Reimplemented from Iterator.
Reimplemented in NonDLHSSampling, NonDDREAMBayesCalibration, NonDPOFDarts, NonDBayesCalibration,
NonDLocalReliability, NonDWASABBayesCalibration, NonDQUESOBayesCalibration, NonDAdaptiveSampling,
NonDGImpSampling, NonDAdaptImpSampling, NonDExpansion, NonDInterval, NonDMultilevelSampling,
PStudyDACE, Verification, NonDGlobalReliability, and RichExtrapVerification.

References Analyzer::bestVarsRespMap, ParamResponsePair::eval_id(), Response::function_values(), Analyzer-
::numLSqTerms, Analyzer::numObjFns, ParamResponsePair::response(), and ParamResponsePair::variables().

Referenced by Analyzer::post_run(), Verification::print_results(), PStudyDACE::print_results(), and NonDL-
HSSampling::print_results().

const Model & algorithm_space_model() const [inline], [protected], [virtual]

default definition that gets redefined in selected derived Minimizers

Reimplemented from Iterator.
Reimplemented in NonDBayesCalibration, NonDExpansion, NonDGlobalInterval, and NonDReliability.

References Iterator::iteratedModel.

void evaluate_parameter_sets ( Model & model, bool logresp_flag, bool logbest_flag ) [protected]

perform function evaluations to map parameter sets (allVariables) into response sets (allResponses)

Convenience function for derived classes with sets of function evaluations to perform (e.g., NonDSampling,
DDACEDesignCompExp, FSUDesignCompExp, ParamStudy).

References Iterator::activeSet, Analyzer::allHeaders, Analyzer::allResponses, Analyzer::allSamples, Analyzer-
::allVariables, Model::asynch_flag(), Analyzer::compactMode, Response::copy(), Model::current_response(), Model-
::current_variables(), Model::evaluate(), Model::evaluate_nowait(), Model::evaluation_id(), Model::synchronize(),
Analyzer::update_best(), Analyzer::update_model_from_sample(), and Analyzer::update_model_from_variables().

Referenced by ParamStudy::core_run(), PSUDEDesignCompExp::core_run(), FSUDesignCompExp::core-
run(), NonDAdaptImpSampling::core_run(), DDAEDesignCompExp::core_run(), NonDLHSSampling::core-
run(), NonDIntegration::core_run(), NonDSampling::core_run(), NonDSparseGrid::evaluate_grid_increment(), Non-
DSparseGrid::evaluate_set(), NonDMultilevelSampling::lf_increment(), NonDMultilevelSampling::multilevel_control-
::variate_mc(), NonDMultilevelSampling::multilevel_mc(), NonDInterval::shared_increment(), Non-
DQUESOBayesCalibration::update_model(), and Analyzer::variance_based_decomp().

void variance_based_decomp ( int ncont, int ndiscont, int ndiscreal, int num_samples ) [protected]

Calculation of sensitivity indices obtained by variance based decomposition. These indices are obtained by the
Saltelli version of the Sobol VBD which uses (K+2)*N function evaluations, where K is the number of dimensions
(uncertain vars) and N is the number of samples.

References Dakota::abort_handler(), Analyzer::allResponses, Analyzer::allSamples, Analyzer::allVariables, Analyzer::compactMode, Variables::continuous_variables(), Dakota::copy_data(), Variables::discrete_int_variables(), Variables::discrete_real_variables(), Analyzer::evaluate_parameter_sets(), Iterator::iteratedModel, Analyzer::num_samples(), Analyzer::numFunctions, Analyzer::S4, Analyzer::T4, and Analyzer::vary_pattern().

Referenced by FSUDesignCompExp::core_run(), DDAEDesignCompExp::core_run(), and NonDLHSSampling::core_run().
void read_variables_responses ( int num_evals, size_t num_vars ) [protected]

convenience function for reading variables/responses (used in derived classes post_input)
  read num_evals variables/responses from file

  References Dakota::abort_handler(), Analyzer::allResponses, Analyzer::allSamples, Analyzer::allVariables,
  ParallelLibrary::command_line_post_run_input(), ParallelLibrary::command_line_user_modes(), Analyzer::compactMode,
  Response::copy(), Variables::copy(), Model::current_response(), Model::current_variables(), Iterator::iteratedModel,
  Iterator::outputLevel, Iterator::parallelLib, ProgramOptions::post_run_input_format(), ParallelLibrary::program_options(),
  Variables::read_tabular(), Analyzer::update_best(), and Analyzer::variables_to_sample().

  Referenced by PSUADEDesignCompExp::post_input(), ParamStudy::post_input(), FSUDesignCompExp::post_input(),
  DDACEDesignCompExp::post_input(), and NonDLHSSampling::post_input().

void print_sobol_indices ( std::ostream & s ) const [protected]

Printing of VBD results.
  printing of variance based decomposition indices.

  References Model::continuous_variable_labels(), Model::discrete_int_variable_labels(), Model::discrete_real_variable_labels(),
  Iterator::iteratedModel, Analyzer::numContinuousVars, Analyzer::numDiscreteIntVars, Analyzer::numDiscreteRealVars,
  Analyzer::response_labels(), Analyzer::S4, Analyzer::T4, Analyzer::vbdDropTol, and Dakota::write_precision.

  Referenced by PStudyDACE::print_results(), and NonDLHSSampling::print_results().

void variables_to_sample ( const Variables & vars, Real * sample_c_vars ) [protected], [virtual]

convert the active continuous variables into a column of allSamples

  Default implementation maps active continuous variables only
  Reimplemented in NonDSampling.

  References Variables::continuous_variables(), and Analyzer::numContinuousVars.

  Referenced by Analyzer::read_variables_responses(), and Analyzer::variables_array_to_samples().

The documentation for this class was generated from the following files:

  • DakotaAnalyzer.hpp
  • DakotaAnalyzer.cpp

13.4 ApplicationInterface Class Reference

Derived class within the interface class hierarchy for supporting interfaces to simulation codes.

Inheritance diagram for ApplicationInterface:
Public Member Functions

- **ApplicationInterface** (const ProblemDescDB &problem_db)
  
  *constructor*

- `~ApplicationInterface()`
  
  *destructor*

Protected Member Functions

- void **init_communicators** (const IntArray &message_lengths, int max_eval_concurrency)
  
  *allocate communicator partitions for concurrent evaluations within an iterator and concurrent multiprocessor analyses within an evaluation.*

- void **set_communicators** (const IntArray &message_lengths, int max_eval_concurrency)
  
  *set the local parallel partition data for an interface (the partitions are already allocated in ParallelLibrary).*

- void **init_serial**()

- int asynch_local_evaluation_concurrency () const
  
  *return asynchLocalEvalConcurrency*

- short **interface_synchronization** () const
  
  *return interfaceSynchronization*

- bool **evaluation_cache** () const
  
  *return evalCacheFlag*

- void **map** (const Variables &vars, const ActiveSet &set, Response &response, bool asynch_flag=false)
  
  *Provides a "mapping" of variables to responses using a simulation. Protected due to Interface letter-envelope idiom.*

- void **manage_failure** (const Variables &vars, const ActiveSet &set, Response &response, int failed_eval_id)
  
  *manages a simulation failure using abort/retry/recover/continuation*

- const IntResponseMap & **synch** ()
  
  *executes a blocking schedule for asynchronous evaluations in the beforeSynchCorePRPQueue and returns all jobs*

- const IntResponseMap & **synch_nowait** ()
executes a nonblocking schedule for asynchronous evaluations in the beforeSynchCorePRPQueue and returns a partial set of completed jobs

- void serve_evaluations()
  run on evaluation servers to serve the iterator master

- void stop_evaluation_servers()
  used by the iterator master to terminate evaluation servers

- bool check_multiprocessor_analysis(bool warn)
  checks on multiprocessor analysis configuration

- bool check_asynchronous(bool warn, int max_eval_concurrency)
  checks on asynchronous configuration (for direct interfaces)

- bool check_multiprocessor_asynchronous(bool warn, int max_eval_concurrency)
  checks on asynchronous settings for multiprocessor partitions

- virtual void derived_map(const Variables &vars, const ActiveSet &set, Response &response, int fn_eval_id)
  Called by map() and other functions to execute the simulation in synchronous mode. The portion of performing an evaluation that is specific to a derived class.

- virtual void derived_map_asynch(const ParamResponsePair &pair)
  Called by map() and other functions to execute the simulation in asynchronous mode. The portion of performing an asynchronous evaluation that is specific to a derived class.

- virtual void wait_local_evaluations(PRQueue &prp_queue)
  For asynchronous function evaluations, this method is used to detect completion of jobs and process their results. It provides the processing code that is specific to derived classes. This version waits for at least one completion.

- virtual void test_local_evaluations(PRQueue &prp_queue)
  For asynchronous function evaluations, this method is used to detect completion of jobs and process their results. It provides the processing code that is specific to derived classes. This version is nonblocking and will return without any completions if none are immediately available.

- virtual void init_communicators_checks(int max_eval_concurrency)
  perform construct-time error checks on the parallel configuration

- virtual void set_communicators_checks(int max_eval_concurrency)
  perform run-time error checks on the parallel configuration

- void master_dynamic_schedule_analyses()
  blocking dynamic schedule of all analyses within a function evaluation using message passing

- void serve_analyses_synch()
  serve the master analysis scheduler and manage one synchronous analysis job at a time

- virtual int synchronous_local_analysis(int analysis_id)
  Execute a particular analysis (identified by analysis_id) synchronously on the local processor. Used for the derived class specifics within ApplicationInterface::serve_analyses_synch().

Protected Attributes

- ParallelLibrary & parallelLib
  reference to the ParallelLibrary object used to manage MPI partitions for the concurrent evaluations and concurrent analyses parallelism levels

- bool suppressOutput
  flag for suppressing output on slave processors

- int evalCommSize
13.4. APPLICATIONINTERFACE CLASS REFERENCE

size of evalComm

- int evalCommRank
  processor rank within evalComm
- int evalServerId
  evaluation server identifier
- bool eaDedMasterFlag
  flag for dedicated master partitioning at ea level
- int analysisCommSize
  size of analysisComm
- int analysisCommRank
  processor rank within analysisComm
- int analysisServerId
  analysis server identifier
- int numAnalysisServers
  current number of analysis servers
- bool multiProcAnalysisFlag
  flag for multiprocessor analysis partitions
- bool asynchLocalAnalysisFlag
  flag for asynchronous local parallelism of analyses
- int asynchLocalAnalysisConcurrency
  limits the number of concurrent analyses in asynchronous local scheduling and specifies hybrid concurrency when message passing
- int asynchLocalEvalConcSpec
  user specification for asynchronous local evaluation concurrency
- int asynchLocalAnalysisConcSpec
  user specification for asynchronous local analysis concurrency
- int numAnalysisDrivers
  the number of analysis drivers used for each function evaluation (from the analysis_drivers interface specification)
- IntSet completionSet
  the set of completed fn_eval_id’s populated by wait_local_evaluations() and test_local_evaluations()
- String failureMessage
  base message for managing failed evals; will be followed with more details in screen output

Private Member Functions

- bool duplication_detect (const Variables &vars, Response &response, bool asynch_flag)
  checks data pairs and beforeSynchCorePRPQueue to see if the current evaluation request has already been performed or queued
- void init_default_asv (size_t num_fns)
  initialize default ASV if needed; this is done at run time due to post-construct time Response size changes.
- void master_dynamic_schedule_evaluations ()
  blocking dynamic schedule of all evaluations in beforeSynchCorePRPQueue using message passing on a dedicated master partition; executes on iteratorComm master
- void peer_static_schedule_evaluations ()
blocking static schedule of all evaluations in beforeSynchCorePRPQueue using message passing on a peer partition; executes on iteratorComm master

- void peer_dynamic_schedule_evaluations()
  blocking dynamic schedule of all evaluations in beforeSynchCorePRPQueue using message passing on a peer partition; executes on iteratorComm master

- void asynchronous_local_evaluations(PRQueue &prp_queue)
  perform all jobs in prp_queue using asynchronous approaches on the local processor

- void synchronous_local_evaluations(PRQueue &prp_queue)
  perform all jobs in prp_queue using synchronous approaches on the local processor

- void master_dynamic_schedule_evaluations_nowait()
  execute a nonblocking dynamic schedule in a master-slave partition

- void peer_static_schedule_evaluations_nowait()
  execute a nonblocking static schedule in a peer partition

- void peer_dynamic_schedule_evaluations_nowait()
  execute a nonblocking dynamic schedule in a peer partition

- void asynchronous_local_evaluations_nowait(PRQueue &prp_queue)
  launch new jobs in prp_queue asynchronously (if capacity is available), perform nonblocking query of all running jobs, and process any completed jobs (handles both master-local and local-peer scheduling cases)

- void broadcast_evaluation(const ParamResponsePair &pair)
  convenience function for broadcasting an evaluation over an evalComm

- void broadcast_evaluation(int fn_eval_id, const Variables &vars, const ActiveSet &set)
  convenience function for broadcasting an evaluation over an evalComm

- void send_evaluation(PRPQueueIter &prp_it, size_t buff_index, int server_id, bool peer_flag)
  helper function for sending sendBuffers[buff_index] to server

- void receive_evaluation(PRPQueueIter &prp_it, size_t buff_index, int server_id, bool peer_flag)
  helper function for processing recvBuffers[buff_index] within scheduler

- void launch_asynch_local(PRPQueueIter &prp_it)
  launch an asynchronous local evaluation

- void process_asynch_local(int fn_eval_id)
  process a completed asynchronous local evaluation

- void process_synch_local(PRPQueueIter &prp_it)
  process a completed synchronous local evaluation

- void assign_asynch_local_queue(PRQueue &local_prp_queue, PRPQueueIter &local_prp_iter)
  helper function for creating an initial active local queue by launching async local jobs from local_prp_queue, as limited by server capacity

- void assign_asynch_local_queue_nowait(PRQueue &local_prp_queue, PRPQueueIter &local_prp_iter)
  helper function for updating an active local queue by backfilling async local jobs from local_prp_queue, as limited by server capacity

- size_t test_local_backfill(PRQueue &assign_queue, PRPQueueIter &assign_iter)
  helper function for testing active async local jobs and then backfilling

- size_t test_receives_backfill(PRPQueueIter &assign_iter, bool peer_flag)
  helper function for testing receive requests and then backfilling jobs

- void serve_evaluations_synch()
  serve the evaluation message passing schedulers and perform one synchronous evaluation at a time
void serve_evaluations_synch_peer()
serve the evaluation message passing schedulers and perform one synchronous evaluation at a time as part of the 1st peer

void serve_evaluations_asynch()
serve the evaluation message passing schedulers and manage multiple asynchronous evaluations

void serve_evaluations_asynch_peer()
serve the evaluation message passing schedulers and perform multiple asynchronous evaluations as part of the 1st peer

void set_evaluation_communicators(const IntArray &message_lengths)
convenience function for updating the local evaluation partition data following ParallelLibrary::init_evaluation_communicators().

void set_analysis_communicators()
convenience function for updating the local analysis partition data following ParallelLibrary::init_analysis_communicators().

void init_serial_evaluations()
set concurrent evaluation configuration for serial operations

void init_serial_analyses()
set concurrent analysis configuration for serial operations (e.g., for local executions on a dedicated master)

const ParamResponsePair & get_source_pair(const Variables &target_vars)
convenience function for the continuation approach in manage_failure() for finding the nearest successful "source" evaluation to the failed "target"

void continuation(const Variables &target_vars, const ActiveSet &set, Response &response, const ParamResponsePair &source_pair, int failed_eval_id)
performs a 0th order continuation method to step from a successful "source" evaluation to the failed "target". Invoked by manage_failure() for failAction == "continuation".

void common_input_filtering(const Variables &vars)
common input filtering operations, e.g. mesh movement

void common_output_filtering(Response &response)
common output filtering operations, e.g. data filtering

Private Attributes

int worldSize
size of MPI_COMM_WORLD

int worldRank
processor rank within MPI_COMM_WORLD

int iteratorCommSize
size of iteratorComm

int iteratorCommRank
processor rank within iteratorComm

bool ieMessagePass
flag for message passing at ie scheduling level

int numEvalServers
current number of evaluation servers

int numEvalServersSpec
user specification for number of evaluation servers

- int procsPerEvalSpec
  user specification for processors per analysis servers

- bool eaMessagePass
  flag for message passing at ea scheduling level

- int numAnalysisServersSpec
  user spec for number of analysis servers

- int procsPerAnalysisSpec
  user specification for processors per analysis servers

- int lenVarsMessage
  length of a MPIPackBuffer containing a Variables object; computed in Model::init_communicators()

- int lenVarsActSetMessage
  length of a MPIPackBuffer containing a Variables object and an ActiveSet object; computed in Model::init_communicators()

- int lenResponseMessage
  length of a MPIPackBuffer containing a Response object; computed in Model::init_communicators()

- int lenPRPairMessage
  length of a MPIPackBuffer containing a ParamResponsePair object; computed in Model::init_communicators()

- short evalScheduling
  user specification of evaluation scheduling algorithm: {DEFAULT,MASTER,PEER_DYNAMIC,PEER_STATIC} - SCHEDULING. Used for manual overrides of auto-configure logic in ParallelLibrary::resolve_inputs().

- short analysisScheduling
  user specification of analysis scheduling algorithm: {DEFAULT,MASTER,PEER} - SCHEDULING. Used for manual overrides of the auto-configure logic in ParallelLibrary::resolve_inputs().

- int asyncLocalEvalConcurrency
  limits the number of concurrent evaluations in asynchronous local scheduling and specifies hybrid concurrency when message passing

- bool asyncLocalEvalStatic
  whether the asynchronous local evaluations are to be performed with a static schedule (default false)

- BitArray localServerAssigned
  array with one bit per logical "server" indicating whether a job is currently running on the server (used for async local static schedules)

- short interfaceSynchronization
  interface synchronization specification: synchronous (default) or asynchronous

- bool headerFlag
  used by synch_nowait to manage header output frequency (since this function may be called many times prior to any completions)

- bool asvControlFlag
  used to manage a user request to deactivate the active set vector control. true = modify the ASV each evaluation as appropriate (default); false = ASV values are static so that the user need not check them on each evaluation.

- bool evalCacheFlag
  used to manage a user request to deactivate the function evaluation cache (i.e., queries and insertions using the data_pairs cache).

- bool nearbyDuplicateDetect
13.4 APPLICATION INTERFACE CLASS REFERENCE

- Flag indicating optional usage of tolerance-based duplication detection (less efficient, but helpful when experiencing restart cache misses)
  - **Real nearbyTolerance**
    - Tolerance value for tolerance-based duplication detection
  - **bool restartFileFlag**
    - Used to manage a user request to deactivate the restart file (i.e., insertions into write_restart).
  - **String gradientType**
    - Type of gradients present in associated Response
  - **String hessianType**
    - Type of Hessians present in associated Response
  - **IntSet gradMixedAnalyticIds**
    - IDs of analytic gradients when mixed gradients present.
  - **IntSet hessMixedAnalyticIds**
    - IDs of analytic gradients when mixed gradients present.
  - **ShortArray defaultASV**
    - The static ASV values used when the user has selected asvControl = off
  - **String failAction**
    - Mitigation action for captured simulation failures: abort, retry, recover, or continuation
  - **int failRetryLimit**
    - Limit on the number of retries for the retry failAction
  - **RealVector failRecoveryFnVals**
    - The dummy function values used for the recover failAction
  - **IntResponseMap historyDuplicateMap**
    - Used to bookkeep asynchronous evaluations which duplicate data pairs evaluations. Map key is evalIdCntr, map value is corresponding response.
    - **std::map<int, std::pair<PRPQueueHIter, Response>> beforeSynchDuplicateMap**
      - Used to bookkeep evalIdCntr, beforeSynchCorePRPQueue iterator, and response of asynchronous evaluations which duplicate queued beforeSynchCorePRPQueue evaluations
    - **PRPQueue beforeSynchCorePRPQueue**
      - Used to bookkeep vars/set/response of nonduplicate asynchronous core evaluations. This is the queue of jobs populated by asynchronous map() that is later scheduled in synch() or synch_nowait().
    - **PRPQueue beforeSynchAlgPRPQueue**
      - Used to bookkeep vars/set/response of asynchronous algebraic evaluations. This is the queue of algebraic jobs populated by asynchronous map() that is later evaluated in synch() or synch_nowait().
    - **PRPQueue asynchLocalActivePRPQueue**
      - Used by nonblocking asynchronous local schedulers to bookkeep active local jobs
    - **std::map<int, IntSizetPair> msgPassRunningMap**
      - Used by nonblocking message passing schedulers to bookkeep which jobs are running remotely
    - **int nowaitEvalIdRef**
      - fnEvalId reference point for preserving modulo arithmetic-based job assignment in case of peer static nonblocking schedulers
    - **MPIPackBuffer * sendBuffers**
      - Array of pack buffers for evaluation jobs queued to a server
CHAPTER 13. CLASS DOCUMENTATION

- MPIUnpackBuffer \* recvBuffers
  
  array of unpack buffers for evaluation jobs returned by a server

- MPI_Request \* recvRequests
  
  array of requests for nonblocking evaluation receives

13.4.1 Detailed Description

Derived class within the interface class hierarchy for supporting interfaces to simulation codes.

**ApplicationInterface** provides an interface class for performing parameter to response mappings using simulation code(s). It provides common functionality for a number of derived classes and contains the majority of all of the scheduling algorithms in DAKOTA. The derived classes provide the specifics for managing code invocations using system calls, forks, direct procedure calls, or distributed resource facilities.

13.4.2 Member Function Documentation

```cpp
defaults of 0 servers are needed to distinguish an explicit user request for 1 server (serialization of a parallelism level) from no user request (use parallel auto-config). This default causes problems when init_communicators() is not called for an interface object (e.g., static scheduling fails in DirectApplicationInterface::derived_map() for NestedModel::optionalInterface). This is the reason for this function: to reset certain defaults for interface objects that are used serially.

Reimplemented from Interface.

References ApplicationInterface::init_serial_analyses(), and ApplicationInterface::init_serial_evaluations().
```

```cpp
void map ( const Variables & vars, const ActiveSet & set, Response & response, bool asynch_flag = false ) [protected], [virtual]
```

Provides a "mapping" of variables to responses using a simulation. Protected due to Interface letter-envelope idiom.

The function evaluator for application interfaces. Called from derived_evaluate() and derived_evaluate_nowait() in derived Model classes. If asynch_flag is not set, perform a blocking evaluation (using derived_map()). If asynch_flag is set, add the job to the beforeSynchCorePRPQueue queue for execution by one of the scheduler routines in synch() or synch_nowait(). Duplicate function evaluations are detected with duplication_detect().

Reimplemented from Interface.

References Response::active_set(), Interface::algebraic_mappings(), Interface::algebraicMappings, Interface::asv_mapping(), ApplicationInterface::asvControlFlag, ApplicationInterface::beforeSynchAlgPRPQueue, ApplicationInterface::broadcast_evaluation(), Response::copy(), Interface::coreMappings, Interface::currEvalId, Dakota::data_pairs, ApplicationInterface::defaultASV, ApplicationInterface::derived_map(), ApplicationInterface::duplication_detect(), ApplicationInterface::evalCacheFlag, Interface::evalIdCntnr, Interface::fineGrainEvalCounters, Interface::fnGradCounter, Interface::fnHessCounter, Interface::fnLabels, Interface::fnValCounter, Response::function_labels(), Interface::init_algebraic_mappings(), ApplicationInterface::init_default_asv(), Interface::init_evaluation_counters(), Interface::interfaceId, ApplicationInterface::manage_failure(), Interface::multiProcEvalFlag, Interface::newEvalIdCntnr, Interface::newFnGradCounter, Interface::newFnHessCounter, Interface::newFnValCounter, Interface::outputLevel, ApplicationInterface::parallelLib, ActiveSet::request_vector(), Interface::response_mapping(), ApplicationInterface::restartFileFlag, and ParallelLibrary::write_restart().
const IntResponseMap & synch() [protected], [virtual]
executes a blocking schedule for asynchronous evaluations in the beforeSynchCorePRPQueue and returns all jobs
This function provides blocking synchronization for all cases of asynchronous evaluations, including the local
asynchronous case (background system call, nonblocking fork, & multithreads), the message passing case, and
the hybrid case. Called from derived synchronize() in derived Model classes.
Reimplemented from Interface.
References Interface::algebraic_mappings(), Interface::asv_mapping(), ApplicationInterface::asynchLocalEvalStatic, ApplicationInterface::asynchronous_local_evaluations(), ApplicationInterface::beforeSynchAlgPRPQueue, ApplicationInterface::beforeSynchCorePRPQueue, ApplicationInterface::beforeSynchDuplicateMap, Interface::coreMappings, ApplicationInterface::evalScheduling, ApplicationInterface::historyDuplicateMap, Interface::ieDedMasterFlag, ApplicationInterface::ieMessagePass, Interface::interfaceId, Interface::interfaceType, ApplicationInterface::master_dynamic_schedule_evaluations(), Interface::multiProcEvalFlag, Interface::outputLevel, ApplicationInterface::peer_dynamic_schedule_evaluations(), ApplicationInterface::peer_static_schedule_evaluations(), Interface::rawResponseMap, and Interface::response_mapping().

const IntResponseMap & synch_nowait() [protected], [virtual]
executes a nonblocking schedule for asynchronous evaluations in the beforeSynchCorePRPQueue and returns a
partial set of completed jobs
This function provides nonblocking synchronization for the local asynchronous case and selected nonblocking
message passing schedulers. Called from derived synchronize_nowait() in derived Model classes.
Reimplemented from Interface.
References Interface::algebraic_mappings(), Interface::asv_mapping(), ApplicationInterface::asynchLocalEvalStatic, ApplicationInterface::asynchronous_local_evaluations_nowait(), ApplicationInterface::beforeSynchAlgPRPQueue, ApplicationInterface::beforeSynchCorePRPQueue, ApplicationInterface::beforeSynchDuplicateMap, Interface::coreMappings, ParamResponsePair::eval_id(), ApplicationInterface::evalScheduling, ApplicationInterface::headerFlag, ApplicationInterface::historyDuplicateMap, Interface::ieDedMasterFlag, ApplicationInterface::ieMessagePass, Interface::interfaceId, Interface::interfaceType, Dakota::lookup_by_eval_id(), ApplicationInterface::master_dynamic_schedule_evaluations_nowait(), Interface::multiProcEvalFlag, Interface::outputLevel, ApplicationInterface::peer_dynamic_schedule_evaluations_nowait(), ApplicationInterface::peer_static_schedule_evaluations_nowait(), Interface::rawResponseMap, ParamResponsePair::response(), Interface::response_mapping(), and Response::update().

void serve_evaluations() [protected], [virtual]
runt on evaluation servers to serve the iterator master
Invoked by the serve() function in derived Model classes. Passes control to serve_evaluations_synch(), serve_evaluations_asynch(), serve_evaluations_synch_peer(), or serve_evaluations_asynch_peer() according to specified concurrency, partition, and scheduler configuration.
Reimplemented from Interface.
References ApplicationInterface::asynchLocalEvalConcurrency, ApplicationInterface::evalServerId, Interface::ieDedMasterFlag, ApplicationInterface::serve_evaluations_asynch(), ApplicationInterface::serve_evaluations_asynch_peer(), ApplicationInterface::serve_evaluations_synch(), and ApplicationInterface::serve_evaluations_synch_peer().

void stop_evaluation_servers() [protected], [virtual]
used by the iterator master to terminate evaluation servers
This code is executed on the iteratorComm rank 0 processor when iteration on a particular model is complete.
It sends a termination signal (tag = 0 instead of a valid fn_eval_id) to each of the slave analysis servers. NOTE:
This function is called from the Strategy layer even when in serial mode. Therefore, use iteratorCommSize to provide appropriate fall through behavior.

Reimplemented from Interface.

References ParallelLibrary::bcast_e(), ParallelLibrary::free(), ParallelConfiguration::ie_parallel_level(), Interface::ieDedMasterFlag, ParallelLibrary::isend_ie(), ApplicationInterface::iteratorCommSize, Interface::multiProcEvalFlag, ApplicationInterface::numEvalServers, Interface::outputLevel, ParallelLibrary::parallelConfiguration(), and ApplicationInterface::parallelLib.

```cpp
void init_communicators_checks ( int max_eval_concurrency ) [protected], [virtual]
```

perform construct-time error checks on the parallel configuration

Override DirectApplicInterface definition if plug-in to allow batch processing in Plugin{Serial,Parallel}DirectApplicInterface.cpp

Reimplemented in DirectApplicInterface, SysCallApplicInterface, and ProcessHandleApplicInterface.

Referenced by ApplicationInterface::init_communicators().

```cpp
void set_communicators_checks ( int max_eval_concurrency ) [protected], [virtual]
```

perform run-time error checks on the parallel configuration

Override DirectApplicInterface definition if plug-in to allow batch processing in Plugin{Serial,Parallel}DirectApplicInterface.cpp

Reimplemented in DirectApplicInterface, SerialDirectApplicInterface, ParallelDirectApplicInterface, SysCallApplicInterface, and ProcessHandleApplicInterface.

Referenced by ApplicationInterface::set_communicators().

```cpp
void master_dynamic_schedule_analyses ( ) [protected]
```

blocking dynamic schedule of all analyses within a function evaluation using message passing

This code is called from derived classes to provide the master portion of a master-slave algorithm for the dynamic scheduling of analyses among slave servers. It is patterned after master_dynamic_schedule_evaluations(). It performs no analyses locally and matches either serve_analyses_synch() or serve_analyses_asynch() on the slave servers, depending on the value of asynchLocalAnalysisConcurrency. Dynamic scheduling assigns jobs in 2 passes. The 1st pass gives each server the same number of jobs (equal to asynchLocalAnalysisConcurrency). The 2nd pass assigns the remaining jobs to slave servers as previous jobs are completed. Single- and multilevel parallel use intra- and inter-communicators, respectively, for send/receive. Specific syntax is encapsulated within ParallelLibrary.

References ApplicationInterface::asynchLocalAnalysisConcurrency, ParallelLibrary::free(), ParallelLibrary::irecv_ea(), ParallelLibrary::isend_ea(), ApplicationInterface::numAnalysisDrivers, ApplicationInterface::numAnalysisServers, ApplicationInterface::parallelLib, ParallelLibrary::waitall(), and ParallelLibrary::waitsome().

Referenced by ProcessHandleApplicInterface::create_evaluation_process(), SysCallApplicInterface::create_evaluation_process(), and DirectApplicInterface::derived_map().

```cpp
void serve_analyses_synch ( ) [protected]
```

serve the master analysis scheduler and manage one synchronous analysis job at a time

This code is called from derived classes to run synchronous analyses on slave processors. The slaves receive requests (blocking receive), do local derived_map_ac’s, and return codes. This is done continuously until a termination signal is received from the master. It is patterned after serve_evaluations_synch().
13.4. APPLICATIONINTERFACE CLASS REFERENCE

References ApplicationInterface::analysisCommRank, ParallelLibrary::bcast_a(), ParallelLibrary::isend_ea(), ApplicationInterface::multiProcAnalysisFlag, ApplicationInterface::parallelLib, ParallelLibrary::recv_ea(), ApplicationInterface::synchronous_local_analysis(), and ParallelLibrary::wait().

Referenced by ProcessHandleApplicInterface::create_evaluation_process(), SysCallApplicInterface::create_evaluation_process(), and DirectApplicInterface::derived_map().

bool duplication_detect ( const Variables & vars, Response & response, bool asynch_flag ) [private]
checks data_pairs and beforeSynchCorePRPQueue to see if the current evaluation request has already been performed or queued.

Called from map() to check incoming evaluation request for duplication with content of data_pairs and beforeSynchCorePRPQueue. If duplication is detected, return true, else return false. Manage bookkeeping with history-DuplicateMap and beforeSynchDuplicateMap. Note that the list searches can get very expensive if a long list is searched on every function evaluation (either from a large number of previous jobs, a large number of pending jobs, or both). For this reason, a user request for deactivation of the evaluation cache results in a complete bypass of duplication_detect(), even though a beforeSynchCorePRPQueue search would still be meaningful. Since the intent of this request is to streamline operations, both list searches are bypassed.

References Response::active_set(), ApplicationInterface::beforeSynchCorePRPQueue, ApplicationInterface::beforeSynchDuplicateMap, Response::copy(), Dakota::data_pairs, ParamResponsePair::eval_id(), Interface::evalIdCntr, ApplicationInterface::historyDuplicateMap, Interface::interfaceId, Dakota::lookup_by_val(), ApplicationInterface::nearbyDuplicateDetect, ApplicationInterface::nearbyTolerance, and Response::update().

Referenced by ApplicationInterface::map().

void init_default_asv ( size_t num_fns ) [private]
initialize default ASV if needed; this is done at run time due to post-construct time Response size changes.

If the user has specified active_set_vector as off, then map() uses a default ASV which is constant for all function evaluations (so that the user need not check the content of the ASV on each evaluation). Only initialized if needed and not already sized.

References ApplicationInterface::asvControlFlag, ApplicationInterface::defaultASV, ApplicationInterface::gradientType, ApplicationInterface::gradMixedAnalyticIds, ApplicationInterface::hessianType, and ApplicationInterface::hessMixedAnalyticIds.

Referenced by ApplicationInterface::map().

void master_dynamic_schedule_evaluations ( ) [private]
blocking dynamic schedule of all evaluations in beforeSynchCorePRPQueue using message passing on a dedicated master partition; executes on iteratorComm master.

This code is called from synch() to provide the master portion of a master-slave algorithm for the dynamic scheduling of evaluations among slave servers. It performs no evaluations locally and matches either serve_evaluations_synch() or serve_evaluations_asynch() on the slave servers, depending on the value of asynchLocalEvalConcurrency. Dynamic scheduling assigns jobs in 2 passes. The 1st pass gives each server the same number of jobs (equal to asynchLocalEvalConcurrency). The 2nd pass assigns the remaining jobs to slave servers as previous jobs are completed and returned. Single- and multilevel parallel use intra- and inter-communicators, respectively, for send/receive. Specific syntax is encapsulated within ParallelLibrary::peer.

References ApplicationInterface::asynchLocalEvalConcurrency, ApplicationInterface::beforeSynchCorePRPQueue, Dakota::lookup_by_eval_id(), ApplicationInterface::numEvalServers, Interface::outputLevel, ApplicationInterface::parallelLib, ApplicationInterface::receive_evaluation(), ApplicationInterface::recvBuffers, ApplicationInterface::recvRequests, ApplicationInterface::send_evaluation(), ApplicationInterface::sendBuffers, ParallelLibrary::waitall(), and ParallelLibrary::waitsome().
Referenced by ApplicationInterface::synch().

```cpp
void peer_static_schedule_evaluations() [private]
```

blocking static schedule of all evaluations in beforeSynchCorePRPQueue using message passing on a peer partition; executes on iteratorComm master

This code runs on the iteratorCommRank 0 processor (the iterator) and is called from synch() in order to manage a static schedule for cases where peer 1 must block when evaluating its local job allocation (e.g., single or multiprocessor direct interface evaluations). It matches serve_evaluations_peer() for any other processors within the first evaluation partition and serve_evaluations_{synch,asynch}() for all other evaluation partitions (depending on asynchLocalEvalConcurrency). It performs function evaluations locally for its portion of the job allocation using either asynchronous_local_evaluations() or synchronous_local_evaluations(). Single-level and multilevel parallel use intra- and inter-communicators, respectively, for send/receive. Specific syntax is encapsulated within ParallelLibrary. The iteratorCommRank 0 processor assigns the static schedule since it is the only processor with access to beforeSynchCorePRPQueue (it runs the iterator and calls synchronize). The alternate design of each peer selecting its own jobs using the modulus operator would be applicable if execution of this function (and therefore the job list) were distributed.

References ApplicationInterface::asynchLocalEvalConcurrency, ApplicationInterface::asynchronous_local_evaluations(), ApplicationInterface::beforeSynchCorePRPQueue, ApplicationInterface::numEvalServers, Interface::outputLevel, ApplicationInterface::parallelLib, ApplicationInterface::receive_evaluation(), ApplicationInterface::recvBuffers, ApplicationInterface::recvRequests, ApplicationInterface::send_evaluation(), ApplicationInterface::sendBuffers, ApplicationInterface::synchronous_local_evaluations(), and ParallelLibrary::waitall().

Referenced by ApplicationInterface::synch().

```cpp
void peer_dynamic_schedule_evaluations() [private]
```

blocking dynamic schedule of all evaluations in beforeSynchCorePRPQueue using message passing on a peer partition; executes on iteratorComm master

This code runs on the iteratorCommRank 0 processor (the iterator) and is called from synch() in order to manage a dynamic schedule, as enabled by nonblocking management of local asynchronous jobs. It matches serve_evaluations_{synch,asynch}() for other evaluation partitions, depending on asynchLocalEvalConcurrency; it does not match serve_evaluations_peer() since, for local asynchronous jobs, the first evaluation partition cannot be multiprocessor. It performs function evaluations locally for its portion of the job allocation using asynchronous_local_evaluations_nowait(). Single-level and multilevel parallel use intra- and inter-communicators, respectively, for send/receive. Specific syntax is encapsulated within ParallelLibrary.

References ApplicationInterface::assign_asynch_local_queue(), ApplicationInterface::asynchLocalEvalConcurrency, ApplicationInterface::beforeSynchCorePRPQueue, ApplicationInterface::msgPassRunningMap, ApplicationInterface::numEvalServers, Interface::outputLevel, ApplicationInterface::recvBuffers, ApplicationInterface::recvRequests, ApplicationInterface::send_evaluation(), ApplicationInterface::sendBuffers, ApplicationInterface::test_local_backfill(), and ApplicationInterface::test_receives_backfill().

Referenced by ApplicationInterface::synch().

```cpp
void asynchronous_local_evaluations( PRPQueue & local_prp_queue ) [private]
```

perform all jobs in prp_queue using asynchronous approaches on the local processor

This function provides blocking synchronization for the local asynch case (background system call, nonblocking fork, or threads). It can be called from synch() for a complete local scheduling of all asynchronous jobs or from peer_{static,dynamic}.schedule_evaluations() to perform a local portion of the total job set. It uses derived_map_asynch() to initiate asynchronous evaluations and wait_local_evaluations() to capture completed jobs, and
mirrors the master_dynamic_schedule_evaluations() message passing scheduler as much as possible. (wait_local_evaluations() is modeled after MPI_Waitsome()).

References ApplicationInterface::assign_async_local_queue(), ApplicationInterface::asyncLocalActivePRPQueue, ApplicationInterface::asyncLocalEvalConcurrency, ApplicationInterface::asyncLocalEvalStatic, ApplicationInterface::completionSet, ApplicationInterface::launch_async_local(), ApplicationInterface::localServerAssigned, Dakota::lookup_by_eval_id(), ApplicationInterface::numEvalServers, Interface::outputLevel, ApplicationInterface::process_async_local(), Interface::rawResponseMap, and ApplicationInterface::wait_local_evaluations().

Referenced by ApplicationInterface::peer_static_schedule_evaluations(), and ApplicationInterface::synch().

void synchronous_local_evaluations ( PRPQueue & local_prp_queue ) [private]
perform all jobs in prp_queue using synchronous approaches on the local processor

This function provides blocking synchronization for the local synchronous case (foreground system call, blocking fork, or procedure call from derived_map()). It is called from peer_static_schedule_evaluations() to perform a local portion of the total job set.

References ApplicationInterface::broadcast_evaluation(), Interface::currEvalId, ApplicationInterface::derived_map(), ApplicationInterface::manage_failure(), Interface::multiProcEvalFlag, and Interface::process_synch_local().

Referenced by ApplicationInterface::peer_static_schedule_evaluations(), and ApplicationInterface::peer_static_schedule_evaluations_nowait().

void master_dynamic_schedule_evaluations_nowait ( ) [private]
execute a nonblocking dynamic schedule in a master-slave partition

This code is called from synch_nowait() to provide the master portion of a nonblocking master-slave algorithm for the dynamic scheduling of evaluations among slave servers. It performs no evaluations locally and matches either serve_evaluations_synch() or serve_evaluations_asynch() on the slave servers, depending on the value of asyncLocalEvalConcurrency. Dynamic scheduling assigns jobs in 2 passes. The 1st pass gives each server the same number of jobs (equal to asyncLocalEvalConcurrency). The 2nd pass assigns the remaining jobs to slave servers as previous jobs are completed. Single- and multilevel parallel use intra- and inter-communicators, respectively, for send/receive. Specific syntax is encapsulated within ParallelLibrary.

References Dakota::abort_handler(), ApplicationInterface::asyncLocalEvalConcurrency, ApplicationInterface::beforeSyncCorePRPQueue, ApplicationInterface::headerFlag, ApplicationInterface::msgPassRunningMap, ApplicationInterface::numEvalServers, ApplicationInterface::recvBuffers, ApplicationInterface::recvRequests, ApplicationInterface::send_evaluation(), ApplicationInterface::sendBuffers, and ApplicationInterface::test_receives_backfill().

Referenced by ApplicationInterface::synch_nowait().

void peer_static_schedule_evaluations_nowait ( ) [private]
execute a nonblocking static schedule in a peer partition

This code runs on the iteratorCommRank 0 processor (the iterator) and is called from synch_nowait() in order to manage a nonblocking static schedule. It matches serve_evaluations_synch() for other evaluation partitions (asyncLocalEvalConcurrency == 1). It performs blocking local function evaluations, one at a time, for its portion of the static schedule and checks for remote completions in between each local completion. Therefore, unlike peer_dynamic_schedule_evaluations_nowait(), this scheduler will always return at least one job. Single-level and multilevel parallel use intra- and inter-communicators, respectively, for send/receive, with specific syntax as encapsulated within ParallelLibrary. The iteratorCommRank 0 processor assigns the static schedule since it is the only processor with access to beforeSyncCorePRPQueue (it runs the iterator and calls synchronize). The alternate design of each peer selecting its own jobs using the modulus operator would be applicable if execution of this function (and therefore the job list) were distributed.
References Dakota::abort_handler(), ApplicationInterface::assign_asynch_local_queue(), ApplicationInterface::assign_asynch_local_queue_nowait(), ApplicationInterface::asynchLocalActivePRPQueue, ApplicationInterface::asynchLocalEvalConcurrency, ApplicationInterface::beforeSyncCorePRPQueue, ApplicationInterface::headerFlag, Interface::interfaceType, Dakota::lookup_by_eval_id(), ApplicationInterface::msgPassRunningMap, Interface::multiProcEvalFlag, ApplicationInterface::nowaitEvalIdRef, ApplicationInterface::numEvalServers, ApplicationInterface::recvBuffers, ApplicationInterface::recvRequests, ApplicationInterface::send_evaluation(), ApplicationInterface::sendBuffers, ApplicationInterface::synchronous_local_evaluations(), ApplicationInterface::test_local_backfill(), and ApplicationInterface::test_receives_backfill().

Referenced by ApplicationInterface::synch_nowait().

```cpp
void peer_dynamic_schedule_evaluations_nowait( ) [private]
execute a nonblocking dynamic schedule in a peer partition
This code runs on the iteratorCommRank 0 processor (the iterator) and is called from synch_nowait() in order to manage a nonblocking static schedule. It matches serve_evaluations.{synch,asynch}() for other evaluation partitions (depending on asynchLocalEvalConcurrency). It performs nonblocking local function evaluations for its portion of the static schedule using asynchronous_local_evaluations(). Single-level and multilevel parallel use intra- and inter-communicators, respectively, for send/receive, with specific syntax as encapsulated within ParallelLibrary. The iteratorCommRank 0 processor assigns the dynamic schedule since it is the only processor with access to beforeSynchCorePRPQueue (it runs the iterator and calls synchronize). The alternate design of each peer selecting its own jobs using the modulus operator would be applicable if execution of this function (and therefore the job list) were distributed.

References Dakota::abort_handler(), ApplicationInterface::assign_asynch_local_queue(), ApplicationInterface::assign_asynch_local_queue_nowait(), ApplicationInterface::asynchLocalActivePRPQueue, ApplicationInterface::asynchLocalEvalConcurrency, ApplicationInterface::beforeSyncCorePRPQueue, ApplicationInterface::headerFlag, Dakota::lookup_by_eval_id(), ApplicationInterface::msgPassRunningMap, ApplicationInterface::numEvalServers, ApplicationInterface::recvBuffers, ApplicationInterface::recvRequests, ApplicationInterface::send_evaluation(), ApplicationInterface::sendBuffers, ApplicationInterface::test_local_backfill(), and ApplicationInterface::test_receives_backfill().

Referenced by ApplicationInterface::synch_nowait().
```

```cpp
void asynchronous_local_evaluations_nowait( PRPQueue & local_prp_queue ) [private]
launch new jobs in prp_queue asynchronously (if capacity is available), perform nonblocking query of all running jobs, and process any completed jobs (handles both local master- and local peer-scheduling cases)
This function provides nonblocking synchronization for the local asynch case (background system call, non-blocking fork, or threads). It is called from synch_nowait() and passed the complete set of all asynchronous jobs (beforeSynchCorePRPQueue). It uses derived_map_asynch() to initiate asynchronous evaluations and test_local_evaluations() to capture completed jobs in nonblocking mode. It mirrors a nonblocking message passing scheduler as much as possible (test_local_evaluations() modeled after MPI_Testsome()). The result of this function is rawResponseMap, which uses eval_id as a key. It is assumed that the incoming local_prp_queue contains only active and new jobs - i.e., all completed jobs are cleared by synch_nowait().

Also supports asynchronous local evaluations with static scheduling. This scheduling policy specifically ensures that a completed asynchronous evaluation eval_id is replaced with an equivalent one, modulo asynchLocalEvalConcurrency. In the nowait case, this could render some servers idle if evaluations don’t come in eval_id order or some evaluations are cancelled by the caller in between calls. If this function is called with unlimited local eval concurrency, the static scheduling request is ignored.

References ApplicationInterface::assign_asynch_local_queue_nowait(), ApplicationInterface::asynchLocalActivePRPQueue, ApplicationInterface::asynchLocalEvalConcurrency, ApplicationInterface::asynchLocalEvalStatic, ApplicationInterface::headerFlag, and ApplicationInterface::test_local_backfill().
```
13.4. APPLICATIONINTERFACE CLASS REFERENCE

Referenced by ApplicationInterface::synch_nowait().

```cpp
void serve_evaluations_synch() [private]

serve the evaluation message passing schedulers and perform one synchronous evaluation at a time.

This code is invoked by serve_evaluations() to perform one synchronous job at a time on each slave/peer server. The servers receive requests (blocking receive), do local synchronous maps, and return results. This is done continuously until a termination signal is received from the master (sent via stop_evaluation_servers()).

References ParallelLibrary::bcast_e(), Interface::currEvalId, ApplicationInterface::derived_map(), ApplicationInterface::evalCommRank, ParallelLibrary::isend_ie(), ApplicationInterface::lenResponseMessage, ApplicationInterface::lenVarsActSetMessage, ApplicationInterface::manage_failure(), Interface::multiProcEvalFlag, ApplicationInterface::parallelLib, ParallelLibrary::recv_ie(), MPIPackBuffer::reset(), and ParallelLibrary::wait().

Referenced by ApplicationInterface::serve_evaluations().
```

```cpp
void serve_evaluations_synch_peer() [private]

serve the evaluation message passing schedulers and perform one synchronous evaluation at a time as part of the 1st peer.

This code is invoked by serve_evaluations() to perform a synchronous evaluation in coordination with the iteratorCommRank 0 processor (the iterator) for static schedules. The bcast() matches either the bcast() in synchronous_local_evaluations(), which is invoked by peer_static_schedule_evaluations(), or the bcast() in map().

References ParallelLibrary::bcast_e(), Interface::currStatic_schedule_evaluations(), ApplicationInterface::derived_map(), ApplicationInterface::lenVarsActSetMessage, ApplicationInterface::manage_failure(), and ApplicationInterface::parallelLib.

Referenced by ApplicationInterface::serve_evaluations().
```

```cpp
void serve_evaluations_asynch() [private]

serve the evaluation message passing schedulers and manage multiple asynchronous evaluations.

This code is invoked by serve_evaluations() to perform multiple asynchronous jobs on each slave/peer server. The servers test for any incoming jobs, launch any new jobs, process any completed jobs, and return any results. Each of these components is nonblocking, although the server loop continues until a termination signal is received from the master (sent via stop_evaluation_servers()). In the master-slave case, the master maintains the correct number of jobs on each slave. In the static scheduling case, each server is responsible for limiting concurrency (since the entire static schedule is sent to the peers at start up).

References Dakota::abort_handler(), ApplicationInterface::asynchLocalActivePRPQueue, ApplicationInterface::asynchLocalEvalConcurrency, ParallelLibrary::bcast_e(), ApplicationInterface::completionSet, ApplicationInterface::derived_map_asynch(), ApplicationInterface::evalCommRank, Interface::interfaceId, ParallelLibrary::irecv_ie(), ApplicationInterface::lenResponseMessage, ApplicationInterface::lenVarsActSetMessage, Dakota::lookup_by_eval_id(), Interface::multiProcEvalFlag, ApplicationInterface::parallelLib, ParallelLibrary::recv_ie(), MPIUnpackBuffer::reset(), ParallelLibrary::send_ie(), ParallelLibrary::test(), and ApplicationInterface::test_local_evaluations().

Referenced by ApplicationInterface::serve_evaluations().
```

```cpp
void serve_evaluations_asynch_peer() [private]

serve the evaluation message passing schedulers and perform multiple asynchronous evaluations as part of the 1st peer.

This code is invoked by serve_evaluations() to perform multiple asynchronous jobs on multiprocessor slave/peer servers. It matches the multiProcEvalFlag beasts in ApplicationInterface::asynchronous_local_evaluations().
```
References Dakota::abort_handler(), ApplicationInterface::asynchLocalActivePRPQueue, ApplicationInterface::asynchLocalEvalConcurrency, ParallelLibrary::bcast_e(), ApplicationInterface::completionSet, ApplicationInterface::derived_map_asynch(), Interface::interfaceId, ApplicationInterface::lenVarsActSetMessage, Dakota::lookup_by_eval_id(), ApplicationInterface::parallelLib, MPIUnpackBuffer::reset(), and ApplicationInterface::test_local_evaluations(). Referenced by ApplicationInterface::serve_evaluations().

The documentation for this class was generated from the following files:
- ApplicationInterface.hpp
- ApplicationInterface.cpp

## 13.5 Approximation Class Reference

Base class for the approximation class hierarchy.

Inheritance diagram for Approximation:

```
Approximation
GaussProcApproximation PecosApproximation SurfpackApproximation TANA3Approximation TaylorApproximation VPSApproximation
```

### Public Member Functions

- **Approximation ()**
  - default constructor
- **Approximation (ProblemDescDB &problem_db, const SharedApproxData &shared_data, const String &approx_label)**
  - standard constructor for envelope
- **Approximation (const SharedApproxData &shared_data)**
  - alternate constructor
- **Approximation (const Approximation &approx)**
  - copy constructor
- **virtual ∼Approximation ()**
  - destructor
- **Approximation operator= (const Approximation &approx)**
  - assignment operator
- **virtual void build ()**
  - builds the approximation from scratch
- **virtual void export_model (const String &fn_label="", const String &export_prefix="", const unsigned short export_format=NO_MODEL_FORMAT)**
  - exports the approximation
- **virtual void rebuild ()**
  - rebuilds the approximation incrementally
- **virtual void pop (bool save_data)**
  - removes entries from end of SurrogateData::{vars,resp}Data (last points appended, or as specified in args)
- **virtual void push ()**
  - restores state prior to previous pop()
- virtual void finalize ()
  finalize approximation by applying all remaining trial sets
- virtual void store (size_t index= NPOS)
  store current approximation state for later combination
- virtual void restore (size_t index= NPOS)
  restore previous approximation state
- virtual void remove_stored (size_t index= NPOS)
  remove a stored approximation prior to combination
- virtual void combine (short corr_type, size_t swap_index)
  combine current approximation with previously stored approximation
- virtual Real value (const Variables &vars)
  retrieve the approximate function value for a given parameter vector
- virtual const RealVector & gradient (const Variables &vars)
  retrieve the approximate function gradient for a given parameter vector
- virtual const RealSymMatrix & hessian (const Variables &vars)
  retrieve the approximate function Hessian for a given parameter vector
- virtual Real prediction_variance (const Variables &vars)
  retrieve the variance of the predicted value for a given parameter vector
- virtual Real value (const RealVector &c_vars)
  retrieve the approximate function value for a given parameter vector
- virtual const RealVector & gradient (const RealVector &c_vars)
  retrieve the approximate function gradient for a given parameter vector
- virtual const RealSymMatrix & hessian (const RealVector &c_vars)
  retrieve the approximate function Hessian for a given parameter vector
- virtual Real prediction_variance (const RealVector &c_vars)
  retrieve the variance of the predicted value for a given parameter vector
- virtual bool diagnostics_available ()
  check if diagnostics are available for this approximation type
- virtual Real diagnostic (const String &metric_type)
  retrieve a single diagnostic metric for the diagnostic type specified
- virtual RealArray cv_diagnostic (const StringArray & metric_types, unsigned num_folds)
  retrieve diagnostic metrics for the diagnostic types specified, applying
- virtual void primary_diagnostics (int fn_index)
  compute and print all requested diagnostics and cross-validation
- virtual RealArray challenge_diagnostic (const StringArray & metric_types, const RealMatrix &challenge_points, const RealVector &challenge_responses)
  compute requested diagnostics for user provided challenge pts
- virtual void challenge_diagnostics (const RealMatrix &challenge_points, const RealVector &challenge_responses)
  compute and print all requested diagnostics for user provided challenge pts
- virtual RealVector approximation_coefficients (bool normalized) const
  return the coefficient array computed by build()/rebuild()
- virtual void approximation_coefficients (const RealVector &approx_coeffs, bool normalized)
set the coefficient array from external sources, rather than computing with build()/rebuild()

- virtual void coefficient_labels (std::vector<std::string> &coeff_labels) const
  print the coefficient array computed in build()/rebuild()

- virtual void print_coefficients (std::ostream &s, bool normalized)
  print the coefficient array computed in build()/rebuild()

- virtual int min_coefficients () const
  return the minimum number of samples (unknowns) required to build the derived class approximation type in numVars dimensions

- virtual int recommended_coefficients () const
  return the recommended number of samples (unknowns) required to build the derived class approximation type in numVars dimensions

- virtual int num_constraints () const
  return the number of constraints to be enforced via an anchor point

- virtual void clear_current ()
  clear current build data in preparation for next build

- int min_points (bool constraint_flag) const
  return the minimum number of points required to build the approximation type in numVars dimensions. Uses _coefficients() and num_constraints().

- int recommended_points (bool constraint_flag) const
  return the recommended number of samples to build the approximation type in numVars dimensions (default same as min_points)

- const Pecos::SurrogateData & approximation_data () const
  return approxData

- void add (const Pecos::SurrogateDataVars &sdv, bool anchor_flag)
  append to SurrogateData::varsData or assign to SurrogateData::anchorVars

- void add (const Variables &vars, bool anchor_flag, bool deep_copy)
  extract the relevant vectors from Variables and invoke add(RealVector&, IntVector&, RealVector&)

- void add (const RealMatrix &sample_vars, bool anchor_flag, bool deep_copy)
  create a RealVector view and invoke add(RealVector&, empty, empty)

- void add (const RealVector &c_vars, const IntVector &di_vars, const RealVector &dr_vars, bool anchor_flag, bool deep_copy)
  shared code among add(Variables&) and add(Real+); adds a new data point by either appending to SurrogateData::varsData or assigning to SurrogateData::anchorVars, as dictated by anchor_flag. Uses add_point() and add_anchor().

- void add (const Pecos::SurrogateDataResp &sdr, bool anchor_flag)
  append to SurrogateData::respData or assign to SurrogateData::anchorResp

- void add (const Response &response, int fn_index, bool anchor_flag, bool deep_copy)
  adds a new data point by either appending to SurrogateData::respData or assigning to SurrogateData::anchorResp, as dictated by anchor_flag. Uses add_point() and add_anchor().

- void add (const RealMatrix &sample_vars, const RealVector &sample_resp)
  add data from the provided samples and response matrices, assuming continuous variables and function values only

- void pop_count (size_t count)
  appends to popCountStack (number of entries to pop from end of SurrogateData::{vars,resp}Data, based on size of last data set appended)
13.5. APPROXIMATION CLASS REFERENCE

- void clear_all()
  clear all build data (current and history) to restore original state
- void clear_anchor()
  clear SurrogateData::anchor\{Vars, Resp\}
- void clear_data()
  clear SurrogateData::\{vars, resp\}Data
- void clear_popped()
  clear popCountStack and SurrogateData::popped\{Vars, Resp\}Trials
- void set_bounds(const RealVector &cl_bnds, const RealVector &cu_bnds, const IntVector &dl_bnds, const IntVector &du_bnds, const RealVector &dr_l_bnds, const RealVector &dr_u_bnds)
  set approximation lower and upper bounds (currently only used by graphics)
- Approximation * approx_rep() const
  returns approxRep for access to derived class member functions that are not mapped to the top Approximation level

Protected Member Functions

- Approximation (BaseConstructor, const ProblemDescDB &problem_db, const SharedApproxData &shared_data, const String &approx_label)
  constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)
- Approximation (NoDBBaseConstructor, const SharedApproxData &shared_data)
  constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

Protected Attributes

- RealVector approxGradient
  gradient of the approximation returned by gradient()
- RealSymMatrix approxHessian
  Hessian of the approximation returned by hessian()
- Pecos::SurrogateData approxData
  contains the variables/response data for constructing a single approximation model (one response function)
- SharedApproxData * sharedDataRep
  contains the approximation data that is shared among the response set
- String approxLabel
  label for approximation, if applicable

Private Member Functions

- Approximation * get_approx (ProblemDescDB &problem_db, const SharedApproxData &shared_data, const String &approx_label)
  Used only by the standard envelope constructor to initialize approxRep to the appropriate derived type.
- Approximation * get_approx (const SharedApproxData &shared_data)
  Used only by the alternate envelope constructor to initialize approxRep to the appropriate derived type.
Private Attributes

- SizetArray popCountStack
  a stack managing the number of points previously added by calls to append() that can be removed by calls to pop()
- Approximation * approxRep
  pointer to the letter (initialized only for the envelope)
- int referenceCount
  number of objects sharing approxRep

13.5.1 Detailed Description

Base class for the approximation class hierarchy.

The Approximation class is the base class for the response data fit approximation class hierarchy in DAKOTA. One instance of an Approximation must be created for each function to be approximated (a vector of Approximations is contained in ApproximationInterface). For memory efficiency and enhanced polymorphism, the approximation hierarchy employs the "letter/envelope idiom" (see Coplien "Advanced C++", p. 133), for which the base class (Approximation) serves as the envelope and one of the derived classes (selected in Approximation::get_approx()) serves as the letter.

13.5.2 Constructor & Destructor Documentation

Approximation()

default constructor

The default constructor is used in Array<Approximation> instantiations and by the alternate envelope constructor. approxRep is NULL in this case (problem_db is needed to build a meaningful Approximation object). This makes it necessary to check for NULL in the copy constructor, assignment operator, and destructor.

Approximation (ProblemDescDB & problem_db, const SharedApproxData & shared_data, const String & approx_label)

standard constructor for envelope

Envelope constructor only needs to extract enough data to properly execute get_approx, since Approximation(BaseConstructor, problem_db) builds the actual base class data for the derived approximations.

References Dakota::abort_handler(), Approximation::approxRep, and Approximation::get_approx().

Approximation (const SharedApproxData & shared_data)

alternate constructor

This is the alternate envelope constructor for instantiations on the fly. Since it does not have access to problem_db, it utilizes the NoDBBaseConstructor constructor chain.

References Dakota::abort_handler(), Approximation::approxRep, and Approximation::get_approx().

Approximation (const Approximation & approx)

copy constructor

Copy constructor manages sharing of approxRep and incrementing of referenceCount.

References Approximation::approxRep, and Approximation::referenceCount.
13.5. APPROXIMATION CLASS REFERENCE

virtual destructor
Destructor decrements referenceCount and only deletes approxRep when referenceCount reaches zero.
References Approximation::approxRep, and Approximation::referenceCount.

protected constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)
This constructor is the one which must build the base class data for all derived classes. get_approx() instantiates a derived class letter and the derived constructor selects this base class constructor in its initialization list (to avoid recursion in the base class constructor calling get_approx() again). Since the letter IS the representation, its rep pointer is set to NULL (an uninitialized pointer causes problems in ~Approximation).

protected constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)
This constructor is the one which must build the base class data for all derived classes. get_approx() instantiates a derived class letter and the derived constructor selects this base class constructor in its initialization list (to avoid recursion in the base class constructor calling get_approx() again). Since the letter IS the representation, its rep pointer is set to NULL (an uninitialized pointer causes problems in ~Approximation).

13.5.3 Member Function Documentation

operator= ( const Approximation & approx )
assignment operator
References Approximation::approxRep, and Approximation::referenceCount.

virtual void build()
builds the approximation from scratch
This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations should explicitly invoke (or reimplement) this base class contribution.
Reimplemented in PecosApproximation, VPSApproximation, GaussProcApproximation, SurfpackApproximation, TaylorApproximation, and TANA3Approximation.
References Dakota::abort_handler(), Approximation::approxData, Approximation::approxRep, Approximation::build(), Approximation::min_points(), SharedApproxData::numVars, and Approximation::sharedDataRep.
Referenced by TANA3Approximation::build(), TaylorApproximation::build(), Approximation::build(), SurfpackApproximation::build(), GaussProcApproximation::build(), VPSApproximation::build(), PecosApproximation::build(), and Approximation::rebuild().

virtual void export_model ( const String & fn_label = "$", const String & export_prefix = "$", const unsigned short export_format = NO_MODEL_FORMAT )
exports the approximation
This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations should explicitly invoke (or reimplement) this base class contribution.

Reimplemented in SurfpackApproximation.

References Approximation::approxRep, and Approximation::export_model().

Referenced by Approximation::export_model().

```cpp
void rebuild() [virtual]
```

rebuilds the approximation incrementally

This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations should explicitly invoke (or reimplement) this base class contribution.

Reimplemented in PecosApproximation.

References Approximation::approxRep, Approximation::build(), and Approximation::rebuild().

Referenced by Approximation::rebuild().

```cpp
void pop(bool save_data) [virtual]
```

removes entries from end of SurrogateData::{vars,resp}Data (last points appended, or as specified in args)

This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations should explicitly invoke (or reimplement) this base class contribution.

Reimplemented in PecosApproximation.

References Dakota::abort_handler(), Approximation::approxData, Approximation::approxRep, Approximation::pop(), and Approximation::popCountStack.

Referenced by Approximation::pop(), and PecosApproximation::pop().

```cpp
void push() [virtual]
```

restores state prior to previous pop()

This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations should explicitly invoke (or reimplement) this base class contribution.

Reimplemented in PecosApproximation.

References Approximation::approxData, Approximation::approxRep, Approximation::popCountStack, Approximation::push(), SharedApproxData::retrieval_index(), and Approximation::sharedDataRep.

Referenced by Approximation::push(), and PecosApproximation::push().

```cpp
void finalize() [virtual]
```

finalize approximation by applying all remaining trial sets

This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations should explicitly invoke (or reimplement) this base class contribution.

Reimplemented in PecosApproximation.

References Approximation::approxData, Approximation::approxRep, Approximation::clear_popped(), SharedApproxData::finalization_index(), Approximation::finalize(), and Approximation::sharedDataRep.

Referenced by Approximation::finalize(), and PecosApproximation::finalize().

```cpp
void clear_current() [inline], [virtual]
```

clear current build data in preparation for next build

Redefined by TANA3Approximation to clear current data but preserve history.

Reimplemented in TANA3Approximation.

References Approximation::approxRep, Approximation::clear_all(), and Approximation::clear_current().
13.6. APPROXIMATIONINTERFACE CLASS REFERENCE

Referenced by Approximation::clear_current().

void clear_all( ) [inline]
clear all build data (current and history) to restore original state
  Clears out any history (e.g., TANA3Approximation use for a different response function in NonDReliability).
  References Approximation::approxData, Approximation::approxRep, and Approximation::clear_all().
  Referenced by Approximation::clear_all(), and Approximation::clear_current().

Approximation * get_approx ( ProblemDescDB & problem_db, const SharedApproxData & shared_data, const String & approx_label ) [private]
Used only by the standard envelope constructor to initialize approxRep to the appropriate derived type.
  Used only by the envelope constructor to initialize approxRep to the appropriate derived type.
  References SharedApproxData::approxType, SharedApproxData::data_rep(), ProblemDescDB::get_bool(), and Dakota::strends().
  Referenced by Approximation::Approximation().

Approximation * get_approx ( const SharedApproxData & shared_data ) [private]
Used only by the alternate envelope constructor to initialize approxRep to the appropriate derived type.
  Used only by the alternate envelope constructor to initialize approxRep to the appropriate derived type.
  References SharedApproxData::approxType, SharedApproxData::data_rep(), and Dakota::strends().
The documentation for this class was generated from the following files:

- DakotaApproximation.hpp
- DakotaApproximation.cpp

13.6 ApproximationInterface Class Reference

Derived class within the interface class hierarchy for supporting approximations to simulation-based results.
Inheritance diagram for ApproximationInterface:

```
  Interface
  
ApproximationInterface
```

Public Member Functions

- ApproximationInterface (ProblemDescDB & problem_db, const Variables & am_vars, bool am_cache, const String & am_interface_id, const StringArray & fn_labels)
  primary constructor
- ApproximationInterface (const String & approx_type, const UShortArray & approx_order, const Variables & am_vars, bool am_cache, const String & am_interface_id, size_t num_fns, short data_order, short output_level)
  alternate constructor for instantiations on the fly
• ∼ApproximationInterface ()
  destructor

Protected Member Functions

• void map (const Variables &vars, const ActiveSet &set, Response &response, bool async_flag=false)
  the function evaluator: provides an approximate "mapping" from the variables to the responses using function-Surfaces
• int minimum_points (bool constraint_flag) const
  returns the minimum number of samples required to build the functionSurfaces
• int recommended_points (bool constraint_flag) const
  returns the recommended number of samples recommended to build the functionSurfaces
• void approximation_function_indices (const IntSet &approx_fn_indices)
  set the (currently active) approximation function index set
• void update_approximation (const Variables &vars, const IntResponsePair &response_pr)
• void update_approximation (const RealMatrix &samples, const IntResponseMap &resp_map)
• void update_approximation (const VariablesArray &vars_array, const IntResponseMap &resp_map)
• void append_approximation (const Variables &vars, const IntResponsePair &response_pr)
• void append_approximation (const RealMatrix &samples, const IntResponseMap &resp_map)
• void append_approximation (const VariablesArray &vars_array, const IntResponseMap &resp_map)
• void build_approximation (const RealVector &c_l_bnds, const RealVector &c_u_bnds, const IntVector &di-l_bnds, const IntVector &di_u_bnds, const RealVector &dr_l_bnds, const RealVector &dr_u_bnds)
• void export_approximation ()
• void rebuild_approximation (const BoolDeque &rebuild_deque)
• void pop_approximation (bool save_surr_data)
• void push_approximation ()
• bool push_available ()
  queries the approximation for the ability to retrieve a previous increment
• void finalize_approximation ()
  finalizes the approximation by applying all trial increments
• void store_approximation (size_t index=NPOS)
  move the current approximation into storage for later combination; the index of the stored approximation can be passed to allow replacement instead of augmentation (default is push_back)
• void restore_approximation (size_t index=NPOS)
  return an approximation from storage; the index identifies a particular stored data set (default is pop_back from stored)
• void remove_stored_approximation (size_t index=NPOS)
  remove a stored approximation, due to redundancy with the current approximation, prior to combination (default for no index is pop_back)
• void combine_approximation (short corr_type)
  combine the current approximation with previously stored data sets
• Real2DArray cv_diagnostics (const StringArray &metrics, unsigned num_folds)
  approximation cross-validation quality metrics per response function
• Real2DArray challenge_diagnostics (const StringArray &metric_types, const RealMatrix &challenge_pts, const RealVector &challenge_resps)
• void **clear_current** ()
  clears current data from an approximation interface
• void **clear_all** ()
  clears all data from an approximation interface
• void **clear_popped** ()
  clears bookkeeping for popped data sets from an approximation interface
• **SharedApproxData & shared_approximation** ()
  retrieve the SharedApproxData within an ApproximationInterface
• std::vector< Approximation > & **approximations** ()
  retrieve the Approximations within an ApproximationInterface
• const Pecos::SurrogateData & **approximation_data** (size_t index)
  retrieve the approximation data from a particular Approximation within an ApproximationInterface
• const RealVectorArray & **approximation_coefficients** (bool normalized=false)
  retrieve the approximation coefficients from each Approximation within an ApproximationInterface
• void **approximation_coefficients** (const RealVectorArray &approx_coeffs, bool normalized=false)
  set the approximation coefficients within each Approximation within an ApproximationInterface
• const RealVector & **approximation_variances** (const Variables &vars)
  retrieve the approximation variances from each Approximation within an ApproximationInterface
• const IntResponseMap & **synch** ()
  recovers data from a series of asynchronous evaluations (blocking)
• const IntResponseMap & **synch_nowait** ()
  recovers data from a series of asynchronous evaluations (nonblocking)

**Private Member Functions**

• void **mixed_add** (const Variables &vars, const Response &response, bool anchor)
  add variables/response data to functionSurfaces using a mixture of shallow and deep copies
• void **mixed_add** (const Real *c_vars, const Response &response, bool anchor)
  add variables/response data to functionSurfaces using a mixture of shallow and deep copies
• void **shallow_add** (const Variables &vars, const Response &response, bool anchor)
  add variables/response data to functionSurfaces using a shallow copy
• void **sample_to_variables** (const Real *sample_c_vars, size_t num_cv, Variables &vars)
  populate continuous variables within vars from sample_c_vars
• void **update_pop_counts** (const IntResponseMap &resp_map)
  append to the popCountStack within each of the functionSurfaces based on the active set definitions within resp_map
• void **read_challenge_points** (bool active_only)
  Load approximation test points from user challenge points file.
Private Attributes

- IntSet **approxFnIndices**
  for incomplete approximation sets, this array specifies the response function subset that is approximated
- **SharedApproxData** **sharedData**
  data that is shared among all functionSurfaces
- std::vector< Approximation > **functionSurfaces**
  list of approximations, one per response function
- RealVectorArray **functionSurfaceCoeffs**
  array of approximation coefficient vectors, one per response function
- RealVector **functionSurfaceVariances**
  vector of approximation variances, one value per response function
- **String** **challengeFile**
  data file for user-supplied challenge data (per interface, since may contain multiple responses)
- unsigned short **challengeFormat**
  tabular format of the challenge points file
- **bool** **challengeActiveOnly**
  whether to import active only
- RealMatrix **challengePoints**
  container for the challenge points data (variables only)
- RealMatrix **challengeResponses**
  container for the challenge points data (responses only)
- **Variables** **actualModelVars**
  copy of the actualModel variables object used to simplify conversion among differing variable views
- **bool** **actualModelCache**
  indicates usage of an evaluation cache by the actualModel
- **String** **actualModelInterfaceId**
  the interface id from the actualModel used for ordered PRPCache lookups
- IntResponseMap **beforeSynchResponseMap**
  bookkeeping map to catalogue responses generated in map() for use in synch() and synch_nowait(). This supports pseudo-asynchronous operations (approximate responses are always computed synchronously, but asynchronous virtual functions are supported through bookkeeping).

Additional Inherited Members

### 13.6.1 Detailed Description

Derived class within the interface class hierarchy for supporting approximations to simulation-based results. **ApproximationInterface** provides an interface class for building a set of global/local/multipoint approximations and performing approximate function evaluations using them. It contains a list of **Approximation** objects, one for each response function.
13.6. APPROXIMATIONINTERFACE CLASS REFERENCE

13.6.2 Member Function Documentation

```cpp
void update_approximation ( const Variables & vars, const IntResponsePair & response_pr )
[protected], [virtual]
```

This function populates/replaces each Approximation::anchorPoint with the incoming variables/response data point.

Reimplemented from Interface.

References ApproximationInterface::actualModelCache, ApproximationInterface::actualModelInterfaceId, Dakota::data_pairs, Dakota::lookup_by_ids(), ApproximationInterface::mixed_add(), and ApproximationInterface::shallow_add().

```cpp
void update_approximation ( const RealMatrix & samples, const IntResponseMap & resp_map )
[protected], [virtual]
```

This function populates/replaces each Approximation::currentPoints with the incoming variables/response arrays.

Reimplemented from Interface.

References Dakota::abort_handler(), ApproximationInterface::actualModelCache, ApproximationInterface::actualModelInterfaceId, ApproximationInterface::actualModelVars, ApproximationInterface::approxFnIndices, Dakota::data_pairs, ApproximationInterface::functionSurfaces, Dakota::lookup_by_ids(), ApproximationInterface::mixed_add(), ApproximationInterface::sample_to_variables(), and ApproximationInterface::shallow_add().

```cpp
void update_approximation ( const VariablesArray & vars_array, const IntResponseMap & resp_map )
[protected], [virtual]
```

This function populates/replaces each Approximation::currentPoints with the incoming variables/response arrays.

Reimplemented from Interface.

References Dakota::abort_handler(), ApproximationInterface::actualModelCache, ApproximationInterface::actualModelInterfaceId, ApproximationInterface::approxFnIndices, Dakota::data_pairs, ApproximationInterface::functionSurfaces, Dakota::lookup_by_ids(), ApproximationInterface::mixed_add(), and ApproximationInterface::shallow_add().

```cpp
void append_approximation ( const Variables & vars, const IntResponsePair & response_pr )
[protected], [virtual]
```

This function appends to each Approximation::currentPoints with one incoming variables/response data point.

Reimplemented from Interface.

References ApproximationInterface::actualModelCache, ApproximationInterface::actualModelInterfaceId, ApproximationInterface::approxFnIndices, Dakota::data_pairs, ApproximationInterface::functionSurfaces, Dakota::lookup_by_ids(), ApproximationInterface::mixed_add(), and ApproximationInterface::shallow_add().

```cpp
void append_approximation ( const RealMatrix & samples, const IntResponseMap & resp_map )
[protected], [virtual]
```

This function appends to each Approximation::currentPoints with multiple incoming variables/response data points.

Reimplemented from Interface.

References Dakota::abort_handler(), ApproximationInterface::actualModelCache, ApproximationInterface::actualModelInterfaceId, ApproximationInterface::actualModelVars, Dakota::data_pairs, Dakota::lookup_by_ids(), ApproximationInterface::mixed_add(), ApproximationInterface::sample_to_variables(), ApproximationInterface::shallow_add(), and ApproximationInterface::update_pop_counts().
void append_approximation ( const VariablesArray & vars_array, const IntResponseMap & resp_map )
[protected], [virtual]

This function appends to each Approximation::currentPoints with multiple incoming variables/response data points.

Reimplemented from Interface.

References Dakota::abort_handler(), ApproximationInterface::actualModelCache, ApproximationInterface::actual-
ModelInterfaceId, Dakota::data_pairs, Dakota::lookup_by_ids(), ApproximationInterface::mixed_add(), Approximation-
Interface::shallow_add(), and ApproximationInterface::update_pop_counts().

void build_approximation ( const RealVector & clbnds, const RealVector & cu_bnds, const IntVector &
di_l_bnds, const IntVector & di_u_bnds, const RealVector & dr_l_bnds, const RealVector & dr_u_bnds )
[protected], [virtual]

This function finds the coefficients for each Approximation based on the data passed through update_approximation() calls. The bounds are used only for graphics visualization.

Reimplemented from Interface.

References ApproximationInterface::approxFnIndices, SharedApproxData::build(), ApproximationInterface-::challengeFile, ApproximationInterface::challengePoints, ApproximationInterface::challengeResponses, Approximation-
Interface::functionSurfaces, ApproximationInterface::read_challenge_points(), SharedApproxData::set_bounds(), and ApproximationInterface::sharedData.

void export_approximation ( )
[protected], [virtual]

This function calls export on each approximation

Reimplemented from Interface.

References ApproximationInterface::approxFnIndices, and ApproximationInterface::functionSurfaces.

void rebuild_approximation ( const BoolDeque & rebuild_deque )
[protected], [virtual]

This function updates the coefficients for each Approximation based on data increments provided by \{update,append\}_
_approximation().

Reimplemented from Interface.

References ApproximationInterface::approxFnIndices, ApproximationInterface::functionSurfaces, SharedApprox-
Data::rebuild(), and ApproximationInterface::sharedData.

void pop_approximation ( bool save_surr_data ) [inline], [protected], [virtual]

This function removes data provided by a previous append_approximation() call, possibly different numbers for
each function, or as specified in pop_counts, which is assumed to be the same for all functions.

Reimplemented from Interface.

References ApproximationInterface::approxFnIndices, ApproximationInterface::functionSurfaces, SharedApprox-
Data::pop(), and ApproximationInterface::sharedData.

void push_approximation ( ) [inline], [protected], [virtual]

This function updates the coefficients for each Approximation based on data increments provided by \{update,append\}_
_approximation().

Reimplemented from Interface.

References ApproximationInterface::approxFnIndices, ApproximationInterface::functionSurfaces, SharedApprox-
Data::post_push(), SharedApproxData::pre_push(), and ApproximationInterface::sharedData.
void read_challenge_points ( bool active_only ) [private]

Load approximation test points from user challenge points file.

Challenge data defaults to active/inactive, but user can override to active only.

References ApproximationInterface::actualModelVars, ApproximationInterface::challengeActiveOnly, ApproximationInterface::challengeFile, ApproximationInterface::challengeFormat, ApproximationInterface::challengePoints, ApproximationInterface::challengeResponses, Variables::copy(), and ApproximationInterface::functionSurfaces.

Referenced by ApproximationInterface::build_approximation().

13.6.3 Member Data Documentation

std::vector<Approximation> functionSurfaces [private]

list of approximations, one per response function

This formulation allows the use of mixed approximations (i.e., different approximations used for different response functions), although the input specification is not currently general enough to support it.

Referenced by ApproximationInterface::append_approximation(), ApproximationInterface::approximation_coefficients(), ApproximationInterface::approximation_data(), ApproximationInterface::approximation_variances(), ApproximationInterface::approximationInterface(), ApproximationInterface::approximations(), ApproximationInterface::build_approximation(), ApproximationInterface::clear_all(), ApproximationInterface::clear_current(), ApproximationInterface::clear_popped(), ApproximationInterface::combine_approximation(), ApproximationInterface::cv_diagnostics(), ApproximationInterface::export_approximation(), ApproximationInterface::finalize_approximation(), ApproximationInterface::map(), ApproximationInterface::minimum_points(), ApproximationInterface::mixed_add(), ApproximationInterface::pop_approximation(), ApproximationInterface::push_approximation(), ApproximationInterface::read_challenge_points(), ApproximationInterface::rebuild_approximation(), ApproximationInterface::recommended_points(), ApproximationInterface::removeStored_approximation(), ApproximationInterface::restore_approximation(), ApproximationInterface::shallow_add(), ApproximationInterface::store_approximation(), ApproximationInterface::update_approximation(), and ApproximationInterface::update_pop_counts().

The documentation for this class was generated from the following files:

- ApproximationInterface.hpp
- ApproximationInterface.cpp

13.7 APPSEvalMgr Class Reference

Evaluation manager class for APPSPACK.
Inherits Executor.

Public Member Functions

- APPSEvalMgr (Model &model)
  constructor
- ~APPSEvalMgr ()
  destructor
- bool isReadyForWork () const
tells APPS whether or not there is a processor available to perform a function evaluation
- bool submit (const int apps_tag, const HOPSPACK::Vector &apps_xtrial, const HOPSPACK::EvalRequestType apps_request)
performs a function evaluation at APPS-provided x_in
• int recv (int &apps_tag, HOPSPACK::Vector &apps_f, HOPSPACK::Vector &apps_cEqs, HOPSPACK::Vector &apps_cIneqs, string &apps_msg) returns a function value to APPS
• std::string getEvaluatorType (void) const
  return the type of the Dakota linked evaluator
• void printDebugInfo (void) const
  empty implementation of debug info needed to complete the interface
• void printTimingInfo (void) const
  empty implementation of timing info needed to complete the interface
• void set_asynch_flag (const bool dakotaAsynchFlag)
  publishes whether or not to do asynchronous evaluations
• void set_blocking_synch (const bool blockingSynchFlag)
  publishes whether or not APPS is operating synchronously
• void set_total_workers (const int numDakotaWorkers)
  publishes the number of processors available for function evaluations
• void set_constraint_map (std::vector<int> constraintMapIndices, std::vector<double> constraintMapMultipliers, std::vector<double> constraintMapOffsets)
  publishes constraint transformation

Private Attributes
• Model & iteratedModel
  reference to the APPSOptimizer’s model passed in the constructor
• bool modelAsynchFlag
  flag for asynchronous function evaluations
• bool blockingSynch
  flag for APPS synchronous behavior
• int numWorkersUsed
  number of processors actively performing function evaluations
• int numWorkersTotal
  total number of processors available for performing function evaluations
• std::vector<int> constrMapIndices
  map from Dakota constraint number to APPS constraint number
• std::vector<double> constrMapMultipliers
  multipliers for constraint transformations
• std::vector<double> constrMapOffsets
  offsets for constraint transformations
• RealVector xTrial
  trial iterate
• std::map<int, int> tagList
  map of DAKOTA eval id to APPS eval id (for asynchronous evaluations)
• std::map<int, RealVector> functionList
  map of APPS eval id to responses (for synchronous evaluations)
• IntResponseMap dakotaResponseMap
  map of DAKOTA responses returned by synchronize_nowait()
13.7. **APPSEVALMGR CLASS REFERENCE**

13.7.1 **Detailed Description**

Evaluation manager class for APPSPACK.

The `APPSEvalMgr` class is derived from APPSPACK’s Executor class. It implements the methods of that class in such a way that allows DAKOTA to manage the computation of responses instead of APPS. Iterate and response values are passed between Dakota and APPSPACK via this interface.

13.7.2 **Constructor & Destructor Documentation**

```cpp
APPSEvalMgr ( Model & model )
```

Constructor

Evaluation manager class for APPSPACK.

The `APPSEvalMgr` class is derived from APPSPACK’s Executor class. It implements the methods of that class in such a way that allows DAKOTA to manage the computation of responses instead of APPS. Iterate and response values are passed between Dakota and APPSPACK via this interface.

13.7.3 **Member Function Documentation**

```cpp
bool isReadyForWork ( ) const
```

Tells APPS whether or not there is a processor available to perform a function evaluation.

Check to see if all processors available for function evaluations are being used. If not, tell APPS that one is available.

References `APPSEvalMgr::numWorkersTotal`, and `APPSEvalMgr::numWorkersUsed`.

```cpp
bool submit ( const int apps_tag, const HOPSPACK::Vector & apps_xtrial, const HOPSPACK::EvalRequestType apps_request )
```

Performs a function evaluation at APPS-provided \( x_{\text{in}} \).

Convert APPSPACK vector of variables to DAKOTA vector of variables and perform function evaluation asynchronously or not as specified in the DAKOTA input deck. If evaluation is asynchronous, map the dakota id to the APPS tag. If evaluation is synchronous, map the responses to the APPS tag.

References `Model::continuous_variable()`, `Model::current_response()`, `Model::cv()`, `Model::discrete_int_sets()`, `Model::discrete_int_variable()`, `Model::discrete_real_variable()`, `Model::discrete_set_int_values()`, `Model::discrete_set_real_values()`, `Model::discrete_set_string_values()`, `Model::discrete_string_variable()`, `Model::div()`, `Model::drv()`, `Model::dsv()`, `Model::evaluate()`, `Model::evaluate_nowait()`, `Model::evaluation_id()`, `Response::function_values()`, `APPSEvalMgr::functionList`, `APPSEvalMgr::iteratedModel`, `APPSEvalMgr::modelAsynchFlag`, `APPSEvalMgr::numWorkersTotal`, `APPSEvalMgr::numWorkersUsed`, `Dakota::set_index_to_value()`, and `APPSEvalMgr::tagList`.

```cpp
int recv ( int & apps_tag, HOPSPACK::Vector & apps_f, HOPSPACK::Vector & apps_cEqs, HOPSPACK::Vector & apps_cIneqs, string & apps_msg )
```

Returns a function value to APPS.

Retrieve a set of response values, convert to APPS data structures, and return them to APPS. APPS tags are tied to corresponding responses using the appropriate (i.e., asynchronous or synchronous) map.

References `APPSEvalMgr::blockingSynch`, `APPSEvalMgr::constrMapIndices`, `APPSEvalMgr::constrMapMultipliers`, `APPSEvalMgr::constrMapOffsets`, `APPSEvalMgr::dakotaResponseMap`, `APPSEvalMgr::functionList`, `APPSEvalMgr::iteratedModel`, `APPSEvalMgr::modelAsynchFlag`, `Model::num_nonlinear_eq_constraints()`, `APPSEvalMgr::numWorkersUsed`, `Model::primary_response_fn_sense()`, `Model::synchronize()`, `Model::synchronize_nowait()`, and `APPSEvalMgr::tagList`. 
The documentation for this class was generated from the following files:

- APPSEvalMgr.hpp
- APPSEvalMgr.cpp

### 13.8 APPSOptimizer Class Reference

Wrapper class for HOPSPACK.

Inheritance diagram for APPSOptimizer:

```
Iterator
     │
     │ Minimizer
     │     │
     │     │ Optimizer
        │
        APPSOptimizer
```

#### Public Member Functions

- **APPSOptimizer (ProblemDescDB &problem_db, Model &model)**
  
  *constructor*

- **APPSOptimizer (Model &model)**

  *alternate constructor for on-the-fly instantiation without ProblemDescDB*

- **~APPSOptimizer ()**

  *destructor*

- **void core_run ()**

  *compute the optimal solution*

#### Protected Member Functions

- **void set_apps_parameters ()**

  *sets options for specific methods based on user specifications*

- **void initialize_variables_and_constraints ()**

  *initializes problem variables and constraints*

#### Protected Attributes

- **int numTotalVars**

  *Total across all types of variables.*

- **HOPSPACK::ParameterList params**

  *Pointer to APPS parameter list.*

- **HOPSPACK::ParameterList * problemParams**
13.8. APPSOPTIMIZER CLASS REFERENCE

Pointer to APPS problem parameter sublist.
- HOPSPACK::ParameterList * linearParams
  Pointer to APPS linear constraint parameter sublist.
- HOPSPACK::ParameterList * mediatorParams
  Pointer to APPS mediator parameter sublist.
- HOPSPACK::ParameterList * citizenParams
  Pointer to APPS citizen/algorithm parameter sublist.
- APPSEvalMgr * evalMgr
  Pointer to the APPS evaluation manager object.
- std::vector<int> constraintMapIndices
  map from Dakota constraint number to APPS constraint number
- std::vector<double> constraintMapMultipliers
  multipliers for constraint transformations
- std::vector<double> constraintMapOffsets
  offsets for constraint transformations

Additional Inherited Members

13.8.1 Detailed Description

Wrapper class for HOPSPACK.

The APPSOptimizer class provides a wrapper for HOPSPACK, a Sandia-developed C++ library for general-
ized pattern search. HOPSPACK defaults to a coordinate pattern search but also allows for augmented search
patterns. It can solve problems with bounds, linear constraints, and general nonlinear constraints. APPSOptimizer
uses an APPSEvalMgr object to manage the function evaluations.

The user input mappings are as follows: output max_function_evaluations, constraint_tol
initial_delta, contraction_factor, threshold_delta, solution_target, synchronization,
merit_function, constraint_penalty, and smoothing_factor are mapped into HOPS's "Display",
"Maximum Evaluations", "Active Tolerance"/"Nonlinear Active Tolerance", "Initial Step", "Contraction Factor",
"Step Tolerance", "Objective Target", "Synchronous Evaluations", "Penalty Function", "Penalty Parameter", and
"Penalty Smoothing Value" data attributes. Refer to the HOPS web site (https://software.sandia.
gov/trac/hopspack) for additional information on HOPS objects and controls.

13.8.2 Member Function Documentation

void core_run() [virtual]

compute the optimal solution

core_run redefines the Optimizer virtual function to perform the optimization using HOPS. It first sets up the
problem data, then executes minimize() on the HOPS optimizer, and finally catalogues the results.
Reimplemented from Iterator.

References Model::asynch_flag(), Iterator::bestResponseArray, Iterator::bestVariablesArray, APPSOptimizer::
constraintMapIndices, APPSOptimizer::constraintMapMultipliers, APPSOptimizer::constraintMapOffsets, Model-
::discrete_int_sets(), Model::discrete_set_int_values(), Model::discrete_set_real_values(), Model::discrete_set_string-
_values(), APPSOptimizer::evalMgr, Model::evaluation_capacity(), APPSOptimizer::initialize_variables_and_constraints(),
void set_apps_parameters() [protected]

sets options for specific methods based on user specifications

Set all of the HOPS algorithmic parameters as specified in the DAKOTA input deck. This is called at construction time.

References APPSOptimizer::citizenParams, Minimizer::constraintTol, APPSOptimizer::evalMgr, ProblemDescDB::get_real(), ProblemDescDB::get_string(), ProblemDescDB::is_null(), APPSOptimizer::linearParams, Iterator::maxEvalConcurrency, Iterator::maxFunctionEvals, APPSOptimizer::mediatorParams, Minimizer::numContinuousVars, Minimizer::numNonlinearConstraints, Model::primary_response_fn::sense(), APPSEvalMgr::set_async_flag(), Dakota::set_index_to_value(), and APPSEvalMgr::set_total_workers().

Referenced by APPSOptimizer::APPSOptimizer().

void initialize_variables_and_constraints() [protected]

initializes problem variables and constraints

Set the variables and constraints as specified in the DAKOTA input deck. This is done at run time.

References Dakota::NPOS, Dakota::abort_handler(), Minimizer::bigIntBoundSize, Minimizer::bigRealBoundSize, APPSOptimizer::constraintMapIndices, APPSOptimizer::constraintMapMultipliers, APPSOptimizer::constraintMapOffsets, Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::continuous_variables(), Model::discrete_int_lower_bounds(), Model::discrete_int_sets(), Model::discrete_int_upper_bounds(), Model::discrete_int_variables(), Model::discrete_real_lower_bounds(), Model::discrete_real_upper_bounds(), Model::discrete_string_variables(), APPSOptimizer::evalMgr, Iterator::iteratedModel, Model::linear_eq_constraint_coeffs(), Model::linear_eq_constraint_targets(), Model::linear_ineq_constraint_coeffs(), Model::linear_ineq_constraint_lower_bounds(), Model::linear_ineq_constraint_upper_bounds(), APPSOptimizer::linearParams, Model::nonlinear_eq_constraint_targets(), Model::nonlinear_ineq_constraint_lower_bounds(), Model::nonlinear_ineq_constraint_upper_bounds(), Minimizer::numContinuousVars, Minimizer::numDiscreteIntVars, Minimizer::numDiscreteRealVars, Minimizer::numDiscreteStringVars, Minimizer::numLinearEqConstraints, Minimizer::numLinearIneqConstraints, Minimizer::numNonlinearEqConstraints, Minimizer::numNonlinearIneqConstraints, APPSOptimizer::numTotalVars, APPSOptimizer::problemParams, APPSEvalMgr::set_constraint_map(), and Dakota::set_value_to_index().

Referenced by APPSOptimizer::core_run().

The documentation for this class was generated from the following files:

- APPSOptimizer.hpp
- APPSOptimizer.cpp

13.9 ApreproWriter Class Reference

Utility used in derived write_core to write in aprepro format.
Public Member Functions

- template<typename ArrayType>
  void operator() (std::ostream &s, size_t start_index, size_t num_items, const ArrayType &array_data, StringMultiArrayConstView label_array)

13.9.1 Detailed Description

Utility used in derived write_core to write in aprepro format.

The documentation for this class was generated from the following file:

- DakotaVariables.hpp

13.10 BaseConstructor Struct Reference

Dummy struct for overloading letter-envelope constructors.

Public Member Functions

- BaseConstructor (int=0)

  C++ structs can have constructors.

13.10.1 Detailed Description

Dummy struct for overloading letter-envelope constructors.

BaseConstructor is used to overload the constructor for the base class portion of letter objects. It avoids infinite recursion (Coplien p.139) in the letter-envelope idiom by preventing the letter from instantiating another envelope. Putting this struct here avoids circular dependencies.

The documentation for this struct was generated from the following file:

- dakota_global_defs.hpp

13.11 BootstrapSampler< Data > Class Template Reference

Actual bootstrap sampler implementation for common data types.

Inheritance diagram for BootstrapSampler< Data >:

```
BootstrapSamplerBase< Data >

BootstrapSampler< Data >

BootstrapSamplerWithGS< Data, Getter, Setter >
```
CHAPTER 13. CLASS DOCUMENTATION

Public Member Functions

- BootstrapSampler (const Data &orig_data, size_t blockSize=1)
  Constructor for the sampler.
- virtual ~BootstrapSampler ()
  Destructor.
- virtual void operator() (size_t num_samp, Data &bootstrapped_sample)

Protected Attributes

- size_t blockSize
  Size of the block defining a sample.

Additional Inherited Members

13.11.1 Detailed Description

template<typename Data>
class Dakota::BootstrapSampler<Data>

Actual bootstrap sampler implementation for common data types.
Template requires the given type to support an STL-like interface, including a size method and begin and end methods returning random access iterators.

13.11.2 Member Function Documentation

virtual void operator() ( size_t num_samp, Data &bootstrapped_sample ) [inline],[virtual]

Implements BootstrapSamplerBase<Data>.
Reimplemented in BootstrapSamplerWithGS<Data, Getter, Setter>.
References BootstrapSampler<Data>::blockSize, BootstrapSamplerBase<Data>::bootstrapRNG, BootstrapSamplerBase<Data>::origData, and BootstrapSamplerBase<Data>::sampler.

The documentation for this class was generated from the following file:

- BootstrapSampler.hpp

13.12 BootstrapSampler<Teuchos::SerialDenseMatrix<OrdinalType, ScalarType>> Class Template Reference

Bootstrap sampler that is specialized to allow for the bootstrapping of RealMatrix.

Inheritance diagram for BootstrapSampler<Teuchos::SerialDenseMatrix<OrdinalType, ScalarType>>:

BootstrapSampler<Teuchos::SerialDenseMatrix<OrdinalType, ScalarType>>
13.13. **BOOTSTRAPSMPLRBASE< DATA > CLASS TEMPLATE REFERENCE**

**Public Types**

- typedef Teuchos::SerialDenseMatrix<OrdinalType, ScalarType> MatType
  
  Convenience definition.

**Public Member Functions**

- **BootstrapSampler** (const MatType &orig_data, size_t block_size=1)
  
  Constructor for the sampler.

- virtual ~BootstrapSampler ()
  
  Destructor.

- virtual void operator() (size_t num_samp, MatType &bootstrapped_sample)

**Protected Attributes**

- size_t blockSize
  
  Size of the block defining a sample.

**Additional Inherited Members**

**13.12.1 Detailed Description**

template<typename OrdinalType, typename ScalarType>

class Dakota::BootstrapSampler<Teuchos::SerialDenseMatrix<OrdinalType, ScalarType> >

Bootstrap sampler that is specialized to allow for the bootstrapping of RealMatrix.

**13.12.2 Member Function Documentation**

virtual void operator() ( size_t num_samp, MatType &bootstrapped_sample ) [inline], [virtual]

Implements BootstrapSamplerBase<Teuchos::SerialDenseMatrix<OrdinalType, ScalarType> >.

References BootstrapSampler< Data >::blockSize, BootstrapSamplerBase< Data >::bootstrapRNG, BootstrapSamplerBase< Data >::origData, and BootstrapSamplerBase< Data >::sampler.

The documentation for this class was generated from the following file:

- BootstrapSampler.hpp

**13.13 BOOTSTRAPSMPLRBASE< DATA > Class Template Reference**

Base class/interface for the bootstrap sampler.

Inheritance diagram for BootstrapSamplerBase< Data >:
Public Member Functions

- **BootstrapSamplerBase** (size_t data_size, Data orig_data)

  Constructor for the bootstrap functor base.

- virtual **~BootstrapSamplerBase** ()

  Destructor.

- virtual void operator() (size_t num_samp, Data &bootstrapped_sample)=0

  Generate and store a new bootstrapped sample into bootstrapped_sample.

- virtual size_t getDataSize ()

  Obtain the number of samples used in the empirical distribution.

- virtual void operator() (Data &bootstrapped_sample)

  Generate and store an dataSize out of dataSize bootstrap sample.

- virtual Data operator() ()

  Return bootstrapped sample.

Static Public Member Functions

- static void **set_seed** (size_t seed)

Protected Attributes

- **boost::random::uniform_int_distribution** sampler

  Uniform distribution to provide samples from the empirical distribution.

- const size_t **dataSize**

  Size of the dataset defining the empirical distribution.

- Data **origData**

  Original data defining the empirical distribution TODO: Consider if it should be const (breaks Teuchos)

Static Protected Attributes

- static **boost::random::mt19937** bootstrapRNG

  Random number generator to use for sampling.

13.13.1 Detailed Description

template<typename Data> class Dakota::BootstrapSamplerBase< Data >

Base class/interface for the bootstrap sampler.

BootstrapSamplerBase defines the minimum interface for a bootstrap sampler and handles initialization of the
random variate generation used by the bootstrap. Functor is templated on the data type, but does not actually
define a data member.

13.13.2 Member Data Documentation

boost::random::mt19937 bootstrapRNG [static], [protected]

Random number generator to use for sampling.

The bootstrapping random number generator.

Referenced by BootstrapSampler< Data >::operator(), BootstrapSampler< Teuchos::SerialDenseMatrix<
OrdinalType, ScalarType > >::operator(), and BootstrapSamplerWithGS< Data, Getter, Setter >::operator().

The documentation for this class was generated from the following file:

• BootstrapSampler.hpp

13.14 BootstrapSamplerWithGS< Data, Getter, Setter > Class Template Reference

A derived sampler to allow for user specification of the accessor methods.

Inheritance diagram for BootstrapSamplerWithGS< Data, Getter, Setter >:

```
BootstrapSamplerBase< Data >
|
BootstrapSampler< Data >
|
BootstrapSamplerWithGS< Data, Getter, Setter >
```

Public Member Functions

• BootstrapSamplerWithGS (const Data &orig_data, Getter getter_method, Setter setter_method)
  Constructor with extra arguments for the accessor methods.

• virtual ~BootstrapSamplerWithGS ()
  Destructor.

• virtual void operator() (size_t num_samp, Data &bootstrapped_sample)
  Generate and store a new bootstrapped sample into bootstrapped_sample TODO: bounds checking.
Protected Attributes

• Getter `getterMethod`
  
  Function to obtain a single sample from a Data object. Function should take a Data object and an unsigned integer corresponding to a sample index and return the sample.

• Setter `setterMethod`
  
  Function to place a single sample into a Data object. Function should take a Data object and an unsigned integer corresponding to the sample index to set.

Additional Inherited Members

13.14.1 Detailed Description

template<typename Data, typename Getter, typename Setter> class Dakota::BootstrapSamplerWithGS<Data, Getter, Setter>

A derived sampler to allow for user specification of the accessor methods.

The documentation for this class was generated from the following file:

• BootstrapSampler.hpp

13.15 `callback_data` Struct Reference

Public Attributes

• double `rosen_cdv_upper_bd`
  
  upper bound value to pass through parser to callback function

13.15.1 Detailed Description

Data structure to pass application-specific values through Dakota back to the callback function, for example to convey late updates to bounds, initial points, etc., to Dakota.

The documentation for this struct was generated from the following file:

• library_mode.cpp

13.16 `COLINApplication` Class Reference

Inherits Application< colin::MO_MINLP2::problem >.

Public Member Functions

• `COLINApplication()`
  
  Default constructor. Required by COLIN’s ApplicationHandle creation.

  • `COLINApplication(Model &model)`
    
    Constructor with Model (not presently used).

• `~COLINApplication()`
  
  Destructor.

• `void set_problem(Model &model)`
13.16. COLINAPPLICATION CLASS REFERENCE

Helper function called after default construction to extract problem information from the Model and set it for COLIN.

- void set_blocking_synch (const bool blockingSynchFlag)
  
  publishes whether or not COLIN is operating synchronously

- virtual utilib::Any spawn_evaluation_impl (const utilib::Any &domain, const colin::AppRequest::request_map_t &requests, utilib::seed_t &seed)

  Schedule one or more requests at specified domain point, returning a DAKOTA-specific evaluation tracking ID.

- virtual bool evaluation_available ()
  
  Check to see if there are any function values ready to be collected.

- virtual void perform_evaluation_impl (const utilib::Any &domain, const colin::AppRequest::request_map_t &requests, utilib::seed_t &seed, colin::AppResponse::response_map_t &colin_responses)

  Perform a function evaluation at t given point.

- virtual utilib::Any collect_evaluation_impl (colin::AppResponse::response_map_t &responses, utilib::seed_t &seed)

  Collect a completed evaluation from DAKOTA.

- virtual void colin_request_to_dakota_request (const utilib::Any &domain, const colin::AppRequest::request_map_t &requests, utilib::seed_t &seed)

  Helper function to convert evaluation request data from COLIN structures to DAKOTA structures.

- virtual void dakota_response_to_colin_response (const Response &dakota_response, colin::AppResponse::response_map_t &colin_responses)

  Helper function to convert evaluation response data from DAKOTA structures to COLIN structures.

- virtual bool map_domain (const utilib::Any &src, utilib::Any &native, bool forward=true) const

  Map the domain point into data type desired by this application context.

Protected Attributes

- Model iteratedModel

  Shallow copy of the model on which COLIN will iterate.

- bool blockingSynch

  Flag for COLIN synchronous behavior (Pattern Search only).

- ActiveSet activeSet

  Local copy of model’s active set for convenience.

- std::vector< int > requestedEvals

  Evaluations queued for async evaluation.

- IntResponseMap dakota_responses

  eval_id to response mapping to cache completed jobs.

13.16.1 Detailed Description

COLINApplication is a DAKOTA class that is derived from COLIN’s Application hierarchy. It redefines a variety of virtual COLIN functions to use the corresponding DAKOTA functions. This is a more flexible algorithm library interfacing approach than can be obtained with the function pointer approaches used by NPSOLOptimizer and SNLLOptimizer.
13.16.2 Member Function Documentation

void set_problem ( Model & model )

Helper function called after default construction to extract problem information from the Model and set it for COLIN.

Set variable bounds and linear and nonlinear constraints. This avoids using probDescDB, so it is called by both the standard and the on-the-fly COLINOptimizer constructors.

References Response::active_set(), COLINApplication::activeSet, Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::current_response(), Model::cv(), Model::discrete_int_lower_bounds(), Model::discrete_int_sets(), Model::discrete_int_upper_bounds(), Model::discrete_set_int_values(), Model::discrete_set_real_values(), Model::discrete_set_string_values(), Model::div(), Model::drv(), Model::dsv(), COLINApplication::iteratedModel, Model::linear_eq_constraint_coeffs(), Model::linear_eq_constraint_targets(), Model::linear_ineq_constraint_coeffs(), Model::linear_ineq_constraint_lower_bounds(), Model::linear_ineq_constraint_upper_bounds(), Model::nonlinear_eq_constraint_targets(), Model::nonlinear_ineq_constraint_lower_bounds(), Model::nonlinear_ineq_constraint_upper_bounds(), Model::num_functions(), Model::num_linear_eq_constraints(), Model::num_linear_ineq_constraints(), Model::num_nonlinear_eq_constraints(), Model::num_nonlinear_ineq_constraints(), and Model::primary_response_fn_sense().

Referenced by COLINApplication::COLINApplication().

utilib::Any spawn_evaluation_impl ( const utilib::Any & domain, const colin::AppRequest::request_map_t & requests, utilib::seed_t & seed ) [virtual]

Schedule one or more requests at specified domain point, returning a DAKOTA-specific evaluation tracking ID.

Schedule one or more requests at specified domain point, returning a DAKOTA-specific evaluation tracking ID. This is only called by COLIN’s concurrent evaluator, which is only instantiated when the Model supports asynch evals. The domain point is guaranteed to be compatible with data type specified by map_domain(...).

References COLINApplication::colin_request_to_dakota_request(), Model::evaluate_nowait(), Model::evaluation_id(), and COLINApplication::iteratedModel.

bool evaluation_available ( ) [virtual]

Check to see if there are any function values ready to be collected.

Check to see if any asynchronous evaluations have finished. This is only called by COLIN’s concurrent evaluator, which is only instantiated when the Model supports asynch evals.

References COLINApplication::blockingSynch, COLINApplication::dakota_responses, COLINApplication::iteratedModel, Model::synchronize(), and Model::synchronize_nowait().

void perform_evaluation_impl ( const utilib::Any & domain, const colin::AppRequest::request_map_t & requests, utilib::seed_t & seed, colin::AppResponse::response_map_t & colin_responses ) [virtual]

Perform a function evaluation at t given point.

Perform an evaluation at a specified domain point. Wait for and return the response. This is only called by COLIN’s serial evaluator, which is only instantiated when the Model does not support asynch evals. The domain point is guaranteed to be compatible with data type specified by map_domain(...).

References COLINApplication::colin_request_to_dakota_request(), Model::current_response(), COLINApplication::dakota_response_to_colin_response(), Model::evaluate(), and COLINApplication::iteratedModel.
**utilib::Any collect_evaluation_impl ( colin::AppResponse::response_map_t & colin_responses, utilib::seed_t & seed ) [virtual]**

Collect a completed evaluation from DAKOTA.

Collect the next completed evaluation from DAKOTA. Always returns the eval of the response returned.

References COLINApplication::dakota_response_to_colin_response(), and COLINApplication::dakota_responses.

**void colin_request_to_dakota_request ( const utilib::Any & domain, const colin::AppRequest::request_map_t & requests, utilib::seed_t & seed ) [virtual]**

Helper function to convert evaluation request data from COLIN structures to DAKOTA structures.

Map COLIN info requests to DAKOTA objectives and constraints.

References Model::continuous_variables(), Model::discrete_int_sets(), Model::discrete_int_variable(), Model::discrete_real_variable(), Model::discrete_set_int_values(), Model::discrete_set_real_values(), Model::discrete_set_string_values(), Model::discrete_string_variable(), Model::div(), Model::drv(), Model::dsv(), COLINApplication::iteratedModel, Model::num_functions(), and Dakota::set_index_to_value().

Referenced by COLINApplication::perform_evaluation_impl(), and COLINApplication::spawn_evaluation_impl().

**void dakota_response_to_colin_response ( const Response & dakota_response, colin::AppResponse::response_map_t & colin_responses ) [virtual]**

Helper function to convert evaluation response data from DAKOTA structures to COLIN structures.

Map DAKOTA objective and constraint values to COLIN response.

References Response::active_set_request_vector(), and Response::function_value().

Referenced by COLINApplication::collect_evaluation_impl(), and COLINApplication::perform_evaluation_impl().

**bool map_domain ( const utilib::Any & src, utilib::Any & native, bool forward = true ) const [virtual]**

Map the domain point into data type desired by this application context.

Map the domain point into data type desired by this application context (utilib::MixedIntVars). This data type can be exposed from the Any &domain presented to spawn and collect.

The documentation for this class was generated from the following files:

- COLINApplication.hpp
- COLINApplication.cpp

## 13.17 COLINOptimizer Class Reference

Wrapper class for optimizers defined using COLIN.

Inheritance diagram for COLINOptimizer:
CHAPTER 13. CLASS DOCUMENTATION

Public Member Functions

- **COLINOptimizer (ProblemDescDB &problem_db, Model &model)**
  *standard constructor*
- **COLINOptimizer (const String &method_name, Model &model, int seed, int max_iter, int max_eval)**
  *alternate constructor for on-the-fly instantiations*
- **COLINOptimizer (const String &method_name, Model &model)**
  *alternate constructor for Iterator instantiations by name*
- **~COLINOptimizer ()**
  *destructor*
- **void reset ()**
  *clears internal optimizer state*
- **void core_run ()**
  *iterates the COLIN solver to determine the optimal solution*
- **bool returns_multiple_points () const**
  *some COLIN methods can return multiple points*

Protected Member Functions

- **void solver_setup (unsigned short method_name)**
  *convenience function for setting up the particular COLIN solver and appropriate Application*
- **void set_rng (int seed)**
  *sets up the random number generator for stochastic methods*
- **void set_solver_parameters ()**
  *sets construct-time options for specific methods based on user specifications, including calling method-specific set functions*
- **void post_run (std::ostream &s)**
  *Get the final set of points from the solver Look up responses and sort, first according to constraint violation, then according to function value.*
- **std::pair<bool, bool> colin_cache_lookup (const colin::AppResponse &colinResponse, Response &tmpResponseHolder)**
  *Retrieve response from Colin AppResponse, return pair indicating success for <objective, constraints>*
- **double constraint_violation (const Response &tmpResponseHolder)**
  *Compute constraint violation, based on nonlinear constraints in iteratedModel and provided Response data.*
13.17. COLINOPTIMIZER CLASS REFERENCE

Protected Attributes

- short solverType
  COLIN solver sub-type as enumerated in COLINOptimizer.cpp.
- colin::SolverHandle colinSolver
  handle to the COLIN solver
- std::pair<colin::ApplicationHandle, COLIN::COLINApplication *> colinProblem
  handle and pointer to the COLINApplication object
- colin::EvaluationManager_Base * colinEvalMgr
  pointer to the COLIN evaluation manager object
- utilib::RNG * rng
  random number generator pointer
- bool blockingSynch
  the synchronization setting: true if blocking, false if nonblocking
- Real constraint_penalty
  Buffer to hold problem constraint_penalty parameter.
- bool constant_penalty
  Buffer to hold problem constant_penalty parameter.

Additional Inherited Members

13.17.1 Detailed Description

Wrapper class for optimizers defined using COLIN.

The COLINOPTIMIZER class wraps COLIN, a Sandia-developed C++ optimization interface library. A variety of COLIN optimizers are defined in COLIN and its associated libraries, including SCOLIB which contains the optimization components from the old COLINY (formerly SGOPT) library. COLIN contains optimizers such as genetic algorithms, pattern search methods, and other nongradient-based techniques. COLINOPTIMIZER uses a COLINApplication object to perform the function evaluations.

The user input mappings are as follows: max_iterations, max_function_evaluations, convergence_tolerance, and solution_accuracy are mapped into COLIN’s max_iterations, max_function_evaluations, this_trial, function_value_tolerance, sufficient_objective_value properties. An outputLevel is mapped to COLIN’s output_level property and a setting of debug activates output of method initialization and sets the COLIN debug attribute to 10000 for the DEBUG output level. Refer to [Hart, W.E., 2006] for additional information on COLIN objects and controls.

13.17.2 Constructor & Destructor Documentation

COLINOPTIMIZER ( ProblemDescDB & problem_db, Model & model )

standard constructor

Standard constructor.

References ProblemDescDB::get_int(), ProblemDescDB::get_ushort(), Iterator::probDescDB, COLINOPTIMIZER::set_rng(), COLINOPTIMIZER::set_solver_parameters(), and COLINOPTIMIZER::solver_setup().
CHAPTER 13. CLASS DOCUMENTATION

COLINOptimizer ( const String & method_name, Model & model, int seed, int max_iter, int max_eval )
alternate constructor for on-the-fly instantiations
  Alternate constructor for on-the-fly instantiations.
  References Iterator::maxFunctionEvals, Iterator::maxIterations, Iterator::method_string_to_enum(), COLINOptimizer::set_rng(), COLINOptimizer::set_solver_parameters(), and COLINOptimizer::solver_setup().

COLINOptimizer ( const String & method_name, Model & model )
alternate constructor for Iterator instantiations by name
  Alternate constructor for Iterator instantiations by name.
  References Iterator::method_string_to_enum(), COLINOptimizer::set_solver_parameters(), and COLINOptimizer::solver_setup().

13.17.3 Member Function Documentation

void core_run ( ) [virtual]
iterates the COLIN solver to determine the optimal solution
  core_run redefines the Optimizer virtual function to perform the optimization using COLIN. It first sets up the problem data, then executes optimize() on the COLIN solver and finally catalogues the results.
  Reimplemented from Iterator.
  References Dakota::NPOS, Dakota::abort_handler(), Model::async_flag(), COLINOptimizer::blockingSynch, COLINOptimizer::colinEvalMgr, COLINOptimizer::colinProblem, COLINOptimizer::colinSolver, COLINOptimizer::constant_penalty, COLINOptimizer::constraint_penalty, Model::continuous_variables(), Model::discrete_int_sets(), Model::discrete_int_variables(), Model::discrete_real_variables(), Model::discrete_set_int_values(), Model::discrete_set_real_values(), Model::discrete_set_string_values(), Model::discrete_string_variables(), Model::evaluation_capacity(), Iterator::iteratedModel, Minimizer::numDiscreteIntVars, Minimizer::numDiscreteRealVars, Minimizer::numDiscreteStringVars, Iterator::outputLevel, Dakota::set_value_to_index(), and COLINOptimizer::solverType.

bool returns_multiple_points ( ) const [virtual]
some COLIN methods can return multiple points
  Designate which solvers can return multiple final points.
  Reimplemented from Iterator.
  References COLINOptimizer::solverType.

void solver_setup ( unsigned short method_name ) [protected]
convenience function for setting up the particular COLIN solver and appropriate Application
  This convenience function is called by the constructors in order to instantiate the solver.
  References COLINOptimizer::colinProblem, COLINOptimizer::colinSolver, COLINOptimizer::constant_penalty, COLINOptimizer::constraint_penalty, ProblemDescDB::get_string(), Iterator::method_enum_to_string(), Iterator::probDescDB, and COLINOptimizer::solverType.
  Referenced by COLINOptimizer::COLINOptimizer().

void set_rng ( int seed ) [protected]
sets up the random number generator for stochastic methods
  Instantiate random number generator (RNG).
  References COLINOptimizer::colinSolver, and COLINOptimizer::rng.
  Referenced by COLINOptimizer::COLINOptimizer().
void set_solver_parameters()

[protected]

sets construct-time options for specific methods based on user specifications, including calling method-specific
set functions.

Sets solver properties based on user specifications. Called at construction time.

References:
Model::asynch_flag(), COLINOptimizer::blockingSynchron, COLINOptimizer::colinSolver, COLINOptimizer::constant_penalty, COLINOptimizer::constraint_penalty, Iterator::convergenceTol, ProblemDescDB::get_bool(), ProblemDescDB::get_int(), ProblemDescDB::get_real(), ProblemDescDB::get_sa(), ProblemDescDB::get_string(), ProblemDescDB::is_null(), Iterator::iteratedModel, Iterator::maxEvalConcurrency, Iterator::maxFunctionEvals, Iterator::maxIterations, Minimizer::numContinuousVars, Iterator::outputLevel, Iterator::probDescDB, and COLINOptimizer::solverType.

Referenced by COLINOptimizer::COLINOptimizer().

void post_run ( std::ostream & s )

[protected], [virtual]

Get the final set of points from the solver. Look up responses and sort, first according to constraint violation, then
according to function value.

Supplement Optimizer::post_run to first retrieve points from the Colin cache (or possibly the Dakota DB) and rank them. When complete, this function will populate bestVariablesArray and bestResponsesArray with iterator-space data, that is, in the context of the solver, leaving any further untransformation to Optimizer.

Reimplemented from Iterator.

References:
Iterator::bestResponseArray, Iterator::bestVariablesArray, COLINOptimizer::colin_cache_lookup(), COLINOptimizer::colinProblem, COLINOptimizer::colinSolver, COLINOptimizer::constraint_violation(), Variables::continuous_variables(), Response::copy(), Variables::copy(), Model::current_response(), Model::current_variables(), Model::discrete_int_sets(), Variables::discrete_int_variable(), Variables::discrete_real_variable(), Model::discrete_set_int_values(), Model::discrete_set_real_values(), Model::discrete_set_string_values(), Variables::discrete_string_variable(), Response::function_values(), Iterator::iteratedModel, Optimizer::localObjectiveRecast, Minimizer::numDiscreteIntVars, Minimizer::numDiscreteRealVars, Minimizer::numDiscreteStringVars, Iterator::numFinalSolutions, Optimizer::numObjectiveFns, Minimizer::objective(), Optimizer::post_run(), Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), Minimizer::resize_best Resp_array(), Minimizer::resize_best_vars_array(), Dakota::set_index_to_value(), and Model::subordinate_model().

std::pair<bool, bool> colin_cache_lookup ( const colin::AppResponse & colinResponse, Response & tmpResponseHolder)

[protected]

Retrieve response from Colin AppResponse, return pair indicating success for <objective, constraints>.

Encapsulated Colin Cache response extraction, which will ultimately become the default lookup. Might want to return separate vectors of function values and constraints for use in the sort, but not for now (least change). Return true if not needed or successful lookup.

References:
Response::function_value(), Minimizer::numNonlinearConstraints, and Optimizer::numObjectiveFns.

Referenced by COLINOptimizer::post_run().

double constraint_violation ( const Response & tmpResponseHolder)

[protected]

Compute constraint violation, based on nonlinear constraints in iteratedModel and provided Response data.

BMA TODO: incorporate constraint tolerance, possibly via elevating SurrBasedMinimizer::constraint_violation(). Always use iteratedModel to get the constraints; they are in the right space.

References:
Response::function_value(), Iterator::iteratedModel, Model::nonlinear_eq_constraint_targets(), Model::nonlinear_ineq_constraint_lower_bounds(), Model::nonlinear_ineq_constraint_upper_bounds(), Model::num_nonlinear_eq_constraints(), Model::num_nonlinear_ineq_constraints(), and Minimizer::numIterPrimaryFns.
Referenced by COLINOptimizer::post_run().
The documentation for this class was generated from the following files:

- COLINOptimizer.hpp
- COLINOptimizer.cpp

### 13.18 CollabHybridMetaIterator Class Reference

Meta-iterator for hybrid iteration using multiple collaborating optimization and nonlinear least squares methods. Inheritance diagram for CollabHybridMetaIterator:

```
CollabHybridMetaIterator
  |          |
  |          |
  MetaIterator
  |          |
  Iterator
```

#### Public Member Functions

- **CollabHybridMetaIterator** (ProblemDescDB &problem_db)
  
  *standard constructor*

- **CollabHybridMetaIterator** (ProblemDescDB &problem_db, Model &model)
  
  *alternate constructor*

- **~CollabHybridMetaIterator** ()
  
  *destructor*

#### Protected Member Functions

- void **core_run** ()
  
  *Performs the collaborative hybrid iteration.*

- void **derived_init_communicators** (ParLevLIter pl_iter)
  
  *derived class contributions to initializing the communicators associated with this Iterator instance*

- void **derived_set_communicators** (ParLevLIter pl_iter)
  
  *derived class contributions to setting the communicators associated with this Iterator instance*

- void **derived_free_communicators** (ParLevLIter pl_iter)
  
  *derived class contributions to freeing the communicators associated with this Iterator instance*

- IntIntPair **estimate_partition_bounds** ()
  
  *estimate the minimum and maximum partition sizes that can be utilized by this Iterator*

- const Variables & **variables_results** () const
  
  *return the final solution from the collaborative iteration (variables)*

- const Response & **response_results** () const
  
  *return the final solution from the collaborative iteration (response)*
Private Attributes

- String hybridCollabType
  *abo or hops*
- StringArray methodList
  *the list of method name identifiers*
- bool lightwtCtor
  *use of lightweight Iterator construction by name*
- IteratorArray selectedIterators
  *the set of iterators, one for each entry in methodList*
- ModelArray selectedModels
  *the set of models, one for each iterator*
- Variables bestVariables
  *best variables found in collaborative iteration*
- Response bestResponse
  *best response found in collaborative iteration*

Additional Inherited Members

13.18.1 Detailed Description

Meta-iterator for hybrid iteration using multiple collaborating optimization and nonlinear least squares methods.
This meta-iterator has two approaches to hybrid iteration: (1) agent-based using the ABO framework; (2) nonagent-based using the HOPSPACK framework.
The documentation for this class was generated from the following files:

- CollabHybridMetaIterator.hpp
- CollabHybridMetaIterator.cpp

13.19 CommandLineHandler Class Reference

Utility class for managing command line inputs to DAKOTA.
Inheritance diagram for CommandLineHandler:

```
CommandLineHandler
  |_____________________________
  | GetLongOpt
  v
CommandLineHandler
```

Public Member Functions

- CommandLineHandler ()
  *default constructor, requires check_usage() call for parsing*
- CommandLineHandler (int argc, char **argv, int world_rank)
  *constructor with parsing*
• ~CommandLineHandler ()
  destructor
• void check_usage (int argc, char **argv)
  Verifies that DAKOTA is called with the correct command usage. Prints a descriptive message and exits the program if incorrect.
• int read_restart_evals () const
  Returns the number of evaluations to be read from the restart file (as specified on the DAKOTA command line) as an integer instead of a const char*.
• void usage (std::ostream &outfile=Cout) const
  Print usage information to outfile, conditionally on rank.

Private Member Functions

• void initialize_options ()
  enrolls the supported command line inputs.
• void output_helper (const std::string &message, std::ostream &os) const
  output only on Dakota worldRank 0 if possible

Private Attributes

• int worldRank
  Rank of this process within Dakota’s allocation; manages conditional output.

Additional Inherited Members

13.19.1 Detailed Description
Utility class for managing command line inputs to DAKOTA.
CommandLineHandler provides additional functionality that is specific to DAKOTA’s needs for the definition and parsing of command line options. Inheritance is used to allow the class to have all the functionality of the base class, GetLongOpt.

13.19.2 Member Function Documentation

void output_helper ( const std::string & message, std::ostream & os ) const [private]
  output only on Dakota worldRank 0 if possible
  When there is a valid ParallelLibrary, output only on rank 0
  References CommandLineHandler::worldRank.
  Referenced by CommandLineHandler::check_usage().
  The documentation for this class was generated from the following files:

• CommandLineHandler.hpp
• CommandLineHandler.cpp

13.20 CommandShell Class Reference
Utility class which defines convenience operators for spawning processes with system calls.
Public Member Functions

- **CommandShell ()**
  - *constructor*
- **~CommandShell ()**
  - *destructor*
- **CommandShell & operator<< (const char *cmd)**
  - *appends cmd to sysCommand*
- **CommandShell & operator<< (const std::string &cmd)**
  - *convenient operator: appends string to the commandString to be executed*
- **CommandShell & operator<< (CommandShell &(*f)(CommandShell &))**
  - *allows passing of the flush function to the shell using <<*
- **CommandShell & flush ()**
  - "flushes" the shell; i.e. executes the sysCommand
- **void asynch_flag (const bool flag)**
  - *set the asynchFlag*
- **bool asynch_flag () const**
  - *get the asynchFlag*
- **void suppress_output_flag (const bool flag)**
  - *set the suppressOutputFlag*
- **bool suppress_output_flag () const**
  - *get the suppressOutputFlag*

Private Attributes

- **std::string sysCommand**
  - *The command string that is constructed through one or more ""insertions and then executed by flush.*
- **bool asynchFlag**
  - *flags nonblocking operation (background system calls)*
- **bool suppressOutputFlag**
  - *flags suppression of shell output (no command echo)*

13.20.1 Detailed Description

Utility class which defines convenience operators for spawning processes with system calls.

The **CommandShell** class wraps the C system() utility and defines convenience operators for building a command string and then passing it to the shell.

13.20.2 Member Function Documentation

**CommandShell & operator<< ( const char * cmd ) [inline]**

- *appends cmd to sysCommand*
  - *convenient operator: appends string to the commandString to be executed*
  - *References CommandShell::sysCommand.*
CommandShell & operator<<( CommandShell &(*)(CommandShell &)*f ) [inline]

allows passing of the flush function to the shell using <<
    convenience operator: allows passing of the flush func to the shell via <<

CommandShell & flush()

"flushes" the shell; i.e. executes the sysCommand
    Executes the sysCommand by passing it to system(). Appends an "&" if asynchFlag is set (background system call) and echos the sysCommand to Cout if suppressOutputFlag is not set.
    References Dakota::abort_handler(), CommandShell::asynchFlag, CommandShell::suppressOutputFlag, and CommandShell::sysCommand.
    Referenced by Dakota::flush().
    The documentation for this class was generated from the following files:
    • CommandShell.hpp
    • CommandShell.cpp

13.21 ConcurrentMetaIterator Class Reference

Meta-iterator for multi-start iteration or pareto set optimization.
    Inheritance diagram for ConcurrentMetaIterator:

    Iterator
    |___ MetaIterator
    |___ ConcurrentMetaIterator

Public Member Functions

- ConcurrentMetaIterator (ProblemDescDB &problem_db)
  standard constructor
- ConcurrentMetaIterator (ProblemDescDB &problem_db, Model &model)
  alternate constructor
- ~ConcurrentMetaIterator ()
  destructor

Protected Member Functions

- void pre_run ()
  pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori
- void core_run ()
  Performs the concurrent iteration by executing selectedIterator on iteratedModel multiple times in parallel for different parameter sets.
void print_results (std::ostream &s)
    print the final iterator results

void derived_init_communicators (ParLevLIter pl_iter)
    derived class contributions to initializing the communicators associated with this Iterator instance

void derived_set_communicators (ParLevLIter pl_iter)
    derived class contributions to setting the communicators associated with this Iterator instance

void derived_free_communicators (ParLevLIter pl_iter)
    derived class contributions to freeing the communicators associated with this Iterator instance

IntIntPair estimate_partition_bounds ()
    estimate the minimum and maximum partition sizes that can be utilized by this Iterator

void initialize_iterator (int job_index)
    used by IteratorScheduler to set the starting data for a run

void pack_parameters_buffer (MPIPackBuffer &send_buffer, int job_index)
    used by IteratorScheduler to pack starting data for an iterator run

void unpack_parameters_initialize (MPIUnpackBuffer &recv_buffer)
    used by IteratorScheduler to unpack starting data and initialize an iterator run

void pack_results_buffer (MPIPackBuffer &send_buffer, int job_index)
    used by IteratorScheduler to pack results data from an iterator run

void unpack_results_buffer (MPIUnpackBuffer &recv_buffer, int job_index)
    used by IteratorScheduler to unpack results data from an iterator run

void update_local_results (int job_index)
    used by IteratorScheduler to update local results arrays

const Model & algorithm_space_model () const
    return the result of any recasting or surrogate model recursion layered on top of iteratedModel by the derived Iterator ctor chain

Private Member Functions

void initialize_iterator (const RealVector &param_set)
    called by unpack_parameters_initialize(MPIUnpackBuffer) and initialize_iterator(int) to update iteratedModel and selectedIterator

void initialize_model ()
    initialize the iterated Model prior to Iterator instantiation and define param_set_len

Private Attributes

Iterator selectedIterator
    the iterator selected for concurrent iteration

bool lightwtCtor
    use of lightweight Iterator construction by name

RealVector initialPt
    the initial continuous variables for restoring the starting point in the Pareto set minimization

RealVectorArray parameterSets
    an array of parameter set vectors (either multistart variable sets or pareto multi-objective/least squares weighting sets) to be performed.
CHAPTER 13. CLASS DOCUMENTATION

- int paramSetLen
  length of each of the parameter sets associated with an iterator job (number of continuous variables for MULTI_START, number of objective funs for PARETO_SET)
- int numRandomJobs
  number of randomly-generated parameter sets to evaluate
- int randomSeed
  seed for random number generator for random samples
- PRPArray prpResults
  1-d array of ParamResponsePair results corresponding to numIteratorJobs

Friends
- class IteratorScheduler
  protect scheduler callback functions from general access

Additional Inherited Members

13.21.1 Detailed Description

Meta-iterator for multi-start iteration or pareto set optimization.

This meta-iterator maintains two concurrent iterator capabilities. First, a general capability for running an iterator multiple times from different starting points is provided (often used for multi-start optimization, but not restricted to optimization). Second, a simple capability for mapping the "pareto frontier" (the set of optimal solutions in multiobjective formulations) is provided. This pareto set is mapped through running an optimizer multiple times for different sets of multiobjective weightings.

13.21.2 Member Function Documentation

void pre_run ( ) [protected], [virtual]

pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori

pre-run phase, which a derived iterator may optionally reimplement; when not present, pre-run is likely integrated into the derived run function. This is a virtual function; when reimplementing, a derived class must call its nearest parent’s pre_run(), if implemented, typically before performing its own implementation steps.

Reimplemented from Iterator.

References Analyzer::all_samples(), Iterator::all_samples(), ParallelLibrary::bcast_hs(), Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::continuous_variables(), Dakota::copy_data(), Model::estimate_message_lengths(), ConcurrentMetaIterator::initialPt, Iterator::iteratedModel, IteratorScheduler::iterator_message_lengths(), IteratorScheduler::iteratorCommRank, IteratorScheduler::iteratorScheduling, IteratorScheduler::iteratorServerId, MetaIterator::message_lengths(), Iterator::method_Name, Iterator::methodPCIter, IteratorScheduler::miPLIndex, IteratorScheduler::numIteratorJobs, IteratorScheduler::numIteratorServers, ConcurrentMetaIterator::numRandomJobs, Iterator::parallelLib, ConcurrentMetaIterator::parameterSets, ConcurrentMetaIterator::paramSetLen, ConcurrentMetaIterator::prpResults, ConcurrentMetaIterator::randomSeed, and MPIPackBuffer::size().
void print_results ( std::ostream & s ) [protected], [virtual]

print the final iterator results

This virtual function provides additional iterator-specific final results outputs beyond the function evaluation summary printed in finalize_run().

Reimplemented from Iterator.

References Variables::continuous_variables(), Variables::discrete_int_variables(), Variables::discrete_real_variables(), ParamResponsePair::eval_id(), Iterator::methodName, ConcurrentMetaIterator::parameterSets, ConcurrentMetaIterator::paramSetLen, ConcurrentMetaIterator::prpResults, ParamResponsePair::response(), ParamResponsePair::variables(), and Response::write_tabular().

The documentation for this class was generated from the following files:

- ConcurrentMetaIterator.hpp
- ConcurrentMetaIterator.cpp

### 13.22 CONMINOptimizer Class Reference

Wrapper class for the CONMIN optimization library.

Inheritance diagram for CONMINOptimizer:

```
    CONMINOptimizer
     |                  
     v                  
Minimizer
     |                  
     v                  
Optimizer
     |                  
     v                  
  Iterator
```

**Public Member Functions**

- CONMINOptimizer (ProblemDescDB &problem_db, Model &model)
  
  *standard constructor*

- CONMINOptimizer (const String &method_string, Model &model)
  
  *alternate constructor; construct without ProblemDescDB*

- ~CONMINOptimizer ()
  
  *destructor*

- void core_run ()
  
  *core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post*

**Protected Member Functions**

- void initialize_run ()
  
  *performs run-time set up*
CHAPTER 13. CLASS DOCUMENTATION

Private Member Functions

- void initialize ()
  
  *Shared constructor code.*
- void allocate_workspace ()
  
  *Allocates workspace for the optimizer.*
- void deallocate_workspace ()
  
  *Releases workspace memory.*
- void allocate_constraints ()
  
  *Allocates constraint mappings.*

Private Attributes

- int conminInfo
  
  *INFO from CONMIN manual.*
- int printControl
  
  *IPRINT from CONMIN manual (controls output verbosity)*
- Real objFnValue
  
  *value of the objective function passed to CONMIN*
- RealVector constraintValues
  
  *array of nonlinear constraint values passed to CONMIN*
- int numConminNlnConstr
  
  *total number of nonlinear constraints seen by CONMIN*
- int numConminLinConstr
  
  *total number of linear constraints seen by CONMIN*
- int numConminConstr
  
  *total number of linear and nonlinear constraints seen by CONMIN*
- SizetArray constraintMappingIndices
  
  *a container of indices for referencing the corresponding Response constraints used in computing the CONMIN constraints.*
- RealArray constraintMappingMultipliers
  
  *a container of multipliers for mapping the Response constraints to the CONMIN constraints.*
- RealArray constraintMappingOffsets
  
  *a container of offsets for mapping the Response constraints to the CONMIN constraints.*
- int N1
  
  *Size variable for CONMIN arrays. See CONMIN manual.*
- int N2
  
  *Size variable for CONMIN arrays. See CONMIN manual.*
- int N3
  
  *Size variable for CONMIN arrays. See CONMIN manual.*
- int N4
  
  *Size variable for CONMIN arrays. See CONMIN manual.*
- int N5
  
  *Size variable for CONMIN arrays. See CONMIN manual.*
- int NFDG
  Finite difference flag.
- int IPRINT
  Flag to control amount of output data.
- int ITMAX
  Flag to specify the maximum number of iterations.
- double FDCH
  Relative finite difference step size.
- double FDCHM
  Absolute finite difference step size.
- double CT
  Constraint thickness parameter.
- double CTMIN
  Minimum absolute value of CT used during optimization.
- double CTL
  Constraint thickness parameter for linear and side constraints.
- double CTLMIN
  Minimum value of CTL used during optimization.
- double DELFUN
  Relative convergence criterion threshold.
- double DABFUN
  Absolute convergence criterion threshold.
- double * conminDesVars
  Array of design variables used by CONMIN (length N1 = numdv+2)
- double * conminLowerBnds
  Array of lower bounds used by CONMIN (length N1 = numdv+2)
- double * conminUpperBnds
  Array of upper bounds used by CONMIN (length N1 = numdv+2)
- double * S
  Internal CONMIN array.
- double * G1
  Internal CONMIN array.
- double * G2
  Internal CONMIN array.
- double * B
  Internal CONMIN array.
- double * C
  Internal CONMIN array.
- int * MS1
  Internal CONMIN array.
- double * SCAL
  Internal CONMIN array.
- double * DF
CHAPTER 13. CLASS DOCUMENTATION

Additional Inherited Members

13.22.1 Detailed Description

Wrapper class for the CONMIN optimization library.

The CONMINOptimizer class provides a wrapper for CONMIN, a Public-domain Fortran 77 optimization library written by Gary Vanderplaats under contract to NASA Ames Research Center. The CONMIN User’s Manual is contained in NASA Technical Memorandum X-62282, 1978. CONMIN uses a reverse communication mode, which avoids the static member function issues that arise with function pointer designs (see NPSOL-Optimizer and SNLLOptimizer).

The user input mappings are as follows: max_iterations is mapped into CONMIN’s ITMAX parameter, max_function_evaluations is implemented directly in the core_run() loop since there is no CONMIN parameter equivalent, convergence_tolerance is mapped into CONMIN’s DELFUN and DABFUN parameters, output verbosity is mapped into CONMIN’s IPRINT parameter (verbose: IPRINT = 4; quiet: IPRINT = 2), gradient mode is mapped into CONMIN’s NFDG parameter, and finite difference step size is mapped into CONMIN’s FDCH and FDCHM parameters. Refer to [Vanderplaats, 1978] for additional information on CONMIN parameters.

13.22.2 Member Function Documentation

```cpp
void core_run() [virtual]
```
core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.
Reimplemented from Iterator.

References CONMINOptimizer::A, Iterator::activeSet, CONMINOptimizer::B, Iterator::bestResponseArray, Iterator::bestVariablesArray, Minimizer::bigRealBoundSize, CONMINOptimizer::C, CONMINOptimizer::conminDesVars, CONMINOptimizer::conminInfo, CONMINOptimizer::conminLowerBnds, CONMINOptimizer::conminUpperBnds, CONMINOptimizer::constraintMappingIndices, CONMINOptimizer::constraintMappingMultipliers, CONMINOptimizer::constraintMappingOffsets, CONMINOptimizer::constraintValues, Model::continuous_variables(), Dakota::copy_data(), CONMINOptimizer::CT, CONMINOptimizer::CTL, CONMINOptimizer::CTMIN, CONMINOptimizer::DFT, CONMINOptimizer::DFTMIN, CONMINOptimizer::DFTCH, CONMINOptimizer::DFTCHM, Response::function_gradients(), Response::function_values(), CONMINOptimizer::G1, CONMINOptimizer::G2, Model::gradient_type(), CONMINOptimizer::IC, CONMINOptimizer::IPRINT, CONMINOptimizer::ISC, Iterator::iteratedModel, CONMINOptimizer::ITMAX, Model::linear_eq_constraint_coeffs(), Model::linear_ineq_constraint_coeffs(), Optimizer::localObjectiveRecast, Iterator::maxFunctionEvals, CONMINOptimizer::MS1, CONMINOptimizer::N1, CONMINOptimizer::N2, CONMINOptimizer::N3, CONMINOptimizer::N4, CONMINOptimizer::N5, CONMINOptimizer::NFDG, Model::num_linear_eq_constraints(), Model::num_linear_ineq_constraints(), CONMINOptimizer::numConminConstr, CONMINOptimizer::numConminNlnConstr, Minimizer::numContinuousVars, Minimizer::numFunctions, Optimizer::numObjectiveFns, CONMINOptimizer::objFnValue, Iterator::outputLevel, Model::primary_response_fn_sense(), ActiveSet::request_value(),
ActiveSet::request_values(), CONMINOptimizer::S, CONMINOptimizer::SCAL, Minimizer::speculativeFlag, and Minimizer::vendorNumericalGradFlag.

### 13.22.3 Member Data Documentation

**int conminInfo [private]**

INFO from CONMIN manual.
- Information requested by CONMIN: 1 = evaluate objective and constraints, 2 = evaluate gradients of objective and constraints.
- Referenced by CONMINOptimizer::core_run(), and CONMINOptimizer::initialize().

**int printControl [private]**

IPRINT from CONMIN manual (controls output verbosity)
- Values range from 0 (nothing) to 4 (most output). 0 = nothing, 1 = initial and final function information, 2 = all of #1 plus function value and design vars at each iteration, 3 = all of #2 plus constraint values and direction vectors, 4 = all of #3 plus gradients of the objective function and constraints, 5 = all of #4 plus proposed design vector, plus objective and constraint functions from the 1-D search
- Referenced by CONMINOptimizer::initialize().

**RealVector constraintValues [private]**

array of nonlinear constraint values passed to CONMIN
- This array must be of nonzero length and must contain only one-sided inequality constraints which are \( \leq 0 \) (which requires a transformation from 2-sided inequalities and equalities).
- Referenced by CONMINOptimizer::allocate_workspace(), and CONMINOptimizer::core_run().

**SizetArray constraintMappingIndices [private]**

a container of indices for referencing the corresponding Response constraints used in computing the CONMIN constraints.
- The length of the container corresponds to the number of CONMIN constraints, and each entry in the container points to the corresponding DAKOTA constraint.
- Referenced by CONMINOptimizer::allocate_constraints(), and CONMINOptimizer::core_run().

**RealArray constraintMappingMultipliers [private]**

a container of multipliers for mapping the Response constraints to the CONMIN constraints.
- The length of the container corresponds to the number of CONMIN constraints, and each entry in the container stores a multiplier for the DAKOTA constraint identified with constraintMappingIndices. These multipliers are currently +1 or -1.
- Referenced by CONMINOptimizer::allocate_constraints(), and CONMINOptimizer::core_run().

**RealArray constraintMappingOffsets [private]**

a container of offsets for mapping the Response constraints to the CONMIN constraints.
- The length of the container corresponds to the number of CONMIN constraints, and each entry in the container stores an offset for the DAKOTA constraint identified with constraintMappingIndices. These offsets involve inequality bounds or equality targets, since CONMIN assumes constraint allowables = 0.
- Referenced by CONMINOptimizer::allocate_constraints(), and CONMINOptimizer::core_run().
int N1 [private]
Size variable for CONMIN arrays. See CONMIN manual.
\( N1 = \text{number of variables} + 2 \)
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), and CONMINOptimizer::initialize_run().

int N2 [private]
Size variable for CONMIN arrays. See CONMIN manual.
\( N2 = \text{number of constraints} + 2\times(\text{number of variables}) \)
Referenced by CONMINOptimizer::allocate_workspace(), and CONMINOptimizer::core_run().

int N3 [private]
Size variable for CONMIN arrays. See CONMIN manual.
\( N3 = \text{Maximum possible number of active constraints} \)
Referenced by CONMINOptimizer::allocate_workspace(), and CONMINOptimizer::core_run().

int N4 [private]
Size variable for CONMIN arrays. See CONMIN manual.
\( N4 = \text{Maximum}(N3, \text{number of variables}) \)
Referenced by CONMINOptimizer::allocate_workspace(), and CONMINOptimizer::core_run().

int N5 [private]
Size variable for CONMIN arrays. See CONMIN manual.
\( N5 = 2\times(N4) \)
Referenced by CONMINOptimizer::allocate_workspace(), and CONMINOptimizer::core_run().

double CT [private]
Constraint thickness parameter.
The value of \( CT \) decreases in magnitude during optimization.
Referenced by CONMINOptimizer::core_run(), and CONMINOptimizer::initialize().

double* S [private]
Internal CONMIN array.
Move direction in N-dimensional space.
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), and CONMINOptimizer::deallocate_workspace().

double* G1 [private]
Internal CONMIN array.
Temporary storage of constraint values.
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), and CONMINOptimizer::deallocate_workspace().
**double** G2 [private]
Internal CONMIN array.
Temporary storage of constraint values.
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), and CONMINOptimizer::deallocate_workspace().

**double** B [private]
Internal CONMIN array.
Temporary storage for computations involving array S.
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), and CONMINOptimizer::deallocate_workspace().

**double** C [private]
Internal CONMIN array.
Temporary storage for use with arrays B and S.
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), and CONMINOptimizer::deallocate_workspace().

**int** MS1 [private]
Internal CONMIN array.
Temporary storage for use with arrays B and S.
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), and CONMINOptimizer::deallocate_workspace().

**double** SCAL [private]
Internal CONMIN array.
Vector of scaling parameters for design parameter values.
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), and CONMINOptimizer::deallocate_workspace().

**double** DF [private]
Internal CONMIN array.
Temporary storage for analytic gradient data.
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), and CONMINOptimizer::deallocate_workspace().

**double** A [private]
Internal CONMIN array.
Temporary 2-D array for storage of constraint gradients.
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), and CONMINOptimizer::deallocate_workspace().
int* ISC  [private]
Internal CONMIN array.
Array of flags to identify linear constraints. (not used in this implementation of CONMIN)
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), CONMINOptimizer::deallocate_workspace(), and CONMINOptimizer::initialize_run().

int* IC  [private]
Internal CONMIN array.
Array of flags to identify active and violated constraints
Referenced by CONMINOptimizer::allocate_workspace(), CONMINOptimizer::core_run(), CONMINOptimizer::deallocate_workspace(), and CONMINOptimizer::initialize_run().

The documentation for this class was generated from the following files:
- CONMINOptimizer.hpp
- CONMINOptimizer.cpp

13.23  ConsoleRedirector Class Reference

Public Member Functions
- **ConsoleRedirector** (std::ostream *&dakota_stream, std::ostream *default_dest)
  Constructor taking a reference to the Dakota Cout/Cerr handle and a default destination to use when no redirection (or destruct)
- **~ConsoleRedirector** ()
  when the redirector stack is destroyed, it will rebind the output handle to the default ostream, then destroy open files
- **void push_back** ()
  push back the default or repeat the last pushed file stream
- **void push_back** (const String &filename)
  push back a new output filestream, or repeat the last one if no filename change
- **void pop_back** ()
  pop the last redirection

Protected Attributes
- std::ostream *&  ostreamHandle
  The handle (target ostream) through which output is sent; typically dakota_cout or dakota_cerr. Will be rebound to specific streams as they are pushed or popped.
- std::ostream * defaultOStream
  initial stream to reset to when redirections are done (typically std::cout or std::cerr)
- std::vector< boost::shared_ptr< OutputWriter > >  ostreamDestinations
  stack of redirections to OutputWriters; shared pointers are used to potentially share the same ostream at multiple levels
13.24. CONSTRAINTS CLASS REFERENCE

Private Member Functions

- `ConsoleRedirector()`
  
  *default constructor is disallowed*

- `ConsoleRedirector(const ConsoleRedirector&)`

  *copy constructor is disallowed due*

- `const ConsoleRedirector& operator=(const ConsoleRedirector&)`

  *assignment is disallowed*

13.23.1 Detailed Description

Component to manage a set of output or error redirections. Push operations may present a new filename, or none in order to preserve current binding to cout/cerr or file, but place an entry on the stack. Cout/Cerr are rebound as needed when a stream is destroyed on pop.

The documentation for this class was generated from the following files:

- OutputManager.hpp
- OutputManager.cpp

13.24 Constraints Class Reference

Base class for the variable constraints class hierarchy.

Inheritance diagram for Constraints:

```
Constraints
   |   |
   v   v
MixedVarConstraints RelaxedVarConstraints
```

Public Member Functions

- `Constraints()`

  *default constructor*

- `Constraints(const ProblemDescDB& prob_db, const SharedVariablesData& svd)`

  *standard constructor*

- `Constraints(const SharedVariablesData& svd)`

  *alternate constructor for instantiations on the fly*

- `Constraints(const Constraints& con)`

  *copy constructor*

- virtual `~Constraints()`

  *destructor*

- `Constraints& operator=(const Constraints& con)`

  *assignment operator*

- virtual `void write(std::ostream& s) const`

  *write a variable constraints object to an std::ostream*
• virtual void read (std::istream &s)
  read a variable constraints object from an std::istream
• const RealVector & continuous_lower_bounds () const
  return the active continuous variable lower bounds
• Real continuous_lower_bound (size_t i) const
  return an active continuous variable lower bound
• void continuous_lower_bounds (const RealVector &cl_bnds)
  set the active continuous variable lower bounds
• void continuous_lower_bound (Real cl_bnd, size_t i)
  set an active continuous variable lower bound
• const RealVector & continuous_upper_bounds () const
  return the active continuous variable upper bounds
• Real continuous_upper_bound (size_t i) const
  return an active continuous variable upper bound
• void continuous_upper_bounds (const RealVector &cu_bnds)
  set the active continuous variable upper bounds
• void continuous_upper_bound (Real cu_bnd, size_t i)
  set an active continuous variable upper bound
• const IntVector & discrete_int_lower_bounds () const
  return the active discrete variable lower bounds
• int discrete_int_lower_bound (size_t i) const
  return an active discrete variable lower bound
• void discrete_int_lower_bounds (const IntVector &dil_bnds)
  set the active discrete variable lower bounds
• void discrete_int_lower_bound (int dil_bnd, size_t i)
  set an active discrete variable lower bound
• const IntVector & discrete_int_upper_bounds () const
  return the active discrete variable upper bounds
• int discrete_int_upper_bound (size_t i) const
  return an active discrete variable upper bound
• void discrete_int_upper_bounds (const IntVector &dil_bnds)
  set the active discrete variable upper bounds
• void discrete_int_upper_bound (int dil_bnd, size_t i)
  set an active discrete variable upper bound
• const RealVector & discrete_real_lower_bounds () const
  return the active discrete variable lower bounds
• Real discrete_real_lower_bound (size_t i) const
  return an active discrete variable lower bound
• void discrete_real_lower_bounds (const RealVector &drl_bnds)
  set the active discrete variable lower bounds
• void discrete_real_lower_bound (Real drl_bnd, size_t i)
  set an active discrete variable lower bound
• const RealVector & discrete_real_upper_bounds () const
13.24. CONSTRAINTS CLASS REFERENCE

- return the active discrete variable upper bounds
  - Real discrete_real_upper_bound (size_t i) const
    return an active discrete variable upper bound
  - void discrete_real_upper_bounds (const RealVector &dru_bnds)
    set the active discrete variable upper bounds
  - void discrete_real_upper_bound (Real dru_bnd, size_t i)
    set an active discrete variable upper bound
  - const RealVector & inactive_continuous_lower_bounds () const
    return the inactive continuous lower bounds
  - void inactive_continuous_lower_bounds (const RealVector &icl_bnds)
    set the inactive continuous lower bounds
  - const RealVector & inactive_continuous_upper_bounds () const
    return the inactive continuous upper bounds
  - void inactive_continuous_upper_bounds (const RealVector &icu_bnds)
    set the inactive continuous upper bounds
  - const IntVector & inactive_discrete_int_lower_bounds () const
    return the inactive discrete lower bounds
  - void inactive_discrete_int_lower_bounds (const IntVector &idil_bnds)
    set the inactive discrete lower bounds
  - const IntVector & inactive_discrete_int_upper_bounds () const
    return the inactive discrete upper bounds
  - void inactive_discrete_int_upper_bounds (const IntVector &idiu_bnds)
    set the inactive discrete upper bounds
  - const RealVector & inactive_discrete_real_lower_bounds () const
    return the inactive discrete lower bounds
  - void inactive_discrete_real_lower_bounds (const RealVector &idrl_bnds)
    set the inactive discrete lower bounds
  - const RealVector & inactive_discrete_real_upper_bounds () const
    return the inactive discrete upper bounds
  - void inactive_discrete_real_upper_bounds (const RealVector &idru_bnds)
    set the inactive discrete upper bounds
  - const RealVector & all_continuous_lower_bounds () const
    returns a single array with all continuous lower bounds
  - void all_continuous_lower_bounds (const RealVector &acl_bnds)
    sets all continuous lower bounds using a single array
  - void all_continuous_lower_bound (Real acl_bnd, size_t i)
    set a lower bound within the all continuous lower bounds array
  - const RealVector & all_continuous_upper_bounds () const
    returns a single array with all continuous upper bounds
  - void all_continuous_upper_bounds (const RealVector &acu_bnds)
    sets all continuous upper bounds using a single array
  - void all_continuous_upper_bound (Real acu_bnd, size_t i)
    set an upper bound within the all continuous upper bounds array
CHAPTER 13. CLASS DOCUMENTATION

- `const IntVector & all_discrete_int_lower_bounds () const`  
  returns a single array with all discrete lower bounds
- `void all_discrete_int_lower_bounds (const IntVector &adil_bnds)`  
  sets all discrete lower bounds using a single array
- `void all_discrete_int_lower_bound (int adil_bnd, size_t i)`  
  set a lower bound within the all discrete lower bounds array
- `const IntVector & all_discrete_int_upper_bounds () const`  
  returns a single array with all discrete upper bounds
- `void all_discrete_int_upper_bounds (const IntVector &adiu_bnds)`  
  sets all discrete upper bounds using a single array
- `void all_discrete_int_upper_bound (int adiu_bnd, size_t i)`  
  set an upper bound within the all discrete upper bounds array
- `const RealVector & all_discrete_real_lower_bounds () const`  
  returns a single array with all discrete lower bounds
- `void all_discrete_real_lower_bounds (const RealVector &adrl_bnds)`  
  sets all discrete lower bounds using a single array
- `void all_discrete_real_lower_bound (Real adrl_bnd, size_t i)`  
  set a lower bound within the all discrete lower bounds array
- `const RealVector & all_discrete_real_upper_bounds () const`  
  returns a single array with all discrete upper bounds
- `void all_discrete_real_upper_bounds (const RealVector &adru_bnds)`  
  sets all discrete upper bounds using a single array
- `void all_discrete_real_upper_bound (Real adru_bnd, size_t i)`  
  set an upper bound within the all discrete upper bounds array
- `size_t num_linear_ineq_constraints () const`  
  return the number of linear inequality constraints
- `size_t num_linear_eq_constraints () const`  
  return the number of linear equality constraints
- `const RealMatrix & linear_ineq_constraint_coeffs () const`  
  return the linear inequality constraint coefficients
- `void linear_ineq_constraint_coeffs (const RealMatrix &lin_ineq_coeffs)`  
  set the linear inequality constraint coefficients
- `const RealVector & linear_ineq_constraint_lower_bounds () const`  
  return the linear inequality constraint lower bounds
- `void linear_ineq_constraint_lower_bounds (const RealVector &lin_ineq_l_bnds)`  
  set the linear inequality constraint lower bounds
- `const RealVector & linear_ineq_constraint_upper_bounds () const`  
  return the linear inequality constraint upper bounds
- `void linear_ineq_constraint_upper_bounds (const RealVector &lin_ineq_u_bnds)`  
  set the linear inequality constraint upper bounds
- `const RealMatrix & linear_eq_constraint_coeffs () const`  
  return the linear equality constraint coefficients
- `void linear_eq_constraint_coeffs (const RealMatrix &lin_eq_coeffs)`  
  set the linear equality constraint coefficients
set the linear equality constraint coefficients

- `const RealVector & linear_eq_constraint_targets() const` return the linear equality constraint targets

- `void linear_eq_constraint_targets(const RealVector &lin_eq_targets)` set the linear equality constraint targets

- `size_t num_nonlinear_ineq_constraints() const` return the number of nonlinear inequality constraints

- `size_t num_nonlinear_eq_constraints() const` return the number of nonlinear equality constraints

- `const RealVector & nonlinear_ineq_constraint_lower_bounds() const` return the nonlinear inequality constraint lower bounds

- `void nonlinear_ineq_constraint_lower_bounds(const RealVector &nln_ineq_l_bnds)` set the nonlinear inequality constraint lower bounds

- `const RealVector & nonlinear_ineq_constraint_upper_bounds() const` return the nonlinear inequality constraint upper bounds

- `void nonlinear_ineq_constraint_upper_bounds(const RealVector &nln_ineq_u_bnds)` set the nonlinear inequality constraint upper bounds

- `const RealVector & nonlinear_eq_constraint_targets() const` return the nonlinear equality constraint targets

- `void nonlinear_eq_constraint_targets(const RealVector &nln_eq_targets)` set the nonlinear equality constraint targets

- `Constraints copy() const` for use when a deep copy is needed (the representation is not shared)

- `void shape()` shape the lower/upper bound arrays based on sharedVarsData

- `void reshape(size_t num_nln_ineq_cons, size_t num_nln_eq_cons, size_t num_lin_ineq_cons, size_t num_lin_eq_cons, const SharedVariablesData &svd)` reshape the linear/nonlinear/bound constraint arrays and the lower/upper bound arrays

- `void reshape()` reshape the lower/upper bound arrays based on sharedVarsData

- `void reshape(size_t num_nln_ineq_cons, size_t num_nln_eq_cons, size_t num_lin_ineq_cons, size_t num_lin_eq_cons)` reshape the linear/nonlinear constraint arrays

- `void inactive_view(short view2)` sets the inactive view based on higher level (nested) context

- `bool is_null() const` function to check constraintsRep (does this envelope contain a letter)
Protected Member Functions

- **Constraints** (BaseConstructor, const ProblemDescDB &problem, const SharedVariablesData &svd)
  
  constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

- **Constraints** (BaseConstructor, const SharedVariablesData &svd)
  
  constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

- **void** build_views ()
  
  construct active/inactive views of all variables arrays

- **void** build_active_views ()
  
  construct active views of all variables bounds arrays

- **void** build_inactive_views ()
  
  construct inactive views of all variables bounds arrays

- **void** manage_linear_constraints (const ProblemDescDB &problem, &problem_db)
  
  perform checks on user input, convert linear constraint coefficient input to matrices, and assign defaults

Protected Attributes

- **SharedVariablesData** sharedVarsData
  
  configuration data shared from a Variables instance

- **RealVector** allContinuousLowerBnds
  
  a continuous lower bounds array combining continuous design, uncertain, and continuous state variable types (all view).

- **RealVector** allContinuousUpperBnds
  
  a continuous upper bounds array combining continuous design, uncertain, and continuous state variable types (all view).

- **IntVector** allDiscreteIntLowerBnds
  
  a discrete lower bounds array combining discrete design and discrete state variable types (all view).

- **IntVector** allDiscreteIntUpperBnds
  
  a discrete upper bounds array combining discrete design and discrete state variable types (all view).

- **RealVector** allDiscreteRealLowerBnds
  
  a discrete lower bounds array combining discrete design and discrete state variable types (all view).

- **RealVector** allDiscreteRealUpperBnds
  
  a discrete upper bounds array combining discrete design and discrete state variable types (all view).

- **size_t** numNonlinearIneqCons
  
  number of nonlinear inequality constraints

- **size_t** numNonlinearEqCons
  
  number of nonlinear equality constraints

- **RealVector** nonlinearIneqConLowerBnds
  
  nonlinear inequality constraint lower bounds

- **RealVector** nonlinearIneqConUpperBnds
  
  nonlinear inequality constraint upper bounds

- **RealVector** nonlinearEqConTargets
  
  nonlinear equality constraint targets
• size_t numLinearIneqCons
  number of linear inequality constraints
• size_t numLinearEqCons
  number of linear equality constraints
• RealMatrix linearIneqConCoeffs
  linear inequality constraint coefficients
• RealMatrix linearEqConCoeffs
  linear equality constraint coefficients
• RealVector linearIneqConLowerBnds
  linear inequality constraint lower bounds
• RealVector linearIneqConUpperBnds
  linear inequality constraint upper bounds
• RealVector linearEqConTargets
  linear equality constraint targets
• RealVector continuousLowerBnds
  the active continuous lower bounds array view
• RealVector continuousUpperBnds
  the active continuous upper bounds array view
• IntVector discreteIntLowerBnds
  the active discrete lower bounds array view
• IntVector discreteIntUpperBnds
  the active discrete upper bounds array view
• RealVector discreteRealLowerBnds
  the active discrete lower bounds array view
• RealVector discreteRealUpperBnds
  the active discrete upper bounds array view
• RealVector inactiveContinuousLowerBnds
  the inactive continuous lower bounds array view
• RealVector inactiveContinuousUpperBnds
  the inactive continuous upper bounds array view
• IntVector inactiveDiscreteIntLowerBnds
  the inactive discrete lower bounds array view
• IntVector inactiveDiscreteIntUpperBnds
  the inactive discrete upper bounds array view
• RealVector inactiveDiscreteRealLowerBnds
  the inactive discrete lower bounds array view
• RealVector inactiveDiscreteRealUpperBnds
  the inactive discrete upper bounds array view

Private Member Functions

• Constraints * get_constraints (const ProblemDescDB &problem_db, const SharedVariablesData &svd)
  Used only by the constructor to initialize constraintsRep to the appropriate derived type.
• Constraints * get_constraints (const SharedVariablesData &svd) const
  Used by copy() to initialize constraintsRep to the appropriate derived type.
CHAPTER 13. CLASS DOCUMENTATION

Private Attributes

- Constraints * constraintsRep
  
  pointer to the letter (initialized only for the envelope)

- int referenceCount
  
  number of objects sharing constraintsRep

13.24.1 Detailed Description

Base class for the variable constraints class hierarchy.

The Constraints class is the base class for the class hierarchy managing bound, linear, and nonlinear constraints. Using the variable lower and upper bounds arrays from the input specification, different derived classes define different views of this data. The linear and nonlinear constraint data is consistent in all views and is managed at the base class level. For memory efficiency and enhanced polymorphism, the variable constraints hierarchy employs the "letter/envelope idiom" (see Coplien "Advanced C++", p. 133), for which the base class (Constraints) serves as the envelope and one of the derived classes (selected in Constraints::get_constraints()) serves as the letter.

13.24.2 Constructor & Destructor Documentation

Constraints()

default constructor

  The default constructor: constraintsRep is NULL in this case (a populated problem db is needed to build a meaningful Constraints object). This makes it necessary to check for NULL in the copy constructor, assignment operator, and destructor.

Constraints ( const ProblemDescDB & problem_db, const SharedVariablesData & svd )

standard constructor

  The envelope constructor only needs to extract enough data to properly execute get_constraints, since the constructor overloaded with BaseConstructor builds the actual base class data inherited by the derived classes.

  References Dakota::abort_handler(), Constraints::constraintsRep, and Constraints::get_constraints().

Constraints ( const SharedVariablesData & svd )

alternate constructor for instantiations on the fly

  Envelope constructor for instantiations on the fly. This constructor executes get_constraints(view), which invokes the default derived/base constructors, followed by a reshape() based on vars comps.

  References Dakota::abort_handler(), Constraints::constraintsRep, and Constraints::get_constraints().

Constraints ( const Constraints & con )

copy constructor

  Copy constructor manages sharing of constraintsRep and incrementing of referenceCount.

  References Constraints::constraintsRep, and Constraints::referenceCount.
13.24. CONSTRAINTS CLASS REFERENCE

~Constraints ( ) [virtual]

destructor


Constraints ( BaseConstructor, const ProblemDescDB & problem_db, const SharedVariablesData & svd ) [protected]

caracterizes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

This constructor is the one which must build the base class data for all derived classes. get_constraints() instantiates a derived class letter and the derived constructor selects this base class constructor in its initialization list (to avoid recursion in the base class constructor calling get_constraints() again). Since the letter IS the representation, its rep pointer is set to NULL (an uninitialized pointer causes problems in ~Constraints).

References Constraints::build_views(), Constraints::manage_linear_constraints(), and Constraints::shape().

Constraints ( BaseConstructor, const SharedVariablesData & svd ) [protected]

caracterizes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

This constructor is the one which must build the base class data for all derived classes. get_constraints() instantiates a derived class letter and the derived constructor selects this base class constructor in its initialization list (to avoid recursion in the base class constructor calling get_constraints() again). Since the letter IS the representation, its rep pointer is set to NULL (an uninitialized pointer causes problems in ~Constraints).

References Constraints::build_views(), and Constraints::shape().

13.24.3 Member Function Documentation

Constraints operator= ( const Constraints & con )

assignment operator


References Constraints::constraintsRep, and Constraints::referenceCount.

Constraints copy ( ) const

for use when a deep copy is needed (the representation is not shared)

Deep copies are used for history mechanisms that catalogue permanent copies (should not change as the representation within userDefinedConstraints changes).

References Constraints::allContinuousLowerBnds, Constraints::allContinuousUpperBnds, Constraints::allDiscreteIntLowerBnds, Constraints::allDiscreteIntUpperBnds, Constraints::allDiscreteRealLowerBnds, Constraints::allDiscreteRealUpperBnds, Constraints::build_views(), Constraints::constraintsRep, Constraints::get_constraints(), Constraints::linearEqConCoeffs, Constraints::linearEqConTargets, Constraints::linearIneqConCoeffs, Constraints::linearIneqConLowerBnds, Constraints::linearIneqConUpperBnds, Constraints::nonlinearEqConTargets, Constraints::nonlinearEqConLowerBnds, Constraints::nonlinearEqConUpperBnds, Constraints::nonlinearIneqConLowerBnds, Constraints::nonlinearIneqConUpperBnds, Constraints::numLinearEqCons, Constraints::numLinearIneqCons, Constraints::numNonlinearEqCons, Constraints::numNonlinearIneqCons, and Constraints::sharedVarsData.

Referenced by SurrogateModel::force_rebuild(), and RecastModel::init_constraints().
**void shape ( )**

shape the lower/upper bound arrays based on sharedVarsData

    Resizes the derived bounds arrays.

    References SharedVariablesData::all_counts(), Constraints::allContinuousLowerBnds, Constraints::allContinuousUpperBnds, Constraints::allDiscreteIntLowerBnds, Constraints::allDiscreteIntUpperBnds, Constraints::allDiscreteRealLowerBnds, Constraints::allDiscreteRealUpperBnds, Constraints::constraintsRep, Constraints::shape(), and Constraints::sharedVarsData.

    Referenced by Constraints::Constraints(), and Constraints::shape().

**void reshape ( size_t num_nln_ineq_cons, size_t num_nln_eq_cons, size_t num_lin_ineq_cons, size_t num_lin_eq_cons )**

reshape the linear/nonlinear constraint arrays

    Resizes the linear and nonlinear constraint arrays at the base class. Does NOT currently resize the derived bounds arrays.

    References Constraints::constraintsRep, Constraints::continuousLowerBnds, Constraints::discreteIntLowerBnds, Constraints::discreteRealLowerBnds, Constraints::linearEqConCoeffs, Constraints::linearEqConTargets, Constraints::linearIneqConCoeffs, Constraints::linearIneqConLowerBnds, Constraints::linearIneqConUpperBnds, Constraints::nonlinearEqConTargets, Constraints::nonlinearIneqConLowerBnds, Constraints::nonlinearIneqConUpperBnds, Constraints::numLinearEqCons, Constraints::numLinearIneqCons, Constraints::numNonlinearEqCons, Constraints::numNonlinearIneqCons, and Constraints::reshape().

**void manage_linear_constraints ( const ProblemDescDB & problem_db ) [protected]**

perform checks on user input, convert linear constraint coefficient input to matrices, and assign defaults

    Convenience function called from derived class constructors. The number of variables active for applying linear constraints is currently defined to be the number of active continuous variables plus the number of active discrete variables (the most general case), even though very few optimizers can currently support mixed variable linear constraints.

    References Dakota::abort_handler(), Constraints::continuousLowerBnds, Dakota::copy_data(), Constraints::discreteIntLowerBnds, Constraints::discreteRealLowerBnds, ProblemDescDB::get_rv(), Constraints::linearEqConCoeffs, Constraints::linearEqConTargets, Constraints::linearIneqConCoeffs, Constraints::linearIneqConLowerBnds, Constraints::linearIneqConUpperBnds, Constraints::numLinearEqCons, and Constraints::numLinearIneqCons.

    Referenced by Constraints::Constraints().

**Constraints * get_constraints ( const ProblemDescDB & problem_db, const SharedVariablesData & svd ) [private]**

Used only by the constructor to initialize constraintsRep to the appropriate derived type.

    Initializes constraintsRep to the appropriate derived type, as given by the variables view.

    References SharedVariablesData::view().

    Referenced by Constraints::Constraints(), and Constraints::copy().

**Constraints * get_constraints ( const SharedVariablesData & svd ) const [private]**

Used by copy() to initialize constraintsRep to the appropriate derived type.

    Initializes constraintsRep to the appropriate derived type, as given by the variables view. The default derived class constructors are invoked.

    References SharedVariablesData::view().
The documentation for this class was generated from the following files:

- DakotaConstraints.hpp
- DakotaConstraints.cpp

## 13.25 DataEnvironment Class Reference

Handle class for environment specification data.

### Public Member Functions

- **DataEnvironment ()**
  * constructor
- **DataEnvironment (const DataEnvironment &)**
  * copy constructor
- **~DataEnvironment ()**
  * destructor
- **DataEnvironment & operator= (const DataEnvironment &)**
  * assignment operator
- **void write (std::ostream &s) const**
  * write a DataEnvironment object to an std::ostream
- **void read (MPIUnpackBuffer &s)**
  * read a DataEnvironment object from a packed MPI buffer
- **void write (MPIPackBuffer &s) const**
  * write a DataEnvironment object to a packed MPI buffer
- **DataEnvironmentRep * data_rep ()**
  * return dataEnvRep

### Private Attributes

- **DataEnvironmentRep * dataEnvRep**
  * pointer to the body (handle-body idiom)

### Friends

- class ProblemDescDB
- class NIDRProblemDescDB

## 13.25.1 Detailed Description

Handle class for environment specification data.

The DataEnvironment class is used to provide a memory management handle for the data in DataEnvironment-Rep. It is populated by IDRProblemDescDB::environment_kwhandler() and is queried by the ProblemDescDB-::get_<datatype>() functions. A single DataEnvironment object is maintained in ProblemDescDB::environment-Spec.

The documentation for this class was generated from the following files:

- DataEnvironment.hpp
- DataEnvironment.cpp
13.26 DataEnvironmentRep Class Reference

Body class for environment specification data.

Public Attributes

- bool checkFlag
  flag for whether to run in check only mode (default false)
- String outputFile
  file name for output redirection (overrides command-line)
- String errorFile
  file name for error redirection (overrides command-line)
- String readRestart
  file name for restart read (overrides command-line)
- int stopRestart
  record at which to stop reading restart
- String writeRestart
  file name for restart write (overrides command-line)
- bool preRunFlag
  flags invocation with command line option -pre_run
- bool runFlag
  flags invocation with command line option -run
- bool postRunFlag
  flags invocation with command line option -post_run
- String preRunInput
  filename for pre_run input
- String preRunOutput
  filename for pre_run output
- String runInput
  filename for run input
- String runOutput
  filename for run output
- String postRunInput
  filename for post_run input
- String postRunOutput
  filename for post_run output
- unsigned short preRunOutputFormat
  tabular format for pre_run output
- unsigned short postRunInputFormat
  tabular format for post_run input
- bool graphicsFlag
  flags use of graphics by the environment (from the graphics specification in EnvIndControl)
- bool tabularDataFlag
  flags tabular data collection by the environment (from the tabular_graphics data specification in EnvIndControl)
• String **tabularDataFile**
  the filename used for tabular data collection by the environment (from the tabular_graphics_file specification in EnvIndControl)

• unsigned short **tabularFormat**
  format for tabular data files (see enum)

• int **outputPrecision**
  output precision for tabular and screen output

• bool **resultsOutputFlag**
  flags use of results output to default file

• String **resultsOutputFile**
  named file for results output

• String **topMethodPointer**
  method identifier for the environment (from the top_method_pointer specification)

**Private Member Functions**

• **DataEnvironmentRep ()**
  constructor

• ~**DataEnvironmentRep ()**
  destructor

• void **write** (std::ostream &s) const
  write a DataEnvironmentRep object to an std::ostream

• void **read** (MPIUnpackBuffer &s)
  read a DataEnvironmentRep object from a packed MPI buffer

• void **write** (MPIPackBuffer &s) const
  write a DataEnvironmentRep object to a packed MPI buffer

**Private Attributes**

• int **referenceCount**
  number of handle objects sharing this dataEnvironmentRep

**Friends**

• class **DataEnvironment**
  the handle class can access attributes of the body class directly

**13.26.1 Detailed Description**

Body class for environment specification data.

The DataEnvironmentRep class is used to contain the data from the environment keyword specification. Default values are managed in the DataEnvironmentRep constructor. Data is public to avoid maintaining set/get functions, but is still encapsulated within ProblemDescDB since ProblemDescDB::environmentSpec is private.

The documentation for this class was generated from the following files:

• DataEnvironment.hpp
• DataEnvironment.cpp
13.27  **DataFitSurrModel Class Reference**

Derived model class within the surrogate model branch for managing data fit surrogates (global and local)

Inheritance diagram for DataFitSurrModel:

```
Model
  SurrogateModel
  DataFitSurrModel
```

**Public Member Functions**

- **DataFitSurrModel** (ProblemDescDB &problem_db)
  
  constructor

- **DataFitSurrModel** (Iterator &dace_iterator, Model &actual_model, const ActiveSet &set, const String &approx_type, const UShortArray &approx_order, short corr_type, short corr_order, short data_order, short output_level, const String &point_reuse, const String &import_build_points_file=String(), unsigned short import_build_format=TABULAR_ANNOTATED, bool import_build_active_only=false, const String &export_approx_points_file=String(), unsigned short export_approx_format=TABULAR_ANNOTATED)
  
  alternate constructor for instantiations on the fly

- **~DataFitSurrModel** ()
  
  destructor

- void **total_points** (int points)
  
  set pointsTotal and pointsManagement mode

**Protected Member Functions**

- void **derived_evaluate** (const ActiveSet &set)
  
  portion of evaluate() specific to DataFitSurrModel

- void **derived_evaluate_nowait** (const ActiveSet &set)
  
  portion of evaluate_nowait() specific to DataFitSurrModel

- const IntResponseMap & **derived_synchronize** ()
  
  portion of synchronize() specific to DataFitSurrModel

- const IntResponseMap & **derived_synchronize_nowait** ()
  
  portion of synchronize_nowait() specific to DataFitSurrModel

- **Iterator & subordinate_iterator** ()
  
  return daceIterator

- **Model & surrogate_model** ()
  
  return this model instance

- **Model & truth_model** ()
  
  return actualModel

- void **derived_subordinate_models** (ModelList &ml, bool recurse_flag)
return actualModel (and optionally its sub-models)

• void update_from_subordinate_model (size_t depth=std::numeric_limits<size_t>::max())
  pass request to actualModel if recursing and then update from it

• Interface & derived_interface ()
  return approxInterface

• void primary_response_fn_weights (const RealVector &wts, bool recurse_flag=true)
  set the relative weightings for multiple objective functions or least squares terms and optionally recurses into actualModel

• void surrogate_response_mode (short mode)
  set responseMode and pass any bypass request on to actualModel for any lower-level surrogates.

• void surrogate_function_indices (const IntSet &surr_fn_indices)
  (re)set the surrogate index set in SurrogateModel::surrogateFnIndices and ApproximationInterface::approxFnIndices

• void build_approximation ()
  Builds the local/multipoint/global approximation using daceIterator/actualModel to generate new data points.

• bool build_approximation (const Variables &vars, const IntResponsePair &response_pr)
  Builds the local/multipoint/global approximation using daceIterator/actualModel to generate new data points that augment the passed vars/response anchor point.

• void update_approximation (bool rebuild_flag)
  replaces the approximation data with daceIterator results and rebuilds the approximation if requested

• void update_approximation (const Variables &vars, const IntResponsePair &response_pr, bool rebuild_flag)
  replaces the anchor point, and rebuilds the approximation if requested

• void update_approximation (const VariablesArray &vars_array, const IntResponseMap &resp_map, bool rebuild_flag)
  replaces the current points array and rebuilds the approximation if requested

• void update_approximation (const RealMatrix &samples, const IntResponseMap &resp_map, bool rebuild_flag)
  replaces the current points array and rebuilds the approximation if requested

• void append_approximation (bool rebuild_flag)
  appends daceIterator results to a global approximation and rebuilds it if requested

• void append_approximation (const Variables &vars, const IntResponsePair &response_pr, bool rebuild_flag)
  appends a point to a global approximation and rebuilds it if requested

• void append_approximation (const VariablesArray &vars_array, const IntResponseMap &resp_map, bool rebuild_flag)
  appends an array of points to a global approximation and rebuilds it if requested

• void append_approximation (const RealMatrix &samples, const IntResponseMap &resp_map, bool rebuild_flag)
  appends a matrix of points to a global approximation and rebuilds it if requested

• void pop_approximation (bool save_surr_data, bool rebuild_flag=false)
  remove approximation data added on previous append_approximation() call or a specified number of points

• void push_approximation ()
  retrieve a previous approximation data state

• bool push_available ()
  query for whether a trial increment can be retrieved
void finalize_approximation()
    finalize data fit by applying all previous trial increments
void store_approximation(size_t index=NPOS)
    store the current data fit approximation for later combination
void restore_approximation(size_t index=NPOS)
    restore a previous data fit approximation
void remove_stored_approximation(size_t index=NPOS)
    store the current data fit approximation for later combination
void combine_approximation(short corr_type)
    combine the current data fit approximation with one previously stored
void run_dace_iterator(bool rebuild_flag)
    execute the DACE iterator, append the approximation data, and rebuild the approximation if indicated
SharedApproxData & shared_approximation()
    retrieve the SharedApproxData from approxInterface
std::vector< Approximation > & approximations()
    retrieve the set of Approximations from approxInterface
const RealVectorArray & approximation_coefficients(bool normalized=false)
    return the approximation coefficients from each Approximation (request forwarded to approxInterface)
void approximation_coefficients(const RealVectorArray &approx_coeffs, bool normalized=false)
    set the approximation coefficients within each Approximation (request forwarded to approxInterface)
const RealVector & approximation_variances(const Variables &vars)
    return the approximation variance from each Approximation (request forwarded to approxInterface)
const Pecos::SurrogateData & approximation_data(size_t index)
    return the approximation data from a particular Approximation (request forwarded to approxInterface)
void component_parallel_mode(short mode)
    update component parallel mode for supporting parallelism in actualModel
IntIntPair estimate_partition_bounds(int max_eval_concurrency)
    estimate the minimum and maximum partition sizes that can be utilized by this Model
void derived_init_communicators(ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
    set up actualModel for parallel operations
void derived_init_serial()
    set up actualModel for serial operations.
void derived_set_communicators(ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
    set active parallel configuration within actualModel
void derived_free_communicators(ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
    deallocate communicator partitions for the DataFitSurrModel (request forwarded to actualModel)
void serve_run(ParLevLIter pl_iter, int max_eval_concurrency)
    Service actualModel job requests received from the master. Completes when a termination message is received from stop_servers().
void stop_servers()
    Executed by the master to terminate actualModel server operations when DataFitSurrModel iteration is complete.
void inactive_view(short view, bool recurse_flag=true)
    update the Model’s inactive view based on higher level (nested) context and optionally recurse into actualModel
const String & \texttt{interface\_id} () const
\quad \text{return the approxInterface identifier}

int \texttt{evaluation\_id} () const
\quad \text{return the current evaluation id for the DataFitSurrModel}

void \texttt{set\_evaluation\_reference} ()
\quad \text{set the evaluation counter reference points for the DataFitSurrModel (request forwarded to approxInterface and actualModel)}

void \texttt{fine\_grained\_evaluation\_counters} ()
\quad \text{request fine-grained evaluation reporting within approxInterface and actualModel}

void \texttt{print\_evaluation\_summary} (std::ostream &s, bool minimal\_header=false, bool relative\_count=true) const
\quad \text{print the evaluation summary for the DataFitSurrModel (request forwarded to approxInterface and actualModel)}

\begin{description}
\item[Protected Attributes]
\item const bool \texttt{exportSurrogate} \quad \text{whether to export the surrogate to file}
\item const bool \texttt{autoRefine} \quad \text{whether to automatically refine the surrogate during the build phase}
\item const int \texttt{maxIterations} \quad \text{Maximum number of times to refine the surrogate.}
\item const int \texttt{maxFuncEvals} \quad \text{Maximum number of evaluations while refining a surrogate.}
\item const Real \texttt{convergenceTolerance} \quad \text{Convergence criterion, compared to CV score for specified metric.}
\item const String \texttt{refineCVMetric} \quad \text{Type of error metric to test for surrogate refinement convergence.}
\item const int \texttt{refineCVFolds} \quad \text{Number of cross validation folds for surrogate refinement.}
\end{description}

\begin{description}
\item[Private Member Functions]
\item void \texttt{import\_points} (unsigned short tabular\_format, bool active\_only) \quad \text{optionally read surrogate data points from provided file}
\item void \texttt{initialize\_export} () \quad \text{initialize file stream for exporting surrogate evaluations}
\item void \texttt{finalize\_export} () \quad \text{finalize file stream for exporting surrogate evaluations}
\item void \texttt{manage\_data\_recastings} () \quad \text{initialize manageRecasting and recastFlags for data import/export}
\item void \texttt{export\_point} (int eval\_id, const Variables &vars, const Response &resp) \quad \text{initialize file stream for exporting surrogate evaluations}
\item void \texttt{derived\_synchronize\_approx} (const IntResponseMap &approx\_resp\_map, IntResponseMap &approx\_\textunderscore resp\_map\_rekey)
\end{description}
CHAPTER 13. CLASS DOCUMENTATION

Common code for processing of approximate response maps shared by derived_synchronize() and derived_synchronize_nowait()

- **void update_global ()**
  Updates fit arrays for global approximations.
- **void update_local_multipoint ()**
  Updates fit arrays for local or multipoint approximations.
- **void build_global ()**
  Builds a global approximation using daceIterator.
- **void build_local_multipoint ()**
  Builds a local or multipoint approximation using actualModel.
- **void refine_surrogate ()**
  Refine the built surrogate until convergence criteria are met.
- **void interface_build_approx ()**
  Call build_approximation on the interface, passing appropriate constraints.
- **void update_actual_model ()**
  update actualModel with data from current variables/labels/bounds/targets
- **void update_from_actual_model ()**
  update current variables/labels/bounds/targets with data from actualModel
- **bool inside (const RealVector &c_vars, const IntVector &di_vars, const RealVector &dr_vars)**
  test if c_vars and d_vars are within [c_l_bnds,c_u_bnds] and [d_l_bnds,d_u_bnds]

Private Attributes

- **int surrModelEvalCntr**
  number of calls to derived_evaluate()/derived_evaluate_nowait()
- **int pointsTotal**
  total points the user specified to construct the surrogate
- **short pointsManagement**
  configuration for points management in build_global()
- **String pointReuse**
  type of point reuse for approximation builds: all, region (default if points file), or none (default if no points file)
- **bool manageRecasting**
  flag indicating need to manage data recastings when importing build data or exporting approximate evaluations
- **BoolDeque recastFlags**
  a key indicating which models within a model recursion involve recasting
- **String importPointsFile**
  file name from import_build_points_file specification
- **String exportPointsFile**
  file name from export_approx_points_file specification
- **unsigned short exportFormat**
  file export format for variables and approximate responses
- **std::ofstream exportFileStream**
  output file stream for export_approx_points_file specification
13.27. **DATAFITSURRMODEL CLASS REFERENCE**

- VariablesList `reuseFileVars`  
  array of variables sets read from the `import_build_points_file`
- ResponseList `reuseFileResponses`  
  array of response sets read from the `import_build_points_file`
- Interface `approxInterface`  
  manages the building and subsequent evaluation of the approximations (required for both global and local)
- Model `actualModel`  
  the truth model which provides evaluations for building the surrogate (optional for global, required for local)
- Iterator `daceIterator`  
  selects parameter sets on which to evaluate `actualModel` in order to generate the necessary data for building global approximations (optional for global since restart data may also be used)

### 13.27.1 Detailed Description

Derived model class within the surrogate model branch for managing data fit surrogates (global and local)

The **DataFitSurrModel** class manages global or local approximations (surrogates that involve data fits) that are used in place of an expensive model. The class contains an `approxInterface` (required for both global and local) which manages the approximate function evaluations, an `actualModel` (optional for global, required for local) which provides truth evaluations for building the surrogate, and a `daceIterator` (optional for global, not used for local) which selects parameter sets on which to evaluate `actualModel` in order to generate the necessary data for building global approximations.

### 13.27.2 Constructor & Destructor Documentation

\[\sim\text{DataFitSurrModel()}\] [inline]

destructor

Virtual destructor handles referenceCount at base *Model* level.

References DataFitSurrModel::finalize_export().

### 13.27.3 Member Function Documentation

\[\text{void derived\_evaluate( const ActiveSet & set )}\] [protected], [virtual]

portion of evaluate() specific to **DataFitSurrModel**

Compute the response synchronously using `actualModel`, `approxInterface`, or both (mixed case). For the `approxInterface` portion, build the approximation if needed, evaluate the approximate response, and apply correction (if active) to the results.

Reimplemented from *Model*.

References DiscrepancyCorrection::active(), Response::active_set(), DataFitSurrModel::actualModel, DiscrepancyCorrection::apply(), SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface, SurrogateModel::asv_mapping(), DataFitSurrModel::build_approximation(), DataFitSurrModel::component_parallel_mode(), DiscrepancyCorrection::compute(), Response::copy(), Model::current_response(), Model::currentResponse, Model::currentResponse, Model::currentResponse, SurrogateModel::deltaCorr, Model::eval_tag_prefix(), Model::evalTagPrefix, Model::evaluate(), DataFitSurrModel::export_point(), SurrogateModel::force_rebuild(), Model::hierarchicalTagging, Interface::map(), Model::outputLevel, ActiveSet::request_vector(), SurrogateModel::response_mapping(), SurrogateModel::responseMode, DataFitSurrModel::surrModelEvalCntr, Response::update(), and DataFitSurrModel::update_actual_model().

void derived_evaluate_nowait ( const ActiveSet & set ) [protected], [virtual]

portion of evaluate_nowait() specific to DataFitSurrModel

Compute the response asynchronously using actualModel, approxInterface, or both (mixed case). For the
approxInterface portion, build the approximation if needed and evaluate the approximate response in a quasi-
asynchronous approach (ApproximationInterface::map() performs the map synchronously and bookkeeps the re-
sults for return in derived_synchronize() below).

Reimplemented from Model.

References DataFitSurrModel::actualModel, SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface,
SurrogateModel::asv_mapping(), DataFitSurrModel::build_approximation(), Variables::copy(), Model::currentResponse,
Model::currentVariables, Model::eval_tag_prefix(), Model::evalTagPrefix, Model::evaluate_nowait(), Interface::evaluation-
_id(), Model::evaluation_id(), DataFitSurrModel::exportPointsFile, SurrogateModel::force_rebuild(), Model::hierarchical-
Tagging, Interface::map(), SurrogateModel::rawVarsMap, ActiveSet::request_vector(), SurrogateModel::response-
Mode, SurrogateModel::surrIdMap, DataFitSurrModel::surrModelEvalCntr, SurrogateModel::truthIdMap, and
DataFitSurrModel::update_actual_model().

const IntResponseMap & derived_synchronize ( ) [protected], [virtual]

portion of synchronize() specific to DataFitSurrModel

Blocking retrieval of asynchronous evaluations from actualModel, approxInterface, or both (mixed case). For the
approxInterface portion, apply correction (if active) to each response in the array. derived_synchronize() is
designed for the general case where derived_evaluate_nowait() may be inconsistent in its use of actual evaluations,
approximate evaluations, or both.

Reimplemented from Model.

References DataFitSurrModel::actualModel, DataFitSurrModel::approxInterface, DataFitSurrModel::component-
_parallel_model(), DiscrepancyCorrection::compute(), SurrogateModel::deltaCorr, DataFitSurrModel::derived_synchronize-
approx(), Model::outputLevel, SurrogateModel::response_mapping(), SurrogateModel::responseMode, Surrogate-
Model::surrIdMap, SurrogateModel::surrResponseMap, Interface::synch(), Model::synchronize(), and Surrogate-
Model::truthIdMap.

const IntResponseMap & derived_synchronize_nowait ( ) [protected], [virtual]

portion of synchronize_nowait() specific to DataFitSurrModel

Nonblocking retrieval of asynchronous evaluations from actualModel, approxInterface, or both (mixed case).
For the approxInterface portion, apply correction (if active) to each response in the map. derived_synchronize-_nowait() is designed for the general case where derived_evaluate_nowait() may be inconsistent in its use of actual
evals, approx evals, or both.

Reimplemented from Model.

References Dakota::abort_handler(), DataFitSurrModel::actualModel, DataFitSurrModel::approxInterface, Surrogate-
Model::cachedApproxRespMap, DataFitSurrModel::component_parallel_mode(), DiscrepancyCorrection::compute(),
SurrogateModel::deltaCorr, DataFitSurrModel::derived_synchronize_approx(), Model::outputLevel, SurrogateModel-
::response_mapping(), SurrogateModel::responseMode, SurrogateModel::surrIdMap, SurrogateModel::surrResponse-
Map, Interface::synch_nowait(), Model::synchronize_nowait(), and SurrogateModel::truthIdMap.

void build_approximation ( ) [protected], [virtual]

Builds the local/multipoint/global approximation using daceIterator/actualModel to generate new data points.

This function constructs a new approximation, discarding any previous data. It constructs any required data for
SurrogateData::{vars,resp}Data and does not define an anchor point for SurrogateData::anchor{Vars,Resp}, so is an unconstrained build.

Reimplemented from Model.
References SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface, DataFitSurrModel::autoRefine, DataFitSurrModel::build_global(), DataFitSurrModel::build_local_multipoint(), Interface::clear_current(), DataFitSurrModel::interface_build_approx(), Dakota::strbegins(), Model::surrogateType, DataFitSurrModel::update_actual_model(), DataFitSurrModel::update_global(), and DataFitSurrModel::update_local_multipoint.

Referenced by DataFitSurrModel::derived_evaluate(), and DataFitSurrModel::derived_evaluate_nowait().

## bool build_approximation ( const Variables & vars, const IntResponsePair & response_pr ) [protected], [virtual]

Builds the local/multipoint/global approximation using daceIterator/actualModel to generate new data points that augment the passed vars/response anchor point.

This function constructs a new approximation, discarding any previous data. It uses the passed data to populate SurrogateData::anchor{Vars,Resp} and constructs any required data points for SurrogateData::{vars,resp}Data.

Reimplemented from Model.

References SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface, DataFitSurrModel::autoRefine, DataFitSurrModel::build_global(), Interface::clear_current(), DataFitSurrModel::interface_build_approx(), Dakota::strbegins(), Model::surrogateType, DataFitSurrModel::update_actual_model(), Interface::update_approximation(), DataFitSurrModel::update_global(), and DataFitSurrModel::update_local_multipoint().

## void update_approximation ( bool rebuild_flag ) [protected], [virtual]

replaces the approximation data with daceIterator results and rebuilds the approximation if requested

This function populates/replaces SurrogateData::anchor{Vars,Resp} and rebuilds the approximation, if requested. It does not clear other data (i.e., SurrogateData::{vars,resp}Data) and does not update the actualModel with revised bounds, labels, etc. Thus, it updates data from a previous call to build_approximation(), and is not intended to be used in isolation.

Reimplemented from Model.

References Iterator::all_responses(), Iterator::all_samples(), Iterator::all_variables(), SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface, Iterator::compact_mode(), DataFitSurrModel::daceIterator, Model::numFns, Interface::rebuild_approximation(), Model::surrogateType, and Interface::update_approximation().

## void update_approximation ( const Variables & vars, const IntResponsePair & response_pr, bool rebuild_flag ) [protected], [virtual]

replaces the anchor point, and rebuilds the approximation if requested

This function populates/replaces SurrogateData::anchor{Vars,Resp} and rebuilds the approximation, if requested. It does not clear other data (i.e., SurrogateData::{vars,resp}Data) and does not update the actualModel with revised bounds, labels, etc. Thus, it updates data from a previous call to build_approximation(), and is not intended to be used in isolation.

Reimplemented from Model.

References SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface, Model::numFns, Interface::rebuild_approximation(), Model::surrogateType, and Interface::update_approximation().

## void update_approximation ( const VariablesArray & vars_array, const IntResponseMap & resp_map, bool rebuild_flag ) [protected], [virtual]

replaces the current points array and rebuilds the approximation if requested

This function populates/replaces SurrogateData::{vars,resp}Data and rebuilds the approximation, if requested. It does not clear other data (i.e., SurrogateData::anchor{Vars,Resp}) and does not update the actualModel with...
revised bounds, labels, etc. Thus, it updates data from a previous call to build_approximation(), and is not intended to be used in isolation.

Reimplemented from Model.

References SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface, Model::numFns, Interface::rebuild_approximation(), Model::surrogateType, and Interface::update_approximation().

void update_approximation ( const RealMatrix & samples, const IntResponseMap & resp_map, bool rebuild_flag ) [protected], [virtual]

replaces the current points array and rebuilds the approximation if requested

This function populates/replaces SurrogateData::{vars,resp}Data and rebuilds the approximation, if requested. It does not clear other data (i.e., SurrogateData::anchor{Vars,Resp}) and does not update the actualModel with revised bounds, labels, etc. Thus, it updates data from a previous call to build_approximation(), and is not intended to be used in isolation.

Reimplemented from Model.

References SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface, Model::numFns, Interface::rebuild_approximation(), Model::surrogateType, and Interface::update_approximation().

void append_approximation ( bool rebuild_flag ) [protected], [virtual]

appends daceIterator results to a global approximation and rebuilds it if requested

This function appends one point to SurrogateData::{vars,resp}Data and rebuilds the approximation, if requested. It does not modify other data (i.e., SurrogateData::anchor{Vars,Resp}) and does not update the actualModel with revised bounds, labels, etc. Thus, it appends to data from a previous call to build_approximation(), and is not intended to be used in isolation.

Reimplemented from Model.

References Iterator::all_responses(), Iterator::all_samples(), Iterator::all_variables(), Interface::append_approximation(), SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface, Iterator::compact_mode(), DataFitSurrModel::daceIterator, Model::numFns, Interface::rebuild_approximation(), and Model::surrogateType.

Referenced by DataFitSurrModel::run_dace_iterator().

void append_approximation ( const Variables & vars, const IntResponsePair & response_pr, bool rebuild_flag ) [protected], [virtual]

appends a point to a global approximation and rebuilds it if requested

This function appends one point to SurrogateData::{vars,resp}Data and rebuilds the approximation, if requested. It does not modify other data (i.e., SurrogateData::anchor{Vars,Resp}) and does not update the actualModel with revised bounds, labels, etc. Thus, it appends to data from a previous call to build_approximation(), and is not intended to be used in isolation.

Reimplemented from Model.

References Interface::append_approximation(), SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface, Model::numFns, Interface::rebuild_approximation(), and Model::surrogateType.

void append_approximation ( const VariablesArray & vars_array, const IntResponseMap & resp_map, bool rebuild_flag ) [protected], [virtual]

appends an array of points to a global approximation and rebuilds it if requested

This function appends multiple points to SurrogateData::{vars,resp}Data and rebuilds the approximation, if requested. It does not modify other data (i.e., SurrogateData::anchor{Vars,Resp}) and does not update the actualModel with revised bounds, labels, etc. Thus, it appends to data from a previous call to build_approximation(), and is not intended to be used in isolation.
Reimplemented from Model.
References Interface::append_approximation(), SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface, Model::numFns, Interface::rebuild_approximation(), and Model::surrogateType.

```cpp
void append_approximation ( const RealMatrix & samples, const IntResponseMap & resp_map, bool rebuild_flag ) [protected], [virtual]
```

appends a matrix of points to a global approximation and rebuilds it if requested.

This function appends multiple points to SurrogateData::{vars,resp}Data and rebuilds the approximation, if requested. It does not modify other data (i.e., SurrogateData::anchor{Vars,Resp}) and does not update the actualModel with revised bounds, labels, etc. Thus, it appends to data from a previous call to build_approximation(), and is not intended to be used in isolation.

Reimplemented from Model.
References Interface::append_approximation(), SurrogateModel::approxBuilds, DataFitSurrModel::approxInterface, Model::numFns, Interface::rebuild_approximation(), and Model::surrogateType.

```cpp
void derived_init_communicators ( ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag = true ) [protected], [virtual]
```

set up actualModel for parallel operations.

asynchronous flags need to be initialized for the sub-models. In addition, max_eval_concurrency is the outer level iterator concurrency, not the DACE concurrency that actualModel will see, and recomputing the message-lengths on the sub-model is probably not a bad idea either. Therefore, recompute everything on actualModel using init_communicators.

Reimplemented from Model.
References DataFitSurrModel::actualModel, DataFitSurrModel::approxInterface, DataFitSurrModel::daceIterator, Model::derivative_concurrency(), ProblemDescDB::get_db_method_node(), ProblemDescDB::get_db_model_node(), Iterator::init_communicators(), Model::init_communicators(), Iterator::is_null(), Model::is_null(), Iterator::iterated_model(), Iterator::maximum_evaluation_concurrency(), Iterator::method_id(), Interface::minimum_points(), Model::model_id(), Model::probDescDB, ProblemDescDB::set_db_list_nodes(), ProblemDescDB::set_db_method_node(), and ProblemDescDB::set_db_model_nodes().

```cpp
int evaluation_id ( ) const [inline], [protected], [virtual]
```

return the current evaluation id for the DataFitSurrModel

return the DataFitSurrModel evaluation count. Due to possibly intermittent use of surrogate bypass, this is not the same as either the approxInterface or actualModel model evaluation counts. It also does not distinguish duplicate evals.

Reimplemented from Model.
References DataFitSurrModel::surrModelEvalCntr.

```cpp
void import_points ( unsigned short tabular_format, bool active_only ) [private]
```

optionally read surrogate data points from provided file.

Constructor helper to read the points file once, if provided, and then reuse its data as appropriate within build_global(). Surrogate data imports default to active/inactive variables, but user can override to active only.

References DataFitSurrModel::actualModel, Model::current_response(), Model::current_variables(), Model::currentResponse, Model::currentVariables, Variables::cv(), Variables::div(), Variables::drv(), Variables::dsv(), DataFitSurrModel::importPointsFile, Model::is_null(), Model::numFns, Model::outputLevel, DataFitSurrModel::reuseFileResponses, DataFitSurrModel::reuseFileVars, and Variables::tv().

Referenced by DataFitSurrModel::DataFitSurrModel().
void initialize_export ( ) [private]
initialize file stream for exporting surrogate evaluations
   Constructor helper to export approximation-based evaluations to a file.
   References Model::currentResponse, Model::currentVariables, DataFitSurrModel::exportFileStream, DataFitSurrModel::exportFormat, and DataFitSurrModel::exportPointsFile.
   Referenced by DataFitSurrModel::DataFitSurrModel().

void finalize_export( ) [private]
finalize file stream for exporting surrogate evaluations
   Constructor helper to export approximation-based evaluations to a file.
   References DataFitSurrModel::exportFileStream, and DataFitSurrModel::exportPointsFile.
   Referenced by DataFitSurrModel::~DataFitSurrModel().

void manage_data_recastings ( ) [private]
initialize manageRecasting and recastFlags for data import/export
   Constructor helper to manage model recastings for data import/export.
   References DataFitSurrModel::manageRecasting, DataFitSurrModel::recastFlags, and Model::subordinate_models().
   Referenced by DataFitSurrModel::DataFitSurrModel().

void export_point ( int eval_id, const Variables & vars, const Response & resp ) [private]
initialize file stream for exporting surrogate evaluations
   Constructor helper to export approximation-based evaluations to a file. Exports all variables, so it’s clear at what values of inactive it was built at.
   References DataFitSurrModel::exportFileStream, DataFitSurrModel::exportFormat, DataFitSurrModel::exportPointsFile, DataFitSurrModel::interface_id(), RecastModel::inverse_transform_response(), DataFitSurrModel::manageRecasting, Model::model_rep(), Model::modelList, DataFitSurrModel::recastFlags, and RecastModel::transform_variables().
   Referenced by DataFitSurrModel::derived_evaluate(), and DataFitSurrModel::derived_synchronize_approx().

void build_global ( ) [private]
Builds a global approximation using daceIterator.
   Determine points to use in building the approximation and then evaluate them on actualModel using daceIterator. Any changes to the bounds should be performed by setting them at a higher level (e.g., SurrBasedOptStrategy).
   References Dakota::abort_handler(), DataFitSurrModel::actualModel, Interface::append_approximation(), Interface::approximation_data(), DataFitSurrModel::approxInterface, DataFitSurrModel::autoRefine, DataFitSurrModel::component_parallel_mode(), Variables::continuous_variables(), Model::currentVariables, Variables::cv(), Model::cv(), DataFitSurrModel::daceIterator, Dakota::data_pairs, Variables::discrete_int_variables(), Variables::discrete_real_variables(), Variables::div(), Model::div(), Variables::drv(), Model::drv(), DataFitSurrModel::importPointsFile, DataFitSurrModel::inside(), Model::interface_id(), RecastModel::inverse_transform_variables(), Iterator::is_null(), Model::is_null(), DataFitSurrModel::manageRecasting, Interface::minimum_points(), Model::model_rep(), Model::modelList, Iterator::num_samples(), Model::outputLevel, DataFitSurrModel::pointReuse, DataFitSurrModel::pointsManagement, DataFitSurrModel::pointsTotal, DataFitSurrModel::recastFlags, Interface::recommended_points(), DataFitSurrModel::refine_surrogate(), DataFitSurrModel::reuseFileResponses, DataFitSurrModel::reuseFileVars, DataFitSurrModel::run_dace_iterator(), Iterator::sampling_reset(), and SurrogateModel::surrogateFnIndices.
void build_local_multipoint() [private]

Builds a local or multipoint approximation using actualModel.

References Response::active_set(), Dakota::abort_handler, Dakota::currentResponse, Dakota::currentVariables, Variables::cv(), Model::cv(), Model::discreteStateSetIntValues, Model::discreteStateSetRealValues, Variables::drv(), Model::drv(), Model::epistemic_distribution_parameters(), Constraints::continuous_lower_bounds(), Model::continuous_lower_bounds(), Constraints::continuous_upper_bounds(), Model::continuous_upper_bounds(), Variables::continuous_variable_labels(), Model::continuous_variable_labels(), Variables::continuous_variables(), Model::continuous_variables(), Constraints::discrete_int_lower_bounds(), Model::discrete_int_lower_bounds(), Constraints::discrete_int_upper_bounds(), Model::discrete_int_upper_bounds(), Variables::discrete_int_variable_labels(), Model::discrete_int_variable_labels(), Variables::discrete_int_variables(), Model::discrete_int_variables(), Constraints::discrete_real_lower_bounds(), Model::discrete_real_lower_bounds(), Constraints::discrete_real_upper_bounds(), Model::discrete_real_upper_bounds(), Variables::discrete_real_variable_labels(), Model::discrete_real_variable_labels(), Variables::discrete_real_variables(), Model::discrete_real_variables(), Constraints::discrete_variable_labels(), Variables::discrete_variable_labels(), Variables::discrete_variables(), Model::discrete_variables(), Constraints::lower_bounds(), Model::lower_bounds(), Constraints::upper_bounds(), Model::upper_bounds(), Constraints::values(), Model::values(), Variables::values(), Model::values(), Constraints::all(), Model::all(), Constraints::linear(), Model::linear(), Constraints::nonlinear(), Model::nonlinear(), Constraints::bound/linear/nonlinear constraints from userDefinedConstraints.

void update_actual_model() [private]

update actualModel with data from current variables/labels/bounds/targets

References Dakota::abort_handler, Dakota::actualModel, Model::asv, Model::approxBuilds, Constraints::continuous_lower_bounds(), Model::continuous_lower_bounds(), Constraints::continuous_upper_bounds(), Model::continuous_upper_bounds(), Variables::continuous_variable_labels(), Model::continuous_variable_labels(), Variables::continuous_variables(), Model::continuous_variables(), Constraints::discrete_int_lower_bounds(), Model::discrete_int_lower_bounds(), Constraints::discrete_int_upper_bounds(), Model::discrete_int_upper_bounds(), Variables::discrete_int_variable_labels(), Model::discrete_int_variable_labels(), Variables::discrete_int_variables(), Model::discrete_int_variables(), Constraints::discrete_real_lower_bounds(), Model::discrete_real_lower_bounds(), Constraints::discrete_real_upper_bounds(), Model::discrete_real_upper_bounds(), Variables::discrete_real_variable_labels(), Model::discrete_real_variable_labels(), Variables::discrete_real_variables(), Model::discrete_real_variables(), Constraints::discrete_variable_labels(), Variables::discrete_variable_labels(), Variables::discrete_variables(), Model::discrete_variables(), Constraints::lower_bounds(), Model::lower_bounds(), Constraints::upper_bounds(), Model::upper_bounds(), Constraints::values(), Model::values(), Variables::values(), Model::values(), Constraints::all(), Model::all(), Constraints::linear(), Model::linear(), Constraints::nonlinear(), Model::nonlinear(), Constraints::bound/linear/nonlinear constraints from userDefinedConstraints.
void update_from_actual_model( ) [private]
update current variables/labels/bounds/targets with data from actualModel

References Dakota::abort_handler(), DataFitSurrModel::actualModel, Model::aleatory_distribution_parameters(), Constraints::all_continuous_lower_bounds(), Model::all_continuous_lower_bounds(), Constraints::all_continuous_upper_bounds(), Model::all_continuous_upper_bounds(), Variables::all_continuous_variable_labels(), Model::all_continuous_variable_labels(), Variables::all_continuous_variables(), Model::all_continuous_variables(), Constraints::all_discrete_int_lower_bounds(), Model::all_discrete_int_lower_bounds(), Constraints::all_discrete_int_upper_bounds(), Model::all_discrete_int_upper_bounds(), Variables::all_discrete_int_variable_labels(), Model::all_discrete_int_variable_labels(), Variables::all_discrete_int_variables(), Model::all_discrete_int_variables(), Constraints::all_discrete_real_lower_bounds(), Model::all_discrete_real_lower_bounds(), Constraints::all_discrete_real_upper_bounds(), Model::all_discrete_real_upper_bounds(), Variables::all_discrete_real_variable_labels(), Model::all_discrete_real_variable_labels(), Variables::all_discrete_real_variables(), Model::all_discrete_real_variables(), SurrogateModel::approxBuilds, Model::current_variables(), Model::currentResponse, Model::currentVariables, Variables::cv(), Model::cv(), Model::discrete_design_set_int_values(), Model::discrete_design_set_real_values(), Model::discrete_state_set_int_values(), Model::discrete_state_set_real_values(), Model::discreteDesignSetIntValues, Model::discreteDesignSetRealValues, Model::discreteStateSetIntValues, Model::discreteStateSetRealValues, Variables::div(), Model::div(), Variables::drv(), Model::drv(), Model::epistDistParams, Model::epistemic_distribution_parameters(), Response::function_labels(), SharedVariablesData::id(), Constraints::linear_eq_constraint_coeffs(), Model::linear_eq_constraint_coeffs(), Constraints::linear_eq_constraint_targets(), Model::linear_eq_constraint_targets(), Constraints::linear_ineq_constraint_coeffs(), Model::linear_ineq_constraint_coeffs(), Constraints::linear_ineq_constraint_lower_bounds(), Model::linear_ineq_constraint_lower_bounds(), Constraints::linear_ineq_constraint_upper_bounds(), Model::linear_ineq_constraint_upper_bounds(), Constraints::nonlinear_eq_constraint_targets(), Model::nonlinear_eq_constraint_targets(), Constraints::nonlinear_ineq_constraint_lower_bounds(), Model::nonlinear_ineq_constraint_lower_bounds(), Constraints::nonlinear_ineq_constraint_upper_bounds(), Model::nonlinear_ineq_constraint_upper_bounds(), Model::num_linear_eq_constraints(), Model::num_linear_eq_constraint_coeffs(), Model::num_linear_eq_constraint_targets(), Model::num_nonlinear_eq_constraints(), Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), Model::primaryRespFnSense, Model::primaryRespFnWts, Model::response_labels(), Variables::shared_data(), and Model::userDefinedConstraints.

Referenced by DataFitSurrModel::build_global(), DataFitSurrModel::build_local_multipoint(), DataFitSurrModel::DataFitSurrModel(), DataFitSurrModel::derived_evaluate(), DataFitSurrModel::derived_evaluate_nowait(), DataFitSurrModel::DataFitSurrModel(), and DataFitSurrModel::update_from_subordinate_model().

13.27.4 Member Data Documentation

Model actualModel [private]
the truth model which provides evaluations for building the surrogate (optional for global, required for local)
actualModel is unrestricted in type; arbitrary nestings are possible.
13.28 DataInterface Class Reference

Handle class for interface specification data.

**Public Member Functions**

- **DataInterface ()**
  constructor
- **DataInterface (const DataInterface &)**
  copy constructor
- **~DataInterface ()**
  destructor
- **DataInterface & operator= (const DataInterface &)**
  assignment operator
- void **write (std::ostream &s) const**
  write a DataInterface object to an std::ostream
- void **read (MPIUnpackBuffer &s)**
  read a DataInterface object from a packed MPI buffer
- void **write (MPIPackBuffer &s) const**
  write a DataInterface object to a packed MPI buffer
- **DataInterfaceRep * data_rep ()**
  return dataIfaceRep

**Static Public Member Functions**

- static bool **id_compare (const DataInterface &di, const std::string &id)**
  compares the idInterface attribute of DataInterface objects

**Private Attributes**

- DataInterfaceRep * **datafaceRep**
  pointer to the body (handle-body idiom)
CHAPTER 13. CLASS DOCUMENTATION

Friends
- class ProblemDescDB
- class NIDRProblemDescDB

13.28.1 Detailed Description
Handle class for interface specification data.

The DataInterface class is used to provide a memory management handle for the data in DataInterface-Rep. It is populated by IDRProblemDescDB::interface_kwhandler() and is queried by the ProblemDescDB::get_<datatype>() functions. A list of DataInterface objects is maintained in ProblemDescDB::dataInterfaceList, one for each interface specification in an input file.

The documentation for this class was generated from the following files:
- DataInterface.hpp
- DataInterface.cpp

13.29 DataMethod Class Reference
Handle class for method specification data.

Public Member Functions
- DataMethod ()
  constructor
- DataMethod (const DataMethod &)
  copy constructor
- ~DataMethod ()
  destructor
- DataMethod & operator= (const DataMethod &)
  assignment operator
- void write (std::ostream &s) const
  write a DataMethod object to an std::ostream
- void read (MPIUnpackBuffer &s)
  read a DataMethod object from a packed MPI buffer
- void write (MPIPackBuffer &s) const
  write a DataMethod object to a packed MPI buffer
- DataMethodRep * data_rep ()
  return dataMethodRep

Static Public Member Functions
- static bool id_compare (const DataMethod &dm, const std::string &id)
  compares the idMethod attribute of DataMethod objects
Private Attributes

- **DataMethodRep * dataMethodRep**
  
  pointer to the body (handle-body idiom)

Friends

- class **ProblemDescDB**
- class **NIDRProblemDescDB**

13.29.1 Detailed Description

Handle class for method specification data.

The **DataMethod** class is used to provide a memory management handle for the data in **DataMethodRep**. It is populated by **IDRProblemDescDB::method_kwhandler()** and is queried by the **ProblemDescDB::get_<datatype>()** functions. A list of **DataMethod** objects is maintained in **ProblemDescDB::dataMethodList**, one for each method specification in an input file.

The documentation for this class was generated from the following files:

- **DataMethod.hpp**
- **DataMethod.cpp**

13.30 DataMethodRep Class Reference

Body class for method specification data.

Public Attributes

- **String idMethod**
  
  string identifier for the method specification data set (from the **id** method specification in **MethodIndControl**)

- **String modelPointer**
  
  string pointer to the model specification to be used by this method (from the **model_pointer** specification in **MethodIndControl**)

- **short methodOutput**
  
  method verbosity control: {SILENT,QUIET,NORMAL,VERBOSE,DEBUG} . OUTPUT (from the **output** specification in **MethodIndControl**)

- **int maxIterations**
  
  maximum number of iterations allowed for the method (from the **max_iterations** specification in **MethodIndControl**)

- **int maxFunctionEvaluations**
  
  maximum number of function evaluations allowed for the method (from the **max_function_evaluations specification in MethodIndControl**)

- **bool speculativeFlag**
  
  flag for use of speculative gradient approaches for maintaining parallel load balance during the line search portion of optimization algorithms (from the **speculative specification in MethodIndControl**)

- **bool methodUseDerivsFlag**
  
  flag for usage of derivative data to enhance the computation of surrogate models (PCE/SC expansions, GP models for EGO/EGRA/EGIE) based on the **use_derivatives specification**
- Real convergenceTolerance
  iteration convergence tolerance for the method (from the convergence_tolerance specification in MethodIndControl)
- Real constraintTolerance
  tolerance for controlling the amount of infeasibility that is allowed before an active constraint is considered to be violated (from the constraint_tolerance specification in MethodIndControl)
- bool methodScaling
  flag indicating scaling status (from the scaling specification in MethodIndControl)
- size_t numFinalSolutions
  number of final solutions returned from the iterator
- RealVector linearIneqConstraintCoeffs
  coefficient matrix for the linear inequality constraints (from the linear_inequality_constraint_matrix specification in MethodIndControl)
- RealVector linearIneqLowerBnds
  lower bounds for the linear inequality constraints (from the linear_inequality_lower_bounds specification in MethodIndControl)
- RealVector linearIneqUpperBnds
  upper bounds for the linear inequality constraints (from the linear_inequality_upper_bounds specification in MethodIndControl)
- StringArray linearIneqScaleTypes
  scaling types for the linear inequality constraints (from the linear_inequality_scale_types specification in MethodIndControl)
- RealVector linearIneqScales
  scaling factors for the linear inequality constraints (from the linear_inequality_scales specification in MethodIndControl)
- RealVector linearEqConstraintCoeffs
  coefficient matrix for the linear equality constraints (from the linear_equality_constraint_matrix specification in MethodIndControl)
- RealVector linearEqTargets
  targets for the linear equality constraints (from the linear_equality_targets specification in MethodIndControl)
- StringArray linearEqScaleTypes
  scaling types for the linear equality constraints (from the linear_equality_scale_types specification in MethodIndControl)
- RealVector linearEqScales
  scaling factors for the linear equality constraints (from the linear_equality_scales specification in MethodIndControl)
- unsigned short methodName
  the method selection: one of the optimizer, least squares, nond, dace, or parameter study methods
- unsigned short subMethod
  enum value for a sub-method type
- String subMethodName
  string identifier for a sub-method name within a multi-option method specification (e.g., from meta-iterators)
- String subModelPointer
  string pointer for a sub-model specification used by a meta-iterator
• String subMethodPointer
  string pointer for a sub-method specification used by a meta-iterator
• int iteratorServers
  number of servers for concurrent iterator parallelism (from the iterator_servers specification)
• int procsPerIterator
  number of processors for each concurrent iterator partition (from the processors_per_iterator specification)
• short iteratorScheduling
  type of scheduling ({DEFAULT,MASTER,PEER }.SCHEDULING) used in concurrent iterator parallelism (from the iterator_scheduling specification)
• StringArray hybridMethodNames
  array of methods for the sequential and collaborative hybrid meta-iterators (from the method_name_list specification)
• StringArray hybridModelPointers
  array of models for the sequential and collaborative hybrid meta-iterators (from the model_pointer_list specification)
• StringArray hybridMethodPointers
  array of methods for the sequential and collaborative hybrid meta-iterators (from the method_pointer_list specification)
• String hybridGlobalMethodName
  global method name for embedded hybrids (from the global_method_name specification)
• String hybridGlobalModelPointer
  global model pointer for embedded hybrids (from the global_model_pointer specification)
• String hybridGlobalMethodPointer
  global method pointer for embedded hybrids (from the global_method_pointer specification)
• String hybridLocalMethodName
  local method name for embedded hybrids (from the local_method_name specification)
• String hybridLocalModelPointer
  local model pointer for embedded hybrids (from the local_model_pointer specification)
• String hybridLocalMethodPointer
  local method pointer for embedded hybrids (from the local_method_pointer specification)
• Real hybridLSProb
  local search probability for embedded hybrids (from the local_search_probability specification)
• int concurrentRandomJobs
  number of random jobs to perform in the pareto_set and multi_start meta-iterators (from the random_starts and random_weight_sets specifications)
• RealVector concurrentParameterSets
  user-specified (i.e., nonrandom) parameter sets to evaluate in the pareto_set and multi_start meta-iterators (from the starting_points and weight_sets specifications)
• unsigned short softConvLimit
  number of consecutive iterations with change less than convergenceTolerance required to trigger convergence
• bool surrBasedLocalLayerBypass
  flag to indicate user-specification of a bypass of any/all layerings in evaluating truth response values in SBL.
• Real surrBasedLocalTRInitSize
initial trust region size in the surrogate-based local method (from the initial_size specification in MethodSBL) note: this is a relative value, e.g., 0.1 = 10% of global bounds distance (upper bound - lower bound) for each variable

- Real surrBasedLocalTRMinSize
  minimum trust region size in the surrogate-based local method (from the minimum_size specification in MethodSBL), if the trust region size falls below this threshold the SBL iterations are terminated (note: if kriging is used with SBL, the min trust region size is set to 1.0e-3 in attempt to avoid ill-conditioned matrixes that arise in kriging over small trust regions)

- Real surrBasedLocalTContractTrigger
  trust region minimum improvement level (ratio of actual to predicted decrease in objective fcn) in the surrogate-based local method (from the contract_threshold specification in MethodSBL), the trust region shrinks or is rejected if the ratio is below this value ("\textit{\textbf{\textit{eta}}}_1" in the Conn-Gould-Toint trust region book)

- Real surrBasedLocalTExpandTrigger
  trust region sufficient improvement level (ratio of actual to predicted decrease in objective fn) in the surrogate-based local method (from the expand_threshold specification in MethodSBL), the trust region expands if the ratio is above this value ("\textit{\textbf{\textit{eta}}}_2" in the Conn-Gould-Toint trust region book)

- Real surrBasedLocalTContract
  trust region contraction factor in the surrogate-based local method (from the contraction_factor specification in MethodSBL)

- Real surrBasedLocalTExpand
  trust region expansion factor in the surrogate-based local method (from the expansion_factor specification in MethodSBL)

- short surrBasedLocalSubProbObj
  SBL approximate subproblem objective: ORIGINAL_PRIMARY, SINGLE_OBJECTIVE, LAGRANGIAN_OBJECTIVE, or AUGMENTED_LAGRANGIAN_OBJECTIVE.

- short surrBasedLocalSubProbCon
  SBL approximate subproblem constraints: NO_CONSTRAINTS, LINEARIZED_CONSTRAINTS, or ORIGINAL_CONSTRAINTS.

- short surrBasedLocalMeritFn
  SBL merit function type: BASIC_PENALTY, ADAPTIVE_PENALTY, BASIC_LAGRANGIAN, or AUGMENTED_LAGRANGIAN.

- short surrBasedLocalAcceptLogic
  SBL iterate acceptance logic: TR_RATIO or FILTER.

- short surrBasedLocalConstrRelax
  SBL constraint relaxation method: NO_RELAX or HOMOTOPY.

- bool surrBasedGlobalReplacePts
  user-specified method for adding points to the set upon which the next surrogate is based in the surrogate-based_global method.

- String dlDetails
  string of options for a dynamically linked solver

- void * dlLib
  handle to dynamically loaded library

- int verifyLevel
  the verify_level specification in MethodNPSOLDC

- Real functionPrecision
  the function_precision specification in MethodNPSOLDC and the EPSILON specification in NOMAD
13.30. **DATAMETHODREP CLASS REFERENCE**

- **Real lineSearchTolerance**
  - The linesearch_tolerance specification in MethodNPSOLDC
- **Real absConvTol**
  - Absolute function convergence tolerance
- **Real xConvTol**
  - X-convergence tolerance
- **Real singConvTol**
  - Singular convergence tolerance
- **Real singRadius**
  - Radius for singular convergence test
- **Real falseConvTol**
  - False-convergence tolerance
- **Real initTRRadius**
  - Initial trust radius
- **int covarianceType**
  - Kind of covariance required
- **bool regressDiag**
  - Whether to print the regression diagnostic vector
- **String searchMethod**
  - The search_method specification for Newton and nonlinear interior-point methods in MethodOPTPPDC
- **Real gradientTolerance**
  - The gradient_tolerance specification in MethodOPTPPDC
- **Real maxStep**
  - The max_step specification in MethodOPTPPDC
- **short meritFn**
  - The merit_function specification for nonlinear interior-point methods in MethodOPTPPDC
- **Real stepLenToBoundary**
  - The stepLen_to_boundary specification for nonlinear interior-point methods in MethodOPTPPDC
- **Real centeringParam**
  - The centering_param specification for nonlinear interior-point methods in MethodOPTPPDC
- **int searchSchemeSize**
  - The search_scheme_size specification for PDS methods in MethodOPTPPDC
- **Real initStepLength**
  - The initStepLength choice for nonlinearly constrained APPS in MethodAPPSDC
- **Real contractStepLength**
  - The contractStepLength choice for nonlinearly constrained APPS in MethodAPPSDC
- **Real threshStepLength**
  - The threshStepLength choice for nonlinearly constrained APPS in MethodAPPSDC
- **String meritFunction**
  - The meritFunction choice for nonlinearly constrained APPS in MethodAPPSDC
- **Real constrPenalty**
  - The constrPenalty choice for nonlinearly constrained APPS in MethodAPPSDC
- **Real smoothFactor**
CHAPTER 13. CLASS DOCUMENTATION

- Real smoothFactor
  the initial smoothFactor value for nonlinearly constrained APPS in MethodAPPSDC
- Real constraintPenalty
  the initial constraint_penalty for COLINY methods in MethodAPPS, MethodSCOLIBDIR, MethodSCOLIBPS, MethodSCOLIBSW and MethodSCOLIBEA
- bool constantPenalty
  the constant_penalty flag for COLINY methods in MethodSCOLIBPS and MethodSCOLIBSW
- Real globalBalanceParam
  the global_balance parameter for the DIRECT method in MethodSCOLIBDIR
- Real localBalanceParam
  the local_balance parameter for the DIRECT method in MethodSCOLIBDIR
- Real maxBoxSize
  the max_boxsize_limit for the DIRECT method in MethodSCOLIBDIR
- Real minBoxSize
  the min_boxsize_limit for the DIRECT method in MethodSCOLIBDIR and MethodNCSUDC
- String boxDivision
  the division setting (major_dimension or all_dimensions) for the DIRECT method in MethodSCOLIBDIR
- bool mutationAdaptive
  the non_adaptive specification for the coliny_ea method in MethodSCOLIBEA
- bool showMiscOptions
  the show_misc_options specification in MethodSCOLIBDC
- StringArray miscOptions
  the misc_options specification in MethodSCOLIBDC
- Real solnTarget
  the solution_target specification in MethodSCOLIBDC
- Real crossoverRate
  the crossover_rate specification for EA methods in MethodSCOLIBEA
- Real mutationRate
  the mutation_rate specification for EA methods in MethodSCOLIBEA
- Real mutationScale
  the mutation_scale specification for EA methods in MethodSCOLIBEA
- Real mutationMinScale
  the min_scale specification for mutation in EA methods in MethodSCOLIBEA
- Real initialDelta
  the initial_delta specification for APPS/COBYLA/PS/SW methods in MethodAPPS, MethodSCOLIBCOB, MethodSCOLIBPS, and MethodSCOLIBSW
- Real threshDelta
  the threshold_delta specification for APPS/COBYLA/PS/SW methods in MethodAPPS, MethodSCOLIBCOB, MethodSCOLIBPS, and MethodSCOLIBSW
- Real contractionFactor
  the contraction_factor specification for APPS/PS/SW methods in MethodAPPS, MethodSCOLIBPS, and MethodSCOLIBSW
- int newSolsGenerated
  the new_solutions_generated specification for GA/EPSA methods in MethodSCOLIBEA
• int numberRetained
  the integer assignment to random, chc, or elitist in the replacement_type specification for GA/EPSA methods in MethodSCOLIBEA

• bool expansionFlag
  the no_expansion specification for APPS/PS/SW methods in MethodAPPS, MethodSCOLIBPS, and MethodSCOLIBSW

• int expandAfterSuccess
  the expand_after_success specification for PS/SW methods in MethodSCOLIBPS and MethodSCOLIBSW

• int contractAfterFail
  the contract_after_failure specification for the SW method in MethodSCOLIBSW

• int mutationRange
  the mutation_range specification for the pga_int method in MethodSCOLIBEA

• int totalPatternSize
  the total_pattern_size specification for PS methods in MethodSCOLIBPS

• bool randomizeOrderFlag
  the stochastic specification for the PS method in MethodSCOLIBPS

• String selectionPressure
  the fitness_type specification for EA methods in MethodSCOLIBEA

• String replacementType
  the replacement_type specification for EA methods in MethodSCOLIBEA

• String crossoverType
  the crossover_type specification for EA methods in MethodSCOLIBEA

• String mutationType
  the mutation_type specification for EA methods in MethodSCOLIBEA

• String exploratoryMoves
  the exploratory_moves specification for the PS method in MethodSCOLIBPS

• String patternBasis
  the pattern_basis specification for APPS/PS methods in MethodAPPS and MethodSCOLIBPS

• String betaSolverName
  beta solvers don’t need documentation

• String evalSynchronize
  the synchronization setting for parallel pattern search methods in MethodSCOLIBPS and MethodAPPS

• size_t numCrossPoints
  The number of crossover points or multi-point schemes.

• size_t numParents
  The number of parents to use in a crossover operation.

• size_t numOffspring
  The number of children to produce in a crossover operation.

• String fitnessType
  the fitness assessment operator to use.

• String convergenceType
  The means by which this JEGA should converge.

• Real percentChange
The minimum percent change before convergence for a fitness tracker converger.

- **size_t numGenerations**
  The number of generations over which a fitness tracker converger should track.

- **Real fitnessLimit**
  The cutoff value for survival in fitness limiting selectors (e.g., below_limit selector).

- **Real shrinkagePercent**
  The minimum percentage of the requested number of selections that must take place on each call to the selector (0, 1).

- **String nichingType**
  The niching type.

- **RealVector nicheVector**
  The discretization percentage along each objective.

- **size_t numDesigns**
  The maximum number of designs to keep when using the max_designs nicher.

- **String postProcessorType**
  The post processor type.

- **RealVector distanceVector**
  The discretization percentage along each objective.

- **String initializationType**
  The means by which the JEGA should initialize the population.

- **String flatFile**
  The filename to use for initialization.

- **String logFile**
  The filename to use for logging.

- **int populationSize**
  The population_size specification for GA methods in MethodSCOLIBEA

- **bool printPopFlag**
  The print_each_pop flag to set the printing of the population at each generation.

- **Real volBoxSize**
  The volume_boxsize_limit for the DIRECT method in MethodNCSUDC

- **int numSymbols**
  The symbols specification for DACE methods

- **bool mainEffectsFlag**
  The main_effects specification for sampling methods in MethodDDACE

- **bool latinizeFlag**
  The latinize specification for FSU QMC and CVT methods in MethodFSUDACE

- **bool volQualityFlag**
  The quality_metrics specification for sampling methods (FSU QMC and CVT methods in MethodFSUDACE)

- **IntVector sequenceStart**
  The sequenceStart specification in MethodFSUDACE

- **IntVector sequenceLeap**
  The sequenceLeap specification in MethodFSUDACE

- **IntVector primeBase**
the primeBase specification in MethodFSUDACE
• int numTrials
  the numTrials specification in MethodFSUDACE
• String trialType
  the trial_type specification in MethodFSUDACE
• int randomSeed
  the seed specification for COLINY, NonD, & DACE methods
• String historyFile
  the HISTORY_FILE specification for NOMAD
• String displayFormat
  the DISPLAY_STATS specification for NOMAD
• Real vns
  the VNS specification for NOMAD
• int neighborOrder
  the NEIGHBOR_ORDER specification for NOMAD
• bool showAllEval
  the DISPLAY_ALL_EVAL specification for NOMAD
• int numSamples
  the samples specification for NonD & DACE methods
• bool fixedSeedFlag
  flag for fixing the value of the seed among different NonD/DACE sample sets. This results in the use of the same sampling stencil/pattern throughout an execution with repeated sampling.
• bool fixedSequenceFlag
  flag for fixing the sequence for Halton or Hammersley QMC sample sets. This results in the use of the same sampling stencil/pattern throughout an execution with repeated sampling.
• bool vbdFlag
  the var_based_decomp specification for a variety of sampling methods
• Real vbdDropTolerance
  the var_based_decomp tolerance for omitting index output
• bool backfillFlag
  the backfill option allows one to augment in LHS sample by enforcing the addition of unique discrete variables to the sample
• bool pcaFlag
  Flag to specify the calculation of principal components when using LHS.
• Real percentVarianceExplained
  The percentage of variance explained by using a truncated number of principal components in PCA.
• bool wilksFlag
  Flag to specify use of Wilks formula to calculate num samples.
• unsigned short wilksOrder
  Wilks order parameter.
• Real wilksConfidenceLevel
  Wilks confidence interval parameter.
• short wilksSidedInterval
  Wilks sided interval type.
• unsigned short vbdOrder
  a sub-specification of vbdFlag: interaction order limit for calculation/output of component VBD indices
• short covarianceControl
  restrict the calculation of a full response covariance matrix for high dimensional outputs: \{DEFAULT, DIAGONAL, FULL\}.COVARIANCE
• String rngName
  the basic random-number generator for NonD
• short refinementType
  refinement type for stochastic expansions from dimension refinement keyword group
• short refinementControl
  refinement control for stochastic expansions from dimension refinement keyword group
• short nestingOverride
  override for default point nesting policy: NO_NESTING OVERRIDE, NESTED, or NON_NESTED
• short growthOverride
  override for default point growth restriction policy: NO_GROWTH OVERRIDE, RESTRICTED, or UNRESTRICTED
• short expansionType
  enumeration for u-space type that defines u-space variable targets for probability space transformations: EXTENDED_U (default), ASKEY_U, STD_NORMAL_U, or STD_UNIFORM_U
• bool piecewiseBasis
  boolean indicating presence of piecewise keyword
• short expansionBasisType
  enumeration indicating type of basis in sparse grid interpolation (Pecos::\{NODAL, HIERARCHICAL\}.INTERPOLANT) or regression (Pecos::\{TENSOR_PRODUCT, TOTAL_ORDER, ADAPTED\}.BASIS).
• UShortArray expansionOrder
  the expansion order specification in MethodNonDPCE
• SizetArray expansionSamples
  the expansion samples specification in MethodNonDPCE
• String expansionSampleType
  allows for incremental PCE construction using the incremental_lhs specification in MethodNonDPCE
• UShortArray quadratureOrder
  the quadrature order specification in MethodNonDPCE and MethodNonDSC
• UShortArray sparseGridLevel
  the sparse grid level specification in MethodNonDPCE, MethodNonDSC, and other stochastic expansion-enabled methods
• RealVector anisoDimPref
  the dimension preference specification for tensor and sparse grids and expansion orders in MethodNonDPCE and MethodNonDSC
• unsigned short cubIntOrder
  the cubature integrand specification in MethodNonDPCE
• SizetArray collocationPoints
  the collocation points specification in MethodNonDPCE
• Real collocationRatio
  the collocation ratio specification in MethodNonDPCE
• Real `collocRatioTermsOrder`
  order applied to the number of expansion terms when applying or computing the collocation ratio within regression PCE; based on the `ratio_order` specification in MethodNonDPCE

• short `regressionType`
  type of regression: LS, OMP, BP, BPDN, LARS, or LASSO

• short `lsRegressionType`
  type of least squares regression: SVD or `EQ`, `CON`, `QR`

• RealVector `regressionNoiseTol`
  noise tolerance(s) for OMP, BPDN, LARS, and LASSO

• Real `regressionL2Penalty`
  L2 regression penalty for a variant of LASSO known as the elastic net method (default of 0 gives standard LASSO)

• bool `crossValidation`
  flag indicating the use of cross-validation across expansion orders (given a prescribed maximum order) and, for some methods, noise tolerances

• bool `crossValidNoiseOnly`
  flag indicating the restriction of cross-validation to estimate only the most effective noise tolerance; used to reduce cost from performing CV over both noise tolerances and expansion orders

• unsigned short `adaptedBasisAdvancements`
  initial grid level for the ADAPTED BASIS EXPANDING FRONT approach to defining the candidate basis for sparse recovery (compressed sensing)

• bool `normalizedCoeffs`
  flag indicating the output of PCE coefficients corresponding to normalized basis polynomials

• String `pointReuse`
  allows PCE construction to reuse points from previous sample sets or data import using the `reuse_points` specification in MethodNonDPCE

• bool `tensorGridFlag`
  flag for usage of a sub-sampled set of tensor-product grid points within regression PCE; based on the `tensor_grid` specification in MethodNonDPCE

• UShortArray `tensorGridOrder`
  order of tensor-product grid points that are sub-sampled within orthogonal least interpolation PCE; based on the `tensor_grid` specification in MethodNonDPCE

• String `importExpansionFile`
  the `import_expansion_file` specification in MethodNonDPCE

• String `exportExpansionFile`
  the `export_expansion_file` specification in MethodNonDPCE

• unsigned short `sampleType`
  the `sample_type` specification in MethodNonDMC, MethodNonDPCE, and MethodNonDSC

• bool `dOptimal`
  whether to generate D-optimal designs

• unsigned short `reliabilitySearchType`
  the type of limit state search in MethodNonDLocalRel (x_taylor_mean, x_taylor_mpp, x_two_point, u_taylor_mean, u_taylor_mpp, u_two_point, or no_approx) or MethodNonDGlobalRel (x_gaussian_process or u_gaussian_process)

• String `reliabilityIntegration`
  the first_order or second_order integration selection in MethodNonDLocalRel
• unsigned short integrationRefine
  the import, adapt_import, or mm_adapt_import integration refinement selection in MethodNonDLocalRel,
  MethodNonDPCE, and MethodNonDSC

• IntVector refineSamples
  Sequence of refinement samples, e.g., the size of the batch (e.g. number of supplemental points added) to be added
  to be added to the build points for an emulator at each iteration.

• SizetArray pilotSamples
  the pilot_samples selection in MethodMultilevelMC

• short distributionType
  the distribution cumulative or complementary specification in MethodNonD

• short responseLevelTarget
  the compute probabilities, reliabilities, or gen_reliabilities specification in MethodNonD

• short responseLevelTargetReduce
  the system series or parallel specification in MethodNonD

• RealVectorArray responseLevels
  the response_levels specification in MethodNonD

• RealVectorArray probabilityLevels
  the probability_levels specification in MethodNonD

• RealVectorArray reliabilityLevels
  the reliability_levels specification in MethodNonD

• RealVectorArray genReliabilityLevels
  the gen_reliability_levels specification in MethodNonD

• int chainSamples
  the number of MCMC chain samples

• int buildSamples
  the number of samples to construct an emulator, e.g., for Bayesian calibration methods

• int samplesOnEmulator
  number of samples to perform on emulator

• int emulatorOrder
  The total order to be used in construction of a VPS surrogate.

• short emulatorType
  the emulator specification in MethodNonDBayesCalib

• String mcmcType
  the mcmc type specification in MethodNonDBayesCalib

• bool standardizedSpace
  use of standardized probability spaces for MCMC within Bayesian inference

• bool adaptPosteriorRefine
  flag indicating adaptive refinement of the emulator in regions of high posterior probability

• bool logitTransform
  flag indicating user activation of logit transform option within QUESO

• unsigned short preSolveMethod
  the method used for performing a pre-solve for the MAP point

• String proposalCovType
13.30. DATAMETHODREP CLASS REFERENCE

the type of proposal covariance: user, derivatives, or prior

- int proposalCovUpdates
  number of updates of the proposal covariance from computing the misfit Hessian using residual values and derivatives

- String proposalCovInputType
  the format of proposal covariance input: diagonal or matrix

- RealVector proposalCovData
  raw list of real data for the proposal covariance

- String proposalCovFile
  file from which to read proposal covariance in diagonal or matrix format

- String fitnessMetricType
  the fitness metric type specification in MethodNonDAdaptive

- String batchSelectionType
  the batch selection type specification in MethodNonDAdaptive

- String lipschitzType
  the Lipschitz type specification in MethodNonDPOFDarts (e.g. either local or global estimation)

- unsigned short calibrateErrorMode
  calibration mode for observation error multipliers (CALIBRATE_*)

- RealVector hyperPriorAlphas
  hyperparameters inverse gamma prior alphas

- RealVector hyperPriorBetas
  hyperparameters inverse gamma prior alphas

- int burnInSamples
  number of MCMC samples to discard from acceptance chain

- int subSamplingPeriod
  period or skip in post-processing the acceptance chain

- int numChains
  number of concurrent chains

- int numCR
  number of CR-factors

- int crossoverChainPairs
  number of crossover chain pairs

- Real grThreshold
  threshold for the Gelman-Rubin statistic

- int jumpStep
  how often to perform a long jump in generations

- String dataDistType
  the type of data distribution: kde, or gaussian

- String dataDistCovInputType
  the format of data distribution gaussian covariance input: diagonal or matrix

- RealVector dataDistMeans
  raw list of real data for the data distribution gaussian means

- RealVector dataDistCovariance
raw list of real data for the data distribution gaussian covariance

- String `dataDistFile`
  file from which to read data distribution data (covariance or samples)

- String `posteriorDensityExportFilename`
  The filename of the export file containing an arbitrary set of samples and their corresponding density values.

- String `posteriorSamplesExportFilename`
  The filename of the export file containing samples from the posterior and their corresponding density values.

- String `posteriorSamplesImportFilename`
  The filename of the import file containing samples at which the posterior will be evaluated.

- bool `generatePosteriorSamples`
  Flag specifying whether to generate random samples from the posterior.

- bool `evaluatePosteriorDensity`
  Flag specifying whether to evaluate the posterior density at a set of samples.

- RealVector `finalPoint`
  the \textit{final point} specification in MethodPSVPS

- RealVector `stepVector`
  the \textit{step vector} specification in MethodPSVPS and MethodPSCPS

- int `numSteps`
  the \textit{num steps} specification in MethodPSVPS

- IntVector `stepsPerVariable`
  the \textit{deltas per variable} specification in MethodPSCPS

- RealVector `listOfPoints`
  the \textit{list of points} specification in MethodPSLPS

- String `pstudyFilename`
  the \textit{import points file} spec for a file-based parameter study

- unsigned short `pstudyFileFormat`
  tabular format for the parameter study points file

- bool `pstudyFileActive`
  whether to import active variables only

- UShortArray `varPartitions`
  the \textit{partitions} specification for PStudy method in MethodPSMPS

- Real `refinementRate`
  rate of mesh refinement in Richardson extrapolation

- String `importBuildPtsFile`
  the file name from the \textit{import build points file} specification

- unsigned short `importBuildFormat`
  tabular format for the build point import file

- bool `importBuildActive`
  whether to import active variables only

- String `importApproxPtsFile`
  the file name from the \textit{import approx points file} specification

- unsigned short `importApproxFormat`
  tabular format for the approx point import file
- `bool importApproxActive`  
  whether to import active variables only
- `String exportApproxPtsFile`  
  the file name from the `export_approx_points_file` specification
- `unsigned short exportApproxFormat`  
  tabular format for the approx point export file
- `String exportMCMCPointsFile`  
  the file name from the `export_mcmc_points_file` specification
- `unsigned short exportMCMCFormat`  
  tabular format for the MCMC chain export file

### Private Member Functions

- `DataMethodRep ()`  
  constructor
- `~DataMethodRep ()`  
  destructor
- `void write (std::ostream &s) const`  
  write a DataInterfaceRep object to an std::ostream
- `void read (MPIUnpackBuffer &s)`  
  read a DataInterfaceRep object from a packed MPI buffer
- `void write (MPIPackBuffer &s) const`  
  write a DataInterfaceRep object to a packed MPI buffer

### Private Attributes

- `int referenceCount`  
  number of handle objects sharing this dataMethodRep

### Friends

- `class DataMethod`  
  the handle class can access attributes of the body class directly

### 13.30.1 Detailed Description

Body class for method specification data.  

The `DataMethodRep` class is used to contain the data from a method keyword specification. Default values are managed in the `DataMethodRep` constructor. Data is public to avoid maintaining set/get functions, but is still encapsulated within `ProblemDescDB` since `ProblemDescDB::dataMethodList` is private.  

The documentation for this class was generated from the following files:

- `DataMethod.hpp`
- `DataMethod.cpp`
13.31 DataModel Class Reference

Handle class for model specification data.

Public Member Functions

- **DataModel ()**
  constructor
- **DataModel (const DataModel &)**
  copy constructor
- **~DataModel ()**
  destructor
- **DataModel & operator= (const DataModel &)**
  assignment operator
- **void write (std::ostream &s) const**
  write a DataModel object to an std::ostream
- **void read (MPIUnpackBuffer &s)**
  read a DataModel object from a packed MPI buffer
- **void write (MPIPackBuffer &s) const**
  write a DataModel object to a packed MPI buffer
- **DataModelRep * data_rep ()**
  return dataModelRep

Static Public Member Functions

- **static bool id_compare (const DataModel &dm, const std::string &id)**
  compares the idModel attribute of DataModel objects

Private Attributes

- **DataModelRep * dataModelRep**
  pointer to the body (handle-body idiom)

Friends

- class ProblemDescDB
- class NIDRProblemDescDB

13.31.1 Detailed Description

Handle class for model specification data.

The DataModel class is used to provide a memory management handle for the data in DataModelRep. It is populated by IDRProblemDescDB::model_kwhandler() and is queried by the ProblemDescDB::get_<datatype>() functions. A list of DataModel objects is maintained in ProblemDescDB::dataModelList, one for each model specification in an input file.

The documentation for this class was generated from the following files:

- DataModel.hpp
- DataModel.cpp
13.32 DataModelRep Class Reference

Body class for model specification data.

Public Attributes

- **String idModel**
  string identifier for the model specification data set (from the id_model specification in ModelIndControl)

- **String modelType**
  model type selection: single, surrogate, or nested (from the model type specification in ModelIndControl)

- **String variablesPointer**
  string pointer to the variables specification to be used by this model (from the variables_pointer specification in ModelIndControl)

- **String interfacePointer**
  string pointer to the interface specification to be used by this model (from the interface_pointer specification in ModelSingle and the optional_interface_pointer specification in ModelNested)

- **String responsesPointer**
  string pointer to the responses specification to be used by this model (from the responses_pointer specification in ModelIndControl)

- **bool hierarchicalTags**
  whether this model and its children will add hierarchy-based tags to eval ids

- **String subMethodPointer**
  pointer to a sub-iterator used for global approximations (from the dace_method_pointer specification in ModelSurrG) or by nested models (from the sub_method_pointer specification in ModelNested)

- **String solutionLevelControl**
  (state) variable identifier that defines a set or range of solution level controls (space/time discretization levels, iterative convergence tolerances, etc.) for defining a secondary hierarchy of fidelity within the scope of a single model form (from solution_level_control specification; see also ordered_model_fidelities)

- **RealVector solutionLevelCost**
  array of relative simulation costs corresponding to each of the solution levels (from solution_level_cost specification; see also solution_level_control); a scalar input is interpreted as a constant cost multiplier to be applied recursively

- **IntSet surrogateFnIndices**
  array specifying the response function set that is approximated

- **String surrogateType**
  the selected surrogate type: local_taylor, multipoint_tana, global_(neural_network,mars,orthogonal_polynomial,gaussian, polynomial,kriging), or hierarchical

- **String actualModelPointer**
  pointer to the model specification for constructing the truth model used in constructing surrogates (from the actual_model_pointer specification in ModelSurrL and ModelSurrMP)

- **StringArray orderedModelPointers**
  an ordered list of model pointers (low to high) corresponding to a hierarchy of modeling fidelity (from the ordered_model_fidelities specification in ModelSurrH)

- **int pointsTotal**
  user-specified lower bound on total points with which to build the model (if reuse_points < pointsTotal, new samples will make up the difference)
• short **pointsManagement**
  
  points management configuration for DataFitSurrModel: DEFAULT_POINTS, MINIMUM_POINTS, or RECOMMENDED_POINTS

• String **approxPointReuse**
  
  sample reuse selection for building global approximations: none, all, region, or file (from the reuse_samples specification in ModelSurrG)

• String **importBuildPtsFile**
  
  the file name from the import_build_points_file specification in ModelSurrG

• unsigned short **importBuildFormat**
  
  tabular format for the build point import file

• bool **importBuildActive**
  
  whether to import active variables only

• String **exportApproxPtsFile**
  
  the file name from the export_approx_points_file specification in ModelSurrG

• unsigned short **exportApproxFormat**
  
  tabular format for the approx point export file

• bool **exportSurrogate**
  
  Option to turn on surrogate model export (export_model)

• String **modelExportPrefix**
  
  the filename prefix for export_model

• unsigned short **modelExportFormat**
  
  Format selection for export_model.

• short **approxCorrectionType**
  
  correction type for global and hierarchical approximations: NO_CORRECTION, ADDITIVE_CORRECTION, MULTIPLICATIVE_CORRECTION, or COMBINED_CORRECTION (from the correction specification in ModelSurrG and ModelSurrH)

• short **approxCorrectionOrder**
  
  correction order for global and hierarchical approximations: 0, 1, or 2 (from the correction specification in ModelSurrG and ModelSurrH)

• bool **modelUseDerivsFlag**
  
  flags the use of derivatives in building global approximations (from the use_derivatives specification in ModelSurrG)

• short **polynomialOrder**
  
  scalar integer indicating the order of the polynomial approximation (1=linear, 2=quadratic, 3=cubic; from the polynomial specification in ModelSurrG)

• RealVector **krigingCorrelations**
  
  vector of correlations used in building a kriging approximation (from the correlations specification in ModelSurrG)

• String **krigingOptMethod**
  
  optimization method to use in finding optimal correlation parameters: none, sampling, local, global

• short **krigingMaxTrials**
  
  maximum number of trials in optimization of kriging correlations

• RealVector **krigingMaxCorrelations**
  
  upper bound on kriging correlation vector

• RealVector **krigingMinCorrelations**
lower bound on kriging correlation vector

- Real **krigingNugget**
  - nugget value for kriging
- short **krigingFindNugget**
  - option to have Kriging find the best nugget value to use
- short **mlsWeightFunction**
  - weight function for moving least squares approximation
- short **rbfBases**
  - bases for radial basis function approximation
- short **rbfMaxPts**
  - maximum number of points for radial basis function approximation
- short **rbfMaxSubsets**
  - maximum number of subsets for radial basis function approximation
- short **rbfMinPartition**
  - minimum partition for radial basis function approximation
- short **marsMaxBases**
  - maximum number of bases for MARS approximation
- String **marsInterpolation**
  - interpolation type for MARS approximation
- short **annRandomWeight**
  - random weight for artificial neural network approximation
- short **annNodes**
  - number of nodes for artificial neural network approximation
- Real **annRange**
  - range for artificial neural network approximation
- bool **domainDecomp**
  - whether domain decomposition is enabled
- String **decompCellType**
  - type of local cell of domain decomp
- int **decompSupportLayers**
  - number of support layers for each local basis function
- bool **decompDiscontDetect**
  - whether discontinuity detection is enabled
- Real **discontJumpThresh**
  - function value (jump) threshold for discontinuity detection in domain decomp
- Real **discontGradThresh**
  - gradient threshold for discontinuity detection in domain decomp
- String **trendOrder**
  - scalar integer indicating the order of the Gaussian process mean (0= constant, 1=linear, 2=quadratic, 3=cubic); from the gaussian process specification in ModelSurfG)
- bool **pointSelection**
  - flag indicating the use of point selection in the Gaussian process
- StringArray **diagMetrics**
List of diagnostic metrics the user requests to assess the goodness of fit for a surrogate model.

- **bool crossValidateFlag**
  
  Flag indicating the use of cross validation on the metrics specified

- **int numFolds**
  
  Number of folds to perform in cross validation

- **Real percentFold**
  
  Percentage of data to withhold for cross validation process

- **bool pressFlag**
  
  Flag indicating the use of PRESS on the metrics specified

- **String importChallengePtsFile**
  
  The file name from the challenge_points_file specification in ModelSurrG

- **StringArray primaryVarMaps**
  
  The primary variable mappings used in nested models for identifying the lower level variable targets for inserting top level variable values (from the primary_variable_mapping specification in ModelNested)

- **StringArray secondaryVarMaps**
  
  The secondary variable mappings used in nested models for identifying the (distribution) parameter targets within the lower level variables for inserting top level variable values (from the secondary_variable_mapping specification in ModelNested)

- **RealVector primaryRespCoeffs**
  
  The primary response mapping matrix used in nested models for weighting contributions from the sub-iterator responses in the top level (objective) functions (from the primary_response_mapping specification in ModelNested)

- **RealVector secondaryRespCoeffs**
  
  The secondary response mapping matrix used in nested models for weighting contributions from the sub-iterator responses in the top level (constraint) functions (from the secondary_response_mapping specification in ModelNested)

- **int subMethodServers**
  
  Number of servers for concurrent sub-iterator parallelism

- **int subMethodProcs**
  
  Number of processors for each concurrent sub-iterator partition

- **short subMethodScheduling**
  
  Scheduling approach for concurrent sub-iterator parallelism: \{DEFAULT,MASTER,PEER\}_SCHEDULING

- **int initialSamples**
  
  Initial samples to build the subspace model

- **IntVector refineSamples**
  
  Refinement samples to add in each batch

- **int maxIterations**
  
  Maximum number of subspace build iterations
• Real convergenceTolerance
  convergence tolerance on build process
• bool subspaceIdBingLi
  Flag to use Bing Li method to identify active subspace dimension.
• bool subspaceIdConstantine
  Flag to use Constantine method to identify active subspace dimension.
• bool subspaceIdEnergy
  Flag to use eigenvalue energy method to identify active subspace dimension.
• int dimension
  Size of subspace.
• int numReplicates
  Number of bootstrap samples for subspace identification.
• bool autoRefine
  whether automatic surrogate refinement is enabled
• int maxFunctionEvals
  maximum evals in refinement
• String refineCVMetric
  metric to use in cross-validation guided refinement
• int refineCVFolds
  number of cross-validation folds in guided refinement
• unsigned short randomFieldIdForm
  Contains which type of random field model.
• unsigned short analyticCovIdForm
  Contains which type of analytic covariance function.
• Real truncationTolerance
  truncation tolerance on build process: percent variance explained
• String propagationModelPointer
  pointer to the model through which to propagate the random field
• String rfDataFileName
  File from which to build the random field.

Private Member Functions

• DataModelRep ()
  constructor
• ~DataModelRep ()
  destructor
• void write (std::ostream &s) const
  write a DataModelRep object to an std::ostream
• void read (MPIUnpackBuffer &s)
  read a DataModelRep object from a packed MPI buffer
• void write (MPIPackBuffer &s) const
  write a DataModelRep object to a packed MPI buffer
CHAPTER 13. CLASS DOCUMENTATION

Private Attributes

- int referenceCount
  
  number of handle objects sharing this dataModelRep

Friends

- class DataModel
  
  the handle class can access attributes of the body class directly

13.32.1 Detailed Description

Body class for model specification data.

The DataModelRep class is used to contain the data from a model keyword specification. Default values are managed in the DataModelRep constructor. Data is public to avoid maintaining set/get functions, but is still encapsulated within ProblemDescDB since ProblemDescDB::dataModelList is private.

The documentation for this class was generated from the following files:

- DataModel.hpp
- DataModel.cpp

13.33 DataResponses Class Reference

Handle class for responses specification data.

Public Member Functions

- DataResponses ()
  
  constructor
- DataResponses (const DataResponses &)
  
  copy constructor
- ~DataResponses ()
  
  destructor
- DataResponses & operator= (const DataResponses &)
  
  assignment operator
- void write (std::ostream &s) const
  
  write a DataResponses object to an std::ostream
- void read (MPIUnpackBuffer &s)
  
  read a DataResponses object from a packed MPI buffer
- void write (MPIPackBuffer &s) const
  
  write a DataResponses object to a packed MPI buffer
- DataResponsesRep * data_rep ()
  
  return dataRespRep

Static Public Member Functions

- static bool id_compare (const DataResponses &dr, const std::string &id)
  
  compares the idResponses attribute of DataResponses objects
Private Attributes

- DataResponsesRep * dataRespRep
  pointer to the body (handle-body idiom)

Friends

- class ProblemDescDB
- class NIDRProblemDescDB

13.33.1 Detailed Description

Handle class for responses specification data.

The DataResponses class is used to provide a memory management handle for the data in DataResponsesRep. It is populated by IDRProblemDescDB::responses_kwhandler() and is queried by the ProblemDescDB::get_<datatype>() functions. A list of DataResponses objects is maintained in ProblemDescDB::dataResponsesList, one for each responses specification in an input file.

The documentation for this class was generated from the following files:

- DataResponses.hpp
- DataResponses.cpp

13.34 DataResponsesRep Class Reference

Body class for responses specification data.

Public Attributes

- String idResponses
  string identifier for the responses specification data set (from the id_responses specification in RespSetId)
- StringArray responseLabels
  the response labels array (from the response_descriptors specification in RespLabels)
- size_t numObjectiveFunctions
  number of objective functions (from the num_objective_functions specification in RespFnOpt)
- size_t numLeastSqTerms
  number of least squares terms (from the num_calibration_terms specification in RespFnLS)
- size_t numNonlinearIneqConstraints
  number of nonlinear inequality constraints (from the num_nonlinear_inequality_constraints specification in RespFnOpt)
- size_t numNonlinearEqConstraints
  number of nonlinear equality constraints (from the num_nonlinear_equality_constraints specification in RespFnOpt)
- size_t numResponseFunctions
  number of generic response functions (from the num_response_functions specification in RespFnGen)
- size_t numScalarObjectiveFunctions
  scalar_objectives: number of objective functions which are scalar
- size_t numScalarLeastSqTerms
CHAPTER 13. CLASS DOCUMENTATION

scalar_calibration_terms: number of calibration terms which are scalar

- `size_t numScalarNonlinearIneqConstraints`
  number of scalar nonlinear inequality constraints (from the `num_scalar_nonlinear_inequality_constraints` specification in `RespFnOpt`)

- `size_t numScalarNonlinearEqConstraints`
  number of scalar nonlinear equality constraints (from the `num_scalar_nonlinear Equality_constraints` specification in `RespFnOpt`)

- `size_t numScalarResponseFunctions`
  scalar responses: number of response functions which are scalar

- `size_t numFieldObjectiveFunctions`
  field objectives: number of objective functions which are field-valued

- `size_t numFieldLeastSqTerms`
  field calibration terms: number of calibration terms which are field-valued

- `size_t numFieldNonlinearIneqConstraints`
  number of field nonlinear inequality constraints (from the `num_scalar_nonlinear_inequality_constraints` specification in `RespFnOpt`)

- `size_t numFieldNonlinearEqConstraints`
  number of field nonlinear equality constraints (from the `num_scalar_nonlinear Equality_constraints` specification in `RespFnOpt`)

- `size_t numFieldResponseFunctions`
  field responses: number of response functions which are field-valued

- `StringArray primaryRespFnSense`
  optimization sense for each objective function: minimize or maximize

- `RealVector primaryRespFnWeights`
  vector of weightings for multiobjective optimization or weighted nonlinear least squares (from the `multi_objective_weights` specification in `RespFnOpt` and the `least_squares_weights` specification in `RespFnLS`)

- `RealVector nonlinearIneqLowerBnds`
  vector of nonlinear inequality constraint lower bounds (from the `nonlinear_inequality_lower_bounds` specification in `RespFnOpt`)

- `RealVector nonlinearIneqUpperBnds`
  vector of nonlinear inequality constraint upper bounds (from the `nonlinear_inequality_upper_bounds` specification in `RespFnOpt`)

- `RealVector nonlinearEqTargets`
  vector of nonlinear equality constraint targets (from the `nonlinear_equation_targets` specification in `RespFnOpt`)

- `StringArray primaryRespFnScaleTypes`
  vector of primary response function scaling types (from the `objective_function_scale_types` specification in `RespFnOpt` and the `least_squares_term_scale_types` specification in `RespFnLS`)

- `RealVector primaryRespFnScales`
  vector of primary response function scaling factors (from the `objective_function_scales` specification in `RespFnOpt` and the `least_squares_term_scales` specification in `RespFnLS`)

- `StringArray nonlinearIneqScaleTypes`
  vector of nonlinear inequality constraint scaling types (from the `nonlinear_inequality_scale_types` specification in `RespFnOpt`)
• RealVector nonlinearIneqScales
  vector of nonlinear inequality constraint scaling factors (from the nonlinear_inequality_scales specification in RespFnOpt)

• StringArray nonlinearEqScaleTypes
  vector of nonlinear equality constraint scaling types (from the nonlinear_equality_scale_types specification in RespFnOpt)

• RealVector nonlinearEqScales
  vector of nonlinear equality constraint scaling factors (from the nonlinear_equality_scales specification in RespFnOpt)

• bool calibrationDataFlag
  whether calibration data was specified

• size_t numExperiments
  number of distinct experiments in experimental data

• size_t numExpConfigVars
  number of experimental configuration vars (state variables) in each row of data

• RealVector expConfigVars
  list of num_experiments x num_config-vars configuration variable values

• bool interpolateFlag
  whether one should interpolate between the experiment and simulation field data

• RealVector expObservations
  list of num_calibration_terms observation data

• RealVector expStdDeviations
  list of 1 or num_calibration_terms observation standard deviations

• String scalarDataFileName
  name of experimental data file containing response data (with optional state variable and sigma data) to read

• unsigned short scalarDataFormat
  tabular format of the scalar data file

• String gradientType
  gradient type: none, numerical, analytic, or mixed (from the no_gradients, numerical_gradients, analytic_gradients, and mixed_gradients specifications in RespGrad)

• String hessianType
  Hessian type: none, numerical, quasi, analytic, or mixed (from the no_hessians, numerical_hessians, quasi_hessians, analytic_hessians, and mixed_hessians specifications in RespHess)

• bool ignoreBounds
  option to ignore bounds when doing finite differences (default is to honor bounds)

• bool centralHess
  Temporary(?) option to use old 2nd-order diffs when computing finite-difference Hessians; default is forward differences.

• String quasiHessianType
  quasi-Hessian type: bfgs, damped_bfgs, or sr1 (from the bfgs and sr1 specifications in RespHess)

• String methodSource
  numerical gradient method source: dakota or vendor (from the method_source specification in RespGradNum and RespGradMixed)

• String intervalType
CHAPTER 13. CLASS DOCUMENTATION

numerical gradient interval type: forward or central (from the interval_type specification in RespGradNum and RespGradMixed)

- **RealVector fdGradStepSize**
  
  vector of finite difference step sizes for numerical gradients, one step size per active continuous variable, used in computing 1st-order forward or central differences (from the fd_gradient_step_size specification in RespGradNum and RespGradMixed)

- **String fdGradStepType**
  
  type of finite difference step to use for numerical gradient: relative - step length is relative to x absolute - step length is what is specified bounds - step length is relative to range of x

- **RealVector fdHessStepSize**
  
  vector of finite difference step sizes for numerical Hessians, one step size per active continuous variable, used in computing 1st-order gradient-based differences and 2nd-order function-based differences (from the fd_hessian_step_size specification in RespHessNum and RespHessMixed)

- **String fdHessStepType**
  
  type of finite difference step to use for numerical Hessian: relative - step length is relative to x absolute - step length is what is specified bounds - step length is relative to range of x

- **IntSet idNumericalGrads**
  
  mixed gradient numerical identifiers (from the id_numerical_gradients specification in RespGradMixed)

- **IntSet idAnalyticGrads**
  
  mixed gradient analytic identifiers (from the id_analytic_gradients specification in RespGradMixed)

- **IntSet idNumericalHessians**
  
  mixed Hessian numerical identifiers (from the id_numerical_hessians specification in RespHessMixed)

- **IntSet idQuasiHessians**
  
  mixed Hessian quasi identifiers (from the id_quasi_hessians specification in RespHessMixed)

- **IntSet idAnalyticHessians**
  
  mixed Hessian analytic identifiers (from the id_analytic_hessians specification in RespHessMixed)

- **IntVector fieldLengths**
  
  number of entries in each field

- **IntVector numCoordsPerField**
  
  number of coordinates per field

- **bool readFieldCoords**
  
  Field data related storage: whether to read simulation field coordinates.

- **StringArray varianceType**
  
  Array which specifies the sigma type per response (none, one constant value, one per response (vector) or a full covariance matrix

Private Member Functions

- **DataResponsesRep ()**
  
  constructor

- **~DataResponsesRep ()**
  
  destructor

- **void write (std::ostream &s) const**
  
  write a DataResponsesRep object to an std::ostream

- **void read (MPIUnpackBuffer &s)**
13.35. **DATATRANSFORMMODEL CLASS REFERENCE**

read a `DataResponsesRep` object from a packed MPI buffer

- void `write` (MPIPackBuffer &s) const
  write a `DataResponsesRep` object to a packed MPI buffer

**Private Attributes**

- int `referenceCount`
  number of handle objects sharing this `dataResponsesRep`

**Friends**

- class `DataResponses`
  the handle class can access attributes of the body class directly

13.34.1 **Detailed Description**

Body class for responses specification data.

The `DataResponsesRep` class is used to contain the data from a responses keyword specification. Default values are managed in the `DataResponsesRep` constructor. Data is public to avoid maintaining set/get functions, but is still encapsulated within `ProblemDescDB` since `ProblemDescDB::dataResponsesList` is private.

The documentation for this class was generated from the following files:

- `DataResponses.hpp`
- `DataResponses.cpp`

---

13.35 **DataTransformModel Class Reference**

Data transformation specialization of `RecastModel`.

Inheritance diagram for `DataTransformModel`:

```
Model
  RecastModel
    DataTransformModel
```

**Public Member Functions**

- `DataTransformModel` (const `Model` &sub_model, const `ExperimentData` &exp_data, size_t num_hyper=0, unsigned short mult_mode=CALIBRATE_NONE, short recast_resp_deriv_order=1)
  standard constructor
- `~DataTransformModel` ()
  destructor
- void `data_transform_response` (const `Variables` &sub_model_vars, const `Response` &sub_model_resp, `Response` &residual_resp)
  Convenience function to help recover a residual response from the submodel.
Protected Member Functions

- **void gen_primary_res_map** (const SharedResponseData &srd, Sizet2DArray &primary_res_map_indices, BoolDequeArray &nonlinear_res_map) const
  
  compute the primary response map for a data transform RecastModel
- **void data_difference_core** (const Variables &submodel_vars, const Variables &recast_vars, const Response &submodel_response, Response &recast_response)

  Core of data difference, which doesn’t perform any output (silent version may not be needed if we manage verbosity more carefully)
- **void expand_var_labels** (const Model &sub_model)

  expand the variable labels to include the hyper parameters
- **template<typename T>**
  
  void expand_array (const SharedResponseData &srd, const T &submodel_array, size_t recast_size, T &recast_array) const

  (if non-empty) expand submodel_array by replicates to populate a recast_array
- **template<typename T>**
  
  void expand_scales_array (const SharedResponseData &srd, const T &submodel_array, size_t submodel_size, size_t recast_size, T &recast_array) const

  If size greater than 1, expand submodel_array by replicates to populate a pre-sized recast_array, otherwise copy.

Static Protected Member Functions

- **static SizetArray variables_expand** (const Model &sub_model, size_t num_hyper)

  expand the variable counts to account for hyper-parameters
- **static short response_order** (const Model &sub_model, short recast_resp_order=1)

  helper to compute the recast response order during member initialization; recast_resp_order passed is the minimum request client needs
- **static void vars_mapping** (const Variables &recast_vars, Variables &submodel_vars)

  map the inbound expanded variables to the sub-model, discarding hyperparams (assumes hyper-parameters are at end of active continuous variables)
- **static void set_mapping** (const Variables &recast_vars, const ActiveSet &recast_set, ActiveSet &submodel_set)

  map the inbound ActiveSet to the sub-model (map derivative variables)
- **static void primary_resp_differencer** (const Variables &submodel_vars, const Variables &recast_vars, const Response &submodel_response, Response &recast_response)

  Recast callback function to difference residuals with observed data.

Protected Attributes

- **const ExperimentData & expData**

  Reference to the experiment data used to construct this Model.
- **size_t numHyperparams**

  Number of calibrated variance multipliers.
- **unsigned short obsErrorMultiplierMode**

  Calibration mode for the hyper-parameters.
Static Protected Attributes

- static DataTransformModel ∗ dtModelInstance
  static pointer to this class for use in static callbacks

13.35.1 Detailed Description

Data transformation specialization of RecastModel.

Specialization of RecastModel to create a residual model that maps (1) from an augmented set of calibration parameters (including hyper-parameters) to those needed by the underlying simulation model and (2) from the simulation model response to a set of residuals, whose overall size may differ from the simulation (sub-model) response. The residuals may be scaled by experiment covariance information. This class provides a simple constructor that forwards to the more complicated RecastModel API.

13.35.2 Constructor & Destructor Documentation

DataTransformModel ( const Model & sub_model, const ExperimentData & exp_data, size_t num_hyper = 0, unsigned short multi_mode = CALIBRATE_NONE, short recastResp_deriv_order = 1 )

standard constructor

This constructor computes various indices and mappings, then updates the properties of the RecastModel. Hyper-parameters are assumed to trail the active continuous variables when presented to this RecastModel.

References Model::current_response(), Model::cv(), Model::div(), Model::drv(), Model::dsv(), DataTransformModel::dtModelInstance, DataTransformModel::expand_array(), DataTransformModel::expand_scales_array(), DataTransformModel::expandVar_labels(), DataTransformModel::expData, DataTransformModel::genPrimaryResp_map(), RecastModel::init_maps(), Model::num_functions(), Model::num_primary_fns(), ExperimentData::num_total_exppoints(), DataTransformModel::numHyperparams, DataTransformModel::primary_resp_differencer(), Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), Model::primaryRespFnSense, Model::primaryRespFnWts, Model::scaling_options(), Model::scalingOpts, DataTransformModel::set_mapping(), Response::shared_data(), and DataTransformModel::vars_mapping().

13.35.3 Member Function Documentation

Size_tArray variables_expand ( const Model & sub_model, size_t num_hyper ) [static], [protected]

expand the variable counts to account for hyper-parameters

Incorporate the hyper parameters into Variables, assuming they are at the end of the active continuous variables. For example, append them to continuous design or continuous aleatory uncertain.

References Dakota::abort_handler(), SharedVariablesData::components_totals(), Model::current_variables(), Variables::shared_data(), Dakota::svd(), and Variables::view().

void set_mapping ( const Variables & recast vars, const ActiveSet & recast set, ActiveSet & sub_model_set ) [static], [protected]

map the inbound ActiveSet to the sub-model (map derivative variables)

RecastModel sets up a default set mapping before calling this update, so focus on updating the derivative variables vector

References Model::cv(), ActiveSet::derivative_vector(), DataTransformModel::dtModelInstance, DataTransformModel::numHyperparams, ActiveSet::request_vector(), and RecastModel::subordinate_model().

Referenced by DataTransformModel::DataTransformModel().
void data_difference_core ( const Variables & submodel_vars, const Variables & recast_vars, const Response & submodel_response, Response & recast_response ) [protected]

Core of data difference, which doesn’t perform any output (silent version may not be needed if we manage verbosity more carefully)
  quiet version of function used in recovery of function values
  References Variables::continuous_variables(), Dakota::copy_data_partial(), Variables::cv(), DataTransformModel::expData, ExperimentData::form_residuals(), DataTransformModel::numHyperparams, DataTransformModel::obs ErrorMultiplierMode, ExperimentData::scale_residuals(), and ExperimentData::variance_active().
  Referenced by DataTransformModel::primary_resp_differencer().

void expand_scales_array ( const SharedResponseData & srd, const T & submodel_array, size_t submodel_size, size_t recast_size, T & recast_array ) const [protected]

If size greater than 1, expand submodel_array by replicates to populate a pre-sized recast_array, otherwise copy.
  Passing the inbound array size so we can use one function for Teuchos and std containers (size vs. length)
  References DataTransformModel::expand_array().
  Referenced by DataTransformModel::DataTransformModel().

13.35.4 Member Data Documentation

DataTransformModel * dtModelInstance [static], [protected]

static pointer to this class for use in static callbacks
  initialization of static needed by RecastModel
  Referenced by DataTransformModel::DataTransformModel(), DataTransformModel::primary_resp_differencer(), and DataTransformModel::set_mapping().
  The documentation for this class was generated from the following files:
  - DataTransformModel.hpp
  - DataTransformModel.cpp

13.36 DataVariables Class Reference

Handle class for variables specification data.

Public Member Functions

- DataVariables ()
  constructor
- DataVariables (const DataVariables &)
  copy constructor
- ~DataVariables ()
  destructor
- DataVariables operator= (const DataVariables &)
  assignment operator
- bool operator== (const DataVariables &)
  equality operator
- void write (std::ostream &s) const
write a `DataVariables` object to an `std::ostream`  

- void `read` (MPIUnpackBuffer &s)
  
  read a `DataVariables` object from a packed MPI buffer

- void `write` (MPIPackBuffer &s) const
  
  write a `DataVariables` object to a packed MPI buffer

- `DataVariablesRep` * `data_rep` ()

  return `dataVarsRep`

- `size_t` `design` ()

  return total number of design variables

- `size_t` `aleatory_uncertain` ()

  return total number of aleatory uncertain variables

- `size_t` `epistemic_uncertain` ()

  return total number of epistemic uncertain variables

- `size_t` `uncertain` ()

  return total number of uncertain variables

- `size_t` `state` ()

  return total number of state variables

- `size_t` `continuous_variables` ()

  return total number of continuous variables

- `size_t` `discrete_variables` ()

  return total number of discrete variables

- `size_t` `total_variables` ()

  return total number of variables

**Static Public Member Functions**

- static bool `id_compare` (const `DataVariables` &dv, const `std::string` &id)

  compares the `idVariables` attribute of `DataVariables` objects

**Private Attributes**

- `DataVariablesRep` * `dataVarsRep`

  pointer to the body (handle-body idiom)

**Friends**

- class `ProblemDescDB`

- class `NIDRProblemDescDB`
13.36.1 Detailed Description

Handle class for variables specification data.

The DataVariables class is used to provide a memory management handle for the data in DataVariablesRep. It is populated by IDRProblemDescDB::variables_kwhandler() and is queried by the ProblemDescDB::get_<datatype>() functions. A list of DataVariables objects is maintained in ProblemDescDB::dataVariablesList, one for each variables specification in an input file.

The documentation for this class was generated from the following files:

- DataVariables.hpp
- DataVariables.cpp

13.37 DataVariablesRep Class Reference

Body class for variables specification data.

Public Attributes

- String idVariables
  
  string identifier for the variables specification data set (from the id_variables specification in VarSetId)

- short varsView
  
  user selection/override of variables view: {DEFAULT,ALL,DESIGN,UNCERTAIN,ALEATORY,UNCERTAIN,EPISTEMIC,UNCERTAIN,STATE}_VIEW

- short varsDomain
  
  user selection/override of variables domain: {DEFAULT,MIXED,RELAXED}_DOMAIN

- bool uncertainVarsInitPt
  
  flag indicating user specification of initial points (for local optimization-based UQ methods) for at least one uncertain variable type

- size_t numContinuousDesVars
  
  number of continuous design variables (from the continuous_design specification in VarDV)

- size_t numDiscreteDesRangeVars
  
  number of discrete design variables defined by an integer range (from the discrete_design_range specification in VarDV)

- size_t numDiscreteDesSetIntVars
  
  number of discrete design variables defined by a set of integers (from the discrete_design_set integer specification in VarDV)

- size_t numDiscreteDesSetStrVars
  
  number of discrete design variables defined by a set of strings (from the discrete_design_set string specification in VarDV)

- size_t numDiscreteDesSetRealVars
  
  number of discrete design variables defined by a set of reals (from the discrete_design_set real specification in VarDV)

- size_t numNormalUncVars
  
  number of normal uncertain variables (from the normal_uncertain specification in VarAUV)

- size_t numLognormalUncVars
  
  number of lognormal uncertain variables (from the lognormal_uncertain specification in VarAUV)

- size_t numUniformUncVars
number of uniform uncertain variables (from the uniform_uncertain specification in VarAUV)

- size_t numLoguniformUncVars
  number of loguniform uncertain variables (from the loguniform_uncertain specification in VarAUV)

- size_t numTriangularUncVars
  number of triangular uncertain variables (from the triangular_uncertain specification in VarAUV)

- size_t numExponentialUncVars
  number of exponential uncertain variables (from the exponential_uncertain specification in VarAUV)

- size_t numBetaUncVars
  number of beta uncertain variables (from the beta_uncertain specification in VarAUV)

- size_t numGammaUncVars
  number of gamma uncertain variables (from the gamma_uncertain specification in VarAUV)

- size_t numGumbelUncVars
  number of gumbel uncertain variables (from the gumbel_uncertain specification in VarAUV)

- size_t numFrechetUncVars
  number of frechet uncertain variables (from the frechet_uncertain specification in VarAUV)

- size_t numWeibullUncVars
  number of weibull uncertain variables (from the weibull_uncertain specification in VarAUV)

- size_t numHistogramBinUncVars
  number of histogram bin uncertain variables (from the histogram_bin_uncertain specification in VarAUV)

- size_t numPoissonUncVars
  number of Poisson uncertain variables (from the poisson_uncertain specification in VarAUV)

- size_t numBinomialUncVars
  number of binomial uncertain variables (from the binomial_uncertain specification in VarAUV)

- size_t numNegBinomialUncVars
  number of negative binomial uncertain variables (from the negative_binomial_uncertain specification in VarAUV)

- size_t numGeometricUncVars
  number of geometric uncertain variables (from the geometric_uncertain specification in VarAUV)

- size_t numHyperGeomUncVars
  number of hypergeometric uncertain variables (from the hypergeometric_uncertain specification in VarAUV)

- size_t numHistogramPtIntUncVars
  number of integer-valued histogram point uncertain variables (from the histogram_point_uncertain specification in VarAUV)

- size_t numHistogramPtStrUncVars
  number of string-valued histogram point uncertain variables (from the histogram_point_uncertain specification in VarAUV)

- size_t numHistogramPtRealUncVars
  number of real-valued histogram point uncertain variables (from the histogram_point_uncertain specification in VarAUV)

- size_t numContinuousIntervalUncVars
  number of continuous epistemic interval uncertain variables (from the continuous_interval_uncertain specification in VarEUV)

- size_t numDiscreteIntervalUncVars
number of discrete epistemic interval uncertain variables (from the discrete_interval_uncertain specification in VarEUV)

- size_t numDiscreteUncSetIntVars
  number of discrete epistemic uncertain integer set variables (from the discrete_uncertain_set integer specification in VarEUV)

- size_t numDiscreteUncSetStrVars
  number of discrete epistemic uncertain string set variables (from the discrete_uncertain_set string specification in VarEUV)

- size_t numDiscreteUncSetRealVars
  number of discrete epistemic uncertain real set variables (from the discrete_uncertain_set real specification in VarEUV)

- size_t numContinuousStateVars
  number of continuous state variables (from the continuous_state specification in VarSV)

- size_t numDiscreteStateRangeVars
  number of discrete state variables defined by an integer range (from the discrete_state_range specification in VarDV)

- size_t numDiscreteStateSetIntVars
  number of discrete state variables defined by a set of integers (from the discrete_state_set integer specification in VarDV)

- size_t numDiscreteStateSetStrVars
  number of discrete state variables defined by a set of strings (from the discrete_state_set string specification in VarDV)

- size_t numDiscreteStateSetRealVars
  number of discrete state variables defined by a set of reals (from the discrete_state_set real specification in VarDV)

- RealVector continuousDesignVars
  initial values for the continuous design variables array (from the continuous_design initial_point specification in VarDV)

- RealVector continuousDesignLowerBnds
  lower bounds array for the continuous design variables (from the continuous_design lower_bounds specification in VarDV)

- RealVector continuousDesignUpperBnds
  upper bounds array for the continuous design variables (from the continuous_design upper_bounds specification in VarDV)

- StringArray continuousDesignScaleTypes
  scale types array for the continuous design variables (from the continuous_design scale_types specification in VarDV)

- RealVector continuousDesignScales
  scales array for the continuous design variables (from the continuous_design scales specification in VarDV)

- IntVector discreteDesignRangeVars
  initial values for the discrete design variables defined by an integer range (from the discrete_design_range initial_point specification in VarDV)

- IntVector discreteDesignRangeLowerBnds
  lower bounds array for the discrete design variables defined by an integer range (from the discrete_design_range lower_bounds specification in VarDV)
• **IntVector** `discreteDesignRangeUpperBnds`  
  upper bounds array for the discrete design variables defined by an integer range (from the `discrete_design_range_upper_bounds` specification in VarDV)

• **BitArray** `discreteDesignRangeCat`  
  is each ddr var strictly categorical (true) or relaxable (false)

• **IntVector** `discreteDesignSetIntVars`  
  initial values for the discrete design variables defined by an integer set (from the `discrete_design_set_int_initial_point` specification in VarDV)

• **StringArray** `discreteDesignSetStrVars`  
  initial values for the discrete design variables defined by a string set (from the `discrete_design_set_str_initial_point` specification in VarDV)

• **RealVector** `discreteDesignSetRealVars`  
  initial values for the discrete design variables defined by a real set (from the `discrete_design_set_real_initial_point` specification in VarDV)

• **IntSetArray** `discreteDesignSetInt`  
  complete set of admissible values for each of the discrete design variables defined by an integer set (from the `discrete_design_set_int_values` specification in VarDV)

• **StringSetArray** `discreteDesignSetStr`  
  complete set of admissible values for each of the discrete design variables defined by a string set (from the `discrete_design_set_str_values` specification in VarDV)

• **RealSetArray** `discreteDesignSetReal`  
  complete set of admissible values for each of the discrete design variables defined by a real set (from the `discrete_design_set_real_values` specification in VarDV)

• **BitArray** `discreteDesignSetIntCat`  
  is each ddsi var strictly categorical (true) or relaxable (false)

• **BitArray** `discreteDesignSetRealCat`  
  is each ddsr var strictly categorical (true) or relaxable (false)

• **RealMatrixArray** `discreteDesignSetIntAdj`  
  Adjacency matrices for each of the discrete design variables defined by an integer set (from the `discrete_design_set_int_categorical_adjacency` specification in VarDV)

• **RealMatrixArray** `discreteDesignSetStrAdj`  
  Adjacency matrices for each of the discrete design variables defined by a string set (from the `discrete_design_set_str_categorical_adjacency` specification in VarDV)

• **RealMatrixArray** `discreteDesignSetRealAdj`  
  Adjacency matrices for each of the discrete design variables defined by a real set (from the `discrete_design_set_real_categorical_adjacency` specification in VarDV)

• **StringArray** `continuousDesignLabels`  
  labels array for the continuous design variables (from the `continuous_design_descriptors` specification in VarDV)

• **StringArray** `discreteDesignRangeLabels`  
  labels array for the discrete design variables defined by an integer range (from the `discrete_design_range_descriptors` specification in VarDV)

• **StringArray** `discreteDesignSetIntLabels`  
  labels array for the discrete design variables defined by an integer set (from the `discrete_design_set_int_descriptors` specification in VarDV)

• **StringArray** `discreteDesignSetStrLabels`
labels array for the discrete design variables defined by a string set (from the `discrete_design_set string descriptors specification in VarDV`)

- **StringArray** `discreteDesignSetRealLabels`
  labels array for the discrete design variables defined by a real set (from the `discrete_design_set real; descriptors specification in VarDV`)

- **RealVector** `normalUncMeans`
  means of the normal uncertain variables (from the `means specification in VarCAUV_Normal`)

- **RealVector** `normalUncStdDevs`
  standard deviations of the normal uncertain variables (from the `std_deviations specification in VarCAUV_Normal`)

- **RealVector** `normalUncLowerBnds`
  distribution lower bounds for the normal uncertain variables (from the `lower_bounds specification in VarCAUV_Normal`)

- **RealVector** `normalUncUpperBnds`
  distribution upper bounds for the normal uncertain variables (from the `upper_bounds specification in VarCAUV_Normal`)

- **RealVector** `normalUncVars`
  initial values of the normal uncertain variables (from the `initial_point specification in VarCAUV_Normal`)

- **RealVector** `lognormalUncLambdas`
  lambdas (means of the corresponding normals) of the lognormal uncertain variables (from the `lambdas specification in VarCAUV_Lognormal`)

- **RealVector** `lognormalUncZetas`
  zetas (standard deviations of the corresponding normals) of the lognormal uncertain variables (from the `zetas specification in VarCAUV_Lognormal`)

- **RealVector** `lognormalUncMeans`
  means of the lognormal uncertain variables (from the `means specification in VarCAUV_Lognormal`)

- **RealVector** `lognormalUncStdDevs`
  standard deviations of the lognormal uncertain variables (from the `std_deviations specification in VarCAUV_Lognormal`)

- **RealVector** `lognormalUncErrFacts`
  error factors for the lognormal uncertain variables (from the `error_factors specification in VarCAUV_Lognormal`)

- **RealVector** `lognormalUncLowerBnds`
  distribution lower bounds for the lognormal uncertain variables (from the `lower_bounds specification in VarCAUV_Lognormal`)

- **RealVector** `lognormalUncUpperBnds`
  distribution upper bounds for the lognormal uncertain variables (from the `upper_bounds specification in VarCAUV_Lognormal`)

- **RealVector** `lognormalUncVars`
  initial values of the lognormal uncertain variables (from the `initial_point specification in VarCAUV_Lognormal`)

- **RealVector** `uniformUncLowerBnds`
  distribution lower bounds for the uniform uncertain variables (from the `lower_bounds specification in VarCAUV_Uniform`)

- **RealVector** `uniformUncUpperBnds`
  distribution upper bounds for the uniform uncertain variables (from the `upper_bounds specification in VarCAUV_Uniform`)
• RealVector uniformUncVars
  initial values of the uniform uncertain variables (from the initial_point specification in VarCAUV_Uniform)
• RealVector loguniformUncLowerBnds
  distribution lower bounds for the loguniform uncertain variables (from the lower_bounds specification in VarCAUV_Loguniform)
• RealVector loguniformUncUpperBnds
  distribution upper bounds for the loguniform uncertain variables (from the upper_bounds specification in VarCAUV_Loguniform)
• RealVector loguniformUncVars
  initial values of the loguniform uncertain variables (from the initial_point specification in VarCAUV_Loguniform)
• RealVector triangularUncModes
  modes of the triangular uncertain variables (from the modes specification in VarCAUV_Triangular)
• RealVector triangularUncLowerBnds
  distribution lower bounds for the triangular uncertain variables (from the lower_bounds specification in VarCAUV_Triangular)
• RealVector triangularUncUpperBnds
  distribution upper bounds for the triangular uncertain variables (from the upper_bounds specification in VarCAUV_Triangular)
• RealVector triangularUncVars
  initial values of the triangular uncertain variables (from the initial_point specification in VarCAUV_Triangular)
• RealVector exponentialUncBetas
  beta factors for the exponential uncertain variables (from the betas specification in VarCAUV_Exponential)
• RealVector exponentialUncVars
  initial values of the exponential uncertain variables (from the initial_point specification in VarCAUV_Exponential)
• RealVector betaUncAlphas
  alpha factors for the beta uncertain variables (from the means specification in VarCAUV_Beta)
• RealVector betaUncBetas
  beta factors for the beta uncertain variables (from the std_deviations specification in VarCAUV_Beta)
• RealVector betaUncLowerBnds
  distribution lower bounds for the beta uncertain variables (from the lower_bounds specification in VarCAUV_Beta)
• RealVector betaUncUpperBnds
  distribution upper bounds for the beta uncertain variables (from the upper_bounds specification in VarCAUV_Beta)
• RealVector betaUncVars
  initial values of the beta uncertain variables (from the initial_point specification in VarCAUV_Beta)
• RealVector gammaUncAlphas
  alpha factors for the gamma uncertain variables (from the alphas specification in VarCAUV_Gamma)
• RealVector gammaUncBetas
  beta factors for the gamma uncertain variables (from the betas specification in VarCAUV_Gamma)
• RealVector gammaUncVars
  initial values of the gamma uncertain variables (from the initial_point specification in VarCAUV_Gamma)
• RealVector gumbelUncAlphas
alpha factors for the gumbel uncertain variables (from the \texttt{alphas} specification in \texttt{VarCAUV\_Gumbel})

- \texttt{RealVector gumbelUncBetas}
- \texttt{RealVector gumbelUncVars}

beta factors for of the gumbel uncertain variables (from the \texttt{betas} specification in \texttt{VarCAUV\_Gumbel})

- \texttt{RealVector gumbelUncBetas}
- \texttt{RealVector gumbelUncVars}

initial values of the gumbel uncertain variables (from the \texttt{initial\_point} specification in \texttt{VarCAUV\_Gumbel})

- \texttt{RealVector frechetUncAlphas}
- \texttt{RealVector frechetUncBetas}

alpha factors for the frechet uncertain variables (from the \texttt{alphas} specification in \texttt{VarCAUV\_Frechet})

- \texttt{RealVector frechetUncBetas}
- \texttt{RealVector frechetUncVars}

initial values of the frechet uncertain variables (from the \texttt{initial\_point} specification in \texttt{VarCAUV\_Frechet})

- \texttt{RealVector weibullUncAlphas}
- \texttt{RealVector weibullUncBetas}

alpha factors for the weibull uncertain variables (from the \texttt{alphas} specification in \texttt{VarCAUV\_Weibull})

- \texttt{RealVector weibullUncBetas}
- \texttt{RealVector weibullUncVars}

initial values of the weibull uncertain variables (from the \texttt{initial\_point} specification in \texttt{VarCAUV\_Weibull})

- \texttt{RealRealMapArray histogramUncBinPairs}

An array for each real-valued bin-based histogram uncertain variable. Each array entry is a map from a real value to its probability. (See continuous linear histogram in LHS manual; from the \texttt{histogram\_bin\_uncertain} specification in \texttt{VarCAUV\_Bin\_Histogram}). (x,y) ordinate specifications are converted to (x,c) counts within NIDR.

- \texttt{RealVector histogramBinUncVars}

initial values of the histogram bin uncertain variables (from the \texttt{initial\_point} specification in \texttt{VarCAUV\_Bin\_Histogram})

- \texttt{RealVector poissonUncLambdas}

\texttt{lambdas} (rate parameter) for the poisson uncertain variables (from the \texttt{lambdas} specification in \texttt{VarDAUV\_Poisson})

- \texttt{IntVector poissonUncVars}

initial values of the poisson uncertain variables (from the \texttt{initial\_point} specification in \texttt{VarDAUV\_Poisson})

- \texttt{BitArray poissonUncCat}

is each poisson var strictly categorical (true) or relaxable (false)

- \texttt{RealVector binomialUncProbPerTrial}

probabilities per each trial (p) for the binomial uncertain variables from the \texttt{prob\_per\_trial} specification in \texttt{VarDAUV\_Binomial})

- \texttt{IntVector binomialUncNumTrials}

Number of trials (N) for the binomial uncertain variables from the \texttt{num\_trials} specification in \texttt{VarDAUV\_Binomial})

- \texttt{IntVector binomialUncVars}

initial values of the binomial uncertain variables (from the \texttt{initial\_point} specification in \texttt{VarDAUV\_Binomial})

- \texttt{BitArray binomialUncCat}

is each binomial var strictly categorical (true) or relaxable (false)

- \texttt{RealVector negBinomialUncProbPerTrial}

probabilities per each trial (p) for the negative binomial uncertain variables from the \texttt{prob\_per\_trial} specification in \texttt{VarDAUV\_Negative\_Binomial})
13.37. DATAVARIABLESREP CLASS REFERENCE

- IntVector `negBinomialUncNumTrials`
  Number of trials (N) for the negative binomial uncertain variables from the `num_trials` specification in `VarDAUV-Negative_Binomial`

- IntVector `negBinomialUncVars`
  initial values of the negative binomial uncertain variables (from the `initial_point` specification in `VarDAUV-Negative_Binomial`)

- BitArray `negBinomialUncCat`
  is each negbinomial var strictly categorical (true) or relaxable (false)

- RealVector `geometricUncProbPerTrial`
  probabilities per each trial (p) for the geometric uncertain variables from the `prob_per_trial` specification in `VarDAUV-Geometric`

- IntVector `geometricUncVars`
  initial values of the geometric uncertain variables (from the `initial_point` specification in `VarDAUV-Geometric`)

- BitArray `geometricUncCat`
  is each geometric var strictly categorical (true) or relaxable (false)

- IntVector `hyperGeomUncTotalPop`
  Size of total populations (N) for the hypergeometric uncertain variables from the `total_population` specification in `VarDAUV-Hypergeometric`

- IntVector `hyperGeomUncSelectedPop`
  Size of selected populations for the hypergeometric uncertain variables from the `selected_population` specification in `VarDAUV-Hypergeometric`

- IntVector `hyperGeomUncNumDrawn`
  Number failed in the selected populations for the hypergeometric variables from the `num_drawn` specification in `VarDAUV-Hypergeometric`

- IntVector `hyperGeomUncVars`
  initial values of the hypergeometric uncertain variables (from the `initial_point` specification in `VarDAUV-Hypergeometric`)

- BitArray `hyperGeomUncCat`
  is each hypergeom var strictly categorical (true) or relaxable (false)

- IntRealMapArray `histogramUncPointIntPairs`
  An array for each integer-valued point-based histogram uncertain variable. Each array entry is a map from an integer value to its probability. (See discrete histogram in LHS manual; from the `histogram_point_uncertain` specification in `VarDAUV-Point_Histogram`)

- IntVector `histogramUncPointIntVars`
  initial values of the real-valued histogram point uncertain variables (from the `initial_point` specification in `VarDAUV-Point_Histogram`)

- BitArray `histogramUncPointIntCat`
  is each hupi var strictly categorical (true) or relaxable (false)

- StringRealMapArray `histogramUncPointStrPairs`
  An array for each string-valued point-based histogram uncertain variable. Each array entry is a map from a string value to its probability. (See discrete histogram in LHS manual; from the `histogram_point_uncertain` specification in `VarDAUV-Point_Histogram`)

- StringArray `histogramUncPointStrUncVars`
  initial values of the real-valued histogram point uncertain variables (from the `initial_point` specification in `VarDAUV-Point_Histogram`)

- RealRealMapArray `histogramUncPointRealPairs`
An array for each real-valued point-based histogram uncertain variable. Each array entry is a map from a real value to its probability. (See discrete histogram in LHS manual; from the histogram_point_uncertain specification in VarDAUV_Point_Histogram)

- **RealVector** `histogramPointRealUncVars`
  initial values of the real-valued histogram point uncertain variables (from the initial_point specification in VarDAUV_Point_Histogram)

- **BitArray** `histogramUncPointRealCat`
  is each hupr var strictly categorical (true) or relaxable (false)

- **RealSymMatrix** `uncertainCorrelations`
  correlation matrix for all uncertain variables (from the uncertain_correlation_matrix specification in VarAUV_Correlations). This matrix specifies rank correlations for LHS sampling and correlation coefficients \( \rho_{ij} \) = normalized covariance matrix for other methods.

- **RealRealPairRealMapArray** `continuousIntervalUncBasicProbs`
  Probability values per interval cell per epistemic interval uncertain variable (from the continuous_interval_uncertain_interval_probs specification in VarCEUV)

- **RealVector** `continuousIntervalUncVars`
  initial values of the continuous interval uncertain variables (from the initial_point specification in VarCEUV)

- **IntIntPairRealMapArray** `discreteIntervalUncBasicProbs`
  Probability values per interval cell per epistemic interval uncertain variable (from the discrete_interval_uncertain_interval_probs specification in VarDIUV)

- **IntVector** `discreteIntervalUncVars`
  initial values of the discrete interval uncertain variables (from the initial_point specification in VarDIUV)

- **BitArray** `discreteIntervalUncCat`
  is each diu var strictly categorical (true) or relaxable (false)

- **IntRealMapArray** `discreteUncSetIntValuesProbs`
  complete set of admissible values with associated basic probability assignments for each of the discrete epistemic uncertain variables defined by an integer set (from the discrete_uncertain_set_integer_set_values specification in VarDUSIV)

- **IntVector** `discreteUncSetIntVars`
  initial values of the discrete uncertain set integer variables (from the initial_point specification in VarDUSIV)

- **BitArray** `discreteUncSetIntCat`
  is each dusi var strictly categorical (true) or relaxable (false)

- **StringRealMapArray** `discreteUncSetStrValuesProbs`
  complete set of admissible values with associated basic probability assignments for each of the discrete epistemic uncertain variables defined by a string set (from the discrete_uncertain_set_string_set_values specification in VarDUSIV)

- **StringArray** `discreteUncSetStrVars`
  initial values of the discrete uncertain set integer variables (from the initial_point specification in VarDUSIV)

- **RealRealMapArray** `discreteUncSetRealValuesProbs`
  complete set of admissible values with associated basic probability assignments for each of the discrete epistemic uncertain variables defined by a real set (from the discrete_uncertain_set_real_set_values specification in VarDUSRV)

- **RealVector** `discreteUncSetRealVars`
  initial values of the discrete uncertain set real variables (from the initial_point specification in VarDUSRV)

- **BitArray** `discreteUncSetRealCat`
is each dusr var strictly categorical (true) or relaxable (false)

- **RealVector** `continuousStateVars`
  initial values for the continuous state variables array (from the `continuous_state initial_point specification` in VarSV)

- **RealVector** `continuousStateLowerBnds`
  lower bounds array for the continuous state variables (from the `continuous_state lower_bounds specification` in VarSV)

- **RealVector** `continuousStateUpperBnds`
  upper bounds array for the continuous state variables (from the `continuous_state upper_bounds specification` in VarSV)

- **IntVector** `discreteStateRangeVars`
  initial values for the discrete state variables defined by an integer range (from the `discrete_state_range initial_point specification` in VarSV)

- **IntVector** `discreteStateRangeLowerBnds`
  lower bounds array for the discrete state variables defined by an integer range (from the `discrete_state_range lower_bounds specification` in VarSV)

- **IntVector** `discreteStateRangeUpperBnds`
  upper bounds array for the discrete state variables defined by an integer range (from the `discrete_state_range upper_bounds specification` in VarSV)

- **BitArray** `discreteStateRangeCat`
  is each dsr var strictly categorical (true) or relaxable (false)

- **IntVector** `discreteStateSetIntVars`
  initial values for the discrete state variables defined by an integer set (from the `discrete_state_set integer initial_point specification` in VarSV)

- **StringArray** `discreteStateSetStrVars`
  initial values for the discrete state variables defined by a string set (from the `discrete_state_set string initial_point specification` in VarSV)

- **RealVector** `discreteStateSetRealVars`
  initial values for the discrete state variables defined by a real set (from the `discrete_state_set real initial_point specification` in VarSV)

- **IntSetArray** `discreteStateSetInt`
  complete set of admissible values for each of the discrete state variables defined by an integer set (from the `discrete_state_set integer set_values specification` in VarSV)

- **StringSetArray** `discreteStateSetStr`
  complete set of admissible values for each of the discrete state variables defined by a string set (from the `discrete_state_set string set_values specification` in VarSV)

- **RealSetArray** `discreteStateSetReal`
  complete set of admissible values for each of the discrete state variables defined by a real set (from the `discrete_state_set real set_values specification` in VarSV)

- **BitArray** `discreteStateSetIntCat`
  is each dssi var strictly categorical (true) or relaxable (false)

- **BitArray** `discreteStateSetRealCat`
  is each dsrr var strictly categorical (true) or relaxable (false)

- **StringArray** `continuousStateLabels`
  labels array for the continuous state variables (from the `continuous_state descriptors specification` in VarSV)
• StringArray `discreteStateRangeLabels`
  labels array for the discrete state variables defined by an integer range (from the `discrete_state_range` descriptors specification in VarSV)

• StringArray `discreteStateSetIntLabels`
  labels array for the discrete state variables defined by an integer set (from the `discrete_state_set` descriptors specification in VarSV)

• StringArray `discreteStateSetStrLabels`
  labels array for the discrete state variables defined by a string set (from the `discrete_state_set` descriptors specification in VarSV)

• StringArray `discreteStateSetRealLabels`
  labels array for the discrete state variables defined by a real set (from the `discrete_state_set` descriptors specification in VarSV)

• IntVector `discreteDesignSetIntLowerBnds`
  discrete design integer set lower bounds inferred from set values

• IntVector `discreteDesignSetIntUpperBnds`
  discrete design integer set upper bounds inferred from set values

• StringArray `discreteDesignSetStrLowerBnds`
  discrete design string set lower bounds inferred from set values

• StringArray `discreteDesignSetStrUpperBnds`
  discrete design string set upper bounds inferred from set values

• RealVector `discreteDesignSetRealLowerBnds`
  discrete design real set lower bounds inferred from set values

• RealVector `discreteDesignSetRealUpperBnds`
  discrete design real set upper bounds inferred from set values

• RealVector `continuousAleatoryUncVars`
  array of values for all continuous aleatory uncertain variables

• RealVector `continuousAleatoryUncLowerBnds`
  distribution lower bounds for all continuous aleatory uncertain variables (collected from `nuv_lower_bounds`, `lnuv_lower_bounds`, `uuv_lower_bounds`, `luuv_lower_bounds`, `tuv_lower_bounds`, and `buv_lower_bounds` specifications in VarAUV, and derived for gamma, gumbel, frechet, weibull and histogram bin specifications)

• RealVector `continuousAleatoryUncUpperBnds`
  distribution upper bounds for all continuous aleatory uncertain variables (collected from `nuv_upper_bounds`, `lnuv_upper_bounds`, `uuv_upper_bounds`, `luuv_upper_bounds`, `tuv_upper_bounds`, and `buv_upper_bounds` specifications in VarAUV, and derived for gamma, gumbel, frechet, weibull and histogram bin specifications)

• StringArray `continuousAleatoryUncLabels`
  labels for all continuous aleatory uncertain variables (collected from `nuv_descriptors`, `lnuv_descriptors`, `uuv_descriptors`, `luuv_descriptors`, `tuv_descriptors`, `buv_descriptors`, `gauv_descriptors`, `guuv_descriptors`, `fuv_descriptors`, `wuv_descriptors`, and `hbuv_descriptors` specifications in VarAUV)

• IntVector `discreteIntAleatoryUncVars`
  array of values for all discrete integer aleatory uncertain variables

• IntVector `discreteIntAleatoryUncLowerBnds`
  distribution lower bounds for all discrete integer aleatory uncertain variables

• IntVector `discreteIntAleatoryUncUpperBnds`
distribution upper bounds for all discrete integer aleatory uncertain variables

- StringArray discreteIntAleatoryUncLabels
  labels for all discrete integer aleatory uncertain variables

- StringArray discreteStrAleatoryUncVars
  array of values for all discrete string epistemic uncertain variables

- StringArray discreteStrAleatoryUncLowerBnds
  distribution lower bounds for all discrete string epistemic uncertain variables

- StringArray discreteStrAleatoryUncUpperBnds
  distribution upper bounds for all discrete string epistemic uncertain variables

- StringArray discreteStrAleatoryUncLabels
  labels for all discrete string epistemic uncertain variables

- RealVector discreteRealAleatoryUncVars
  array of values for all discrete real aleatory uncertain variables

- RealVector discreteRealAleatoryUncLowerBnds
  distribution lower bounds for all discrete real aleatory uncertain variables

- RealVector discreteRealAleatoryUncUpperBnds
  distribution upper bounds for all discrete real aleatory uncertain variables

- StringArray discreteRealAleatoryUncLabels
  labels for all discrete real aleatory uncertain variables

- RealVector continuousEpistemicUncVars
  array of values for all continuous epistemic uncertain variables

- RealVector continuousEpistemicUncLowerBnds
  distribution lower bounds for all continuous epistemic uncertain variables

- RealVector continuousEpistemicUncUpperBnds
  distribution upper bounds for all continuous epistemic uncertain variables

- StringArray continuousEpistemicUncLabels
  labels for all continuous epistemic uncertain variables

- IntVector discreteIntEpistemicUncVars
  array of values for all discrete integer epistemic uncertain variables

- IntVector discreteIntEpistemicUncLowerBnds
  distribution lower bounds for all discrete integer epistemic uncertain variables

- IntVector discreteIntEpistemicUncUpperBnds
  distribution upper bounds for all discrete integer epistemic uncertain variables

- StringArray discreteIntEpistemicUncLabels
  labels for all discrete integer epistemic uncertain variables

- StringArray discreteStrEpistemicUncVars
  array of values for all discrete string epistemic uncertain variables

- StringArray discreteStrEpistemicUncLowerBnds
  distribution lower bounds for all discrete string epistemic uncertain variables

- StringArray discreteStrEpistemicUncUpperBnds
  distribution upper bounds for all discrete string epistemic uncertain variables

- StringArray discreteStrEpistemicUncLabels
  labels for all discrete string epistemic uncertain variables
• RealVector discreteRealEpistemicUncVars
  array of values for all discrete real epistemic uncertain variables
• RealVector discreteRealEpistemicUncLowerBnds
  distribution lower bounds for all discrete real epistemic uncertain variables
• RealVector discreteRealEpistemicUncUpperBnds
  distribution upper bounds for all discrete real epistemic uncertain variables
• StringArray discreteRealEpistemicUncLabels
  labels for all discrete real epistemic uncertain variables
• IntVector discreteStateSetIntLowerBnds
  discrete state integer set lower bounds inferred from set values
• IntVector discreteStateSetIntUpperBnds
  discrete state integer set upper bounds inferred from set values
• StringArray discreteStateSetStrLowerBnds
  discrete state string set lower bounds inferred from set values
• StringArray discreteStateSetStrUpperBnds
  discrete state string set upper bounds inferred from set values
• RealVector discreteStateSetRealLowerBnds
  discrete state real set lower bounds inferred from set values
• RealVector discreteStateSetRealUpperBnds
  discrete state real set upper bounds inferred from set values

Private Member Functions

• DataVariablesRep ()
  default constructor
• ~DataVariablesRep ()
  destructor
• void write (std::ostream &s) const
  write a DataVariablesRep object to an std::ostream
• void read (MPIUnpackBuffer &s)
  read a DataVariablesRep object from a packed MPI buffer
• void write (MPIPackBuffer &s) const
  write a DataVariablesRep object to a packed MPI buffer

Private Attributes

• int referenceCount
  number of handle objects sharing dataVarsRep

Friends

• class DataVariables
  the handle class can access attributes of the body class directly
13.37.1 Detailed Description

Body class for variables specification data.

The `DataVariablesRep` class is used to contain the data from a variables keyword specification. Default values are managed in the `DataVariablesRep` constructor. Data is public to avoid maintaining set/get functions, but is still encapsulated within `ProblemDescDB` since `ProblemDescDB::dataVariablesList` is private.

The documentation for this class was generated from the following files:

- `DataVariables.hpp`
- `DataVariables.cpp`

13.38 DDACEDesignCompExp Class Reference

Wrapper class for the DDACE design of experiments library.

Inheritance diagram for DDACEDesignCompExp:

```
  Iterator
    Analyzer
      PStudyDACE
        DDACEDesignCompExp
```

Public Member Functions

- `DDACEDesignCompExp (ProblemDescDB &problem_db, Model &model)`
  primary constructor for building a standard DACE iterator
- `DDACEDesignCompExp (Model &model, int samples, int symbols, int seed, unsigned short sampling_method)`
  alternate constructor used for building approximations
- `~DDACEDesignCompExp ()`
  destructor
- `bool resize ()`
  reinitializes iterator based on new variable size
- `void pre_run ()`
  pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori
- `void core_run ()`
  core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post
- `void post_input ()`
  read tabular data for post-run mode
- `void post_run (std::ostream &s)`
post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way

- int num_samples () const
- void sampling_reset (int min_samples, bool all_data_flag, bool stats_flag)
  reset sampling iterator to use at least min_samples
- unsigned short sampling_scheme () const
  return sampling name
- void vary_pattern (bool pattern_flag)
  sets varyPattern in derived classes that support it
- void get_parameter_sets (Model &model)
  Returns one block of samples (ndim * num_samples)

Private Member Functions

- void compute_main_effects ()
  builds a DDaceMainEffects::OneWayANOVA if mainEffectsFlag is set
- boost::shared_ptr <<DDaceSamplerBase > create_sampler (Model &model)
  create a DDACE sampler
- void resolve_samples_symbols ()
  convenience function for resolving number of samples and number of symbols from input.

Static Private Member Functions

- static void copy_data (const std::vector<DDaceSamplePoint> &dspa, Real *ptr, const int ptr_len)
  copy DDACE point to RealVector

Private Attributes

- unsigned short daceMethod
  oas, lhs, oa_lhs, random, box_behnken, central_composite, or grid
- int samplesSpec
  initial specification of number of samples
- int symbolsSpec
  initial specification of number of symbols
- int numSamples
  current number of samples to be evaluated
- int numSymbols
  current number of symbols to be used in generating the sample set (inversely related to number of replications)
- const int seedSpec
  the user seed specification for the random number generator (allows repeatable results)
- int randomSeed
  current seed for the random number generator
- bool allDataFlag
  flag which triggers the update of allVars/allResponses for use by Iterator::all_variables() and Iterator::all_responses()
13.38. DDACEDESIGNCOMPEXP CLASS REFERENCE

- `size_t numDACERuns`
  counter for number of executions for this object
- `bool varyPattern`
  flag for continuing the random number sequence from a previous execution (e.g., for surrogate-based optimization) so that multiple executions are repeatable but not correlated.
- `bool mainEffectsFlag`
  flag which specifies main effects
- `std::vector<std::vector<int>> symbolMapping`
  mapping of symbols for main effects calculations

Additional Inherited Members

### 13.38.1 Detailed Description

Wrapper class for the DDACE design of experiments library.

The DDACEDESIGNCOMPEXP class provides a wrapper for DDACE, a C++ design of experiments library from the Computational Sciences and Mathematics Research (CSMR) department at Sandia’s Livermore CA site. This class uses design and analysis of computer experiments (DACE) methods to sample the design space spanned by the bounds of a Model. It returns all generated samples and their corresponding responses as well as the best sample found.

### 13.38.2 Constructor & Destructor Documentation

**DDACEDesignCompExp ( ProblemDescDB & problemdb, Model & model )**

primary constructor for building a standard DACE iterator

This constructor is called for a standard iterator built with data from probDescDB.

References Dakota::abort_handler(), DDACEDesignCompExp::daceMethod, DDACEDesignCompExp::mainEffectsFlag, Iterator::maxEvalConcurrency, Analyzer::numContinuousVars, and DDACEDesignCompExp::numSamples.

**DDACEDesignCompExp ( Model & model, int samples, int symbols, int seed, unsigned short sampling_method )**

alternate constructor used for building approximations

This alternate constructor is used for instantiations on-the-fly, using only the incoming data. No problem description database queries are used.

References Iterator::maxEvalConcurrency, DDACEDesignCompExp::numSamples, and DDACEDesignCompExp::resolve_samples_symbols().

### 13.38.3 Member Function Documentation

**void pre_run ( ) [virtual]**

pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori

pre-run phase, which a derived iterator may optionally reimplement; when not present, pre-run is likely integrated into the derived run function. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s pre_run(), if implemented, typically before performing its own implementation steps.

Reimplemented from Analyzer.
References DDACEDesignCompExp::get_parameter_sets(), Iterator::iteratedModel, Analyzer::pre_run(), and PStudyDACE::varBasedDecompFlag.

```cpp
void core_run() [virtual]
```
core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post run function for the iterator class hierarchy. All derived classes need to redefine it.

Reimplemented from Iterator.

References DDACEDesignCompExp::allDataFlag, Analyzer::evaluate_parameter_sets(), Iterator::iteratedModel, DDACEDesignCompExp::mainEffectsFlag, Analyzer::numContinuousVars, Analyzer::numLSqTerms, Analyzer::numObjFns, DDACEDesignCompExp::numSamples, Iterator::subIteratorFlag, PStudyDACE::varBasedDecompFlag, and Analyzer::variance_based_decomp().

```cpp
void post_run(std::ostream &s) [virtual]
```
post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way

Post-run phase, which a derived iterator may optionally reimplement; when not present, post-run is likely integrated into run. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s post_run(), typically after performing its own implementation steps.

Reimplemented from Analyzer.

References Dakota::abort_handler(), Analyzer::allResponses, Analyzer::allSamples, SensAnalysisGlobal::compute_correlations(), DDACEDesignCompExp::compute_main_effects(), DDACEDesignCompExp::create_sampler(), Iterator::iteratedModel, DDACEDesignCompExp::mainEffectsFlag, Analyzer::post_run(), PStudyDACE::pStudyDACESensGlobal, DDACEDesignCompExp::seedSpec, Iterator::subIteratorFlag, DDACEDesignCompExp::symbol-Mapping, and PStudyDACE::varBasedDecompFlag.

```cpp
int num_samples() const [inline], [virtual]
```
return current number of evaluation points. Since the calculation of samples, collocation points, etc. might be costly, provide a default implementation here that backs out from the maxEvalConcurrency.

Reimplemented from Analyzer.

References DDACEDesignCompExp::numSamples.

```cpp
void resolve_samples_symbols() [private]
```
convenience function for resolving number of samples and number of symbols from input.

This function must define a combination of samples and symbols that is acceptable for a particular sampling algorithm. Users provide requests for these quantities, but this function must enforce any restrictions imposed by the sampling algorithms.

References Dakota::abort_handler(), DDACEDesignCompExp::daceMethod, Analyzer::numContinuousVars, DDACEDesignCompExp::numSamples, DDACEDesignCompExp::numSymbols, and Iterator::submethod_enum_to_string().

Referenced by DDACEDesignCompExp::DDACEDesignCompExp(), DDACEDesignCompExp::get_parameter_sets(), and DDACEDesignCompExp::post_input().

```cpp
void copy_data(const std::vector<DDaceSamplePoint> &dspa, Real *ptr, const int ptr_len) [static], [private]
```
copy DDACE point to RealVector

copy DDACE point array to RealVectorArray copy DDACE point array to Real*
References Dakota::abort_handler().
Referenced by DDACEDesignCompExp::get_parameter_sets().
The documentation for this class was generated from the following files:

- DDACEDesignCompExp.hpp
- DDACEDesignCompExp.cpp

### 13.39 DirectApplicInterface Class Reference

Derived application interface class which spawns simulation codes and testers using direct procedure calls.

Inheritance diagram for DirectApplicInterface:

```
Interface
  ApplicationInterface
    DirectApplicInterface
```

#### Public Member Functions

- **DirectApplicInterface (const ProblemDescDB &problem_db)**
  
  *Constructor*

- **~DirectApplicInterface ()**

  *Destructor*

- **void derived_map (const Variables &vars, const ActiveSet &set, Response &response, int fn_eval_id)**

  Called by map() and other functions to execute the simulation in synchronous mode. The portion of performing an evaluation that is specific to a derived class.

- **void derived_map_asynch (const ParamResponsePair &pair)**

  Called by map() and other functions to execute the simulation in asynchronous mode. The portion of performing an asynchronous evaluation that is specific to a derived class.

- **void wait_local_evaluations (PRPQueue &prp_queue)**

  For asynchronous function evaluations, this method is used to detect completion of jobs and process their results. It provides the processing code that is specific to derived classes. This version waits for at least one completion.

- **void test_local_evaluations (PRPQueue &prp_queue)**

  For asynchronous function evaluations, this method is used to detect completion of jobs and process their results. It provides the processing code that is specific to derived classes. This version is nonblocking and will return without any completions if none are immediately available.

- **int synchronous_local_analysis (int analysis_id)**

- **const StringArray & analysis_drivers () const**

  *retrieve the analysis drivers specification for application interfaces*

- **void init_communicators_checks (int max_eval_concurrency)**

- **void set_communicators_checks (int max_eval_concurrency)**

CHAPTER 13. CLASS DOCUMENTATION

Protected Member Functions

- virtual int derived_map_if (const Dakota::String &if_name)
  execute the input filter portion of a direct evaluation invocation
- virtual int derived_map_ac (const Dakota::String &ac_name)
  execute an analysis code portion of a direct evaluation invocation
- virtual int derived_map_of (const Dakota::String &of_name)
  execute the output filter portion of a direct evaluation invocation
- virtual void set_local_data (const Variables &vars, const ActiveSet &set)
  convenience function for local test simulators which sets per-evaluation variable and active set attributes; derived classes reimplementing this likely need to invoke the base class API
- virtual void set_local_data (const Response &response)
  convenience function for local test simulators which sets per-evaluation response attributes; derived classes reimplementing this likely need to invoke the base class API
- virtual void set_local_data (const Variables &vars, const ActiveSet &set, const Response &response)
  convenience function for local test simulators which sets per-evaluation variable, active set, and response attributes; derived classes reimplementing this likely need to invoke the base class API
- void overlay_response (Response &response)
  convenience function for local test simulators which overlays response contributions from multiple analyses using MPIReduce

Protected Attributes

- String iFilterName
  name of the direct function input filter
- String oFilterName
  name of the direct function output filter
- driver_t iFilterType
  enum type of the direct function input filter
- driver_t oFilterType
  enum type of the direct function output filter
- bool gradFlag
  signals use of fnGrads in direct simulator functions
- bool hessFlag
  signals use of fnHessians in direct simulator functions
- size_t numFns
  number of functions in fnVals
- size_t numVars
  total number of continuous and discrete variables
- size_t numACV
  total number of continuous variables
- size_t numADIV
  total number of discrete integer variables
- size_t numADRV
  total number of discrete real variables
• `size_t numADSV`
  total number of discrete string variables
• `size_t numDerivVars`
  number of active derivative variables
• `unsigned short localDataView`
  bit-wise record of which local data views are active; see enum local_data_t
• `RealVector xC`
  continuous variables used within direct simulator fns
• `IntVector xDI`
  discrete int variables used within direct simulator fns
• `RealVector xDR`
  discrete real variables used within direct simulator fns
• `StringMultiArray xDS`
  discrete string variables used within direct simulator fns
• `StringMultiArray xCLabels`
  continuous variable labels
• `StringMultiArray xDILabels`
  discrete integer variable labels
• `StringMultiArray xDRLabels`
  discrete real variable labels
• `StringMultiArray xDSLabels`
  discrete string variable labels
• `std::map< String, var_t > varTypeMap`
  map from variable label to enum
• `std::map< String, driver_t > driverTypeMap`
  map from driver name to enum
• `std::map< var_t, Real > xCM`
  map from var_t enum to continuous value
• `std::map< var_t, int > xDIM`
  map from var_t enum to discrete int value
• `std::map< var_t, Real > xDRM`
  map from var_t enum to discrete real value
• `std::map< var_t, String > xDSM`
  map from var_t enum to discrete string value
• `std::vector< var_t > varTypeDVV`
  var_t enumerations corresponding to DVV components
• `std::vector< var_t > xCMLabels`
  var_t enumerations corresponding to continuous variable labels
• `std::vector< var_t > xDIMLabels`
  var_t enumerations corresponding to discrete integer variable labels
• `std::vector< var_t > xDRMLabels`
  var_t enumerations corresponding to discrete real variable labels
• `std::vector< var_t > xDSMLabels`
\texttt{var\_t} enumerations corresponding to discrete string variable labels

- **ShortArray** \texttt{directFnASV}
  - \texttt{class scope} \texttt{active set vector}
- **SizetArray** \texttt{directFnDVS}
  - \texttt{class scope} \texttt{derivative variables vector}
- **RealVector** \texttt{fnVals}
  - \texttt{response fn values within direct simulator fns}
- **RealMatrix** \texttt{fnGrads}
  - \texttt{response fn gradients w/ direct simulator fns}
- **RealSymMatrixArray** \texttt{fnHessians}
  - \texttt{response fn Hessians within direct fns}
- **StringArray** \texttt{analysisDrivers}
  - \textit{the set of analyses within each function evaluation (from the analysis\_drivers interface specification)}
- **std::vector<\texttt{driver\_t}>** \texttt{analysisDriverTypes}
  - \texttt{conversion of analysisDrivers to driver\_t}
- **size\_t** \texttt{analysisDriverIndex}
  - \texttt{the index of the active analysis driver within analysisDrivers}
- **String2DArray** \texttt{analysisComponents}
  - \textit{the set of optional analysis components used by the analysis drivers (from the analysis\_components interface specification)}

Private Member Functions

- **void** \texttt{map\_labels\_to\_enum (StringMultiArrayConstView &src, std::vector<\texttt{var\_t}> &dest)}
  - \textit{map labels in src to var\_t in dest}

13.39.1 Detailed Description

Derived application interface class which spawns simulation codes and testers using direct procedure calls.

\texttt{DirectApplicInterface} uses a few linkable simulation codes and several internal member functions to perform parameter to response mappings.

13.39.2 Member Function Documentation

int synchronous\_local\_analysis ( int \textit{analysis\_id} ) \texttt{[inline], [virtual]}

This code provides the derived function used by \texttt{ApplicationInterface::serve\_analyses\_synch()}. Reimplemented from \texttt{ApplicationInterface}.

References \texttt{DirectApplicInterface::analysisDriverIndex}, \texttt{DirectApplicInterface::analysisDrivers}, and \texttt{DirectApplicInterface::derived\_map\_ac()}. 

\texttt{void init\_communicators\_checks ( int \textit{max\_eval\_concurrency} ) \texttt{[inline], [virtual]}}

Process init issues as warnings since some contexts (e.g., \texttt{HierarchSurrModel}) initialize more configurations than will be used and \texttt{DirectApplicInterface} allows override by derived plug-ins.

Reimplemented from \texttt{ApplicationInterface}.

References \texttt{ApplicationInterface::check\_asynchronous()}, and \texttt{ApplicationInterface::check\_multiprocessor\_asynchronous()}. 

void set_communicators_checks ( int max_eval_concurrency ) [inline], [virtual]

Process run-time issues as hard errors.
  Reimplemented from ApplicationInterface.
  Reimplemented in SerialDirectApplicInterface, and ParallelDirectApplicInterface.
  References Dakota::abort_handler(), ApplicationInterface::check_asynchronous(), and ApplicationInterface-::check_multiprocessor_asynchronous().

int derived_map_ac ( const Dakota::String & ac_name ) [protected], [virtual]

execute an analysis code portion of a direct evaluation invocation
  When a direct analysis/filter is a member function, the (vars,set,response) data does not need to be passed through the API. If, however, non-member analysis/filter functions are added, then pass (vars,set,response) through to the non-member fns:

  // API declaration
  int sim(const Variables& vars, const ActiveSet& set, Response& response);
  // use of API within derived_map_ac()
  if (ac_name == "sim")
    fail_code = sim(directFnVars, directFnActSet, directFnResponse);

  Reimplemented in SerialDirectApplicInterface, ParallelDirectApplicInterface, MatlabInterface, PythonInterface, TestDriverInterface, and ScilabInterface.
  References Dakota::abort_handler(), and ApplicationInterface::analysisServerId.
  Referenced by DirectApplicInterface::derived_map(), and DirectApplicInterface::synchronous_local_analysis().
  The documentation for this class was generated from the following files:

  • DirectApplicInterface.hpp
  • DirectApplicInterface.cpp

13.40 DiscrepancyCorrection Class Reference

Base class for discrepancy corrections.

Public Member Functions

  • DiscrepancyCorrection ()
    default constructor
  • DiscrepancyCorrection (Model &surr_model, const IntSet &surr_fn_indices, short corr_type, short corr_order)
    standard constructor
  • DiscrepancyCorrection (const IntSet &surr_fn_indices, size_t num_fns, size_t num_vars, short corr_type, short corr_order)
    alternate constructor
  • ~DiscrepancyCorrection ()
    destructor
  • void initialize (Model &surr_model, const IntSet &surr_fn_indices, short corr_type, short corr_order)
    initialize the DiscrepancyCorrection data
  • void initialize (const IntSet &surr_fn_indices, size_t num_fns, size_t num_vars, short corr_type, short corr_order)
CHAPTER 13. CLASS DOCUMENTATION

initialize the DiscrepancyCorrection data

- void compute (const Variables &vars, const Response &truth_response, const Response &approx_response, bool quiet_flag=false)
  compute the correction required to bring approx_response into agreement with truth_response and store in {add,mult}Corrections

- void compute (const Response &truth_response, const Response &approx_response, Response &discrepancy_response, bool quiet_flag=false)
  compute the correction required to bring approx_response into agreement with truth_response and store in discrepancy_response

- void apply (const Variables &vars, Response &approx_response, bool quiet_flag=false)
  apply the correction computed in compute() to approx_response

- bool active () const
  indicates an active correction via non-empty correctionType

- short correction_type () const
  return correctionType

- short correction_order () const
  return correctionOrder

- short data_order () const
  return dataOrder

- bool computed () const
  return correctionComputed

Protected Attributes

- IntSet surrogateFnIndices
  for mixed response sets, this array specifies the response function subset that is approximated

- short correctionType
  approximation correction approach to be used: NO_CORRECTION, ADDITIVE_CORRECTION, MULTIPLICATIVE_CORRECTION, or COMBINED_CORRECTION.

- short correctionOrder
  approximation correction order to be used: 0, 1, or 2

- short dataOrder
  order of correction data in 3-bit format: overlay of 1 (value), 2 (gradient), and 4 (Hessian)

- bool correctionComputed
  flag indicating whether or not a correction has been computed and is available for application

- size_t numFns
  total number of response functions (of which surrogateFnIndices may define a subset)

- size_t numVars
  number of continuous variables active in the correction
Private Member Functions

- void initialize_corrections ()
  *internal convenience function shared by overloaded initialize() variants
- bool check_scaling (const RealVector &truth_fns, const RealVector &approx_fns)
  *define badScalingFlag
- void compute_additive (const Response &truth_response, const Response &approx_response, int index, Real &discrep_fn, RealVector &discrep_grad, RealSymMatrix &discrep_hess)
  *internal convenience function for computing additive corrections between truth and approximate responses
- void compute_multiplicative (const Response &truth_response, const Response &approx_response, int index, Real &discrep_fn, RealVector &discrep_grad, RealSymMatrix &discrep_hess)
  *internal convenience function for computing multiplicative corrections between truth and approximate responses
- void apply_additive (const Variables &vars, Response &approx_response)
  *internal convenience function for applying additive corrections to an approximate response
- void apply_multiplicative (const Variables &vars, Response &approx_response)
  *internal convenience function for applying multiplicative corrections to an approximate response
- void apply_additive (const Variables &vars, RealVector &approx_fns)
  *internal convenience function for applying additive corrections to a set of response functions
- void apply_multiplicative (const Variables &vars, RealVector &approx_fns)
  *internal convenience function for applying multiplicative corrections to a set of response functions
- const Response & search_db (const Variables &search_vars, const ShortArray &search_asv)
  *search data pairs for missing approximation data

Private Attributes

- bool badScalingFlag
  *flag used to indicate function values near zero for multiplicative corrections; triggers an automatic switch to additive corrections
- bool computeAdditive
  *flag indicating the need for additive correction calculations
- bool computeMultiplicative
  *flag indicating the need for multiplicative correction calculations
- SharedApproxData sharedData
  *data that is shared among all correction Approximations
- std::vector< Approximation > addCorrections
  *array of additive corrections; surrogate models of a model discrepancy function (formed from model differences)
- std::vector< Approximation > multCorrections
  *array of multiplicative corrections; surrogate models of a model discrepancy function (formed from model ratios)
- Model surrModel
  *shallow copy of the surrogate model instance as returned by Model::surrogate_model() (the DataFitSurrModel or HierarchSurrModel::lowFidelityModel instance)
- RealVector combineFactors
  *factors for combining additive and multiplicative corrections. Each factor is the weighting applied to the additive correction and 1.-factor is the weighting applied to the multiplicative correction. The factor value is determined by an additional requirement to match the high fidelity function value at the previous correction point (e.g., previous trust region center). This results in a multipoint correction instead of a strictly local correction.
13.40.1 Detailed Description

Base class for discrepancy corrections. The DiscrepancyCorrection class provides common functions for computing and applying corrections to approximations.

13.40.2 Member Function Documentation

```cpp
void compute ( const Variables & vars, const Response & truth_response, const Response & approx_response, bool quiet_flag = false )
```

compute the correction required to bring approx_response into agreement with truth_response and store in \{add,mult\}Corrections

Compute an additive or multiplicative correction that corrects the approx_response to have 0th-order consistency (matches values), 1st-order consistency (matches values and gradients), or 2nd-order consistency (matches values, gradients, and Hessians) with the truth_response at a single point (e.g., the center of a trust region). The 0th-order, 1st-order, and 2nd-order corrections use scalar values, linear scaling functions, and quadratic scaling functions, respectively, for each response function.

References: Response::active_set(), DiscrepancyCorrection::addCorrections, DiscrepancyCorrection::apply(), DiscrepancyCorrection::apply_additive(), DiscrepancyCorrection::apply_multiplicative(), DiscrepancyCorrection::approxFnsCenter, DiscrepancyCorrection::approxFnsPrevCenter, DiscrepancyCorrection::approxGradsCenter, DiscrepancyCorrection::badScalingFlag, DiscrepancyCorrection::check_scaling(), DiscrepancyCorrection::combineFactors, DiscrepancyCorrection::compute_additive(), DiscrepancyCorrection::compute_multiplicative(), DiscrepancyCorrection::computeAdditive, DiscrepancyCorrection::computeMultiplicative, Variables::continuous_variables(), Response::copy(), DiscrepancyCorrection::correctionComputed, DiscrepancyCorrection::correctionOrder, DiscrepancyCorrection::correctionPrevCenterPt, DiscrepancyCorrection::correctionType, DiscrepancyCorrection::dataOrder, Variables::discrete_int_variables(), Variables::discrete_real_variables(), Response::function_gradients(), Response::function_values(), Model::is_null(), DiscrepancyCorrection::multCorrections, DiscrepancyCorrection::numFns, DiscrepancyCorrection::numVars, ActiveSet::request_values(), DiscrepancyCorrection::sharedData, DiscrepancyCorrection::surrModel, DiscrepancyCorrection::surrogateFnIndices, DiscrepancyCorrection::truthFnsCenter, and DiscrepancyCorrection::truthFnsPrevCenter.

Referenced by SurrBasedLocalMinimizer::core_run(), HierarchSurrModel::derived_evaluate(), DataFitSurrModel::derived_evaluate(), HierarchSurrModel::derived_evaluate_nowait(), DataFitSurrModel::derived_synchronize(), HierarchSurrModel::derived_synchronize_combine(), and DataFitSurrModel::derived_synchronize_nowait().

The documentation for this class was generated from the following files:

- DiscrepancyCorrection.hpp
- DiscrepancyCorrection.cpp
13.41  DOTOptimizer Class Reference

Wrapper class for the DOT optimization library.

Inheritance diagram for DOTOptimizer:

```
DOTOptimizer
  ├── Optimizer
  │   ├── Minimizer
  │   │   └── Iterator
```

Public Member Functions

- **DOTOptimizer** (ProblemDescDB &problem_db, Model &model)
  
  *standard constructor*

- **DOTOptimizer** (const String &method_string, Model &model)
  
  *alternate constructor; construct without ProblemDescDB*

- **~DOTOptimizer** ()

  *destructor*

- void **core_run** ()
  
  *core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post*

Protected Member Functions

- void **initialize_run** ()
  
  *performs run-time set up*

Private Member Functions

- void **initialize** ()
  
  *Shared constructor code.*

- void **allocate_workspace** ()
  
  *Allocates workspace for the optimizer.*

- void **allocate_constraints** ()
  
  *Allocates constraint mappings.*

Private Attributes

- int **dotInfo**
  
  *INFO from DOT manual.*

- int **dotFDSinfo**
CHAPTER 13. CLASS DOCUMENTATION

internal DOT parameter NGOTOZ

- int dotMethod
  METHOD from DOT manual.

- int printControl
  IPRINT from DOT manual (controls output verbosity)

- RealArray realCntlParmArray
  RPRM from DOT manual.

- IntArray intCntlParmArray
  IPRM from DOT manual.

- RealVector designVars
  array of design variable values passed to DOT

- Real objFnValue
  value of the objective function passed to DOT

- RealVector constraintValues
  array of nonlinear constraint values passed to DOT

- int realWorkSpaceSize
  size of realWorkSpace

- int intWorkSpaceSize
  size of intWorkSpace

- RealArray realWorkSpace
  real work space for DOT

- IntArray intWorkSpace
  int work space for DOT

- int numDotNlnConstr
  total number of nonlinear constraints seen by DOT

- int numDotLinConstr
  total number of linear constraints seen by DOT

- int numDotConstr
  total number of linear and nonlinear constraints seen by DOT

- SizetArray constraintMappingIndices
  a container of indices for referencing the corresponding Response constraints used in computing the DOT constraints.

- RealArray constraintMappingMultipliers
  a container of multipliers for mapping the Response constraints to the DOT constraints.

- RealArray constraintMappingOffsets
  a container of offsets for mapping the Response constraints to the DOT constraints.
Additional Inherited Members

13.41.1 Detailed Description

Wrapper class for the DOT optimization library.

The DOTOptimizer class provides a wrapper for DOT, a commercial Fortran 77 optimization library from Vanderplaats Research and Development. It uses a reverse communication mode, which avoids the static member function issues that arise with function pointer designs (see NPSOLOptimizer and SNLLOptimizer).

The user input mappings are as follows: max_iterations is mapped into DOT’s ITMAX parameter within its IPRM array, max_function_evaluations is implemented directly in the core_run() loop since there is no DOT parameter equivalent, convergence_tolerance is mapped into DOT’s DELOBJ parameter (the relative convergence tolerance) within its RPRM array, output verbosity is mapped into DOT’s IPRINT parameter within its function call parameter list (verbose: IPRINT = 7; quiet: IPRINT = 3), and optimization_type is mapped into DOT’s MINMAX parameter within its function call parameter list. Refer to [Vanderplaats Research and Development, 1995] for information on IPRM, RPRM, and the DOT function call parameter list.

13.41.2 Member Function Documentation

```cpp
void core_run() [virtual]
```
core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post run function for the iterator class hierarchy. All derived classes need to redefine it.
Reimplemented from Iterator.

References Iterator::activeSet, Iterator::bestResponseArray, Iterator::bestVariablesArray, DOTOptimizer::constraintMappingIndices, DOTOptimizer::constraintMappingMultipliers, DOTOptimizer::constraintMappingOffsets, DOTOptimizer::constraintValues, Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::continuous_variables(), Model::current_response(), DOTOptimizer::designVars, DOTOptimizer::dotFDSinfo, DOTOptimizer::dotInfo, DOTOptimizer::dotMethod, Model::evaluate(), Response::function_gradients(), Response::function_values(), Model::gradient_type(), DOTOptimizer::intCntlParmArray, DOTOptimizer::intWorkSpace, DOTOptimizer::intWorkSpaceSize, Iterator::iteratedModel, Model::linear_eq_constraint_coeffs(), Model::linear_ineq_constraint_coeffs(), Optimizer::localObjectiveRecast, Iterator::maxFunctionEvals, Model::num_linear_eq_constraints(), Model::num_linear_ineq_constraints(), Minimizer::numContinuousVars, DOTOptimizer::numDotConstr, DOTOptimizer::numDotNlnConstr, Minimizer::numFunctions, Optimizer::numObjectiveFns, DOTOptimizer::objFnValue, Iterator::outputLevel, Model::primary_response_fn_sense(), DOTOptimizer::printControl, DOTOptimizer::realCntlParmArray, DOTOptimizer::realWorkSpace, DOTOptimizer::realWorkSpaceSize, ActiveSet::request_value(), ActiveSet::request_values(), Minimizer::speculativeFlag, and Minimizer::vendorNumericalGradFlag.

13.41.3 Member Data Documentation

```cpp
int dotInfo [private]
```
INFO from DOT manual.

Information requested by DOT: 0=optimization complete, 1=get values, 2=get gradients
Referenced by DOTOptimizer::core_run(), and DOTOptimizer::initialize_run().

```cpp
int dotFDSinfo [private]
```
internal DOT parameter NGOTOZ

the DOT parameter list has been modified to pass NGOTOZ, which signals whether DOT is finite-differencing (nonzero value) or performing the line search (zero value).
Referenced by DOTOptimizer::core_run().
int dotMethod  [private]

METHOD from DOT manual.
   For nonlinear constraints: 0/1 = dot_mmfd, 2 = dot_slp, 3 = dot_sqp. For unconstrained: 0/1 = dot_bfgs, 2 = dot_rcg.
   Referenced by DOTOptimizer::allocate_constraints(), DOTOptimizer::allocate_workspace(), DOTOptimizer::core_run(), and DOTOptimizer::DOTOptimizer().

int printControl  [private]

IPRINT from DOT manual (controls output verbosity)
   Values range from 0 (least output) to 7 (most output).
   Referenced by DOTOptimizer::core_run(), and DOTOptimizer::DOTOptimizer().

RealArray realCntlParmArray  [private]

RPRM from DOT manual.
   Array of real control parameters.
   Referenced by DOTOptimizer::core_run(), and DOTOptimizer::initialize().

IntArray intCntlParmArray  [private]

IPRM from DOT manual.
   Array of integer control parameters.
   Referenced by DOTOptimizer::core_run(), and DOTOptimizer::initialize().

RealVector constraintValues  [private]

array of nonlinear constraint values passed to DOT
   This array must be of nonzero length and must contain only one-sided inequality constraints which are <= 0
   (which requires a transformation from 2-sided inequalities and equalities).
   Referenced by DOTOptimizer::allocate_constraints(), and DOTOptimizer::core_run().

SizetArray constraintMappingIndices  [private]

a container of indices for referencing the corresponding Response constraints used in computing the DOT constraints.
   The length of the container corresponds to the number of DOT constraints, and each entry in the container points to the corresponding DAKOTA constraint.
   Referenced by DOTOptimizer::allocate_constraints(), and DOTOptimizer::core_run().

RealArray constraintMappingMultipliers  [private]

a container of multipliers for mapping the Response constraints to the DOT constraints.
   The length of the container corresponds to the number of DOT constraints, and each entry in the container stores a multiplier for the DAKOTA constraint identified with constraintMappingIndices. These multipliers are currently +1 or -1.
   Referenced by DOTOptimizer::allocate_constraints(), and DOTOptimizer::core_run().
RealArray constraintMappingOffsets  [private]

a container of offsets for mapping the Response constraints to the DOT constraints.

The length of the container corresponds to the number of DOT constraints, and each entry in the container
stores an offset for the DAKOTA constraint identified with constraintMappingIndices. These offsets involve
inequality bounds or equality targets, since DOT assumes constraint allowables = 0.

Referenced by DOTOptimizer::allocate_constraints(), and DOTOptimizer::core_run().

The documentation for this class was generated from the following files:

- DOTOptimizer.hpp
- DOTOptimizer.cpp

13.42 JEGAOptimizer::Driver Class Reference

A subclass of the JEGA front end driver that exposes the individual protected methods to execute the algorithm.

Inherits Driver.

Public Member Functions

- GeneticAlgorithm * ExtractAllData (const AlgorithmConfig &algConfig)
  Reads all required data from the problem description database stored in the supplied algorithm config.

- DesignOFSortSet PerformIterations (GeneticAlgorithm *theGA)
  Performs the required iterations on the supplied GA.

- void DestroyAlgorithm (GeneticAlgorithm *theGA)
  Deletes the supplied GA.

- Driver (const ProblemConfig &probConfig)
  Default constructs a Driver.

13.42.1 Detailed Description

A subclass of the JEGA front end driver that exposes the individual protected methods to execute the algorithm.

This is necessary because DAKOTA requires that all problem information be extracted from the problem
description DB at the time of Optimizer construction and the front end does it all in the execute algorithm method
which must be called in core_run.

13.42.2 Constructor & Destructor Documentation

Driver ( const ProblemConfig & probConfig )  [inline]

Default constructs a Driver.

Parameters

- probConfig
  The definition of the problem to be solved by this Driver whenever ExecuteAlgorithm is called.

The problem can be solved in multiple ways by multiple algorithms even using multiple different evaluators by
issuing multiple calls to ExecuteAlgorithm with different AlgorithmConfigs.
13.42.3 Member Function Documentation

**GeneticAlgorithm:: ExtractAllData ( const AlgorithmConfig & algConfig ) [inline]**

Reads all required data from the problem description database stored in the supplied algorithm config.
- The returned GA is fully configured and ready to be run. It must also be destroyed at some later time. You MUST call DestroyAlgorithm for this purpose. Failure to do so could result in a memory leak and an eventual segmentation fault! Be sure to call DestroyAlgorithm prior to destroying the algorithm config that was used to create it!
- This is just here to expose the base class method to users.

**Parameters**

- **algConfig** The fully loaded configuration object containing the database of parameters for the algorithm to be run on the known problem.

**Returns**

- The fully configured and loaded GA ready to be run using the PerformIterations method.

Referenced by JEGAOptimizer::core_run().

**DesignOFSortSet PerformIterations ( GeneticAlgorithm * theGA ) [inline]**

Performs the required iterations on the supplied GA.
- This includes the calls to AlgorithmInitialize and AlgorithmFinalize and logs some information if appropriate.
- This is just here to expose the base class method to users.

**Parameters**

- **theGA** The GA on which to perform iterations. This parameter must be non-null.

**Returns**

- The final solutions reported by the supplied GA after all iterations and call to AlgorithmFinalize.

Referenced by JEGAOptimizer::core_run().

**void DestroyAlgorithm ( GeneticAlgorithm * theGA ) [inline]**

Deletes the supplied GA.
- Use this method to destroy a GA after all iterations have been run. This method knows if the log associated with the GA was created here and needs to be destroyed as well or not.
- This is just here to expose the base class method to users.
- Be sure to use this prior to destroying the algorithm config object which contains the target. The GA destructor needs the target to be in tact.

**Parameters**

- **theGA** The algorithm that is no longer needed and thus must be destroyed.

Referenced by JEGAOptimizer::core_run().

The documentation for this class was generated from the following file:

- JEGAOptimizer.cpp
13.43 EffGlobalMinimizer Class Reference

Implementation of Efficient Global Optimization/Least Squares algorithms.

Inheritance diagram for EffGlobalMinimizer:

```
EffGlobalMinimizer
  SurrBasedMinimizer
    Minimizer
      Iterator
```

Public Member Functions

- **EffGlobalMinimizer (ProblemDescDB &problem_db, Model &model)**
  
  *standard constructor*

- **~EffGlobalMinimizer ()**
  
  *alternate constructor for instantiations “on the fly”*

- **void core_run ()**
  
  *core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post*

- **const Model & algorithm_space_model () const**

Private Member Functions

- **void minimize_surrogates_on_model ()**
  
  *called by minimize_surrogates for setUpType == ”model”*

- **void get_best_sample ()**
  
  *called by minimize_surrogates for setUpType == ”user_functions”*

- **Real expected_improvement (const RealVector &means, const RealVector &variances)**
  
  *expected improvement function for the GP*

- **RealVector expected_violation (const RealVector &means, const RealVector &variances)**
  
  *expected violation function for the constraint functions*

- **void update_penalty ()**
  
  *initialize and update the penaltyParameter*

Static Private Member Functions

- **static void EIF_objective_eval (const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)**
  
  *static function used as the objective function in the Expected Improvement (EIF) problem formulation for PMA*
CHAPTER 13. CLASS DOCUMENTATION

Private Attributes

- String setUpType
  controls iteration mode: "model" (normal usage) or "user_functions" (user-supplied functions mode for "on the fly" instantiations).
- Model fHatModel
  GP model of response, one approximation per response function.
- Model eifModel
  recast model which assimilates mean and variance to solve the max(EIF) sub-problem
- Real meritFnStar
  minimum penalized response from among true function evaluations
- RealVector truthFnStar
  true function values corresponding to the minimum penalized response
- RealVector varStar
  point that corresponds to the optimal value meritFnStar
- short dataOrder
  order of the data used for surrogate construction, in ActiveSet request vector 3-bit format; user may override responses spec

Static Private Attributes

- static EffGlobalMinimizer * effGlobalInstance
  pointer to the active object instance used within the static evaluator functions in order to avoid the need for static data

Additional Inherited Members

13.43.1 Detailed Description

Implementation of Efficient Global Optimization/Least Squares algorithms.

The EffGlobalMinimizer class provides an implementation of the Efficient Global Optimization algorithm developed by Jones, Schonlau, & Welch as well as adaptation of the concept to nonlinear least squares.

13.43.2 Constructor & Destructor Documentation

~EffGlobalMinimizer ( )
alternate constructor for instantiations "on the fly"
  destructor

13.43.3 Member Function Documentation

void core_run ( ) [virtual]
core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post
  Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.
  Reimplemented from Iterator.
  References Dakota::abort_handler(), EffGlobalMinimizer::minimize_surrogates_on_model(), and EffGlobalMinimizer::setUpType.
const Model & algorithm.space.model( ) const [inline], [virtual]

default definition that gets redefined in selected derived Minimizers
   Reimplemented from Minimizer.
   References EffGlobalMinimizer::fHatModel.

void get_best_sample( ) [private]
called by minimize_surrogates for setUpType == "user_functions"
   determine best solution from among sample data for expected improvement function
   References Model::approximation_data(), SurrBasedMinimizer::augmented_lagrangian_merit(), Model::continuous_variables(), Dakota::copy_data(), Model::current_response(), Model::evaluate(), EffGlobalMinimizer::fHatModel, Response::function_values(), Iterator::iteratedModel, EffGlobalMinimizer::meritFnStar, Minimizer::numFunctions, SurrBasedMinimizer::origNonlinEqTargets, SurrBasedMinimizer::origNonlinIneqLowerBnds, SurrBasedMinimizer::origNonlinIneqUpperBnds, Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), EffGlobalMinimizer::truthFnStar, and EffGlobalMinimizer::varStar.
   Referenced by EffGlobalMinimizer::minimize_surrogates_on_model().
   The documentation for this class was generated from the following files:

   - EffGlobalMinimizer.hpp
   - EffGlobalMinimizer.cpp

13.44 EmbedHybridMetaIterator Class Reference

Meta-iterator for closely-coupled hybrid iteration, typically involving the embedding of local search methods within global search methods.
   Inheritance diagram for EmbedHybridMetaIterator:

   ![Inheritance Diagram]

   - EmbedHybridMetaIterator (ProblemDescDB &problem_db)
     *standard constructor*
   - EmbedHybridMetaIterator (ProblemDescDB &problem_db, Model &model)
     *alternate constructor*
   - ~EmbedHybridMetaIterator ()
     *destructor*
Protected Member Functions

- **void core_run ()**
  
  Performs the hybrid iteration by executing global and local iterators, using a set of models that may vary in fidelity.

- **void derived_init_communicators (ParLevLIter pl_iter)**
  
  derived class contributions to initializing the communicators associated with this Iterator instance

- **void derived_set_communicators (ParLevLIter pl_iter)**
  
  derived class contributions to setting the communicators associated with this Iterator instance

- **void derived_free_communicators (ParLevLIter pl_iter)**
  
  derived class contributions to freeing the communicators associated with this Iterator instance

- **IntIntPair estimate_partition_bounds ()**
  
  estimate the minimum and maximum partition sizes that can be utilized by this Iterator

- **const Variables & variables_results () const**
  
  return the final solution from the embedded hybrid (variables)

- **const Response & response_results () const**
  
  return the final solution from the embedded hybrid (response)

Private Attributes

- **Iterator globalIterator**
  
  the top-level outer iterator (e.g., global minimizer)

- **Model globalModel**
  
  the model employed by the top-level outer iterator

- **Iterator localIterator**
  
  the inner iterator (e.g., local minimizer)

- **Model localModel**
  
  the model employed by the inner iterator

- **Real localSearchProb**
  
  the probability of running a local search refinement within phases of the global minimization for tightly-coupled hybrids

Additional Inherited Members

13.44.1 Detailed Description

Meta-iterator for closely-coupled hybrid iteration, typically involving the embedding of local search methods within global search methods.

This meta-iterator uses multiple methods in close coordination, generally using a local search minimizer repeatedly within a global minimizer (the local search minimizer refines candidate minima which are fed back to the global minimizer).

The documentation for this class was generated from the following files:

- EmbedHybridMetaIterator.hpp
- EmbedHybridMetaIterator.cpp
13.45 Environment Class Reference

Base class for the environment class hierarchy.

Inheritance diagram for Environment:

- Environment
  - ExecutableEnvironment
  - LibraryEnvironment

Public Member Functions

- Environment ()
  
  default constructor: empty envelope

- Environment (int argc, char *argv[])
  
  envelope constructor for ExecutableEnvironment letter

- Environment (ProgramOptions prog_opts)

- Environment (MPI_Comm dakota_mpi_comm, ProgramOptions prog_opts=ProgramOptions())

- Environment (const String &env_type)
  
  envelope constructor for letter type identified by String

- Environment (const Environment &env)
  
  copy constructor

- virtual ~Environment ()

  destructor

- Environment operator=(const Environment &env)

  assignment operator

- virtual void execute ()

  the run function for the environment: invoke the iterator(s) on the model(s). Called from main.cpp.

- bool check () const

  Print status of check and return true if in a "check" mode, including version and help. Return false if proceeding to a run mode.

- MPIManager & mpi_manager ()

  return mpiManager

- ProgramOptions & program_options ()

  return programOptions

- OutputManager & output_manager ()

  return outputManager

- ParallelLibrary & parallel_library ()

  return parallelLib

- ProblemDescDB & problem_description_db ()

  return probDescDB

- const Variables & variables_results () const

  return the final environment solution (variables)
• const Response & response_results () const
  return the final environment solution (response)

• void exit_mode (const String &mode="exit")
  allow environment clients to set Dakota exit behavior (throw vs. exit)

Protected Member Functions

• Environment (BaseConstructor)
  constructor initializes the base class part of default-constructed letters

• Environment (BaseConstructor, int argc, char *argv[])
  constructor initializes the base class part of executable letter classes

• Environment (BaseConstructor, ProgramOptions prog_opts, MPI_Comm dakota_mpi_comm=MPI_COMM_WORLD)
  constructor initializes the base class part of library letter classes

• void parse (bool check_bcast_database=true, DbCallbackFunctionPtr callback=NULL, void *callback_data=NULL)
  parse inputs, callbacks, and optionally check and broadcast

• void construct ()
  Instantiate topLevelIterator.

• void destruct ()
  Deallocate parallel partitioning for topLevelIterator.

Protected Attributes

• MPIManager mpiManager
  the MPI manager instance

• ProgramOptions programOptions
  the command line options manager

• OutputManager outputManager
  (tagged) output stream manager

• ParallelLibrary parallelLib
  the parallel library instance

• ProblemDescDB probDescDB
  the parser database instance

• Iterator topLevelIterator
  the top level (meta-)iterator

• UsageTracker usageTracker
  tool for Dakota usage tracking (this is a thin wrapper class)

Private Member Functions

• Environment * get_environment (const String &env_type)
  Used by the envelope to instantiate the correct letter class.
Private Attributes

- **Environment * environmentRep**
  - pointer to the letter (initialized only for the envelope)
- **int referenceCount**
  - number of objects sharing environmentRep

13.45.1 Detailed Description

Base class for the environment class hierarchy.

The `Environment` class is the base class for the class hierarchy providing the top level control in DAKOTA. The environment is responsible for creating and managing iterators and models. For memory efficiency and enhanced polymorphism, the environment hierarchy employs the "letter/envelope idiom" (see Coplien “Advanced C++”, p. 133), for which the base class (`Environment`) serves as the envelope and one of the derived classes (selected in `Environment::get_environment()`) serves as the letter.

13.45.2 Constructor & Destructor Documentation

**Environment ( )**

default constructor: empty envelope

Default envelope constructor. `environmentRep` is NULL in this case, which makes it necessary to check for NULL in the copy constructor, assignment operator, and destructor.

**Environment ( int argc, char * argv[ ] )**

envelope constructor for `ExecutableEnvironment` letter

Envelope constructor for `ExecutableEnvironment`. Selection of derived type by `get_environment()` is not necessary in this case.

References Dakota::abort_handler(), and `Environment::environmentRep`.

**Environment ( ProgramOptions prog_opts )**

Envelope constructor for `LibraryEnvironment`. Selection of derived type by `get_environment()` is not necessary in this case.

References Dakota::abort_handler(), and `Environment::environmentRep`.

**Environment ( MPI_Comm dakota_mpi_comm, ProgramOptions prog_opts = ProgramOptions ( ) )**

Envelope constructor for `LibraryEnvironment`. Selection of derived type by `get_environment()` is not necessary in this case.

References Dakota::abort_handler(), and `Environment::environmentRep`.

**Environment ( const String & env_type )**

envelope constructor for letter type identified by String

Alternate construction by String. Envelope constructor invokes `get_environment()` which instantiates a derived class letter; the derived constructor selects a `BaseConstructor` constructor in its initialization list to avoid the recursion of a base class constructor calling `get_environment()` again.

References Dakota::abort_handler(), Environment::environmentRep, and `Environment::get_environment()`.
CHAPTER 13. CLASS DOCUMENTATION

**Environment ( const Environment & env )**

copy constructor

- Copy constructor manages sharing of environmentRep and incrementing of referenceCount.
- References Environment::environmentRep, and Environment::referenceCount.

**~Environment ( ) [virtual]**

destructor

- Destructor decrements referenceCount and only deletes environmentRep when referenceCount reaches zero.
- References Environment::destruct(), Environment::environmentRep, and Environment::referenceCount.

**Environment ( BaseConstructor ) [protected]**

constructor initializes the base class part of default-constructed letters

- This letter constructor initializes base class data for inherited environments that are default constructed. Since the letter IS the representation, its representation pointer is set to NULL (an uninitialized pointer causes problems in ~Environment).
- Use cases: library with no options, no MPI comm
- References ProgramOptions::exit_mode(), Environment::exit_mode(), WorkdirHelper::initialize(), and Environment::programOptions.

**Environment ( BaseConstructor, int argc, char * argv[] ) [protected]**

constructor initializes the base class part of executable letter classes

- This letter constructor initializes base class data for inherited environments: instantiate/initialize the environment, options, parallel library, and problem description database objects. Since the letter IS the representation, its representation pointer is set to NULL (an uninitialized pointer causes problems in ~Environment).
- Use cases: executable with command-line args
- References ProgramOptions::exit_mode(), Environment::exit_mode(), WorkdirHelper::initialize(), and Environment::programOptions.

**Environment ( BaseConstructor, ProgramOptions prog_opts, MPI_Comm dakota_mpi_comm = MPI_COMM_WORLD ) [protected]**

constructor initializes the base class part of library letter classes

- This letter constructor initializes base class data for inherited environments. Since the letter IS the representation, its representation pointer is set to NULL (an uninitialized pointer causes problems in ~Environment).
- Use cases: library with program options library with program options and MPI comm
- References ProgramOptions::exit_mode(), Environment::exit_mode(), WorkdirHelper::initialize(), and Environment::programOptions.

### 13.45.3 Member Function Documentation

**Environment operator= ( const Environment & env )**

assignment operator

- References Environment::environmentRep, and Environment::referenceCount.
void exit_mode ( const String & mode = "exit" )

allow environment clients to set Dakota exit behavior (throw vs. exit)
   Set the global variable controlling Dakota’s exit behavior. Call with no arguments to reset to default behavior.
   References Dakota::abort_handler(), and Dakota::abort_mode.
   Referenced by Environment::Environment(), and run_dakota_data().

void parse ( bool check_bcast_database = true, DbCallbackFunctionPtr callback = NULL, void * callback_data = NULL ) [protected]

parse inputs, callbacks, and optionally check and broadcast
   Parse input file and invoked any callbacks, then optionally check and sync database if check_bcast_database = true
   References ProblemDescDB::check_and_broadcast(), ProgramOptions::input_file(), ProgramOptions::input_string(), ProblemDescDB::parse_inputs(), Environment::probDescDB, and Environment::programOptions.
   Referenced by ExecutableEnvironment::ExecutableEnvironment(), and LibraryEnvironment::LibraryEnvironment().

Environment * get_environment ( const String & env_type ) [private]

Used by the envelope to instantiate the correct letter class.
   Used only by the envelope constructor to initialize environmentRep to the appropriate derived type, as given by the environmentName attribute.
   Referenced by Environment::Environment().
   The documentation for this class was generated from the following files:

   • DakotaEnvironment.hpp
   • DakotaEnvironment.cpp

13.46  NomadOptimizer::Evaluator Class Reference

NOMAD-based Evaluator class.
   Inherits Evaluator.

Public Member Functions

• Evaluator (const NOMAD::Parameters &p, Model &model)
  Constructor.

• ~Evaluator (void)
  Destructor.

• bool eval_x (NOMAD::Eval_Point &x, const NOMAD::Double &h_max, bool &count_eval) const
  Main Evaluation Method.

• void set_constraint_map (int numNomadNonlinearIneqConstraints, int numNomadNonlinearEqConstraints,
   std::vector<int> constraintMapIndices, std::vector<double> constraintMapMultipliers,
   std::vector<double> constraintMapOffsets)
  publishes constraint transformation
Private Attributes

- Model & _model
- int n_cont
- int n_disc_int
- int n_disc_real
- int numNomadNonlinearIneqConstr
  Number of nonlinear constraints after put into Nomad format.
- int numNomadNonlinearEqConstr
- std::vector<int> constrMapIndices
  map from Dakota constraint number to Nomad constraint number
- std::vector<double> constrMapMultipliers
  multipliers for constraint transformations
- std::vector<double> constrMapOffsets
  offsets for constraint transformations

13.46.1 Detailed Description

NOMAD-based Evaluator class.

The NOMAD process requires an evaluation step, which calls the Simulation program. In the simplest version of this call, NOMAD executes the black box executable, which proceeds to write a file in a NOMAD-compatible format, which NOMAD reads to continue the process.

Because DAKOTA files are different from NOMAD files, and the simulations processed by DAKOTA already produce DAKOTA-compatible files, we cannot use this method for NOMAD. Instead, we implement the Nomad-Evaluator class, which takes the NOMAD inputs and passes them to DAKOTA’s Interface for processing. The evaluator then passes the evaluation Responses into the NOMAD objects for further analysis.

13.46.2 Constructor & Destructor Documentation

Evaluator ( const NOMAD::Parameters & p, Model & model )

Constructor.

NOMAD Evaluator Constructor

Parameters

<table>
<thead>
<tr>
<th>p</th>
<th>NOMAD Parameters object</th>
</tr>
</thead>
<tbody>
<tr>
<td>model</td>
<td>DAKOTA Model object</td>
</tr>
</tbody>
</table>

13.46.3 Member Function Documentation

bool eval_x ( NOMAD::Eval_Point & x, const NOMAD::Double & h_max, bool & count_eval ) const

Main Evaluation Method.

Method that handles the communication between the NOMAD search process and the Black Box Evaluation managed by DAKOTA’s Interface.
Parameters

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x$</td>
<td>Object that contains the points that need to be evaluated. Once the evaluation is completed, this object also stores the output back to be read by NOMAD.</td>
</tr>
<tr>
<td>$h_{\text{max}}$</td>
<td>Current value of the barrier parameter. Not used in this implementation.</td>
</tr>
<tr>
<td>$\text{count}_{\text{eval}}$</td>
<td>Flag that indicates whether this evaluation counts towards the max number of evaluations, often set to $\text{false}$ when the evaluation does not meet certain costs during expensive evaluations. Not used in this implementation.</td>
</tr>
</tbody>
</table>

Returns

$\text{true}$ if the evaluation was successful; $\text{false}$ otherwise.

References Dakota::set_index_to_value().

The documentation for this class was generated from the following files:

- NomadOptimizer.hpp
- NomadOptimizer.cpp

13.47 JEGAOptimizer::Evaluator Class Reference

An evaluator specialization that knows how to interact with Dakota.
Inherits GeneticAlgorithmEvaluator.

Public Member Functions

- virtual bool Evaluate (DesignGroup &group)
  Does evaluation of each design in group.
- virtual bool Evaluate (Design &des)
  This method cannot be used!!
- virtual std::string GetName () const
  Returns the proper name of this operator.
- virtual std::string GetDescription () const
  Returns a full description of what this operator does and how.
- virtual GeneticAlgorithmOperator * Clone (GeneticAlgorithm &algorithm) const
  Creates and returns a pointer to an exact duplicate of this operator.
- Evaluator (GeneticAlgorithm &algorithm, Model &model)
  Constructs a Evaluator for use by algorithm.
- Evaluator (const Evaluator &copy)
  Copy constructs a Evaluator.
- Evaluator (const Evaluator &copy, GeneticAlgorithm &algorithm, Model &model)
  Copy constructs a Evaluator for use by algorithm.

Static Public Member Functions

- static const std::string & Name ()
  Returns the proper name of this operator.
- static const std::string & Description ()
  Returns a full description of what this operator does and how.
CHAPTER 13. CLASS DOCUMENTATION

Protected Member Functions

- void SeparateVariables (const Design &from, RealVector &intoCont, IntVector &intoDiscInt, RealVector &intoDiscReal, StringMultiArray &intoDiscString) const
  
  This method fills intoCont, intoDiscInt and intoDiscReal appropriately using the values of from.

- void RecordResponses (const RealVector &from, Design &into) const
  
  Records the computed objective and constraint function values into into.

- std::size_t GetNumberNonLinearConstraints () const
  
  Returns the number of non-linear constraints for the problem.

- std::size_t GetNumberLinearConstraints () const
  
  Returns the number of linear constraints for the problem.

Private Member Functions

- Evaluator (GeneticAlgorithm &algorithm)
  
  This constructor has no implementation and cannot be used.

Private Attributes

- Model & _model
  
  The Model known by this evaluator.

13.47.1 Detailed Description

An evaluator specialization that knows how to interact with Dakota. This evaluator knows how to use the model to do evaluations both in synchronous and asynchronous modes.

13.47.2 Constructor & Destructor Documentation

Evaluator ( GeneticAlgorithm & algorithm, Model & model ) [inline]

Constructs a Evaluator for use by algorithm.

The optimizer is needed for purposes of variable scaling.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>algorithm</td>
<td>The GA for which the new evaluator is to be used.</td>
</tr>
<tr>
<td>model</td>
<td>The model through which evaluations will be done.</td>
</tr>
</tbody>
</table>

Evaluator ( const Evaluator & copy ) [inline]

Copy constructs a Evaluator.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>copy</td>
<td>The evaluator from which properties are to be duplicated into this.</td>
</tr>
</tbody>
</table>

Evaluator ( const Evaluator & copy, GeneticAlgorithm & algorithm, Model & model ) [inline]

Copy constructs a Evaluator for use by algorithm.

The optimizer is needed for purposes of variable scaling.
Parameters

<table>
<thead>
<tr>
<th>copy</th>
<th>The existing Evaluator from which to retrieve properties.</th>
</tr>
</thead>
<tbody>
<tr>
<td>algorithm</td>
<td>The GA for which the new evaluator is to be used.</td>
</tr>
<tr>
<td>model</td>
<td>The model through which evaluations will be done.</td>
</tr>
</tbody>
</table>

Evaluator ( GeneticAlgorithm & algorithm ) [private]

This constructor has no implementation and cannot be used.
This constructor can never be used. It is provided so that this operator can still be registered in an operator registry even though it can never be instantiated from there.

Parameters

| algorithm | The GA for which the new evaluator is to be used. |

13.47.3 Member Function Documentation

static const std::string& Name ( ) [inline], [static]

Returns the proper name of this operator.

Returns

The string "DAKOTA JEGA Evaluator".

static const std::string& Description ( ) [inline], [static]

Returns a full description of what this operator does and how.
The returned text is:

This evaluator uses Sandia’s DAKOTA optimization software to evaluate the passed in Designs. This makes it possible to take advantage of the fact that DAKOTA is designed to run on massively parallel machines.

Returns

A description of the operation of this operator.

void SeparateVariables ( const Design & from, RealVector & intoCont, IntVector & intoDiscInt, RealVector & intoDiscReal, StringMultiArray & intoDiscString ) const [protected]

This method fills intoCont, intoDiscInt and intoDiscReal appropriately using the values of from.
The discrete integer design variable values are placed in intoDiscInt, the discrete real design variable values are placed in intoDiscReal, and the continuum are placed into intoCont. The values are written into the vectors from the beginning so any previous contents of the vectors will be overwritten.
Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>from</code></td>
<td>The Design class object from which to extract the discrete design variable values.</td>
</tr>
<tr>
<td><code>intoDiscInt</code></td>
<td>The vector into which to place the extracted discrete integer values.</td>
</tr>
<tr>
<td><code>intoDiscReal</code></td>
<td>The vector into which to place the extracted discrete real values.</td>
</tr>
<tr>
<td><code>intoCont</code></td>
<td>The vector into which to place the extracted continuous values.</td>
</tr>
</tbody>
</table>

References JEGAOptimizer::Evaluator::model, Model::cv(), Model::discrete_int_sets(), Model::discrete_set_string_values(), Model::div(), Model::drv(), Model::dsv(), and Dakota::set_index_to_value().

```cpp
void RecordResponses ( const RealVector & from, Design & into ) const [protected]
```

Records the computed objective and constraint function values into `into`.

This method takes the response values stored in `from` and properly transfers them into the `into` design.

The response vector `from` is expected to contain values for each objective function followed by values for each non-linear constraint in the order in which the info objects were loaded into the target by the optimizer class.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>from</code></td>
<td>The vector of responses to install into <code>into</code>.</td>
</tr>
<tr>
<td><code>into</code></td>
<td>The Design to which the responses belong and into which they must be written.</td>
</tr>
</tbody>
</table>

```cpp
std::size_t GetNumberNonLinearConstraints ( ) const [inline], [protected]
```

Returns the number of non-linear constraints for the problem.

This is computed by adding the number of non-linear equality constraints to the number of non-linear inequality constraints. These values are obtained from the model.

Returns

- The total number of non-linear constraints.

```cpp
std::size_t GetNumberLinearConstraints ( ) const [inline], [protected]
```

Returns the number of linear constraints for the problem.

This is computed by adding the number of linear equality constraints to the number of linear inequality constraints. These values are obtained from the model.

Returns

- The total number of linear constraints.

```cpp
bool Evaluate ( DesignGroup & group ) [virtual]
```

Does evaluation of each design in `group`.

This method uses the `Model` known by this class to get Designs evaluated. It properly formats the Design class information in a way that Dakota will understand and then interprets the Dakota results and puts them back into the Design class object. It respects the asynchronous flag in the `Model` so evaluations may occur synchronously or asynchronously.

Prior to evaluating a Design, this class checks to see if it is marked as already evaluated. If it is, then the evaluation of that Design is not carried out. This is not strictly necessary because Dakota keeps track of evaluated designs and does not re-evaluate. An exception is the case of a population read in from a file complete with responses where Dakota is unaware of the evaluations.
**Parameters**

| group | The group of Design class objects to be evaluated. |

**Returns**

true if all evaluations completed and false otherwise.

**virtual bool Evaluate ( Design & des ) [inline], [virtual]**

This method cannot be used!!

This method does nothing and cannot be called. This is because in the case of asynchronous evaluation, this method would be unable to conform. It would require that each evaluation be done in a synchronous fashion.

**Parameters**

| des | A Design that would be evaluated if this method worked. |

**Returns**

Would return true if the Design were evaluated and false otherwise. Never actually returns here. Issues a fatal error. Otherwise, it would always return false.

**virtual std::string GetName ( ) const [inline], [virtual]**

Returns the proper name of this operator.

**Returns**

See Name().

**virtual std::string GetDescription ( ) const [inline], [virtual]**

Returns a full description of what this operator does and how.

**Returns**

See Description().

**virtual GeneticAlgorithmOperator* Clone ( GeneticAlgorithm & algorithm ) const [inline], [virtual]**

Creates and returns a pointer to an exact duplicate of this operator.

**Parameters**

| algorithm | The GA for which the clone is being created. |

**Returns**

A clone of this operator.
13.47.4 Member Data Documentation

Model& _model [private]

The Model known by this evaluator.

It is through this model that evaluations will take place.

Referenced by JEGAOptimizer::Evaluator::SeparateVariables().

The documentation for this class was generated from the following file:

- JEGAOptimizer.cpp

13.48 JEGAOptimizer::EvaluatorCreator Class Reference

A specialization of the JEGA::FrontEnd::EvaluatorCreator that creates a new instance of a Evaluator.

Inherits EvaluatorCreator.

Public Member Functions

- virtual GeneticAlgorithmEvaluator* CreateEvaluator (GeneticAlgorithm &alg)

  Overriden to return a newly created Evaluator.

- EvaluatorCreator (Model &theModel)

  Constructs an EvaluatorCreator using the supplied model.

Private Attributes

- Model & _theModel

  The user defined model to be passed to the constructor of the Evaluator.

13.48.1 Detailed Description

A specialization of the JEGA::FrontEnd::EvaluatorCreator that creates a new instance of a Evaluator.

13.48.2 Constructor & Destructor Documentation

EvaluatorCreator (Model & theModel ) [inline]

Constructs an EvaluatorCreator using the supplied model.

Parameters

| theModel | The Dakota::Model this creator will pass to the created evaluator. |

13.48.3 Member Function Documentation

virtual GeneticAlgorithmEvaluator* CreateEvaluator (GeneticAlgorithm & alg ) [inline], [virtual]

Overriden to return a newly created Evaluator.

The GA will assume ownership of the evaluator so we needn’t worry about keeping track of it for destruction.

The additional parameters needed by the Evaluator are stored as members of this class at construction time.
Parameters

| alg | The GA for which the evaluator is to be created. |

Returns

A pointer to a newly created Evaluator.

The documentation for this class was generated from the following file:

- JEGAOptimizer.cpp

### 13.49 ExecutableEnvironment Class Reference

Environment corresponding to execution as a stand-alone application.

Inheritance diagram for ExecutableEnvironment:

```
Environment

ExecutableEnvironment
```

**Public Member Functions**

- ExecutableEnvironment ()
  
  *default constructor*

- ExecutableEnvironment (int argc, char∗ argv[ ])
  
  *constructor*

- ∼ExecutableEnvironment ()
  
  *destructor*

- void execute ()
  
  *the run function for the environment: invoke the iterator(s) on the model(s). Called from main.cpp.*

**Additional Inherited Members**

### 13.49.1 Detailed Description

Environment corresponding to execution as a stand-alone application.

This environment corresponds to a stand-alone executable program, e.g., main.cpp. It sets up the ParallelLibrary, ProgramOptions, and ProblemDescDB objects based on access to command line arguments.

The documentation for this class was generated from the following files:

- ExecutableEnvironment.hpp
- ExecutableEnvironment.cpp

### 13.50 ExperimentData Class Reference

Interpolation method for interpolating between experimental and model data. I need to work on inputs/outputs to this method. For now, this assumes interpolation of functional data.
Public Member Functions

- **ExperimentData ()**
  - default constructor

- **ExperimentData (const ProblemDescDB &prob_desc_db, const SharedResponseData &srd, short output_level)**
  - typical DB-based constructor

- **ExperimentData (size_t num_experiments, size_t num_config_vars, const boost::filesystem::path &data_prefix, const SharedResponseData &srd, const StringArray &variance_types, short output_level, std::string scalarDataFilename="")**
  - temporary? constructor for testing

- **void load_data (const std::string &context_message)**
  - Load experiments from data files (simple scalar or field)

- **size_t num_experiments () const**
  - retrieve the number of experiments

- **size_t num_total_exppoints () const**
  - retrieve the total number of experimental data points over all experiments

- **size_t num_scalars () const**
  - retrieve the number of scalars (applies to all experiments)

- **size_t num_fields () const**
  - retrieve the number of fields (applies to all experiments)

- **const RealVector & config_vars (size_t experiment)**
  - retrieve the vector of configuration variables for the given experiment number

- **const RealVector & all_data (size_t experiment)**
  - return contiguous vector of all data (scalar, followed by field) for the specified experiment

- **void per_exp_length (IntVector &per_length) const**
  - return the individual sizes of the experimental data lengths (all function values, scalar and field)

- **const IntVector & field_lengths (size_t experiment) const**
  - return the field lengths for specified experiment index

- **Real scalar_data (size_t response, size_t experiment)**
  - retrieve the data value for the given response, for the given experiment

- **RealVector field_data_view (size_t response, size_t experiment) const**
  - retrieve a view of the field data for the given response, for the given experiment

- **RealMatrix field.coords_view (size_t response, size_t experiment) const**
  - retrieve a view of the field data coordinates for the given response, for the given experiment

- **bool variance_type_active (short variance_type) const**
  - whether the specified variance type (enum value) is present and active

- **bool variance_active () const**
  - whether any variance type is active

- **Real apply_covariance (const RealVector &residuals, size_t experiment) const**
  - apply the covariance responses to compute the triple product $v' = \text{inv}(C) \times v$ for the given experiment

- **void apply_covariance_inv_sqrt (const RealVector &residuals, size_t experiment, RealVector &weighted_residuals) const**
  - apply inverse sqrt of the covariance to compute weighted residuals
• void apply_covariance_inv_sqrt (const RealMatrix &gradients, size_t experiment, RealMatrix &weighted_gradients) const
  apply inverse sqrt of the covariance to compute weighted gradients

• void apply_covariance_inv_sqrt (const RealSymMatrixArray &hessians, size_t experiment, RealSymMatrixArray &weighted_hessians) const
  apply inverse sqrt of the covariance to compute weighted Hessians

• void get_main_diagonal (RealVector &diagonal, size_t experiment) const
  return a (copy) vector containing the main diagonal entries of a specified experimental covariance matrix

• void cov_std_deviation (RealVectorArray &std_deviation) const
  get the standard deviation of the observation error process, one vector per experiment

• void cov_as_correlation (RealSymMatrixArray &corr_matrix) const
  get the observation error covariance as a correlation matrix, one vector per experiment

• void form_residuals (const Response &simResp, Response &residualResp) const
  form residuals for all experiments, interpolating if necessary

• void form_residuals (const Response &simResp, size_t expNum, const ShortArray &totalAsv, size_t residual_offset, Response &residualResp) const
  form residuals for an individual experiment, interpolating if necessary

• void recover_model (size_t numPriFns, RealVector &modelFns) const
  recover original model from the first experiment block in a full set of residuals; works in no interpolation case only
  (sizes same)

• bool interpolate_flag () const
  flag for interpolation. If 0, no interpolation. If 1, interpolate.

• void interpolate_simulation_data (const Response &simResp, size_t expNum, const ShortArray &totalAsv, size_t exp_offset, Response &interpResp) const
  Interpolate simulation data (values, gradients and hessians) onto the coordinates of the experimental data.

• void scale_residuals (const Response &residual_response, RealVector &scaled_residuals) const
  Apply the experiment data covariance to the residual data (scale functions by $\Gamma(d^{-1/2})$), returning in scaled_residuals.

• void scale_residuals (Response &residual_response) const
  Apply the experiment data covariance to the residual data in-place (scale functions, gradients, and Hessians by $\Gamma(d^{-1/2})$)

• void build_gradient_of_sum_square_residuals (const Response &resp, RealVector &ssr_gradient)
  Build the gradient of the ssr from residuals and function gradients based on the response’s active set request vector.

• void build_gradient_of_sum_square_residuals (const Response &resp, const ShortArray &asrv, RealVector &ssr_gradient)
  Build the gradient of the ssr from residuals and function gradients using the passed active set request vector (overrides the response’s request vector)

• void build_gradient_of_sum_square_residuals_from_response (const Response &resp, const ShortArray &asrv, int expInd, RealVector &ssr_gradient)
  Update the gradient of ssr with the values from the gradient associated with a single experiment.

• void build_gradient_of_sum_square_residuals_from_function_data (const RealMatrix &func_gradients, const RealVector &residuals, RealVector &ssr_gradient, const ShortArray &asrv)
  Construct the gradient of the sum of squares of residuals.

• void build_hessian_of_sum_square_residuals (const Response &resp, RealSymMatrix &ssr_hessian)
Build the hessian of the ssr from residuals, function gradients and function hessians based on the response’s active set request vector.

- void build_hessian_of_sum_square_residuals (const Response &resp, const ShortArray &asrv, RealSymMatrix &ssr_hessian)
  
  Build the hessian of the ssr from residuals, function gradients and function hessians using the passed active set request vector (overrides the response’s request vector).

- void build_hessian_of_sum_square_residuals_from_response (const Response &resp, const ShortArray &asrv, int exp_ind, RealSymMatrix &ssr_hessian)
  
  Update the hessian of ssr with the values from the hessian associated with a single experiment.

- void build_hessian_of_sum_square_residuals_from_function_data (const RealSymMatrixArray &func_hessians, const RealMatrix &func_gradients, const RealVector &residuals, RealSymMatrix &ssr_hessian, const ShortArray &asrv)
  
  Construct the hessian of the sum of squares of residuals.

- void scale_residuals (const RealVector &multipliers, unsigned short multiplier_mode, size_t num_calib_params, Response &residual_response) const
  
  In-place scale the residual response (functions, gradients, Hessians) by sqrt(multipliers), according to blocks indicated by multiplier mode.

- Real cov_determinant (const RealVector &multipliers, unsigned short multiplier_mode) const
  
  Returns the determinant of (covariance block-scaled by the passed multipliers).

- Real half_log_cov_determinant (const RealVector &multipliers, unsigned short multiplier_mode) const
  
  Returns the log of the determinant of (covariance block-scaled by the passed multipliers).

- void half_log_cov_det_gradient (const RealVector &multipliers, unsigned short multiplier_mode, size_t hyper_offset, RealVector &gradient) const
  
  Populated the passed gradient with derivatives w.r.t. the hyper-parameter multipliers, starting at hyper_offset (must be sized).

- void half_log_cov_det_hessian (const RealVector &multipliers, unsigned short multiplier_mode, size_t hyper_offset, RealSymMatrix &hessian) const
  
  Populated the passed Hessian with derivatives w.r.t. the hyper-parameter multipliers, starting at hyper_offset (must be sized).

- StringArray hyperparam_labels (unsigned short multiplier_mode) const
  
  Generate variable labels for the covariance (error) multiplier hyperparams.

Protected Member Functions

- ShortArray determine_active_request (const Response &resid_resp) const
  
  Perform check on the active request vector to make sure it is amenable to interpolation of simulation data and application of apply covariance.

- SizetArray residuals_per_multiplier (unsigned short multiplier_mode) const
  
  Count the number of residuals influenced by each multiplier.

- void generate_multipliers (const RealVector &multipliers, unsigned short multiplier_mode, RealVector &expanded_multipliers) const
  
  Generate a set of multipliers commensurate with the residual size for the total experiment data set. Instead of repeating the loops all over the place, generate an expanded set of multipliers; the conditionals get too complicated otherwise.

- void resid2mult_map (unsigned short multiplier_mode, IntVector &resid2mult_indices) const
  
  Return the index of the multiplier that affects each residual.
Private Member Functions

- void initialize (const StringArray &variance_types, const SharedResponseData &srd)
  
  *shared body of constructor initialization*

- void parse_sigma_types (const StringArray &sigma_types)
  
  *parse user-provided sigma type strings and populate enums*

- void load_experiment (size_t exp_index, std::ifstream &scalar_data_stream, size_t num_field_sigma_matrices, size_t num_field_sigma_diagonals, size_t num_field_sigma_scalars, size_t num_field_sigma_none, Response &exp_resp)
  
  *Load a single experiment exp_index into exp_resp.*

- void read_scalar_sigma (std::ifstream &scalar_data_stream, RealVector &sigma_scalars, IntVector &scalar_map_indices)
  
  *read or default populate the scalar sigma*

- RealVector residuals_view (const RealVector &residuals, size_t experiment) const
  
  *Return a view (to allowing updating in place) of the residuals associated with a given experiment, from a vector containing residuals from all experiments.*

- RealMatrix gradients_view (const RealMatrix &gradients, size_t experiment) const
  
  *Return a view (to allowing updating in place) of the gradients associated with a given experiment, from a matrix containing gradients from all experiments.*

- RealSymMatrixArray hessians_view (const RealSymMatrixArray &hessians, size_t experiment) const
  
  *Return a view (to allowing updating in place) of the hessians associated with a given experiment, from an array containing the hessians from all experiments.*

Private Attributes

- bool calibrationDataFlag
  
  *whether the user specified a calibration data block*

- size_t numExperiments
  
  *the total number of experiments*

- size_t numConfigVars
  
  *number of configuration (state) variables to read for each experiment*

- UShortArray varianceTypes
  
  *type of variance specified for each variable, one per response group; empty varianceType indicates none specified by user*

- Real covarianceDeterminant
  
  *cached product of each experiment covariance’s determinant*

- Real logCovarianceDeterminant
  
  *cached sum of each experiment covariance’s log determinant*

- boost::filesystem::path dataPathPrefix
  
  *path to prepend to any data file names*

- String scalarDataFilename
  
  *the user-specified scalar data filename*

- unsigned short scalarDataFormat
  
  *tabular format of the simple scalar data file; supports TABULAR_NONE, TABULAR_HEADER, TABULAR_EVAL_ID, TABULAR_EXPRANNOT*
• `size_t scalarSigmaPerRow`
  number of sigma values to read from each row in simple data file format (calculated from variance types strings
• `bool readSimFieldCoords`
  whether to read coordinate data files for simulation fields
• `SharedResponseData simulationSRD`
  archived shared data for use in sizing fields, total functions (historically we read all functions, including constraints, which might not be correct)
• `bool interpolateFlag`
  flag for interpolation.
• `short outputLevel`
  output verbosity level
• `std::vector< Response > allExperiments`
  Vector of numExperiments ExperimentResponses, holding the observed data and error (sigma/covariance) for each experiment.
• `std::vector< RealVector > allConfigVars`
  Vector of numExperiments configurations at which data were gathered; empty if no configurations specified.
• `IntVector experimentLengths`
  Length of each experiment.
• `IntVector expOffsets`
  function index offsets for individual experiment data sets

### 13.50.1 Detailed Description

Interpolation method for interpolating between experimental and model data. I need to work on inputs/outputs to this method. For now, this assumes interpolation of functional data.

As Brian suggested, this class has the experimental data (coordinates and RealVectorArray interpolated-Results; The `ExperimentData` class is used to read and populate data (currently from user-specified files and/or the input spec) relating to experimental (physical observations) data for the purposes of calibration. Such data may include (for example): number of experiments, configuration variables, type of data (scalar vs. functional), treatment of sigma (experimental uncertainties). This class also provides an interpolation capability to interpolate between simulation or experimental data so that the differencing between simulation and experimental data may be performed properly.

### 13.50.2 Member Function Documentation

```cpp
void form_residuals ( const Response & sim_resp, Response & residual_resp ) const
```

form residuals for all experiments, interpolating if necessary

This assumes the source gradient/Hessian are size less or equal to the destination response, and that the leading part is to be populated.

References `ExperimentData::determine_active_request()`, `ExperimentData::numExperiments`, and `ExperimentData::per_exp_length()`.

Referenced by `DataTransformModel::data_difference_core()`.
void form_residuals ( const Response & sim_resp, size_t exp_ind, const ShortArray & total_asv, size_t exp_offset, Response & residual_resp ) const

form residuals for an individual experiment, interpolating if necessary

This assumes the source gradient/Hessian are size less or equal to the destination response, and that the leading part is to be populated.

References ExperimentData::allExperiments, ExperimentData::field_data_view(), Response::field_lengths(), Response::function_gradient_view(), Response::function_gradients(), Response::function_gradients_view(), Response::function_hessian_view(), Response::function_hessians(), Response::function_hessians_view(), ExperimentData::interpolate_simulation_data(), ExperimentData::interpolateFlag, ExperimentData::num_fields(), ExperimentData::num_scalars(), and ExperimentData::outputLevel.

void recover_model ( size_t num_prfns, RealVector & best_fns ) const

recover original model from the first experiment block in a full set of residuals; works in no interpolation case only (sizes same)

Add the data back to the residual to recover the model, for use in surrogated-based LSQ where DB lookup will fail (need approx eval DB). best_fns contains primary and secondary responses

References Dakota::abort_handler(), ExperimentData::allExperiments, Response::function_value(), ExperimentData::interpolateFlag, and Response::num_functions().

Referenced by LeastSq::post_run().

void build_gradient_of_sum_square_residuals_from_function_data ( const RealMatrix & func_gradients, const RealVector & residuals, RealVector & ssr_gradient, const ShortArray & asrv )

Construct the gradient of the sum of squares of residuals.
Parameters

| func_gradients | A matrix containing the gradients of the residual vector |
| residuals | A vector of residuals (mismatch between experimental data and the corresponding function values |
| asrv | The active set request vector |

Referenced by ExperimentData::build_gradient_of_sum_square_residuals_from_response().

void build_hessian_of_sum_square_residuals_from_function_data ( const RealSymMatrixArray & func_hessians, const RealMatrix & func_gradients, const RealVector & residuals, RealSymMatrix & ssr_hessian, const ShortArray & asrv )

Construct the hessian of the sum of squares of residuals.
Parameters

| func_hessians | A list of matrices containing the Hessians of the function elements in the residual vector |
| func_gradients | A matrix containing the gradients of the residual vector |
| residuals | A vector of residuals (mismatch between experimental data and the corresponding function values |
The active set request vector

Referenced by ExperimentData::build_hessian_of_sum_square_residuals_from_response().

```cpp
void scale_residuals ( const RealVector & multipliers, unsigned short multiplier_mode, size_t num_calib_params, Response & residual_response ) const
```

in-place scale the residual response (functions, gradients, Hessians) by sqrt(multipliers), according to blocks indicated by multiplier mode

In-place scaling of residual response by hyper-parameter multipliers

References Dakota::abort_handler(), Response::active_set_request_vector(), Response::function_gradient_view(), Response::function_hessian_view(), Response::function_value(), Response::function_value_view(), ExperimentData::num_total_exppoints(), and ExperimentData::resid2mult_map().

```cpp
Real cov_determinant ( const RealVector & multipliers, unsigned short multiplier_mode ) const
```

returns the determinant of (covariance block-scaled by the passed multipliers)

Determinant of the total covariance used in inference, which has blocks mult_i * I * Cov_i.

References Dakota::abort_handler(), ExperimentData::covarianceDeterminant, ExperimentData::generate_multipliers(), and ExperimentData::num_total_exppoints().

```cpp
Real half_log_cov_determinant ( const RealVector & multipliers, unsigned short multiplier_mode ) const
```

returns the log of the determinant of (covariance block-scaled by the passed multipliers)

Determinant of half the log of total covariance used in inference, which has blocks mult_i * I * Cov_i.

References Dakota::abort_handler(), ExperimentData::generate_multipliers(), ExperimentData::logCovarianceDeterminant, and ExperimentData::num_total_exppoints().

Referenced by NonDBayesCalibration::log_likelihood(), and NonDQUESOBayesCalibration::print_results().

```cpp
void half_log_cov_det_gradient ( const RealVector & multipliers, unsigned short multiplier_mode, size_t hyper_offset, RealVector & gradient ) const
```

populated the passed gradient with derivatives w.r.t. the hyper-parameter multipliers, starting at hyper_offset (must be sized)

Compute the gradient of scalar f(m) 0.5*log(det(mult*Cov)) w.r.t. mults. Since this is the only use case, we include the 0.5 factor and perform an update in-place.

References ExperimentData::num_total_exppoints(), and ExperimentData::residuals_per_multiplier().

Referenced by NonDBayesCalibration::neg_log_post_resp_mapping().

```cpp
void half_log_cov_det_hessian ( const RealVector & multipliers, unsigned short multiplier_mode, size_t hyper_offset, RealSymMatrix & hessian ) const
```

populated the passed Hessian with derivatives w.r.t. the hyper-parameter multipliers, starting at hyper_offset (must be sized)

Compute the gradient of scalar f(m) log(det(mult*Cov)) w.r.t. mults

References ExperimentData::num_total_exppoints(), and ExperimentData::residuals_per_multiplier().

Referenced by NonDBayesCalibration::neg_log_post_resp_mapping().
SizetArray residuals_per_multiplier ( unsigned short multiplier_mode ) const [protected]

count the number of residuals influenced by each multiplier

Calculate how many residuals each multiplier affects

References ExperimentData::allExperiments, SharedResponseData::num_field_response_groups(), ExperimentData::num_fields(), SharedResponseData::num_response_groups(), SharedResponseData::num_scalar_responses(), ExperimentData::numExperiments, and ExperimentData::simulationSRD.

Referenced by ExperimentData::half_log_cov_det_gradient(), and ExperimentData::half_log_cov_det_hessian().

void parse_sigma_types ( const StringArray & sigma_types ) [private]

parse user-provided sigma type strings and populate enums

Validate user-provided sigma specification. User can specify 0, 1, or num_response_groups sigmas. If specified, sigma types must be the same for all scalar responses.

References Dakota::abort_handler(), SharedResponseData::num_response_groups(), SharedResponseData::num_scalar_responses(), ExperimentData::scalarDataFilename, ExperimentData::scalarSigmaPerRow, ExperimentData::simulationSRD, and ExperimentData::varianceTypes.

Referenced by ExperimentData::initialize().

void load_experiment ( size_t exp_index, std::ifstream & scalar_data_stream, size_t num_field_sigma_matrices, size_t num_field_sigma_diagonals, size_t num_field_sigma_scalars, size_t num_field_sigma_none, Response & exp Resp ) [private]

Load a single experiment exp_index into exp Resp.

Load an experiment from a mixture of legacy format data and field data format files

References ExperimentData::dataPathPrefix, Response::field_coords(), Response::field_group_labels(), ExperimentData::field_lengths(), Response::field_lengths(), Response::field_values(), Response::function_labels(), Response::function_value(), Dakota::is_matrix_symmetric(), SharedResponseData::num_field_response_groups(), ExperimentData::num_fields(), SharedResponseData::num_scalar_responses(), ExperimentData::num_scalars(), ExperimentData::read_scalar_sigma(), ExperimentData::scalarDataFilename, ExperimentData::scalarSigmaPerRow, Response::set_full_covariance(), ExperimentData::simulationSRD, and ExperimentData::varianceTypes.

Referenced by ExperimentData::load_data().

The documentation for this class was generated from the following files:

• ExperimentData.hpp
• ExperimentData.cpp

13.51  ExperimentResponse Class Reference

Container class for response functions and their derivatives. ExperimentResponse provides the body class.

Inheritance diagram for ExperimentResponse:

```
Response

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ExperimentResponse</td>
</tr>
</tbody>
</table>
```


CHAPTER 13. CLASS DOCUMENTATION

Public Member Functions

- **ExperimentResponse ()**
  default constructor
- **ExperimentResponse (const Variables &vars, const ProblemDescDB &problem_db)**
  standard constructor built from problem description database
- **ExperimentResponse (const SharedResponseData &srd, const ActiveSet &set)**
  alternate constructor that shares a SharedResponseData instance
- **ExperimentResponse (const SharedResponseData &srd)**
  alternate constructor that shares a SharedResponseData instance
- **ExperimentResponse (const ActiveSet &set)**
  alternate constructor using limited data
- **~ExperimentResponse ()**
  destructor
- **void set_scalar_covariance (RealVector &scalars)**
  method to set the covariance matrix defined for ExperimentResponse
- **const ExperimentCovariance & experiment_covariance () const**
  retrieve the ExperimentCovariance structure
- **void set_full_covariance (std::vector<RealMatrix> &matrices, std::vector<RealVector> &diagonals, RealVector &scalars, IntVector matrix_map_indices, IntVector diagonal_map_indices, IntVector scalar_map_indices)**
  method to set the full covariance matrices for ExperimentResponse
- **Real apply_covariance (const RealVector &residual) const**
  method to compute the triple product $v' \cdot \text{inv}(C) \cdot v$.
- **void apply_covariance_inv_sqrt (const RealVector &residuals, RealVector &weighted_residuals) const**
  method to compute $(v' \cdot \text{inv}(C)^{1/2})$, to compute weighted residual
- **void apply_covariance_inv_sqrt (const RealMatrix &gradients, RealMatrix &weighted_gradients) const**
- **void apply_covariance_inv_sqrt (const RealSymMatrixArray &hessians, RealSymMatrixArray &weighted_hessians) const**
- **void get_covariance_diagonal (RealVector &diagonal) const**
- **Real covariance_determinant () const**
  covariance determinant for this experiment (default 1.0)
- **Real log_covariance_determinant () const**
  log covariance determinant for this experiment (default 0.0)

Protected Member Functions

- **void copy_rep (Response *source_response_rep)**
  Specialization of copy_rep; pulls base class data as well as derived specific data from the source rep into the this object.

Private Attributes

- **ExperimentCovariance expDataCovariance**
  sigma terms...
Additional Inherited Members

13.51.1 Detailed Description

Container class for response functions and their derivatives. **ExperimentResponse** provides the body class.

The **ExperimentResponse** class is the "representation" of the response container class. It is the "body" portion of the "handle-body idiom" (see Coplien "Advanced C++", p. 58). The handle class (**Response**) provides for memory efficiency in management of multiple response objects through reference counting and representation sharing. The body class (**ExperimentResponse**) actually contains the response data (functionValues, function-Gradients, functionHessians, etc.). The representation is hidden in that an instance of **ExperimentResponse** may only be created by **Response**. Therefore, programmers create instances of the **Response** handle class, and only need to be aware of the handle/body mechanisms when it comes to managing shallow copies (shared representation) versus deep copies (separate representation used for history mechanisms).

The documentation for this class was generated from the following files:

- ExperimentResponse.hpp
- ExperimentResponse.cpp

13.52 FileReadException Class Reference

base class for Dakota file read exceptions (to allow catching both tabular and general file truncation issues)

Inheritance diagram for FileReadException:

```
FileReadException
     /       \
ResultsFileError TabularDataTruncated
```

Public Member Functions

- **FileReadException** (const std::string &msg)

13.52.1 Detailed Description

base class for Dakota file read exceptions (to allow catching both tabular and general file truncation issues)

The documentation for this class was generated from the following file:

- dakota_global_defs.hpp

13.53 ForkApplicInterface Class Reference

Derived application interface class which spawns simulation codes using fork/execvp/waitpid.

Inheritance diagram for ForkApplicInterface:
Public Member Functions

- **ForkApplicInterface** (const ProblemDescDB &problem_db)
  
  *constructor*
- **~ForkApplicInterface** ()
  
  *destructor*

Protected Member Functions

- void **wait_local_evaluations** (PRPQueue &prp_queue)
  
  For asynchronous function evaluations, this method is used to detect completion of jobs and process their results. It provides the processing code that is specific to derived classes. This version waits for at least one completion.
- void **test_local_evaluations** (PRPQueue &prp_queue)
  
  For asynchronous function evaluations, this method is used to detect completion of jobs and process their results. It provides the processing code that is specific to derived classes. This version is nonblocking and will return without any completions if none are immediately available.
- pid_t **create_analysis_process** (bool block_flag, bool new_group)
  
  Spawn a child process for an analysis component within an evaluation using fork()/execvp() and wait for completion using waitpid() if block_flag is true
- size_t **wait_local_analyses** ()
  
  Wait for asynchronous analyses on the local processor, completing at least one job
- size_t **test_local_analyses_send** (int analysis_id)
  
  Test for asynchronous analysis completions on the local processor and return results for any completions by sending messages
- void **join_evaluation_process_group** (bool new_group)
  
  Create (if new_group) and join the process group for async evaluations
- void **join_analysis_process_group** (bool new_group)
  
  Create (if new_group) and join the process group for async analyses
- void **evaluation_process_group_id** (pid_t pgid)
  
  Set evalProcGroupId
- pid_t **evaluation_process_group_id** () const
  
  Return evalProcGroupId
- void **analysis_process_group_id** (pid_t pgid)
Private Member Functions

- std::map< pid_t, int >& process_id_map

Private Attributes

- pid_t evalProcGroupId
- pid_t analysisProcGroupId

Additional Inherited Members

13.53.1 Detailed Description

Derived application interface class which spawns simulation codes using fork/execvp/waitpid.
ForkApplicInterface is used on Unix systems and is a peer to SpawnApplicInterface for Windows systems.
The documentation for this class was generated from the following files:

- ForkApplicInterface.hpp
- ForkApplicInterface.cpp

13.54 FSUDesignCompExp Class Reference

Wrapper class for the FSUDace QMC/CVT library.
Inheritance diagram for FSUDesignCompExp:
Public Member Functions

- **FSUDesignCompExp (ProblemDescDB &problem_db, Model &model)**
  
  *primary constructor for building a standard DACE iterator*

- **FSUDesignCompExp (Model &model, int samples, int seed, unsigned short sampling_method)**
  
  *alternate constructor for building a DACE iterator on-the-fly*

- **~FSUDesignCompExp ()**
  
  *destructor*

- **bool resize ()**
  
  *reinitializes iterator based on new variable size*

Protected Member Functions

- **void pre_run ()**
  
  *pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori*

- **void core_run ()**
  
  *core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post*

- **void post_input ()**
  
  *read tabular data for post-run mode*

- **void post_run (std::ostream &s)**
  
  *post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way*

- **int num_samples () const**

- **void sampling_reset (int min_samples, bool all_data_flag, bool stats_flag)**
  
  *reset sampling iterator to use at least min_samples*

- **unsigned short sampling_scheme () const**
  
  *return sampling name*

- **void vary_pattern (bool pattern_flag)**
  
  *sets varyPattern in derived classes that support it*

- **void get_parameter_sets (Model &model)**
  
  *Returns one block of samples (ndim * num_samples)*
Private Member Functions

- void `enforce_input_rules()`
  enforce sanity checks/modifications for the user input specification

Private Attributes

- int `samplesSpec`
  initial specification of number of samples
- int `numSamples`
  current number of samples to be evaluated
- bool `allDataFlag`
  flag which triggers the update of allVars/allResponses for use by `Iterator::all_variables()` and `Iterator::all_responses()`
- `size_t numDACERuns`
  counter for number of executions for this object
- bool `latinizeFlag`
  flag which specifies latinization of QMC or CVT sample sets
- `IntVector sequenceStart`
  Integer vector defining a starting index into the sequence for random variable sampled. Default is 0 0 0 (e.g. for three random variables).
- `IntVector sequenceLeap`
  Integer vector defining the leap number for each sequence being generated. Default is 1 1 1 (e.g. for three random vars.)
- `IntVector primeBase`
  Integer vector defining the prime base for each sequence being generated. Default is 2 3 5 (e.g., for three random vars.)
- int `seedSpec`
  the user seed specification for the random number generator (allows repeatable results)
- int `randomSeed`
  current seed for the random number generator
- bool `varyPattern`
  flag for continuing the random number or QMC sequence from a previous execution (e.g., for surrogate-based optimization) so that multiple executions are repeatable but not identical.
- int `numCVTTrials`
  specifies the number of sample points taken at internal CVT iteration
- int `trialType`
  Trial type in CVT. Specifies where the points are placed for consideration relative to the centroids. Choices are grid (2), halton (1), uniform (0), or random (-1). Default is random.

Additional Inherited Members

13.54.1 Detailed Description

Wrapper class for the FSUDace QMC/CVT library.

The `FSUDesignCompExp` class provides a wrapper for FSUDace, a C++ design of experiments library from Florida State University. This class uses quasi Monte Carlo (QMC) and Centroidal Voronoi Tessellation (CVT) methods to uniformly sample the parameter space spanned by the active bounds of the current Model. It returns all generated samples and their corresponding responses as well as the best sample found.
CHAPTER 13. CLASS DOCUMENTATION

13.54.2 Constructor & Destructor Documentation

FSUDesignCompExp ( ProblemDescDB & problem_db, Model & model )

primary constructor for building a standard DACE iterator
This constructor is called for a standard iterator built with data from probDescDB.
References Dakota::abort_handler(), ProblemDescDB::get_bool(), ProblemDescDB::get_int(), ProblemDescDB::get_iv(), ProblemDescDB::get_string(), Iterator::maxEvalConcurrency, Iterator::methodName, Analyzer::numContinuousVars, FSUDesignCompExp::numCVTTrials, FSUDesignCompExp::numSamples, FSUDesignCompExp::primeBase, Iterator::probDescDB, FSUDesignCompExp::randomSeed, FSUDesignCompExp::seedSpec, FSUDesignCompExp::sequenceLeap, FSUDesignCompExp::sequenceStart, FSUDesignCompExp::trialType, and FSUDesignCompExp::varyPattern.

FSUDesignCompExp ( Model & model, int samples, int seed, unsigned short sampling_method )

alternate constructor for building a DACE iterator on-the-fly
This alternate constructor is used for instantiations on-the-fly, using only the incoming data. No problem description database queries are used.
References Dakota::abort_handler(), Iterator::maxEvalConcurrency, Iterator::methodName, Analyzer::numContinuousVars, FSUDesignCompExp::numCVTTrials, FSUDesignCompExp::numSamples, FSUDesignCompExp::primeBase, FSUDesignCompExp::randomSeed, FSUDesignCompExp::seedSpec, FSUDesignCompExp::sequenceLeap, FSUDesignCompExp::sequenceStart, and FSUDesignCompExp::trialType.

13.54.3 Member Function Documentation

void pre_run ( ) [protected], [virtual]

pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori
pre-run phase, which a derived iterator may optionally reimplement; when not present, pre-run is likely integrated into the derived run function. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s pre_run(), if implemented, typically before performing its own implementation steps.
Reimplemented from Analyzer.
References FSUDesignCompExp::get_parameter_sets(), Iterator::iteratedModel, Analyzer::pre_run(), and P-StudyDACE::varBasedDecompFlag.

void core_run ( ) [protected], [virtual]

core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.
Reimplemented from Iterator.
References FSUDesignCompExp::allDataFlag, Analyzer::evaluate_parameter_sets(), Iterator::iteratedModel, Analyzer::numContinuousVars, Analyzer::numLSqTerms, Analyzer::numObjFns, FSUDesignCompExp::numSamples, Iterator::subIteratorFlag, PStudyDACE::varBasedDecompFlag, and Analyzer::variance_based_decomp().

void post_run ( std::ostream & s ) [protected], [virtual]

post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way
Post-run phase, which a derived iterator may optionally reimplement; when not present, post-run is likely integrated into run. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s post_run(), typically after performing its own implementation steps.
Reimplemented from Analyzer.
References Analyzer::allResponses, Analyzer::allSamples, SensAnalysisGlobal::compute_correlations(), Analyzer::post_run(), PStudyDACE::pStudyDACEsensGlobal, Iterator::subIteratorFlag, and PStudyDACE::varBasedDecompFlag.

```cpp
int num_samples() const [inline], [protected], [virtual]
```
Return current number of evaluation points. Since the calculation of samples, collocation points, etc. might be costly, provide a default implementation here that backs out from the maxEvalConcurrency.
Reimplemented from Analyzer.
References FSUDesignCompExp::numSamples.

```cpp
void enforce_input_rules() [private]
```
enforce sanity checks/modifications for the user input specification
Users may input a variety of quantities, but this function must enforce any restrictions imposed by the sampling algorithms.
References Dakota::abort_handler(), Iterator::methodName, Analyzer::numContinuousVars, FSUDesignCompExp::numSamples, and FSUDesignCompExp::primeBase.
Referenced by FSUDesignCompExp::get_configuration().
The documentation for this class was generated from the following files:
- FSUDesignCompExp.hpp
- FSUDesignCompExp.cpp

### 13.55 FunctionEvalFailure Class Reference

exception class for function evaluation failures
Inherits runtime_error.

**Public Member Functions**

- FunctionEvalFailure (const std::string &msg)

### 13.55.1 Detailed Description

exception class for function evaluation failures
The documentation for this class was generated from the following file:
- dakota_global_defs.hpp

### 13.56 GaussProcApproximation Class Reference

Derived approximation class for Gaussian Process implementation.
Inheritance diagram for GaussProcApproximation:
CHAPTER 13. CLASS DOCUMENTATION

Public Member Functions

- **GaussProcApproximation ()**
  
  default constructor

- **GaussProcApproximation (const SharedApproxData &shared_data)**
  
  alternate constructor

- **GaussProcApproximation (const ProblemDescDB &problem_db, const SharedApproxData &shared_data, const String &approx_label)**
  
  standard constructor

- **~GaussProcApproximation ()**
  
  destructor

Protected Member Functions

- **int min_coefficients () const**
  
  return the minimum number of samples (unknowns) required to build the derived class approximation type in num-Vars dimensions

- **int num_constraints () const**
  
  return the number of constraints to be enforced via an anchor point

- **void build ()**
  
  find the covariance parameters governing the Gaussian process response

- **Real value (const Variables &vars)**
  
  retrieve the function value for a given parameter set

- **const RealVector & gradient (const Variables &vars)**
  
  retrieve the function gradient at the predicted value for a given parameter set

- **Real prediction_variance (const Variables &vars)**
  
  retrieve the variance of the predicted value for a given parameter set

Private Member Functions

- **void GPmodel_build ()**
  
  Function to compute hyperparameters governing the GP.

- **void GPmodel_apply (const RealVector &new_x, bool variance_flag, bool gradients_flag)**
  
  Function returns a response value using the GP surface.

- **void normalize_training_data ()**
  
  Normalizes the initial inputs upon which the GP surface is based.

- **void get_trend ()**
  
  Gets the trend (basis) functions for the calculation of the mean of the GP If the order = 0, the trend is a constant, if the order = 1, trend is linear, if order = 2, trend is quadratic.
• void get_beta_coefficients ()
  Gets the beta coefficients for the calculation of the mean of the GP.
• int get_cholesky_factor ()
  Gets the Cholesky factorization of the covariance matrix, with error checking.
• void get_process_variance ()
  Gets the estimate of the process variance given the values of beta and the correlation lengthscales.
• void get_cov_matrix ()
  Calculates the covariance matrix for a given set of input points
• void get_cov_vector ()
  Calculates the covariance vector between a new point \( x \) and the set of inputs upon which the GP is based
• void optimize_theta_global ()
  Sets up and performs the optimization of the negative log likelihood to determine the optimal values of the covariance parameters using NCSUDirect
• void optimize_theta_multipoint ()
  Sets up and performs the optimization of the negative log likelihood to determine the optimal values of the covariance parameters using a gradient-based solver and multiple starting points
• void predict (bool variance_flag, bool gradients_flag)
  Calculates the predicted new response value for \( x \) in normalized space.
• Real calc_nll ()
  Calculates the negative log likelihood function (based on covariance matrix)
• void calc_grad_nll ()
  Gets the gradient of the negative log likelihood function with respect to the correlation lengthscales, \( \theta \).
• void get_grad_cov_vector ()
  Calculates the derivatives of the covariance vector, with respect to each component of \( x \).
• void run_point_selection ()
  Runs the point selection algorithm, which will choose a subset of the training set with which to construct the GP model, and estimate the necessary parameters.
• void initialize_point_selection ()
  Initializes the point selection routine by choosing a small initial subset of the training points.
• void pointsel_get_errors (RealArray &delta)
  Uses the current GP model to compute predictions at all of the training points and find the errors.
• int addpoint (int, IntArray &added_index)
  Adds a point to the effective training set. Returns 1 on success.
• int pointsel_add_sel (const RealArray &delta)
  Accepts a vector of unsorted prediction errors, determines which points should be added to the effective training set, and adds them.
• Real maxval (const RealArray &)
  Returns the maximum value of the elements in a vector.
• void pointsel_write_points ()
  Writes out the training set before and after point selection.
• void lhood_2d_grid_eval ()
  For problems with 2D input, evaluates the negative log likelihood on a grid.
• void writex (const char[])
  Writes out the current training set (in original units) to a specified file.
• void writeCovMat (char[])
  Writes out the covariance matrix to a specified file.
CHAPTER 13. CLASS DOCUMENTATION

Static Private Member Functions

- static void negloglik (int mode, int n, const Teuchos::SerialDenseVector< int, double >&X, Real &fx, Teuchos::SerialDenseVector< int, double >&grad_x, int &result_mode)
  
  static function used by OPT++ as the objective function to optimize the hyperparameters in the covariance of the GP by minimizing the negative log likelihood

- static void constraint_eval (int mode, int n, const Teuchos::SerialDenseVector< int, double >&X, Teuchos::SerialDenseVector< int, double >&g, Teuchos::SerialDenseMatrix< int, double >&gradC, int &result_mode)
  
  static function used by OPT++ as the constraint function in the optimization of the negative log likelihood. Currently this function is empty: it is an unconstrained optimization.

- static double negloglikNCSU (const RealVector &x)
  
  function used by NCSUOptimizer to optimize negloglik objective

Private Attributes

- Real approxValue
  
  value of the approximation returned by value()

- Real approxVariance
  
  value of the approximation returned by prediction_variance()

- RealMatrix trainPoints
  
  A 2-D array (num sample sites = rows, num vars = columns) used to create the Gaussian process.

- RealMatrix trainValues
  
  An array of response values; one response value per sample site.

- RealVector trainMeans
  
  The mean of the input columns of trainPoints.

- RealVector trainStdvs
  
  The standard deviation of the input columns of trainPoints.

- RealMatrix normTrainPoints
  
  Current working set of normalized points upon which the GP is based.

- RealMatrix trendFunction
  
  matrix to hold the trend function

- RealMatrix betaCoeffs
  
  matrix to hold the beta coefficients for the trend function

- RealSymMatrix covMatrix
  
  The covariance matrix where each element (i,j) is the covariance between points Xi and Xj in the initial set of samples.

- RealMatrix covVector
  
  The covariance vector where each element (j,0) is the covariance between a new point X and point Xj from the initial set of samples.

- RealMatrix approxPoint
  
  Point at which a prediction is requested. This is currently a single point, but it could be generalized to be a vector of points.

- RealMatrix gradNegLogLikTheta
  
  matrix to hold the gradient of the negative log likelihood with respect to the theta correlation terms
13.56. GAUSSPROCAPPROXIMATION CLASS REFERENCE

- Teuchos::SerialSpdDenseSolver
  < int, Real > covSlvr
  The global solver for all computations involving the inverse of the covariance matrix.
- RealMatrix gradCovVector
  A matrix, where each column is the derivative of the covVector with respect to a particular component of X.
- RealMatrix normTrainPointsAll
  Set of all original samples available.
- RealMatrix trainValuesAll
  All original samples available.
- RealMatrix trendFunctionAll
  Trend function values corresponding to all original samples.
- RealMatrix Rinv_YFb
  Matrix for storing inverse of correlation matrix Rinv*(Y-Fb)
- size_t numObs
  The number of observations on which the GP surface is built.
- size_t numObsAll
  The original number of observations.
- short trendOrder
  The number of variables in each X variable (number of dimensions of the problem).
- RealVector thetaParams
  Theta is the vector of covariance parameters for the GP. We determine the values of theta by optimization. Currently, the covariance function is theta[0]*exp(-0.5*sume)+delta*pow(sige,2). sume is the sum squared of weighted distances; it involves a sum of theta[1](Xi(1)-Xj(1))^2 + theta[2](Xi(2)-Xj(2))^2 + ... where Xi(1) is the first dimension value of multi-dimensional variable Xi. delta*pow(sige,2) is a jitter term used to improve matrix computations. delta is zero for the covariance between different points and 1 for the covariance between the same point. sige is the underlying process error.
- Real procVar
  The process variance, the multiplier of the correlation matrix.
- IntArray pointsAddedIndex
  Used by the point selection algorithm, this vector keeps track all points which have been added.
- int cholFlag
  A global indicator for success of the Cholesky factorization.
- bool usePointSelection
  A flag to indicate the use of point selection

Static Private Attributes

- static GaussProcApproximation * GInstance
  pointer to the active object instance used within the static evaluator

Additional Inherited Members

13.56.1 Detailed Description

Derived approximation class for Gaussian Process implementation.

The GaussProcApproximation class provides a global approximation (surrogate) based on a Gaussian process. The Gaussian process is built after normalizing the function values, with zero mean. Opt++ is used to determine the optimal values of the covariance parameters, those which minimize the negative log likelihood function.
CHAPTER 13. CLASS DOCUMENTATION

13.56.2 Constructor & Destructor Documentation

GaussProcApproximation ( ) [inline]

default constructor

alternate constructor used by EffGlobalOptimization and NonDGlobalReliability that does not use a problem
database defaults here are no point selectinn and quadratic trend function.

13.56.3 Member Function Documentation

void GPmodel_apply ( const RealVector & new x, bool variance_flag, bool gradients_flag ) [private]

Function returns a response value using the GP surface.
The response value is computed at the design point specified by the RealVector function argument.
References Dakota::abort_handler(), GaussProcApproximation::approxPoint, GaussProcApproximation::get_cov_vector(),
SharedApproxData::numVars, GaussProcApproximation::predict(), Approximation::sharedDataRep,
GaussProcApproximation::trainMeans, and GaussProcApproximation::trainStdvs.
Referenced by GaussProcApproximation::gradient(), GaussProcApproximation::pointsel_get_errors(),
GaussProcApproximation::prediction_variance(), and GaussProcApproximation::value().

13.56.4 Member Data Documentation

short trendOrder [private]

The number of variables in each X variable (number of dimensions of the problem).
The order of the basis function for the mean of the GP If the order = 0, the trend is a constant, if the order = 1,
trend is linear, if order = 2, trend is quadratic.
Referenced by GaussProcApproximation::GaussProcApproximation(), GaussProcApproximation::get_beta_coefficients(),
GaussProcApproximation::get_trend(), GaussProcApproximation::GPmodel_build(), and GaussProcApproximation::predict().
The documentation for this class was generated from the following files:

- GaussProcApproximation.hpp
- GaussProcApproximation.cpp

13.57 GeneralReader Class Reference

Utility used in derived read_core to read in generic format.

Public Member Functions

- template<typename ArrayType>
  void operator() (std::istream &s, size_t start_index, size_t num_items, ArrayType &array_data, StringMulti-
  ArrayView label_array)

13.57.1 Detailed Description

Utility used in derived read_core to read in generic format.
The documentation for this class was generated from the following file:

- DakotaVariables.hpp
13.58 GeneralWriter Class Reference

Utility used in derived write_core to write in generic format.

Public Member Functions

- template<typename ArrayType>
  void operator()(std::ostream &s, size_t start_index, size_t num_items, const ArrayType &array_data, StringMultiArrayConstView label_array)

13.58.1 Detailed Description

Utility used in derived write_core to write in generic format.

The documentation for this class was generated from the following file:

- DakotaVariables.hpp

13.59 GetLongOpt Class Reference

GetLongOpt is a general command line utility from S. Manoharan (Advanced Computer Research Institute, Lyon, France).

Inheritance diagram for GetLongOpt:

```
CommandLineHandler
   |
   v
GetLongOpt
```

Public Types

- enum OptType { Valueless, OptionalValue, MandatoryValue }

    enum for different types of values associated with command line options.

Public Member Functions

- GetLongOpt (const char optmark= '-')

    Constructor.

- ~GetLongOpt ()

    Destructor.

- int parse (int argc, char *const *argv)

    parse the command line args (argc, argv).

- int parse (char *const str, char *const p)

    parse a string of options (typically given from the environment).

- int enroll (const char *const opt, const OptType t, const char *const desc, const char *const val)

    Add an option to the list of valid command line options.

- const char * retrieve (const char *const opt) const
Retrieve value of option.

- **void usage (std::ostream &outfile=Cout) const**
  
  Print usage information to outfile.

- **void usage (const char ∗str)**
  
  Change header of usage output to str.

- **void store (const char ∗name, const char ∗value)**
  
  Store a specified option value.

### Private Member Functions

- **char ∗basename (char ∗const p) const**
  
  extract the base name from a string as delimited by '/'

- **int setcell (Cell ∗c, char ∗valtoken, char ∗nexttoken, const char ∗p)**
  
  internal convenience function for setting Cell::value

### Private Attributes

- **Cell ∗table**
  
  option table

- **const char ∗ustring**
  
  usage message

- **char ∗pname**
  
  program basename

- **char optmarker**
  
  option marker

- **int enroll_done**
  
  finished enrolling

- **Cell ∗last**
  
  last entry in option table

### 13.59.1 Detailed Description

GetLongOpt is a general command line utility from S. Manoharan (Advanced Computer Research Institute, Lyon, France).

GetLongOpt manages the definition and parsing of "long options." Command line options can be abbreviated as long as there is no ambiguity. If an option requires a value, the value should be separated from the option either by whitespace or an "=".

### 13.59.2 Member Enumeration Documentation

**enum OptType**

enum for different types of values associated with command line options.

**Enumerator**

- **Valueless** option that may never have a value
- **OptionalValue** option with optional value
- **MandatoryValue** option with required value
13.59. GETLONGOPT CLASS REFERENCE

13.59.3 Constructor & Destructor Documentation

GetLongOpt ( const char optmark = '-' )

Constructor.

Constructor for GetLongOpt takes an optional argument: the option marker. If unspecified, this defaults to '-', the standard (?) Unix option marker.


13.59.4 Member Function Documentation

int parse ( int argc, char *const *argv )

parse the command line args (argc, argv).

A return value < 1 represents a parse error. Appropriate error messages are printed when errors are seen. parse returns the the optind (see getopt(3)) if parsing is successful.


Referenced by CommandLineHandler::check_usage().

int parse ( char *const str, char *const p )

parse a string of options (typically given from the environment).

A return value < 1 represents a parse error. Appropriate error messages are printed when errors are seen. parse takes two strings: the first one is the string to be parsed and the second one is a string to be prefixed to the parse errors.


int enroll ( const char *const opt, const OptType t, const char *const desc, const char *const val )

Add an option to the list of valid command options.

enroll adds option specifications to its internal database. The first argument is the option sting. The second is an enum saying if the option is a flag (Valueless), if it requires a mandatory value (MandatoryValue) or if it takes an optional value (OptionalValue). The third argument is a string giving a brief description of the option. This description will be used by GetLongOpt::usage. GetLongOpt, for usage-printing, uses {$val} to represent values needed by the options. {$<val>} is a mandatory value and {{[val]}} is an optional value. The final argument to enroll is the default string to be returned if the option is not specified. For flags (options with Valueless), use "" (empty string, or in fact any arbitrary string) for specifying TRUE and 0 (null pointer) to specify FALSE.


Referenced by CommandLineHandler::initialize_options().

const char * retrieve ( const char *const opt ) const

Retrieve value of option.

The values of the options that are enrolled in the database can be retrieved using retrieve. This returns a string and this string should be converted to whatever type you want. See atoi, atof, atol, etc. If a "parse" is not done before retrieving all you will get are the default values you gave while enrolling! Ambiguities while retrieving (may happen when options are abbreviated) are resolved by taking the matching option that was enrolled last. For example, -{v} will expand to {-verify}. If you try to retrieve something you didn’t enroll, you will get a warning message.
References GetLongOpt::optmarker, and GetLongOpt::table. Referenced by CommandLineHandler::check_usage(), ProgramOptions::manage_run_modes(), ProgramOptions::ProgramOptions(), and CommandLineHandler::read_restart_evals().

```cpp
void usage ( const char * str ) [inline]
```
Change header of usage output to str.  
GetLongOpt::usage is overloaded. If passed a string "str", it sets the internal usage string to "str". Otherwise it simply prints the command usage.  
References GetLongOpt::ustring. 
The documentation for this class was generated from the following files:
- CommandLineHandler.hpp
- CommandLineHandler.cpp

13.60 Graphics Class Reference

The Graphics class provides a single interface to 2D (motif) and 3D (PLPLOT) graphics; there is only one instance of this OutputManager::dakotaGraphics.

Public Member Functions
- Graphics () [constructor]
- ~Graphics () [destructor]
- void create_plots_2d (const Variables &vars, const Response &response) [creates the 2d graphics window and initializes the plots]
- void add_datapoint (int graphics_cntr, const Variables &vars, const Response &response) [adds data to each window in the 2d graphics based on the results of a model evaluation]
- void add_datapoint (int i, double x, double y) [adds data to a single window in the 2d graphics]
- void new_dataset (int i) [creates a separate line graphic for subsequent data points for a single window in the 2d graphics]
- void close () [close graphics windows]
- void set_x_labels2d (const char *x_label) [set x label for each plot equal to x_label]
- void set_y_labels2d (const char *y_label) [set y label for each plot equal to y_label]
- void set_x_label2d (int i, const char *x_label) [set x label for ith plot equal to x_label]
- void set_y_label2d (int i, const char *y_label) [set y label for ith plot equal to y_label]
13.60. GRAPHICS CLASS REFERENCE

Private Attributes

- Graphics2D * graphics2D
  
  pointer to the 2D graphics object
- bool win2dOn
  
  flag to indicate if 2D graphics window is active

13.60.1 Detailed Description

The Graphics class provides a single interface to 2D (motif) and 3D (PLPLOT) graphics; there is only one instance of this OutputManager::dakotaGraphics.

13.60.2 Member Function Documentation

void create_plots_2d ( const Variables & vars, const Response & response )

creates the 2d graphics window and initializes the plots

Sets up a single event loop for duration of the dakotaGraphics object, continuously adding data to a single window. There is no reset. To start over with a new data set, you need a new object (delete old and instantiate new).

References Variables::continuous_variable_labels(), Variables::cv(), Variables::discrete_int_variable_labels(), Variables::discrete_real_variable_labels(), Variables::div(), Variables::drv(), Response::function_labels(), Graphics::graphics2D, Response::num_functions(), Dakota::re_match(), and Graphics::win2dOn.

Referenced by SurrBasedMinimizer::initialize_graphics(), NonDReliability::initialize_graphics(), and Iterator::initialize_graphics().

void add_datapoint ( int graphics_cntr, const Variables & vars, const Response & response )

adds data to each window in the 2d graphics based on the results of a model evaluation

Adds data to each 2d plot and each tabular data column (one for each active variable and for each response function). graphicsCntr is used for the x axis in the graphics and the first column in the tabular data.

References Response::active_set_request_vector(), Variables::continuous_variables(), Variables::discrete_int_variables(), Variables::discrete_real_variables(), Response::function_values(), Graphics::graphics2D, and Graphics::win2dOn.

Referenced by OutputManager::add_datapoint(), NonDLocalReliability::mean_value(), and NonDLocalReliability::update_level_data().

void add_datapoint ( int i, double x, double y )

adds data to a single window in the 2d graphics

Adds data to a single 2d plot. Allows complete flexibility in defining other kinds of x-y plotting in the 2D graphics.

References Graphics::graphics2D, and Graphics::win2dOn.

void new_dataset ( int i )

creates a separate line graphic for subsequent data points for a single window in the 2d graphics

Used for displaying multiple data sets within the same plot.

References Graphics::graphics2D, and Graphics::win2dOn.

Referenced by NonDLocalReliability::update_level_data().

The documentation for this class was generated from the following files:
13.61 GridApplicInterface Class Reference

Derived application interface class which spawns simulation codes using grid services such as Condor or Globus.

Inheritance diagram for GridApplicInterface:

```
  Interface
  |     |
  v     v
ApplicationInterface

  |     |
  v     v
ProcessApplicInterface

  |     |
  v     v
SysCallApplicInterface

  v
GridApplicInterface
```

### Public Member Functions

- **GridApplicInterface** (const ProblemDescDB &problem_db)
  
  *constructor*

- **~GridApplicInterface ()**
  
  *destructor*

- **void derived_map (const Variables &vars, const ActiveSet &set, Response &response, int fn_eval_id)**

  Called by `map()` and other functions to execute the simulation in synchronous mode. The portion of performing an evaluation that is specific to a derived class.

- **void derived_map_asynch (const ParamResponsePair &pair)**

  Called by `map()` and other functions to execute the simulation in asynchronous mode. The portion of performing an asynchronous evaluation that is specific to a derived class.

- **void wait_local_evaluations (PRPQueue &prp_queue)**

  For asynchronous function evaluations, this method is used to detect completion of jobs and process their results. It provides the processing code that is specific to derived classes. This version waits for at least one completion.

- **void test_local_evaluations (PRPQueue &prp_queue)**

  Convenience function for common code between wait and nowait case.

- **int synchronous_local_analysis (int analysis_id)**

### Protected Member Functions

- **bool grid_file_test (const String &root_file)**

  test file(s) for existence based on root_file name
13.62. HIERARCHSURRMODEL CLASS REFERENCE

Protected Attributes

- IntSet idSet
  Set of function evaluation id’s for active asynchronous system call evaluations.
- IntShortMap failCountMap
  map linking function evaluation id’s to number of response read failures
- start_grid_computing_t start_grid_computing
  handle to dynamically linked start_grid_computing function
- perform_analysis_t perform_analysis
  handle to dynamically linked perform_analysis grid function
- get_jobs_completed_t get_jobs_completed
  handle to dynamically linked get_jobs_completed grid function
- stop_grid_computing_t stop_grid_computing
  handle to dynamically linked stop_grid_computing function

13.61.1 Detailed Description

Derived application interface class which spawns simulation codes using grid services such as Condor or Globus. This class is currently a modified copy of SysCallApplicInterface adapted for use with an external grid services library which was dynamically linked using dlopen() services.

13.61.2 Member Function Documentation

int synchronous_local_analysis ( int analysis_id ) [inline], [virtual]

This code provides the derived function used by ApplicationInterface::serve_analyses_synch(). TODO - allow local analyses??????
  Reimplemented from ApplicationInterface.
  References SysCallApplicInterface::spawn_analysis_to_shell().
  The documentation for this class was generated from the following files:
  - GridApplicInterface.hpp
  - GridApplicInterface.cpp

13.62 HierarchSurrModel Class Reference

Derived model class within the surrogate model branch for managing hierarchical surrogates (models of varying fidelity).

Inheritance diagram for HierarchSurrModel:
CHAPTER 13. CLASS DOCUMENTATION

Public Member Functions

- HierarchSurrModel (ProblemDescDB &problem_db)
  
  constructor

- ~HierarchSurrModel ()
  
  destructor

Protected Member Functions

- void derived_evaluate (const ActiveSet &set)
  
  portion of evaluate() specific to HierarchSurrModel

- void derived_evaluate_nowait (const ActiveSet &set)
  
  portion of evaluate_nowait() specific to HierarchSurrModel

- const IntResponseMap & derived_synchronize ()
  
  portion of synchronize() specific to HierarchSurrModel

- const IntResponseMap & derived_synchronize_nowait ()
  
  portion of synchronize_nowait() specific to HierarchSurrModel

- Model & surrogate_model ()
  
  return the active low fidelity model

- void surrogate_model_indices (size_t lf_model_index, size_t lf_soln_lev_index=NPOS)
  
  set the indices identifying the active low fidelity model

- void surrogate_model_indices (const SizetSizetPair &lf_form_level)
  
  set the index pair identifying the active low fidelity model

- const SizetSizetPair & surrogate_model_indices () const
  
  return the indices identifying the active low fidelity model

- Model & truth_model ()
  
  return the active high fidelity model

- void truth_model_indices (size_t hf_model_index, size_t hf_soln_lev_index=NPOS)
  
  set the indices identifying the active high fidelity model

- void truth_model_indices (const SizetSizetPair &hf_form_level)
  
  set the index pair identifying the active high fidelity model

- const SizetSizetPair & truth_model_indices () const
  
  return the indices identifying the active high fidelity model

- void derived_subordinate_models (ModelList &ml, bool recurse_flag)
  
  return orderedModels and, optionally, their sub-model recursions

- void primary_response_fn_weights (const RealVector &wts, bool recurse_flag=true)
  
  set the relative weightings for multiple objective functions or least squares terms and optionally recurses into LF/HF models

- void surrogate_response_mode (short mode)
  
  set responseMode and pass any bypass request on to the high fidelity model for any lower-level surrogate recursions

- void surrogate_function_indices (const IntSet &surr_fn_indices)
  
  (re)set the surrogate index set in SurrogateModel::surrogateFnIndices

- void build_approximation ()
  
  use the high fidelity model to compute the truth values needed for correction of the low fidelity model results
void component_parallel_mode (short mode)
  update component parallel mode for supporting parallelism in the low ad high fidelity models

IntIntPair estimate_partition_bounds (int max_eval_concurrency)
  estimate the minimum and maximum partition sizes that can be utilized by this Model

void derived_init_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  set up parallel operations for the array of ordered model fidelities

void derived_init_serial ()
  set up serial operations for the array of ordered model fidelities

void derived_set_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  set active parallel configuration within the current low and high fidelity models identified by &{low,high}Fidelity-Indices

void derived_free_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  deallocate communicator partitions for the HierarchSurrModel (request forwarded to the the array of ordered model fidelities)

void serve_run (ParLevLIter pl_iter, int max_eval_concurrency)
  Service the low and high fidelity model job requests received from the master; completes when termination message received from stop_servers().

void stop_servers ()
  Executed by the master to terminate the low and high fidelity model server operations when iteration on the HierarchSurrModel is complete.

void inactive_view (short view, bool recurse_flag=true)
  update the Model’s inactive view based on higher level (nested) context and optionally recurse into

int evaluation_id () const
  Return the current evaluation id for the HierarchSurrModel.

void set_evaluation_reference ()
  set the evaluation counter reference points for the HierarchSurrModel (request forwarded to the low and high fidelity models)

void fine_grained_evaluation_counters ()
  request fine-grained evaluation reporting within the low and high fidelity models

void print_evaluation_summary (std::ostream &s, bool minimal_header=false, bool relative_count=true) const
  print the evaluation summary for the HierarchSurrModel (request forwarded to the low and high fidelity models)

Private Member Functions

void update_model (Model &model)
  update the passed model (low or high fidelity) with current variable values/bounds/labels

const IntResponseMap & derived_synchronize_same_model ()
  called from derived_synchronize() for case of a shared model form between low and high fidelity, resulting in a single combined job queue

const IntResponseMap & derived_synchronize_competing ()
  called from derived_synchronize() for case of distinct model forms with competing job queues

const IntResponseMap & derived_synchronize_distinct_model ()
  called from derived_synchronize() for case of distinct model forms without competing job queues
• void derived_synchronize_combine (const IntResponseMap &hf_resp_map, IntResponseMap &lf_resp_map, IntResponseMap &combined_resp_map)

  combine the HF and LF response maps into a combined response map according to the responseMode

• const IntResponseMap & derived_synchronize_same_model_nowait ()

called from derived_synchronize_nowait() for case of a shared model form between low and high fidelity, resulting in a single combined job queue

• const IntResponseMap & derived_synchronize_distinct_model_nowait ()

called from derived_synchronize_nowait() for case of distinct model forms with separate job queues

• void derived_synchronize_combine_nowait (const IntResponseMap &hf_resp_map, IntResponseMap &lf_resp_map, IntResponseMap &combined_resp_map)

  combine the available components from HF and LF response maps into a combined response map according to the responseMode

• void resize_response ()

  resize currentResponse based on responseMode

• void aggregate_response (const Response &hf_resp, const Response &lf_resp, Response &agg_resp)

  aggregate LF and HF response to create a new response with 2x size

• void compute_apply_delta (IntResponseMap &lf_resp_map)

  helper function used in the AUTO_CORRECTED_SURROGATE responseMode for computing a correction and applying it to lf_resp_map

• void check_key (int key1, int key2) const

  check for consistency in response map keys

**Private Attributes**

• int hierModelEvalCntr

  number of calls to derived_evaluate()/derived_evaluate_nowait()

• ModelArray orderedModels

  Ordered sequence (low to high) of model fidelities. Models are of arbitrary type and supports recursions.

• SizetSizetPair lowFidelityIndices

  index of the low fidelity model that is currently active within orderedModels; provides approximate low fidelity function evaluations.

• SizetSizetPair highFidelityIndices

  index of the high fidelity model that is currently active within orderedModels; provides truth evaluations for computing corrections to the low fidelity results.

• bool sameModelForm

  flag indicating that the {low,high}FidelityIndices correspond to the same model instance, requiring modifications to the updating process

• Response truthResponseRef

  the reference truth (high fidelity) response computed in build_approximation() and used for calculating corrections

• IntResponseMap cachedTruthRespMap

  map of truth (high-fidelity) responses retrieved in derived_synchronize_nowait() that could not be returned since corresponding low-fidelity response portions were still pending
13.62. HIERARCHSURRMODEL CLASS REFERENCE

**Additional Inherited Members**

### 13.62.1 Detailed Description

Derived model class within the surrogate model branch for managing hierarchical surrogates (models of varying fidelity).

The HierarchSurrModel class manages hierarchical models of varying fidelity. The class contains an ordered array of model forms (fidelity ordered from low to high), where each model form may also contain a set of solution levels (space/time discretization, convergence tolerances, etc.). At run time, one of these combinations is activated as the low fidelity model and used to perform approximate function evaluations, while another of these combinations is activated as the high fidelity model and used to provide truth evaluations for computing corrections to the low fidelity results.

### 13.62.2 Member Function Documentation

```cpp
void derived_evaluate ( const ActiveSet & set ) [protected, [virtual]]
```

portion of evaluate() specific to HierarchSurrModel

Compute the response synchronously using LF model, HF model, or both (mixed case). For the LF model portion, compute the high fidelity response if needed with build_approximation(), and, if correction is active, correct the low fidelity results.

Reimplemented from Model.

References Response::active_set(), HierarchSurrModel::aggregate_response(), DiscrepancyCorrection::apply(), SurrogateModel::approxBuilds, SurrogateModel::asv_mapping(), HierarchSurrModel::build_approximation(), HierarchSurrModel::component_parallel_mode(), DiscrepancyCorrection::compute(), DiscrepancyCorrection::computed(), Response::copy(), Model::current_response(), Model::currentResponse, Model::currentVariables, SurrogateModel::deltaCorr, Model::eval_tag_prefix(), Model::evalTagPrefix, Model::evaluate(), SurrogateModel::force_rebuild(), Model::hierarchicalTagging, HierarchSurrModel::hiModelEvalCntr, HierarchSurrModel::highFidelityIndices, HierarchSurrModel::lowFidelityIndices, HierarchSurrModel::orderedModels, Model::outputLevel, ActiveSet::request_vector(), SurrogateModel::response_mapping(), SurrogateModel::responseMode, HierarchSurrModel::sameModelForm, Model::solution_level_index(), HierarchSurrModel::truthResponseRef, Response::update(), and HierarchSurrModel::update_model().

```cpp
void derived_evaluate_nowait ( const ActiveSet & set ) [protected, [virtual]]
```

portion of evaluate_nowait() specific to HierarchSurrModel

Compute the response asynchronously using LF model, HF model, or both (mixed case). For the LF model portion, compute the high fidelity response with build_approximation() (for correcting the low fidelity results in derived_synchronize() and derived_synchronize_nowait()) if not performed previously.

Reimplemented from Model.

References DiscrepancyCorrection::apply(), SurrogateModel::approxBuilds, SurrogateModel::asv_mapping(), Model::asynch_flag(), HierarchSurrModel::build_approximation(), SurrogateModel::cachedApproxRespMap, HierarchSurrModel::cachedTruthRespMap, HierarchSurrModel::component_parallel_mode(), DiscrepancyCorrection::compute(), DiscrepancyCorrection::computed(), Response::copy(), Variables::copy(), Model::current_response(), Model::currentVariables, SurrogateModel::deltaCorr, ActiveSet::derivative_vector(), Model::eval_tag_prefix(), Model::evalTagPrefix, Model::evaluate(), Model::evaluation_id(), SurrogateModel::force_rebuild(), Model::hierarchicalTagging, HierarchSurrModel::hiModelEvalCntr, HierarchSurrModel::highFidelityIndices, HierarchSurrModel::lowFidelityIndices, HierarchSurrModel::orderedModels, Model::outputLevel, SurrogateModel::rawVarsMap, ActiveSet::request_vector(), SurrogateModel::responseMode, HierarchSurrModel::sameModelForm, Model::solution_level_index(), SurrogateModel::surrIdMap, SurrogateModel::truthIdMap, HierarchSurrModel::truthResponseRef, and HierarchSurrModel::update_model().
const IntResponseMap & derived_synchronize() [protected], [virtual]

portion of synchronize() specific to HierarchSurrModel

Blocking retrieval of asynchronous evaluations from LF model, HF model, or both (mixed case). For the LF model portion, apply correction (if active) to each response in the array. derived_synchronize() is designed for the general case where derived_evaluate_nowait() may be inconsistent in its use of low fidelity evaluations, high fidelity evaluations, or both.

Reimplemented from Model.

References HierarchSurrModel::derived_synchronize_competing(), HierarchSurrModel::derived_synchronize_distinct_model(), HierarchSurrModel::derived_synchronize_same_model(), HierarchSurrModel::sameModelForm, SurrogateModel::surrIdMap, SurrogateModel::surrResponseMap, and SurrogateModel::truthIdMap.

const IntResponseMap & derived_synchronize_nowait() [protected], [virtual]

portion of synchronize_nowait() specific to HierarchSurrModel

Nonblocking retrieval of asynchronous evaluations from LF model, HF model, or both (mixed case). For the LF model portion, apply correction (if active) to each response in the map. derived_synchronize_nowait() is designed for the general case where derived_evaluate_nowait() may be inconsistent in its use of actual evals, approx evals, or both.

Reimplemented from Model.

References HierarchSurrModel::derived_synchronize_distinct_model_nowait(), HierarchSurrModel::derived_synchronize_same_model_nowait(), HierarchSurrModel::sameModelForm, and SurrogateModel::surrResponseMap.

Referenced by HierarchSurrModel::derived_synchronize_competing().

int evaluation_id() const [inline], [protected], [virtual]

Return the current evaluation id for the HierarchSurrModel.

return the hierarchical model evaluation count. Due to possibly intermittent use of surrogate bypass, this is not the same as either the loFi or hiFi model evaluation counts. It also does not distinguish duplicate evals.

Reimplemented from Model.

References HierarchSurrModel::hierModelEvalCntr.

The documentation for this class was generated from the following files:

- HierarchSurrModel.hpp
- HierarchSurrModel.cpp

13.63 Interface Class Reference

Base class for the interface class hierarchy.

Inheritance diagram for Interface:
Public Member Functions

- **Interface ()**
  default constructor
- **Interface (ProblemDescDB &problem_db)**
  standard constructor for envelope
- **Interface (const Interface &interface_in)**
  copy constructor
- **virtual ~Interface ()**
  destructor
- **Interface operator= (const Interface &interface_in)**
  assignment operator
- **virtual void map (const Variables &vars, const ActiveSet &set, Response &response, bool asynch_flag=false)**
  the function evaluator: provides a "mapping" from the variables to the responses.
- **virtual const IntResponseMap & synch ()**
  recovers data from a series of asynchronous evaluations (blocking)
- **virtual const IntResponseMap & synch_nowait ()**
  recovers data from a series of asynchronous evaluations (nonblocking)
- **virtual void serve_evaluations ()**
  evaluation server function for multiprocessor executions
- **virtual void stop_evaluation_servers ()**
  send messages from iterator rank 0 to terminate evaluation servers
- **virtual void init_communicators (const IntArray &message_lengths, int max_eval_concurrency)**
  allocate communicator partitions for concurrent evaluations within an iterator and concurrent multiprocessor analyses within an evaluation.
- **virtual void set_communicators (const IntArray &message_lengths, int max_eval_concurrency)**
  set the local parallel partition data for an interface (the partitions are already allocated in ParallelLibrary).
- **virtual void init_serial ()**
reset certain defaults for serial interface objects.

- virtual int \texttt{asynch\_local\_evaluation\_concurrency} () const
  return the user-specified concurrency for asynch local evaluations

- virtual short \texttt{interface\_synchronization} () const
  return the user-specified interface synchronization

- virtual int \texttt{minimum\_points} (bool constraint\_flag) const
  returns the minimum number of points required to build a particular \texttt{ApproximationInterface} (used by \texttt{DataFitSurrModels}).

- virtual int \texttt{recommended\_points} (bool constraint\_flag) const
  returns the recommended number of points required to build a particular \texttt{ApproximationInterface} (used by \texttt{DataFitSurrModels}).

- virtual void \texttt{approximation\_function\_indices} (const \texttt{IntSet} &\texttt{approx\_fn\_indices})
  set the (currently active) approximation function index set

- virtual void \texttt{update\_approximation} (const \texttt{Variables} &\texttt{vars}, const \texttt{IntResponsePair} &\texttt{response\_pr})
  updates the anchor point for an approximation

- virtual void \texttt{update\_approximation} (const \texttt{RealMatrix} &\texttt{samples}, const \texttt{IntResponseMap} &\texttt{resp\_map})
  updates the current data points for an approximation

- virtual void \texttt{update\_approximation} (const \texttt{VariablesArray} &\texttt{vars\_array}, const \texttt{IntResponseMap} &\texttt{resp\_map})
  updates the current data points for an approximation

- virtual void \texttt{append\_approximation} (const \texttt{Variables} &\texttt{vars}, const \texttt{IntResponsePair} &\texttt{response\_pr})
  appends a single point to an existing approximation

- virtual void \texttt{append\_approximation} (const \texttt{RealMatrix} &\texttt{samples}, const \texttt{IntResponseMap} &\texttt{resp\_map})
  appends multiple points to an existing approximation

- virtual void \texttt{append\_approximation} (const \texttt{VariablesArray} &\texttt{vars\_array}, const \texttt{IntResponseMap} &\texttt{resp\_map})
  appends multiple points to an existing approximation

- virtual void \texttt{build\_approximation} (const \texttt{RealVector} &\texttt{c\_l\_bnds}, const \texttt{RealVector} &\texttt{c\_u\_bnds}, const \texttt{IntVector} &\texttt{di\_l\_bnds}, const \texttt{IntVector} &\texttt{di\_u\_bnds}, const \texttt{RealVector} &\texttt{dr\_l\_bnds}, const \texttt{RealVector} &\texttt{dr\_u\_bnds})
  builds the approximation

- virtual void \texttt{export\_approximation} ()
  export the approximation to disk

- virtual void \texttt{rebuild\_approximation} (const \texttt{BoolDeque} &\texttt{rebuild\_deque})
  rebuilds the approximation after a data update

- virtual void \texttt{pop\_approximation} (bool save\_surr\_data)
  removes data from last append from the approximation

- virtual void \texttt{push\_approximation} ()
  retrieves approximation data from a previous state (negates pop)

- virtual bool \texttt{push\_available} ()
  queries the approximation for the ability to retrieve a previous increment

- virtual void \texttt{finalize\_approximation} ()
  finalizes the approximation by applying all trial increments

- virtual void \texttt{store\_approximation} (size\_t index=NPOS)
  move the current approximation into storage for later combination; the index of the stored approximation can be passed to allow replacement instead of augmentation (default is \texttt{push\_back})
• virtual void restore_approximation (size_t index=NPOS)
  return an approximation from storage; the index identifies a particular stored data set (default is pop_back from stored)
• virtual void remove_stored_approximation (size_t index=NPOS)
  remove a stored approximation, due to redundancy with the current approximation, prior to combination (default for no index is pop_back)
• virtual void combine_approximation (short corr_type)
  combine the current approximation with previously stored data sets
• virtual Real2DArray cv_diagnostics (const StringArray &metric_types, unsigned num_folds)
  approximation cross-validation quality metrics per response function
• virtual RealArray challenge_diagnostics (const String &metric_type, const RealMatrix &challenge_pts)
  approximation challenge data metrics per response function
• virtual void clear_current ()
  clears current data from an approximation interface
• virtual void clear_all ()
  clears all data from an approximation interface
• virtual void clear_popped ()
  clears bookkeeping for popped data sets from an approximation interface
• virtual SharedApproxData & shared_approximation ()
  retrieve the SharedApproxData within an ApproximationInterface
• virtual std::vector<Approximation> & approximations ()
  retrieve the Approximations within an ApproximationInterface
• virtual const Pecos::SurrogateData & approximation_data (size_t index)
  retrieve the approximation data from a particular Approximation within an ApproximationInterface
• virtual const RealVectorArray & approximation_coefficients (bool normalized=false)
  retrieve the approximation coefficients from each Approximation within an ApproximationInterface
• virtual void approximation_coefficients (const RealVectorArray &approx_coeffs, bool normalized=false)
  set the approximation coefficients within each Approximation within an ApproximationInterface
• virtual const RealVector & approximation_variances (const Variables &vars)
  retrieve the approximation variances from each Approximation within an ApproximationInterface
• virtual const StringArray & analysis_drivers () const
  retrieve the analysis drivers specification for application interfaces
• virtual bool evaluation_cache () const
  return flag indicating usage of the global evaluation cache
• virtual void file_cleanup () const
  clean up any interface parameter/response files when aborting
• void assign_rep (Interface *interface_rep, bool ref_count_incr=true)
  assign letter or replace existing letter with a new one
• unsigned short interface_type () const
  returns the interface type
• const String & interface_id () const
returns the interface identifier

- **int evaluation_id()** const
  returns the value of the (total) evaluation id counter for the interface

- **void fine_grained_evaluation_counters(size_t num_fns)**
  set fineGrainEvalCounters to true and initialize counters if needed

- **void init_evaluation_counters(size_t num_fns)**
  initialize fine grained evaluation counters, sizing if needed

- **void set_evaluation_reference()**
  set evaluation count reference points for the interface

- **void print_evaluation_summary(std::ostream &s, bool minimal_header, bool relative_count) const**
  print an evaluation summary for the interface

- **bool multi_proc_eval()** const
  returns a flag signaling the use of multiprocessor evaluation partitions

- **bool iterator_eval_dedicated_master()** const
  returns a flag signaling the use of a dedicated master processor at the iterator-evaluation scheduling level

- **bool is_null()** const
  function to check interfaceRep (does this envelope contain a letter?)

- **void eval_tag_prefix(const String &eval_id_str, bool append_iface_id=true)**
  set the evaluation tag prefix (does not recurse)

### Protected Member Functions

- **Interface (BaseConstructor, const ProblemDescDB &problem_db)**
  constructor initializes the base class part of letter classes *(BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)*

- **Interface (NoDBBaseConstructor, size_t num_fns, short output_level)**
  constructor initializes the base class part of letter classes *(NoDBBaseConstructor used for on the fly instantiations without a DB)*

- **void init_algebraic_mappings(const Variables &vars, const Response &response)**
  Define algebraicACVIndices, algebraicACVIds, and algebraicFnIndices.

- **void asv_mapping(const ActiveSet &total_set, ActiveSet &algebraic_set, ActiveSet &core_set)**
  define the evaluation requirements for algebraic_mappings() (algebraic_set) and the core Application/Approximation mapping (core_set) from the total Interface evaluation requirements (total_set)

- **void asv_mapping(const ActiveSet &algebraic_set, ActiveSet &total_set)**
  map an algebraic ASV back to original total ordering for asynch recovery

- **void algebraic_mappings(const Variables &vars, const ActiveSet &algebraic_set, Response &algebraic_response)**
  evaluate the algebraic_response using the AMPL solver library and the data extracted from the algebraic_mappings file

- **void response_mapping(const Response &algebraic_response, const Response &core_response, Response &total_response)**
  combine the response from algebraic_mappings() with the response from derived_map() to create the total response

- **String final_eval_id_tag(int fn_eval_id)**
  form and return the final evaluation ID tag, appending iface ID if needed
Protected Attributes

- **unsigned short interfaceType**
  the interface type: enum for system, fork, direct, grid, or approximation

- **String interfaceId**
  the interface specification identifier string from the DAKOTA input file

- **bool algebraicMappings**
  flag for the presence of algebraic mappings that define the subset of an Interface’s parameter to response mapping that is explicit and algebraic.

- **bool coreMappings**
  flag for the presence of non-algebraic mappings that define the core of an Interface’s parameter to response mapping (using analysis_drivers for ApplicationInterface or functionSurfaces for ApproximationInterface).

- **short outputLevel**
  output verbosity level: \{SILENT, QUIET, NORMAL, VERBOSE, DEBUG\} _OUTPUT

- **int currEvalId**
  identifier for the current evaluation, which may differ from the evaluation counters in the case of evaluation scheduling; used on iterator master as well as server processors. Currently, this is set prior to all invocations of derived_map() for all processors.

- **bool fineGrainEvalCounters**
  controls use of fn val/grad/hess counters for detailed evaluation report

- **int evalIdCntr**
  total interface evaluation counter

- **int newEvalIdCntr**
  new (non-duplicate) interface evaluation counter

- **int evalIdRefPt**
  iteration reference point for evalIdCntr

- **int newEvalIdRefPt**
  iteration reference point for newEvalIdCntr

- **IntArray fnValCounter**
  number of value evaluations by resp fn

- **IntArray fnGradCounter**
  number of gradient evaluations by resp fn

- **IntArray fnHessCounter**
  number of Hessian evaluations by resp fn

- **IntArray newFnValCounter**
  number of new value evaluations by resp fn

- **IntArray newFnGradCounter**
  number of new gradient evaluations by resp fn

- **IntArray newFnHessCounter**
  number of new Hessian evaluations by resp fn

- **IntArray fnValRefPt**
  iteration reference point for fnValCounter

- **IntArray fnGradRefPt**
  iteration reference point for fnGradCounter
• IntArray fnHessRefPt
  iteration reference point for fnHessCounter

• IntArray newFnValRefPt
  iteration reference point for newFnValCounter

• IntArray newFnGradRefPt
  iteration reference point for newFnGradCounter

• IntArray newFnHessRefPt
  iteration reference point for newFnHessCounter

• IntResponseMap rawResponseMap
  Set of responses returned after either a blocking or nonblocking schedule of asynchronous evaluations.

• StringArray fnLabels
  response function descriptors (used in print_evaluation_summary() and derived direct interface classes); initialized in map() functions due to potential updates after construction

• bool multiProcEvalFlag
  flag for multiprocessor evaluation partitions (evalComm)

• bool ieDedMasterFlag
  flag for dedicated master partitioning at the iterator level

• String evalTagPrefix
  set of period-delimited evaluation ID tags to use in evaluation tagging

• bool appendIfaceId
  whether to append the interface ID to the prefix during map (default true)

Private Member Functions

• Interface * get_interface (ProblemDescDB &problem_db)
  Used by the envelope to instantiate the correct letter class.

• int algebraic_function_type (String)
  Used by algebraic mappings to determine the correct AMPL function evaluation call to make.

Private Attributes

• StringArray algebraicVarTags
  set of variable tags from AMPL stub.col

• SizetArray algebraicACVIndices
  set of indices mapping AMPL algebraic variables to DAKOTA all continuous variables

• SizetArray algebraicACVIds
  set of ids mapping AMPL algebraic variables to DAKOTA all continuous variables

• StringArray algebraicFnTags
  set of function tags from AMPL stub.row

• IntArray algebraicFnTypes
  function type: $>0$ = objective, $<0$ = constraint $|value|>-1$ is the objective (constraint) index when making AMPL objval (conival) calls

• SizetArray algebraicFnIndices
  set of indices mapping AMPL algebraic objective functions to DAKOTA response functions
13.63 INTERFACE CLASS REFERENCE

- **RealArray algebraicConstraintWeights**
  
  set of weights for computing Hessian matrices for algebraic constraints;

- **int numAlgebraicResponses**
  
  number of algebraic responses (objectives+constraints)

- **Interface * interfaceRep**
  
  pointer to the letter (initialized only for the envelope)

- **int referenceCount**
  
  number of objects sharing interfaceRep

- **ASL * asl**
  
  pointer to an AMPL solver library (ASL) object

13.63.1 Detailed Description

Base class for the interface class hierarchy.

The Interface class hierarchy provides the part of a Model that is responsible for mapping a set of Variables into a set of Responses. The mapping is performed using either a simulation-based application interface or a surrogate-based approximation interface. For memory efficiency and enhanced polymorphism, the interface hierarchy employs the "letter/envelope idiom" (see Coplien "Advanced C++", p. 133), for which the base class (Interface) serves as the envelope and one of the derived classes (selected in Interface::get_interface()) serves as the letter.

13.63.2 Constructor & Destructor Documentation

**Interface ( )**

default constructor
  
  used in Model envelope class instantiations

**Interface ( ProblemDescDB & problem_db )**

standard constructor for envelope
  
  Used in Model instantiation to build the envelope. This constructor only needs to extract enough data to properly execute get_interface, since Interface::Interface(BaseConstructor, problem_db) builds the actual base class data inherited by the derived interfaces.

  References Dakota::abort_handler(), Interface::get_interface(), and Interface::interfaceRep.

**Interface ( const Interface & interface_in )**

copy constructor
  
  Copy constructor manages sharing of interfaceRep and incrementing of referenceCount.

  References Interface::interfaceRep, and Interface::referenceCount.

**~Interface ( ) [virtual]**

destructor
  
  Destructor decrements referenceCount and only deletes interfaceRep if referenceCount is zero.

  References Interface::interfaceRep, and Interface::referenceCount.
Interface (BaseConstructor, const ProblemDescDB & problem_db) [protected]

constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

This constructor is the one which must build the base class data for all inherited interfaces. get_interface() instantiates a derived class letter and the derived constructor selects this base class constructor in its initialization list (to avoid the recursion of the base class constructor calling get_interface() again). Since this is the letter and the letter IS the representation, interfaceRep is set to NULL (an uninitialized pointer causes problems in ~Interface).

References Dakota::abort_handler(), Interface::algebraic_function_type(), Interface::algebraicConstraintWeights, Interface::algebraicFnTags, Interface::algebraicFnTypes, Interface::algebraicMappings, Interface::algebraicVarTags, Interface::asl, ProblemDescDB::get_string(), Interface::outputLevel, and Dakota::strends().

13.63.3 Member Function Documentation

Interface operator= (const Interface & interface_in)

assignment operator


References Interface::interfaceRep, and Interface::referenceCount.

void assign_rep ( Interface * interface_rep, bool ref_count_incr = true)

assign letter or replace existing letter with a new one

Similar to the assignment operator, the assign_rep() function decrements referenceCount for the old interfaceRep and assigns the new interfaceRep. It is different in that it is used for publishing derived class letters to existing envelopes, as opposed to sharing representations among multiple envelopes (in particular, assign_rep is passed a letter object and operator= is passed an envelope object). Letter assignment supports two models as governed by ref_count_incr:

- ref_count_incr = true (default): the incoming letter belongs to another envelope. In this case, increment the reference count in the normal manner so that deallocation of the letter is handled properly.
- ref_count_incr = false: the incoming letter is instantiated on the fly and has no envelope. This case is modeled after get_interface(): a letter is dynamically allocated using new and passed into assign_rep, the letter’s reference count is not incremented, and the letter is not remotely deleted (its memory management is passed over to the envelope).

References Dakota::abort_handler(), Interface::interfaceRep, and Interface::referenceCount.

Referenced by DataFitSurrModel::DataFitSurrModel(), parallel_interface_plugin(), LibraryEnvironment::plugin_interface(), and run_dakota().

void eval_tag_prefix (const String & eval_id_str, bool append_iface_id = true)

set the evaluation tag prefix (does not recurse)

default implementation just sets the list of eval ID tags; derived classes containing additional models or interfaces should override (currently no use cases)

References Interface::append_ifaceId, Interface::eval_tag_prefix(), Interface::evalTagPrefix, and Interface::interfaceRep.

Referenced by NestedModel::derived_evaluate(), SimulationModel::eval_tag_prefix(), and Interface::eval_tag_prefix().
void response_mapping ( const Response & algebraic_response, const Response & core_response, Response & total_response ) [protected]

combine the response from algebraic_mappings() with the response from derived_map() to create the total response.

This function will get invoked even when only algebraic mappings are active (no core mappings from derived_map), since the AMPL algebraic_response may be ordered differently from the total_response. In this case, the core_response object is unused.

References Dakota::NPOS, Dakota::abort_handler(), Response::active_set_derivative_vector(), Response::active_set_request_vector(), Interface::algebraicACVIds, Interface::algebraicFnIndices, Interface::coreMappings, Dakota::find_index(), Response::function_gradient(), Response::function_gradient_view(), Response::function_gradients(), Response::function_hessian(), Response::function_hessian_view(), Response::function_hessians(), Response::function_values(), Response::function_values_view(), Interface::outputLevel, Response::reset(), and Response::reset_inactive().

Referenced by ApproximationInterface::map(), ApplicationInterface::map(), ApplicationInterface::synch(), and ApplicationInterface::synch_nowait().

Interface * get_interface ( ProblemDescDB & problem_db ) [private]

Used by the envelope to instantiate the correct letter class.

used only by the envelope constructor to initialize interfaceRep to the appropriate derived type.

References ProblemDescDB::get_string(), ProblemDescDB::get_ushort(), and Interface::interface_type().

Referenced by Interface::Interface().

### 13.63.4 Member Data Documentation

IntResponseMap rawResponseMap [protected]

Set of responses returned after either a blocking or nonblocking schedule of asynchronous evaluations.

The map is a full/partial set of completions which are identified through their evalIdCntr key. The raw set is postprocessed (i.e., finite diff grads merged) in Model::synchronize() where it becomes responseMap.

Referenced by ApplicationInterface::asynchronous_local_evaluations(), ApplicationInterface::process_asynch_local(), ApplicationInterface::process_synch_local(), ApplicationInterface::receive_evaluation(), ApplicationInterface::synch(), ApproximationInterface::synch(), ApplicationInterface::synch_nowait(), ApproximationInterface::synch_nowait(), ApplicationInterface::test_local_backfill(), and ApplicationInterface::test_receives_backfill().

The documentation for this class was generated from the following files:

- DakotaInterface.hpp
- DakotaInterface.cpp

### 13.64 Iterator Class Reference

Base class for the iterator class hierarchy.

Inheritance diagram for Iterator:
Public Member Functions

- **Iterator ()**
  
  default constructor

- **Iterator (ProblemDescDB &problem_db)**
  
  standard envelope constructor, which constructs its own model(s)

- **Iterator (ProblemDescDB &problem_db, Model &model)**
  
  alternate envelope constructor which uses the ProblemDescDB but accepts a model from a higher level (meta-iterator) context, instead of constructing its own

- **Iterator (const String &method_string, Model &model)**
  
  alternate envelope constructor for instantiations by name without the ProblemDescDB

- **Iterator (const Iterator &iterator)**
  
  copy constructor

- virtual ~Iterator ()
  
  destructor

- **Iterator operator= (const Iterator &iterator)**
  
  assignment operator

- virtual derived_set_communicators (ParLevLIter pl_iter)
  
  derived class contributions to setting the communicators associated with this Iterator instance

- virtual derived_free_communicators (ParLevLIter pl_iter)
  
  derived class contributions to freeing the communicators associated with this Iterator instance

- virtual initialize_run ()
  
  utility function to perform common operations prior to pre_run(); typically memory initialization; setting of instance pointers

- virtual pre_run ()
  
  pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori

- virtual core_run ()
  
  core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

- virtual post_run (std::ostream &s)
  
  post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way

- virtual finalize_run ()
  
  utility function to perform common operations following post_run(); deallocation and resetting of instance pointers

- virtual pre_output ()
write variables to file, following pre-run

- virtual void post_input()
  
  read tabular data for post-run mode

- virtual void reset()
  
  restore initial state for repeated sub-iterator executions

- virtual void initialize_iterator(int job_index)
  
  used by IteratorScheduler to set the starting data for a run

- virtual void pack_parameters_buffer(MPIPackBuffer &send_buffer, int job_index)
  
  used by IteratorScheduler to pack starting data for an iterator run

- virtual void unpack_parameters_buffer(MPIUnpackBuffer &recv_buffer)
  
  used by IteratorScheduler to unpack starting data for an iterator run

- virtual void unpack_parameters_initialize(MPIUnpackBuffer &recv_buffer)
  
  used by IteratorScheduler to unpack starting data and initialize an iterator run

- virtual void pack_results_buffer(MPIPackBuffer &send_buffer, int job_index)
  
  used by IteratorScheduler to pack results data from an iterator run

- virtual void unpack_results_buffer(MPIUnpackBuffer &recv_buffer, int job_index)
  
  used by IteratorScheduler to unpack results data from an iterator run

- virtual void update_local_results(int job_index)
  
  used by IteratorScheduler to update local results arrays

- virtual const Variables & variables_results() const
  
  return a single final iterator solution (variables)

- virtual const Response & response_results() const
  
  return a single final iterator solution (response)

- virtual const VariablesArray & variables_array_results() const
  
  return multiple final iterator solutions (variables). This should only be used if returns_multiple_points() returns true.

- virtual const ResponseArray & response_array_results() const
  
  return multiple final iterator solutions (response). This should only be used if returns_multiple_points() returns true.

- virtual bool accepts_multiple_points() const
  
  indicates if this iterator accepts multiple initial points. Default return is false. Override to return true if appropriate.

- virtual bool returns_multiple_points() const
  
  indicates if this iterator returns multiple final points. Default return is false. Override to return true if appropriate.

- virtual void initial_points(const VariablesArray &pts)
  
  sets the multiple initial points for this iterator. This should only be used if accepts_multiple_points() returns true.

- virtual void response_results_active_set(const ActiveSet &set)
  
  set the requested data for the final iterator response results

- virtual void initialize_graphics(int iterator_server_id=1)
  
  initialize the 2D graphics window and the tabular graphics data

- virtual void print_results(std::ostream &s)
  
  print the final iterator results

- virtual const Model & algorithm_space_model() const
  
  return the result of any recasting or surrogate model recursion layered on top of iteratedModel by the derived Iterator ctor chain
• virtual unsigned short uses_method () const
  return name of any enabling iterator used by this iterator
• virtual void method_recourse ()
  perform a method switch, if possible, due to a detected conflict
• virtual const VariablesArray & all_variables ()
  return the complete set of evaluated variables
• virtual const RealMatrix & all_samples ()
  return the complete set of evaluated samples
• virtual const IntResponseMap & all_responses () const
  return the complete set of computed responses
• virtual int num_samples () const
  get the current number of samples
• virtual void sampling_reset (int min_samples, bool all_data_flag, bool stats_flag)
  reset sampling iterator to use at least min_samples
• virtual void sampling_reference (int samples_ref)
  set reference number of samples, which is a lower bound during reset
• virtual void sampling_increment ()
  increment to next in sequence of refinement samples
• virtual unsigned short sampling_scheme () const
  return sampling name
• virtual bool compact_mode () const
  returns Analyzer::compactMode
• virtual IntIntPair estimate_partition_bounds ()
  estimate the minimum and maximum partition sizes that can be utilized by this Iterator
• virtual bool resize ()
  reinitializes iterator based on new variable size
• void initialize_communicators (ParLevLIter pl_iter)
  initialize the communicators associated with this Iterator instance
• void set_communicators (ParLevLIter pl_iter)
  set the communicators associated with this Iterator instance
• void free_communicators (ParLevLIter pl_iter)
  free the communicators associated with this Iterator instance
• void resize_communicators (ParLevLIter pl_iter, bool reinit_comms)
  Resize the communicators. This is called from the letter's resize()
• void parallel_configuration_iterator (ParConfigLIter pc_iter)
  set methodPCIter
• ParConfigLIter parallel_configuration_iterator () const
  return methodPCIter
• void run (ParLevLIter pl_iter)
  invoke set_communicators(pl_iter) prior to run()
• void run ()
  orchestrate initialize/pre/core/post/finalize phases
• void assign_rep (Iterator *iterator_rep, bool ref_count_incr=true)
• void iterated_model (const Model &model)
  set the iteratedModel (iterators and meta-iterators using a single model instance)

• Model & iterated_model ()
  return the iteratedModel (iterators & meta-iterators using a single model instance)

• ProblemDescDB & problem_description_db () const
  return the problem description database (probDescDB)

• ParallelLibrary & parallel_library () const
  return the parallel library (parallelLib)

• void method_name (unsigned short m_name)
  set the method name to an enumeration value

• unsigned short method_name () const
  return the method name via its native enumeration value

• void method_string (const String &m_str)
  set the method name by string

• String method_string () const
  return the method name by string

• String method_enum_to_string (unsigned short method_name) const
  convert a method name enumeration value to a string

• unsigned short method_string_to_enum (const String &method_name) const
  convert a method name string to an enumeration value

• String submethod_enum_to_string (unsigned short submethod_name) const
  convert a method name enumeration value to a string

• const String & method_id () const
  return the method identifier (methodId)

• int maximum_evaluation_concurrency () const
  return the maximum evaluation concurrency supported by the iterator

• void maximum_evaluation_concurrency (int max_conc)
  set the maximum evaluation concurrency supported by the iterator

• void convergence_tolerance (Real conv_tol)
  set the method convergence tolerance (convergenceTol)

• Real convergence_tolerance () const
  return the method convergence tolerance (convergenceTol)

• void output_level (short out_lev)
  set the method output level (outputLevel)

• short output_level () const
  return the method output level (outputLevel)

• void summary_output (bool summary_output_flag)
  Set summary output control; true enables evaluation/results summary.

• size_t num_final_solutions () const
  return the number of solutions to retain in best variables/response arrays

• void num_final_solutions (size_t num_final)
  set the number of solutions to retain in best variables/response arrays
• void active_set (const ActiveSet &set)
  set the default active set vector (for use with iterators that employ evaluate parameter sets())
• const ActiveSet & active_set () const
  return the default active set vector (used by iterators that employ evaluate parameter sets())
• void sub_iterator_flag (bool si_flag)
  set subIteratorFlag (and update summaryOutputFlag if needed)
• void active_variable_mappings (const SizetArray &c_index1, const SizetArray &di_index1, const SizetArray &ds_index1, const SizetArray &dr_index1, const ShortArray &c_target2, const ShortArray &di_target2, const ShortArray &ds_target2, const ShortArray &dr_target2)
  set primaryA\{CV, DIV, DRV\}MapIndices, secondaryA\{CV, DIV, DRV\}MapTargets
• bool is_null () const
  function to check iteratorRep (does this envelope contain a letter?)
• Iterator * iterator_rep () const
  returns iteratorRep for access to derived class member functions that are not mapped to the top Iterator level
• virtual void eval_tag_prefix (const String &eval_id_str)
  set the hierarchical eval ID tag prefix

Protected Member Functions

• Iterator (BaseConstructor, ProblemDescDB &problem_db)
  constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)
• Iterator (NoDBBaseConstructor, unsigned short method_name, Model &model)
  alternate constructor for base iterator classes constructed on the fly
• virtual void derived_init_communicators (ParLevLIter pl_iter)
  derived class contributions to initializing the communicators associated with this Iterator instance
• virtual const VariablesArray & initial_points () const
  gets the multiple initial points for this iterator. This will only be meaningful after a call to initial_points mutator.
• StrSizet run_identifier () const
  get the unique run identifier based on method name, id, and number of executions

Static Protected Member Functions

• static void gnewton_set_recast (const Variables &recast_vars, const ActiveSet &recast_set, ActiveSet &sub_model_set)
  conversion of request vector values for the Gauss-Newton Hessian approximation
Protected Attributes

- **ProblemDescDB & probDescDB**
  class member reference to the problem description database

- **ParallelLibrary & parallelLib**
  class member reference to the parallel library

- **ParConfigLIter methodPCIter**
  the active ParallelConfiguration used by this Iterator instance

- **Model iteratedModel**
  the model to be iterated (for iterators and meta-iterators employing a single model instance)

- **size_t myModelLayers**
  number of Models locally (in Iterator or derived classes) wrapped around the initially passed in Model

- **unsigned short methodName**
  name of the iterator (the user's method spec)

- **Real convergenceTol**
  iteration convergence tolerance

- **int maxIterations**
  maximum number of iterations for the iterator

- **int maxFunctionEvals**
  maximum number of fn evaluations for the iterator

- **int maxEvalConcurrency**
  maximum number of concurrent model evaluations

- **ActiveSet activeSet**
  the response data requirements on each function evaluation

- **size_t numFinalSolutions**
  number of solutions to retain in best variables/response arrays

- **VariablesArray bestVariablesArray**
  collection of N best solution variables found during the study; always in context of Model originally passed to the Iterator (any in-flight Recasts must be undone)

- **ResponseArray bestResponseArray**
  collection of N best solution responses found during the study; always in context of Model originally passed to the Iterator (any in-flight Recasts must be undone)

- **bool subIteratorFlag**
  flag indicating if this Iterator is a sub-iterator (NestedModel::subIterator or DataFitSurrModel::daceIterator)

- **SizetArray primaryACVarMapIndices**
  "primary" all continuous variable mapping indices flowed down from higher level iteration

- **SizetArray primaryADIVarMapIndices**
  "primary" all discrete int variable mapping indices flowed down from higher level iteration

- **SizetArray primaryADSVarMapIndices**
  "primary" all discrete string variable mapping indices flowed down from higher level iteration

- **SizetArray primaryADRVarMapIndices**
  "primary" all discrete real variable mapping indices flowed down from higher level iteration

- **ShortArray secondaryACVarMapTargets**
  "secondary" all continuous variable mapping targets flowed down from higher level iteration
CHAPTER 13. CLASS DOCUMENTATION

- **ShortArray** `secondaryADIVarMapTargets`
  "secondary" all discrete int variable mapping targets flowed down from higher level iteration
- **ShortArray** `secondaryADSVarMapTargets`
  "secondary" all discrete string variable mapping targets flowed down from higher level iteration
- **ShortArray** `secondaryADRVarMapTargets`
  "secondary" all discrete real variable mapping targets flowed down from higher level iteration
- **short** `outputLevel`
  output verbosity level: `[SILENT,QUIET,NORMAL,VERBOSE,DEBUG]`, OUTPUT
- **bool** `summaryOutputFlag`
  flag for summary output (evaluation stats, final results); default true, but false for on-the-fly (helper) iterators and sub-iterator use cases
- **ResultsManager & resultsDB**
  reference to the global iterator results database
- **ResultsNames resultsNames**
  valid names for iterator results

**Private Member Functions**

- **Iterator * get_iterator (ProblemDescDB &problem_db)**
  Used by the envelope to instantiate the correct letter class.
- **Iterator * get_iterator (ProblemDescDB &problem_db, Model &model)**
  Used by the envelope to instantiate the correct letter class.
- **Iterator * get_iterator (const String &method_string, Model &model)**
  Used by the envelope to instantiate the correct letter class.

**Private Attributes**

- **String** `methodName`
  method identifier string from the input file
- **size_t** `execNum`
  an execution number for this instance of the class, unique across all instances of same methodName/methodId
- **std::map< size_t, ParConfigLIter >** `methodPCIterMap`
  track the available configurations that have been created (init_comms) and are available for activation at run time (set_comms)
- **Iterator * iteratorRep**
  pointer to the letter (initialized only for the envelope)
- **int** `referenceCount`
  number of objects sharing iteratorRep

**13.64.1 Detailed Description**

Base class for the iterator class hierarchy.

The **Iterator** class is the base class for one of the primary class hierarchies in DAKOTA. The iterator hierarchy contains all of the iterative algorithms which use repeated execution of simulations as function evaluations. For memory efficiency and enhanced polymorphism, the iterator hierarchy employs the "letter/envelope idiom" (see Coplien "Advanced C++", p. 133), for which the base class (**Iterator**) serves as the envelope and one of the derived classes (selected in **Iterator::get_iterator()**) serves as the letter.
13.64.2 Constructor & Destructor Documentation

Iterator ( )
default constructor

The default constructor is used in Vector<Iterator> instantiations and for initialization of Iterator objects contained in meta-Iterators and Model recursions. iteratorRep is NULL in this case, making it necessary to check for NULL pointers in the copy constructor, assignment operator, and destructor.

Iterator ( ProblemDescDB & problem_db )
standard envelope constructor, which constructs its own model(s)

Envelope constructor only needs to extract enough data to properly execute get_iterator(), since letter holds the actual base class data. This version is used for top-level ProblemDescDB-driven construction of all Iterators and MetaIterators, which construct their own Model instances.

References Dakota::abort_handler(), Iterator::get_iterator(), and Iterator::iteratorRep.

Iterator ( ProblemDescDB & problem_db, Model & model )
alternate envelope constructor which uses the ProblemDescDB but accepts a model from a higher level (meta-iterator) context, instead of constructing its own

Envelope constructor only needs to extract enough data to properly execute get_iterator(), since letter holds the actual base class data. This version is used for ProblemDescDB-driven construction of Iterators that are passed a Model from a higher-level context (e.g., a MetaIterator instantiates its sub-iterator(s) by name instead of pointer and passes in its iteratedModel, since these sub-iterators lack their own model pointers).

References Dakota::abort_handler(), Iterator::get_iterator(), and Iterator::iteratorRep.

Iterator ( const String & method_string, Model & model )
alternate envelope constructor for instantiations by name without the ProblemDescDB

Used in sub-iterator instantiations within iterator constructors. Envelope constructor only needs to extract enough data to properly execute get_iterator(), since letter holds the actual base class data. This version is used for lightweight constructions without the ProblemDescDB.

References Dakota::abort_handler(), Iterator::get_iterator(), and Iterator::iteratorRep.

Iterator ( const Iterator & iterator )
copy constructor

Copy constructor manages sharing of iteratorRep and incrementing of referenceCount.

References Iterator::iteratorRep, and Iterator::referenceCount.

~Iterator ( ) [virtual]
destructor

Destructor decrements referenceCount and only deletes iteratorRep when referenceCount reaches zero.

References Iterator::iteratorRep, and Iterator::referenceCount.
CHAPTER 13. CLASS DOCUMENTATION

Iterator ( BaseConstructor, ProblemDescDB & problem_db ) [protected]

constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

This constructor builds the base class data for all inherited iterators, including meta-iterators. get_iterator() instantiates a derived class and the derived class selects this base class constructor in its initialization list (to avoid the recursion of the base class constructor calling get_iterator() again). Since the letter IS the representation, its representation pointer is set to NULL (an uninitialized pointer causes problems in ~Iterator).

References Iterator::method_enum_to_string(), Iterator::methodName, and Iterator::outputLevel.

Iterator ( NoDBBaseConstructor, unsigned short method_name, Model & model ) [protected]

alternate constructor for base iterator classes constructed on the fly

This alternate constructor builds base class data for inherited iterators. It is used for on-the-fly instantiations for which DB queries cannot be used, and is not used for construction of meta-iterators.

Iterator ( NoDBBaseConstructor, unsigned short method_name ) [protected]

alternate constructor for base iterator classes constructed on the fly

This alternate constructor builds base class data for inherited iterators. It is used for on-the-fly instantiations for which DB queries cannot be used, and is not used for construction of meta-iterators. It has no incoming model, so only sets up a minimal set of defaults. However, its use is preferable to the default constructor, which should remain as minimal as possible.

13.64.3 Member Function Documentation

Iterator operator= ( const Iterator & iterator )

assignment operator


References Iterator::iteratorRep, and Iterator::referenceCount.

void initialize_run ( ) [virtual]

utility function to perform common operations prior to pre_run(); typically memory initialization; setting of instance pointers

Perform initialization phases of run sequence, like allocating memory and setting instance pointers. Commonly used in sub-iterator executions. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s initialize_run(), typically before performing its own implementation steps.

Reimplemented in NonD, SNLLOptimizer, Analyzer, NLPQLPOptimizer, SNLLLeastSq, Minimizer, CONMINOptimizer, DOTOptimizer, Optimizer, and LeastSq.

References Iterator::initialize_run(), and Iterator::iteratorRep.

Referenced by Iterator::initialize_run(), Iterator::run(), and SeqHybridMetaIterator::run_sequential_adaptive().

void pre_run ( ) [virtual]

pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori
pre-run phase, which a derived iterator may optionally reimplement; when not present, pre-run is likely integrated into the derived run function. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s `pre_run()`, if implemented, typically before performing its own implementation steps.

Reimplemented in Analyzer, NonDLHSSampling, DDACEDesignCompExp, ConcurrentMetaIterator, NonDRKDDarts, FSUDesignCompExp, ParamStudy, NonDMultilevelSampling, and PSUADeDesignCompExp.

References Iterator::iteratorRep, and Iterator::pre_run().

Referenced by Iterator::pre_run(), and Iterator::run().

```cpp
void core_run() [virtual]
```
core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post
Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.

Reimplemented in JEGAOptimizer, NonDSampling, SNLLOptimizer, NonDIntegration, NonDLHSSampling, NonDGPMSEBayesCalibration, NPSOLOptimizer, NLPSQLPOptimizer, NonDDREAMBayesCalibration, COLINOptimizer, SNLLLeastSq, NomadOptimizer, APPSOptimizer, NonDWASABIBayesCalibration, NonDLocalReliability, NonDQUEOSBayesCalibration, SeqHybridMetaIterator, NLSOLSLeastSq, NonDACTiveSampling, ConcurrentMetaIterator, DDACEDesignCompExp, NCSUOptimizer, NonDGPImpSampling, CONMINOptimizer, DOTOptimizer, NonDAdaptImpSampling, NonDPOFDarts, FSUDesignCompExp, NonDGlobalInterval, NonDLocalInterval, NonlinearCGOptimizer, ParamStudy, PSUADeDesignCompExp, SurrogateGlobalMinimizer, EmbedHybridMetaIterator, NonDExpansion, NonDMultilevelSampling, SurrBasedLocalMinimizer, CollabHybridMetaIterator, NL2SOLSLeastSq, NonDGlobalReliability, EffGlobalMinimizer, NonDLHISLeastSq, NonDRKDarts, OptDartsOptimizer, RichExtrapVerification, and PebbleMinimizer.

References Dakota::abort_handler(), Iterator::core_run(), and Iterator::iteratorRep.

Referenced by Iterator::core_run(), and Iterator::run().

```cpp
void post_run (std::ostream & s) [virtual]
```
post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way
Post-run phase, which a derived iterator may optionally reimplement; when not present, post-run is likely integrated into run. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s post_run(), typically after performing its own implementation steps.

Reimplemented in NonDRKDDarts, SNLLOptimizer, COLINOptimizer, Analyzer, SNLLLeastSq, NonDLHSSampling, Minimizer, DDACEDesignCompExp, Optimizer, FSUDesignCompExp, MetaIterator, ParamStudy, PSUADeDesignCompExp, NonDMultilevelSampling, and LeastSq.

References Iterator::iteratorRep, and Iterator::post_run().

Referenced by Iterator::post_run(), and Iterator::run().

```cpp
void finalize_run() [virtual]
```
utility function to perform common operations following post_run(); deallocation and resetting of instance pointers
Optional: perform finalization phases of run sequence, like deallocating memory and resetting instance pointers. Commonly used in sub-iterator executions. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s finalize_run(), typically after performing its own implementation steps.

Reimplemented in NonD, SNLLOptimizer, Analyzer, SNLLLeastSq, Minimizer, Optimizer, and LeastSq.

References Iterator::finalize_run(), and Iterator::iteratorRep.

Referenced by Minimizer::finalize_run(), Analyzer::finalize_run(), Iterator::finalize_run(), NonD::finalize_run(), Iterator::run(), and SeqHybridMetaIterator::run_sequential_adaptive().
void initialize_graphics ( int iterator_server_id = 1 ) [virtual]

initialize the 2D graphics window and the tabular graphics data

This is a convenience function for encapsulating graphics initialization operations. It is overridden by derived
classes that specialize the graphics display.

Reimplemented in NonDReliability, and SurrBasedMinimizer.

References Model::auto_graphics(), Graphics::create_plots_2d(), OutputManager::create_tabular_datastream(),
Model::current_response(), Model::current_variables(), OutputManager::graph2DFlag, OutputManager::graphics(),
Iterator::initialize_graphics(), Iterator::iterated_variables(), OutputManager::tabularFlag.

Referenced by CollabHybridMetaIterator::core_run(), EmbedHybridMetaIterator::core_run(), ConcurrentMeta-
Iterator::core_run(), Environment::execute(), Iterator::initialize_graphics(), SeqHybridMetaIterator::run_sequential(),
and SeqHybridMetaIterator::run_sequential_adaptive() .

void print_results ( std::ostream & s ) [virtual]

print the final iterator results

This virtual function provides additional iterator-specific final results outputs beyond the function evaluation
summary printed in finalize_run() .

Reimplemented in Analyzer, NonDLHSSampling, NonDDREAMBayesCalibration, NonDPOFDarts, NonD-
BayesCalibration, NonDLocalReliability, NonDWasABI_BayesCalibration, NonDQUESOBayesCalibration, Seq-
HybridMetaIterator, NonDAdaptiveSampling, ConcurrentMetaIterator, NonDGPImpSampling, Optimizer, Non-
DAlimitImpSampling, NonDExpansion, NonDInterval, NonDMultilevelSampling, PStudyDACE, LeastSq, Veri-

References Iterator::iteratorRep, and Iterator::print_results().

Referenced by MetaIterator::post_run(), Minimizer::post_run(), and Iterator::print_results().

unsigned short uses_method ( ) const [virtual]

return name of any enabling iterator used by this iterator

This is used to avoid clashes in state between non-object-oriented (i.e., F77, C) iterator executions, when such
iterators could potentially be executing simultaneously (e.g., nested execution). It is not an issue (and a used
method is not reported) in cases where a helper execution is completed before a lower level one could be initiated;
an example of this is DIRECT for maximization of expected improvement: the EIF maximization is completed
before a new point evaluation (which could include nested iteration) is performed.

Reimplemented in NonDLocalReliability, and NonDLocalInterval.

References Iterator::iteratorRep, and Iterator::uses_method().

Referenced by DOTOptimizer::initialize(), CONMINOptimizer::initialize(), NCSUOptimizer::initialize(), N-
LPQLP_Optimizer::initialize(), NonDLocalInterval::initialize(), NonDLocalInterval(), NonDLocalReliability::NonDLocalReliability(),
SOLBase::SOLBase(), and Iterator::uses_method().

void run ( )

orchestrate initialize/pre/core/post/finalize phases

Iterator supports a construct/initialize-run/pre-run/core-run/post-run/finalize-run/destruct progression. This
member (non-virtual) function sequences these run phases.

References ParallelLibrary::command_line_post_run(), ParallelLibrary::command_line_pre_run(), ParallelLibrary-
::command_line_run(), Iterator::core_run(), Iterator::execNum, Iterator::finalize_run(), ResultsID::increment_id(),
void assign_rep ( Iterator * iterator_rep, bool ref_count_incr = true )

replaces existing letter with a new one

Similar to the assignment operator, the assign_rep() function decrements referenceCount for the old iterator-Rep and assigns the new iteratorRep. It is different in that it is used for publishing derived class letters to existing envelopes, as opposed to sharing representations among multiple envelopes (in particular, assign_rep is passed a letter object and operator= is passed an envelope object). Letter assignment supports two models as governed by ref_count_incr:

- ref_count_incr = true (default): the incoming letter belongs to another envelope. In this case, increment the reference count in the normal manner so that deallocation of the letter is handled properly.
- ref_count_incr = false: the incoming letter is instantiated on the fly and has no envelope. This case is modeled after get_iterator(): a letter is dynamically allocated using new and passed into assign_rep, the letter’s reference count is not incremented, and the letter is not remotely deleted (its memory management is passed over to the envelope).

References Dakota::abort_handler(), Iterator::iterator_rep(), Iterator::iteratorRep, and Iterator::referenceCount.

References by NonDExpansion::construct_cubature(), NonDExpansion::construct_expansion_sampler(), NonDAdaptiveSampling::construct_fsu_sampler(), NonD::construct_lhs(), NonDExpansion::construct_quadrature(), NonDExpansion::construct_sparse_grid(), Minimizer::data_transform_model(), EffGlobalMinimizer::EffGlobalMinimizer(), ActiveSubspaceModel::init_fullspace_sampler(), NonDLocalInterval::method_recourse(), NonDLocalReliability::method_recourse(), NonDAdaptiveSampling::NonDAdaptiveSampling(), NonDBayesCalibration::NonDBayesCalibration(), NonDGPImpSampling::NonDGPImpSampling(), NonDGPMSABayesCalibration::NonDGPMSABayesCalibration(), NonDLHSInterval::NonDLHSInterval(), NonDLocalInterval::NonDLocalInterval(), NonDLocalReliability::NonDLocalReliability(), GaussProcApproximation::optimize_theta_global(), GaussProcApproximation::optimize_theta_multipoint(), and SurrBasedLocalMinimizer::relax_constraints().

void eval_tag_prefix ( const String & eval_id_str ) [virtual]

set the hierarchical eval ID tag prefix

This prepend may need to become a virtual function if the tagging should propagate to other subModels or helper Iterators an Iterator may contain.

References by NestedModel::derived_evaluate(), Iterator::eval_tag_prefix(), Iterator::init_communicators(), NestedModel::initialize_iterator(), and DataFitSurrModel::run_dace_iterator().

void gnewton_set_recast ( const Variables & recast_vars, const ActiveSet & recast_set, ActiveSet & sub_model_set ) [static], [protected]

conversion of request vector values for the Gauss-Newton Hessian approximation

For Gauss-Newton Hessian requests, activate the 2 bit and mask the 4 bit.

References by NonDBayesCalibration::NonDBayesCalibration(), and Optimizer::reduce_model().
**Iterator ∗ get_iterator ( ProblemDescDB & problem_db ) [private]**

Used by the envelope to instantiate the correct letter class.

Used only by the envelope constructor to initialize iteratorRep to the appropriate derived type, as given by the DB's method_name. Supports all iterators and meta-iterators. These instantiations will NOT recurse on the Iterator(problem_db) constructor due to the use of BaseConstructor.

References ProblemDescDB::get_model(), ProblemDescDB::get_ushort(), Iterator::method_enum_to_string(), Iterator::method_name(), and Dakota::SUBMETHOD_COLLABORATIVE.

Referenced by Iterator::Iterator().

**Iterator ∗ get_iterator ( ProblemDescDB & problem_db, Model & model ) [private]**

Used by the envelope to instantiate the correct letter class.

Used only by the envelope constructor to initialize iteratorRep to the appropriate derived type. Alternate construction of meta-iterators is supported to enable use of meta-iterators as components. These instantiations will NOT recurse on the Iterator(problem_db, model) constructor due to the use of BaseConstructor.

References ProblemDescDB::get_ushort(), Iterator::method_enum_to_string(), Iterator::method_name(), Iterator::probDescDB, and Dakota::SUBMETHOD_COLLABORATIVE.

**Iterator ∗ get_iterator ( const String & method_string, Model & model ) [private]**

Used by the envelope to instantiate the correct letter class.

Used only by the envelope constructor to initialize iteratorRep to the appropriate derived type, as given by the passed method_string. Lightweight instantiations by name are supported by a subset of Iterators (primarily Minimizers).

References Dakota::strbegins(), and Dakota::strends().

### 13.64.4 Member Data Documentation

ProblemDescDB & probDescDB [protected]

class member reference to the problem description database

Iterator and Model cannot use a shallow copy of ProblemDescDB due to circular destruction dependency (reference counts can’t get to 0, since ProblemDescDB contains {iterator, model} List.

Referenced by MetaIterator::allocate_by_name(), MetaIterator::allocate_by_pointer(), Analyzer::Analyzer(), MetaIterator::check_model(), COLINOptimizer::COLINOptimizer(), CollabHybridMetaIterator::CollabHybridMetaIterator(), Minimizer::data_transform_model(), SurrBasedMinimizer::derived_init_communicators(), CollabHybridMetaIterator::derived_init_communicators(), EmbedHybridMetaIterator::derived_init_communicators(), ConcurrentMetaIterator::derived_init_communicators(), SeqHybridMetaIterator::derived_init_communicators(), EffGlobalMinimizer::EffGlobalMinimizer(), MetaIterator::estimate_by_name(), MetaIterator::estimate_by_pointer(), CollabHybridMetaIterator::estimate_partition_bounds(), EmbedHybridMetaIterator::estimate_partition_bounds(), ConcurrentMetaIterator::estimate_partition_bounds(), SeqHybridMetaIterator::estimate_partition_bounds(), SeqHybridMetaIterator::estimate_partition_bounds(), FSUDesignCompExp::FSUDesignCompExp(), Iterator::get_iterator(), ConcurrentMetaIterator::initialize_model(), JEGAOptimizer::JEGAOptimizer(), MetaIterator::new_model(), NLSSOL::LeastSq::NLSSOL::LeastSq(), NomadOptimizer::NomadOptimizer(), NonD::NonD(), NonDAdaptImpSampling::NonDAdaptImpSampling(), NonDAdaptiveSampling::NonDAdaptiveSampling(), NonDBayesCalibration::NonDBayesCalibration(), NonDCalibration::NonDCalibration(), NonDInterval::NonDInterval(), NonDG::NonDG, NonDGGlobalReliability::NonDGGlobalReliability(), NonDGImpSampling::NonDGImpSampling(), NonDGP::NonDGP, NonDGPMSABayesCalibration::NonDGPMSABayesCalibration(), NonDInterval::NonDInterval(), NonDLocalInterval::NonDLocalInterval(), NonDLocalReliability::NonDLocalReliability(), NonDMultilevelSampling::NonDMultilevelSampling(), NonDPolynomialChaos::NonDPolynomialChaos(), NonDQuadrature::NonDQuadrature(), NonDSampling::NonDSampling(), NonDSparseGrid::NonDSparseGrid(), NonDStochCollocation-
int maxEvalConcurrency [protected]

maximum number of concurrent model evaluations

This is important for parallel configuration init/set/free and may be set within empty envelope instances. Therefore, it cannot be pushed down into Analyzer/Minimizer derived classes.

Referenced by DDACEDesignCompExp::DDACEDesignCompExp(), SurrBasedMinimizer::derived_free_communicators(), NonDGlobalReliability::derived_free_communicators(), NonDLocalInterval::derived_free_communicators(), NonDExpansion::derived_free_communicators(), NonDGPImpSampling::derived_free_communicators(), NonDLocalReliability::derived_free_communicators(), NonDPolynomialChaos::derived_free_communicators(), NonDBayesCalibration::derived_free_communicators(), NonDBayesCalibration::derived_init_communicators(), Iterator::derived_free_communicators(), NonDExpansion::derived_free_communicators(), NonDExpansion::derived_init_communicators(), NonDGlobalInterval::derived_free_communicators(), NonDExpansion::derived_init_communicators(), NonDGPImpSampling::derived_init_communicators(), NonDExpansion::derived_init_communicators(), NonDLocalReliability::derived_init_communicators(), NonDPolynomialChaos::derived_init_communicators(), NonDBayesCalibration::derived_init_communicators(), Iterator::derived_init_communicators(), SurrBasedMinimizer::derived_free_communicators(), SurrBasedMinimizer::derived_init_communicators(), NonDExpansion::derived_free_communicators(), NonDExpansion::derived_init_communicators(), NonDExpansion::derived_set_communicators(), NonDExpansion::derived_set_communicators(), NonDLocalReliability::derived_set_communicators(), NonDPolynomialChaos::derived_set_communicators(), NonDBayesCalibration::derived_set_communicators(), Iterator::derived_set_communicators(), NonD::derived_set_communicators(),-nonDExpansion::derived_set_communicators(), NonD::derived_set_communicators(), EffGlobalMinimizer::EffGlobalMinimizer(), Iterator::maximum_concurrency(), Iterator::update_from_model().

The documentation for this class was generated from the following files:

- DakotaIterator.hpp
- DakotaIterator.cpp

### 13.65  IteratorScheduler Class Reference

This class encapsulates scheduling operations for concurrent sub-iteration within an outer level context (e.g., meta-iteration, nested models).
CHAPTER 13. CLASS DOCUMENTATION

Public Member Functions

- **IteratorScheduler** (ParallelLibrary &parallel_lib, bool peer_assign_jobs, int num_servers=0, int procs_per_iterator=0, short scheduling=DEFAULT_SCHEDULING)
  
  constructor

- ~IteratorScheduler ()
  
  destructor

- void construct_sub_iterator (ProblemDescDB &problem_db, Iterator &sub_iterator, Model &sub_model, const String &method_ptr, const String &method_name, const String &model_ptr)
  
  instantiate sub_iterator on the current rank if not already constructed

- IntIntPair configure (ProblemDescDB &problem_db, Iterator &sub_iterator, Model &sub_model)
  
  performs sufficient initialization to define partitioning controls (min and max processors per iterator server)

- IntIntPair configure (ProblemDescDB &problem_db, const String &method_string, Iterator &sub_iterator, Model &sub_model)
  
  performs sufficient initialization to define partitioning controls (min and max processors per iterator server)

- IntIntPair configure (ProblemDescDB &problem_db, Iterator &sub_iterator)
  
  performs sufficient initialization to define partitioning controls (min and max processors per iterator server)

- void partition (int max_iterator_concurrency, IntIntPair &ppi_pr)
  
  convenience function for initializing iterator communicators, setting parallel configuration attributes, and managing outputs and restart.

- void init_iterator (ProblemDescDB &problem_db, Iterator &sub_iterator, Model &sub_model)
  
  invokes static version of this function with appropriate parallelism level

- void init_iterator (ProblemDescDB &problem_db, const String &method_string, Iterator &sub_iterator, Model &sub_model)
  
  invokes static version of this function with appropriate parallelism level

- void set_iterator (Iterator &sub_iterator)
  
  invokes static version of this function with appropriate parallelism level

- void run_iterator (Iterator &sub_iterator)
  
  invokes static version of this function with appropriate parallelism level

- void free_iterator (Iterator &sub_iterator)
  
  invokes static version of this function with appropriate parallelism level

- void free_iterator_parallelism ()
  
  convenience function for deallocating the concurrent iterator parallelism level

- template<typename MetaType>
  
  void schedule_iterators (MetaType &meta_object, Iterator &sub_iterator)
  
  short convenience function for distributing control among master_dynamic_schedule_iterators(), serve_iterators(), and peer_static_schedule_iterators()

- template<typename MetaType>
  
  void master_dynamic_schedule_iterators (MetaType &meta_object)
  
  executed by the scheduler master to manage a dynamic schedule of iterator jobs among slave iterator servers

- void stop_iterator_servers ()
  
  executed by the scheduler master to terminate slave iterator servers

- template<typename MetaType>
  
  void serve_iterators (MetaType &meta_object, Iterator &sub_iterator)
  
  executed on the slave iterator servers to perform iterator jobs assigned by the scheduler master
### Static Public Member Functions

- **static void init_iterator (ProblemDescDB &problem_db, Iterator &sub_iterator, ParLevLIter pl_iter)**  
  convenience function for allocation of an iterator and (parallel) initialization of its comms
- **static void init_iterator (ProblemDescDB &problem_db, Model &sub_model, ParLevLIter pl_iter)**  
  convenience function for lightweight allocation of an iterator and (parallel) initialization of its comms
- **static void set_iterator (Iterator &sub_iterator, ParLevLIter pl_iter)**  
  convenience function for setting comms prior to running an iterator
- **static void run_iterator (Iterator &sub_iterator, ParLevLIter pl_iter)**  
  Convenience function for invoking an iterator and managing parallelism. This version omits communicator repartitioning. Function must be public due to use by MINLPNode.
- **static void free_iterator (Iterator &sub_iterator, ParLevLIter pl_iter)**  
  convenience function for deallocating comms after running an iterator

### Public Attributes

- **ParallelLibrary & parallelLib**  
  reference to the ParallelLibrary instance
- **int numIteratorJobs**  
  number of iterator executions to schedule
- **int numIteratorServers**  
  number of concurrent iterator partitions
- **int procsPerIterator**  
  partition size request
- **int iteratorCommRank**  
  processor rank in iteratorComm
• int iteratorCommSize
  number of processors in iteratorComm
• int iteratorServerId
  identifier for an iterator server
• bool messagePass
  flag for message passing among iterator servers
• short iteratorScheduling
  \{DEFAULT,MASTER,PEER\} SCHEDULING
• bool peerAssignJobs
  flag indicating need for peer 1 to assign jobs
  < to peers 2-n
• ParConfigLLIter schedPCIter
  iterator for active parallel configuration
• size_t miPLIndex
  index of active parallel level (corresponding
  < to ParallelConfiguration::miPLIters) to use < for parallelLib send/recv

Private Attributes
• int paramsMsgLen
  length of MPI buffer for parameter input instance(s)
• int resultsMsgLen
  length of MPI buffer for results output instance(s)

13.65.1 Detailed Description
This class encapsulates scheduling operations for concurrent sub-iteration within an outer level context (e.g.,
meta-iteration, nested models).
  In time, a Scheduler class hierarchy is envisioned, but for now, this class is not part of a hierarchy.

13.65.2 Constructor & Destructor Documentation
IteratorScheduler ( ParallelLibrary & parallelLib, bool peer_assign_jobs, int num_servers = 0, int
procs_per_iterator = 0, short scheduling = DEFAULT_SCHEDULING )
constructor
  Current constructor parameters are the input specification components, which are requests subject to override
by ParallelLibrary::init_iterator_communicators().

13.65.3 Member Function Documentation
void init_iterator ( ProblemDescDB & problem_db, Iterator & sub_iterator, ParLevLLIter pl_iter )
[static]
convenience function for allocation of an iterator and (parallel) initialization of its comms
  This is a convenience function for encapsulating the allocation of communicators prior to running an iterator.
References ProblemDescDB::get_iterator(), ProblemDescDB::get_model(), ProblemDescDB::get_ushort(), Model::init_comms_bcast_flag(), Iterator::init_communicators(), Iterator::is_null(), Model::is_null(), Iterator::iterated_model(), Iterator::maximum_evaluation_concurrency(), Iterator::method_name(), Model::serve_init_communicators(), and Model::stop_init_communicators().

Referenced by MetaIterator::allocate_by_name(), MetaIterator::allocate_by_pointer(), Environment::construct(), ConcurrentMetaIterator::derived_init_communicators(), NestedModel::derived_init_communicators(), and IteratorScheduler::init_iterator().

```c
void init_iterator ( ProblemDescDB & problem_db, Iterator & sub_iterator, Model & sub_model, ParLevLIter pl_iter ) [static]
```

convenience function for allocation of an iterator and (parallel) initialization of its comms

This is a convenience function for encapsulating the allocation of communicators prior to running an iterator.

References ProblemDescDB::get_iterator(), ProblemDescDB::get_ushort(), Model::init_comms_bcast_flag(), Iterator::init_communicators(), Iterator::is_null(), Iterator::iterated_model(), Iterator::maximum_evaluation_concurrency(), Iterator::method_name(), Model::serve_init_communicators(), and Model::stop_init_communicators().

```c
void init_iterator ( ProblemDescDB & problem_db, const String & method_string, Iterator & sub_iterator, Model & sub_model, ParLevLIter pl_iter ) [static]
```

convenience function for lightweight allocation of an iterator and (parallel) initialization of its comms

This is a convenience function for encapsulating the allocation of communicators prior to running an iterator.

References ProblemDescDB::get_iterator(), Model::init_comms_bcast_flag(), Iterator::init_communicators(), Iterator::is_null(), Iterator::iterated_model(), Iterator::maximum_evaluation_concurrency(), Iterator::method_string(), Model::serve_init_communicators(), and Model::stop_init_communicators().

```c
void set_iterator ( Iterator & sub_iterator, ParLevLIter pl_iter ) [static]
```

convenience function for setting comms prior to running an iterator

This is a convenience function for encapsulating the deallocation of communicators after running an iterator.

References Iterator::derived_set_communicators(), and Iterator::set_communicators().

Referenced by CollabHybridMetaIterator::derived_set_communicators(), EmbedHybridMetaIterator::derived_set_communicators(), ConcurrentMetaIterator::derived_set_communicators(), SeqHybridMetaIterator::derived_set_communicators(), NestedModel::derived_set_communicators(), and IteratorScheduler::set_iterator().

```c
void run_iterator ( Iterator & sub_iterator, ParLevLIter pl_iter ) [static]
```

Convenience function for invoking an iterator and managing parallelism. This version omits communicator repartitioning. Function must be public due to use by MINLPNode.

This is a convenience function for encapsulating the parallel features (run/serve) of running an iterator. This function omits allocation/deallocation of communicators to provide greater efficiency in approaches that involve multiple iterator executions but only require communicator allocation/deallocation to be performed once.

References Model::finalize_mapping(), Model::initialize_mapping(), Iterator::iterated_model(), Iterator::maximum_evaluation_concurrency(), Iterator::method_name(), Iterator::resize(), Iterator::resize_communicators(), Iterator::run(), Model::serve_finalize_mapping(), Model::serve_init_mapping(), Model::serve_run(), Model::stop_finalize_mapping(), Model::stop_init_mapping(), and Model::stop_servers().

Referenced by NestedModel::derived_evaluate(), Environment::execute(), IteratorScheduler::peer_static_schedule_iterators(), IteratorScheduler::run_iterator(), and IteratorScheduler::serve_iterators().
**CHAPTER 13. CLASS DOCUMENTATION**

```cpp
void free_iterator ( Iterator & sub_iterator, ParLevIter pl_iter ) [static]
```

convenience function for deallocating comms after running an iterator

This is a convenience function for encapsulating the deallocation of communicators after running an iterator.

References Iterator::derived_free_communicators(), Iterator::free_communicators(), and Iterator::method_name().

Referenced by CollabHybridMetaIterator::derived_free_communicators(), EmbedHybridMetaIterator::derived_free_communicators(), ConcurrentMetaIterator::derived_free_communicators(), SeqHybridMetaIterator::derived_free_communicators(), NestedModel::derived_free_communicators(), Environment::destruct(), and IteratorScheduler::free_iterator().

```cpp
IntIntPair configure ( ProblemDescDB & problem_db, Iterator & sub_iterator, Model & sub_model )
```

performs sufficient initialization to define partitioning controls (min and max processors per iterator server)

This is a convenience function for computing the minimum and maximum partition size prior to concurrent iterator partitioning.

References ProblemDescDB::get_iterator(), IteratorScheduler::schedPCIter, and ParallelLevel::server_communicator_rank().

Referenced by IteratorScheduler::configure(), ConcurrentMetaIterator::derived_init_communicators(), NestedModel::derived_init_communicators(), MetaIterator::estimate_by_name(), and MetaIterator::estimate_by_pointer().

```cpp
IntIntPair configure ( ProblemDescDB & problem_db, const String & method_string, Iterator & sub_iterator, Model & sub_model )
```

performs sufficient initialization to define partitioning controls (min and max processors per iterator server)

This is a convenience function for computing the minimum and maximum partition size prior to concurrent iterator partitioning.

References IteratorScheduler::configure(), ProblemDescDB::get_iterator(), IteratorScheduler::schedPCIter, and ParallelLevel::server_communicator_rank().

```cpp
IntIntPair configure ( ProblemDescDB & problem_db, Iterator & sub_iterator )
```

performs sufficient initialization to define partitioning controls (min and max processors per iterator server)

This is a convenience function for computing the minimum and maximum partition size prior to concurrent iterator partitioning.

References ParallelLibrary::bcast(), Iterator::estimate_partition_bounds(), ProblemDescDB::get_db_method_node(), ProblemDescDB::get_db_model_node(), IteratorScheduler::parallelLib, IteratorScheduler::schedPCIter, ParallelLevel::server_communicator_rank(), ParallelLevel::server_communicator_size(), ProblemDescDB::set_db_method_node(), ProblemDescDB::set_db_model_nodes(), and MPIPackBuffer::size().

```cpp
void partition ( int max_iterator_concurrency, IntIntPair & ppi )
```

convenience function for initializing iterator communicators, setting parallel configuration attributes, and managing outputs and restart.

Called from derived class constructors once maxIteratorConcurrency is defined but prior to instantiating Iterators and Models.

References ParallelLibrary::init_iterator_communicators(), IteratorScheduler::iteratorScheduling, IteratorScheduler::numIteratorServers, ParallelLibrary::parallel_configuration_iterator(), IteratorScheduler::parallelLib, IteratorScheduler::procsPerIterator, ParallelLibrary::push_output_tag(), and IteratorScheduler::update().

Referenced by CollabHybridMetaIterator::derived_init_communicators(), EmbedHybridMetaIterator::derived_init_communicators(), ConcurrentMetaIterator::derived_init_communicators(), SeqHybridMetaIterator::derived_init_communicators(), and NestedModel::derived_init_communicators().
void schedule_iterators ( MetaType & meta_object, Iterator & sub_iterator )

short convenience function for distributing control among master_dynamic_schedule_iterators(), serve_iterators(), and peer_static_schedule_iterators()

This implementation supports the scheduling of multiple jobs using a single iterator/model pair. Additional future (overloaded) implementations could involve independent iterator instances.

References IteratorScheduler::iteratorScheduling, IteratorScheduler::iteratorServerId, IteratorScheduler::lead_rank(), IteratorScheduler::master_dynamic_schedule_iterators(), IteratorScheduler::numIteratorServers, ParallelLibrary::parallel_configuration_iterator(), IteratorScheduler::parallelLib, IteratorScheduler::peer_static_schedule_iterators(), IteratorScheduler::serve_iterators(), and IteratorScheduler::stop_iterator_servers().

Referenced by CollabHybridMetaIterator::core_run(), EmbedHybridMetaIterator::core_run(), ConcurrentMetaIterator::core_run(), NestedModel::derived_synchronize(), SeqHybridMetaIterator::run_sequential(), and NestedModel::serve_run().

void master_dynamic_schedule_iterators ( MetaType & meta_object )

executed by the scheduler master to manage a dynamic schedule of iterator jobs among slave iterator servers

This function is adapted from ApplicationInterface::master_dynamic_schedule_evaluations().

References ParallelLibrary::free(), ParallelLibrary::irecv_mi(), ParallelLibrary::isend_mi(), IteratorScheduler::miPLIndex, IteratorScheduler::numIteratorJobs, IteratorScheduler::numIteratorServers, IteratorScheduler::parallelLib, MPIPackBuffer::reset(), MPIUnpackBuffer::resize(), IteratorScheduler::resultsMsgLen, ParallelLibrary::waitall(), and ParallelLibrary::waitsome().

Referenced by IteratorScheduler::schedule_iterators().

void serve_iterators ( MetaType & meta_object, Iterator & sub_iterator )

executed on the slave iterator servers to perform iterator jobs assigned by the scheduler master

This function is similar in structure to ApplicationInterface::serve_evaluations_synch().

References ParallelLibrary::bcast_i(), IteratorScheduler::iteratorCommRank, IteratorScheduler::iteratorCommSize, IteratorScheduler::miPLIndex, ParallelLibrary::parallel_time(), IteratorScheduler::parallelLib, IteratorScheduler::paramsMsgLen, ParallelLibrary::recv_mi(), IteratorScheduler::resultsMsgLen, IteratorScheduler::run_iterator(), and ParallelLibrary::send_mi().

Referenced by IteratorScheduler::schedule_iterators().

The documentation for this class was generated from the following files:

- IteratorScheduler.hpp
- IteratorScheduler.cpp

13.66  JEGAOptimizer Class Reference

A version of Dakota::Optimizer for instantiation of John Eddy’s Genetic Algorithms (JEGA).

Inheritance diagram for JEGAOptimizer:
Classes

- class **Driver**
  
  A subclass of the JEGA front end driver that exposes the individual protected methods to execute the algorithm.

- class **Evaluator**
  
  An evaluator specialization that knows how to interact with Dakota.

- class **EvaluatorCreator**
  
  A specialization of the JEGA::FrontEnd::EvaluatorCreator that creates a new instance of a Evaluator.

Public Member Functions

- virtual void **core_run** ()
  
  Performs the iterations to determine the optimal set of solutions.

- virtual bool **accepts_multiple_points** () const
  
  Overridden to return true since JEGA algorithms can accept multiple initial points.

- virtual bool **returns_multiple_points** () const
  
  Overridden to return true since JEGA algorithms can return multiple final points.

- virtual void **initial_points** (const VariablesArray &pts)
  
  Overridden to assign the _initPts member variable to the passed in collection of Dakota::Variables.

- virtual const VariablesArray & **initial_points** () const
  
  Overridden to return the collection of initial points for the JEGA algorithm created and run by this JEGAOptimizer.

- **JEGAOptimizer** (ProblemDescDB &problem_db, Model &model)

  Constructs a JEGAOptimizer class object.

- **~JEGAOptimizer** ()

  Destructs a JEGAOptimizer.

Protected Member Functions

- void **LoadDakotaResponses** (const JEGA::Utilities::Design &from, Variables &vars, Response &resp) const

  Loads the JEGA-style Design class into equivalent Dakota-style Variables and Response objects.

- void **ReCreateTheParameterDatabase** ()

  Destroys the current parameter database and creates a new empty one.

- void **LoadTheParameterDatabase** ()

  Reads information out of the known Dakota::ProblemDescDB and puts it into the current parameter database.
13.66. JEGAOPTIMIZER CLASS REFERENCE

- void LoadAlgorithmConfig (JEGA::FrontEnd::AlgorithmConfig &aConfig)
  
  Completely initializes the supplied algorithm configuration.
- void LoadProblemConfig (JEGA::FrontEnd::ProblemConfig &pConfig)
  
  Completely initializes the supplied problem configuration.
- void LoadTheDesignVariables (JEGA::FrontEnd::ProblemConfig &pConfig)
  
  Adds DesignVariableInfo objects into the problem configuration object.
- void LoadTheObjectiveFunctions (JEGA::FrontEnd::ProblemConfig &pConfig)
  
  Adds ObjectiveFunctionInfo objects into the problem configuration object.
- void LoadTheConstraints (JEGA::FrontEnd::ProblemConfig &pConfig)
  
  Adds ConstraintInfo objects into the problem configuration object.
- void GetBestSolutions (const JEGA::Utilities::DesignOFSortSet &from, const JEGA::Algorithms::GeneticAlgorithm &theGA, std::multimap<RealRealPair, JEGA::Utilities::Design *> &designSortMap)
  
  Returns up to _numBest designs sorted by DAKOTA’s fitness (L2 constraint violation, then utopia or objective), taking into account the algorithm type. The front of the returned map can be viewed as a single "best".
- void GetBestMOSolutions (const JEGA::Utilities::DesignOFSortSet &from, const JEGA::Algorithms::GeneticAlgorithm &theGA, std::multimap<RealRealPair, JEGA::Utilities::Design *> &designSortMap)
  
  Retreive the best Designs from a set of solutions assuming that they are generated by a multi objective algorithm.
- void GetBestSOSolutions (const JEGA::Utilities::DesignOFSortSet &from, const JEGA::Algorithms::GeneticAlgorithm &theGA, std::multimap<RealRealPair, JEGA::Utilities::Design *> &designSortMap)
  
  Retreive the best Designs from a set of solutions assuming that they are generated by a single objective algorithm.
- JEGA::DoubleMatrix ToDoubleMatrix (const VariablesArray &variables) const
  
  Converts the items in a VariablesArray into a DoubleMatrix whereby the items in the matrix are the design variables.

Private Attributes

- EvaluatorCreator * _theEvalCreator
  
  A pointer to an EvaluatorCreator used to create the evaluator used by JEGA in Dakota (a JEGAEvaluator).
- JEGA::Utilities::ParameterDatabase * _theParamDB
  
  A pointer to the ParameterDatabase from which all parameters are retrieved by the created algorithms.
- VariablesArray _initPts
  
  An array of initial points to use as an initial population.

Additional Inherited Members

13.66.1 Detailed Description

A version of Dakota::Optimizer for instantiation of John Eddy’s Genetic Algorithms (JEGA).

This class encapsulates the necessary functionality for creating and properly initializing the JEGA algorithms (MOGA and SOGA).

13.66.2 Constructor & Destructor Documentation

JEGAOptimizer ( ProblemDescDB & problem_db, Model & model )

Constructs a JEGAOptimizer class object.

This method does some of the initialization work for the algorithm. In particular, it initialized the JEGA core.
Parameters

<table>
<thead>
<tr>
<th>problem_db</th>
<th>The Dakota::ProblemDescDB with information on how the algorithm controls should be set.</th>
</tr>
</thead>
<tbody>
<tr>
<td>model</td>
<td>The Dakota::Model that will be used by this optimizer for problem information, etc.</td>
</tr>
</tbody>
</table>

References JEGAOptimizer::theEvalCreator, ProblemDescDB::get_int(), ProblemDescDB::get_short(), Iterator::iteratedModel, JEGAOptimizer::LoadTheParameterDatabase(), Iterator::maxEvalConcurrency, Iterator::methodName, Iterator::numFinalSolutions, and Iterator::probDescDB.

13.66.3 Member Function Documentation

void LoadDakotaResponses ( const JEGA::Utilities::Design & from, Dakota::Variables & vars, Dakota::Response & resp ) const [protected]

Loads the JEGA-style Design class into equivalent Dakota-style Variables and Response objects.
This version is meant for the case where a Variables and a Response object exist and just need to be loaded.
Parameters

<table>
<thead>
<tr>
<th>from</th>
<th>The JEGA Design class object from which to extract the variable and response information for Dakota.</th>
</tr>
</thead>
<tbody>
<tr>
<td>vars</td>
<td>The Dakota::Variables object into which to load the design variable values of from.</td>
</tr>
<tr>
<td>resp</td>
<td>The Dakota::Response object into which to load the objective function and constraint values of from.</td>
</tr>
</tbody>
</table>

References Variables::continuous_variables(), Variables::discrete_int_variables(), Variables::discrete_real_variables(), Variables::discrete_string_variable(), Response::function_values(), and Dakota::set_index_to_value().

void LoadTheParameterDatabase ( ) [protected]

Reads information out of the known Dakota::ProblemDescDB and puts it into the current parameter database.
This should be called from the JEGAOptimizer constructor since it is the only time when the problem description database is certain to be configured to supply data for this optimizer.
Referenced by JEGAOptimizer::JEGAOptimizer().

void LoadAlgorithmConfig ( JEGA::FrontEnd::AlgorithmConfig & aConfig ) [protected]

Completely initializes the supplied algorithm configuration.
This loads the supplied configuration object with appropriate data retrieved from the parameter database.
Parameters

| aConfig | The algorithm configuration object to load. |

void LoadProblemConfig ( JEGA::FrontEnd::ProblemConfig & pConfig ) [protected]

Completely initializes the supplied problem configuration.
This loads the fresh configuration object using the LoadTheDesignVariables, LoadTheObjectiveFunctions, and LoadTheConstraints methods.
13.66. JEGA OPTIMIZER CLASS REFERENCE

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pConfig</td>
<td>The problem configuration object to load.</td>
</tr>
</tbody>
</table>

void LoadTheDesignVariables ( JEGA::FrontEnd::ProblemConfig & pConfig ) [protected]

Adds DesignVariableInfo objects into the problem configuration object.
This retrieves design variable information from the ParameterDatabase and creates DesignVariableInfo’s from it.
Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pConfig</td>
<td>The problem configuration object to load.</td>
</tr>
</tbody>
</table>

References Model::continuous_lower_bounds().

void LoadTheObjectiveFunctions ( JEGA::FrontEnd::ProblemConfig & pConfig ) [protected]

Adds ObjectiveFunctionInfo objects into the problem configuration object.
This retrieves objective function information from the ParameterDatabase and creates ObjectiveFunctionInfo’s from it.
Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pConfig</td>
<td>The problem configuration object to load.</td>
</tr>
</tbody>
</table>

References Dakota::asstring(), Dakota::copy_row_vector(), and Model::nonlinear_ineq_constraint_lower_bounds().

void LoadTheConstraints ( JEGA::FrontEnd::ProblemConfig & pConfig ) [protected]

Adds ConstraintInfo objects into the problem configuration object.
This retrieves constraint function information from the ParameterDatabase and creates ConstraintInfo’s from it.
Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pConfig</td>
<td>The problem configuration object to load.</td>
</tr>
</tbody>
</table>

References Dakota::asstring(), Dakota::copy_row_vector(), and Model::nonlinear_ineq_constraint_lower_bounds().

void GetBestSolutions ( const JEGA::Utilities::DesignOFSortSet & from, const JEGA::Algorithms::GeneticAlgorithm & theGA, std::multimap< RealRealPair, JEGA::Utilities::Design * > & designSortMap ) [protected]

Returns up to numBest designs sorted by DAKOTA’s fitness (L2 constraint violation, then utopia or objective), taking into account the algorithm type. The front of the returned map can be viewed as a single “best”.
Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>from</td>
<td>The full set of designs returned by the solver.</td>
</tr>
<tr>
<td>theGA</td>
<td>The GA used to generate this set; needed for its weights in the SO case, provided to both for consistency</td>
</tr>
</tbody>
</table>
**designSortMap**  Map of best solutions with key pair<constraintViolation, fitness>
eventually this functionality must be moved into a separate post-processing application for MO datasets.

```cpp
void GetBestMOSolutions ( const JEGA::Utilities::DesignOFSortSet & from, const JEGA::Algorithms::GeneticAlgorithm & theGA, std::multimap<RealRealPair, JEGA::Utilities::Design *> & designSortMap ) [protected]
```
Retrive the best Designs from a set of solutions assuming that they are generated by a multi objective algorithm. eventually this functionality must be moved into a separate post-processing application for MO datasets.

```cpp
void GetBestSOSolutions ( const JEGA::Utilities::DesignOFSortSet & from, const JEGA::Algorithms::GeneticAlgorithm & theGA, std::multimap<RealRealPair, JEGA::Utilities::Design *> & designSortMap ) [protected]
```
Retrive the best Designs from a set of solutions assuming that they are generated by a single objective algorithm. eventually this functionality must be moved into a separate post-processing application for MO datasets.

References Dakota::abort(handler()).

```cpp
JEGA::DoubleMatrix ToDoubleMatrix ( const VariablesArray & variables ) const [protected]
```
Converts the items in a VariablesArray into a DoubleMatrix whereby the items in the matrix are the design variables.
The matrix will not contain responses but when being used by Dakota, this doesn’t matter. JEGA will attempt to re-evaluate these points but Dakota will recognize that they do not require re-evaluation and thus it will be a cheap operation.
Parameters

| variables | The array of DakotaVariables objects to use as the contents of the returned matrix. |

Returns

The matrix created using the supplied VariablesArray.

```cpp
void core_run ( ) [virtual]
```
Performs the iterations to determine the optimal set of solutions.
Override of pure virtual method in Optimizer base class.
The extraction of parameter values actually occurs in this method when the JEGA::FrontEnd::Driver::ExecuteAlgorithm is called. Also the loading of the problem and algorithm configurations occurs in this method. That way, if it is called more than once and the algorithm or problem has changed, it will be accounted for.
Reimplemented from Iterator.
References JEGAOptimizer::Driver::DestroyAlgorithm(), JEGAOptimizer::Driver::ExtractAllData(), and JEGAOptimizer::Driver::PerformnIterations().

```cpp
bool accepts_multiple_points ( ) const [virtual]
```
Overridden to return true since JEGA algorithms can accept multiple initial points.
Returns

true, always.
Reimplemented from Iterator.
bool returns_multiple_points() const [virtual]
Overridden to return true since JEGA algorithms can return multiple final points.

Returns
true, always.

Reimplemented from Iterator.

void initial_points(const VariablesArray & pts) [virtual]
Overridden to assign the _initPts member variable to the passed in collection of Dakota::Variables.

Parameters

| pts | The array of initial points for the JEGA algorithm created and run by this JEGAOptimizer. |

Reimplemented from Iterator.

const VariablesArray & initial_points() const [virtual]
Overridden to return the collection of initial points for the JEGA algorithm created and run by this JEGAOptimizer.

Returns
The collection of initial points for the JEGA algorithm created and run by this JEGAOptimizer.

Reimplemented from Iterator.

13.66.4 Member Data Documentation

VariablesArray _initPts [private]
An array of initial points to use as an initial population.

This member is here to help support the use of JEGA algorithms in Dakota strategies. If this array is populated, then whatever initializer is specified will be ignored and the DoubleMatrix initializer will be used instead on a matrix created from the data in this array.

The documentation for this class was generated from the following files:

- JEGAOptimizer.hpp
- JEGAOptimizer.cpp

13.67 LabelsWriter Class Reference

Utility used in derived write_core to write labels in tabular format.

Public Member Functions

- template<
typeName ArrayType >
  void operator() (std::ostream &s, size_t start_index, size_t num_items, const ArrayType &array_data, StringMultiArrayConstView label_array)
13.67.1 Detailed Description
Utility used in derived write_core to write labels in tabular format.

13.67.2 Member Function Documentation
void operator() ( std::ostream & s, size_t start_index, size_t num_items, const ArrayType & array_data, StringMultiArrayConstView label_array ) [inline]
The tabular labels writer only forwards the label arrays
The documentation for this class was generated from the following file:
• DakotaVariables.hpp

13.68 LeastSq Class Reference
Base class for the nonlinear least squares branch of the iterator hierarchy.
Inheritance diagram for LeastSq:

Protected Member Functions
• LeastSq ()
  default constructor
• LeastSq (ProblemDescDB &problem_db, Model &model)
  standard constructor
• LeastSq (unsigned short method_name, Model &model)
  alternate "on the fly" constructor
• ~LeastSq ()
  destructor
• void initialize_run ()
• void post_run (std::ostream &s)
• void finalize_run ()
  utility function to perform common operations following post_run(); deallocation and resetting of instance pointers
• void print_results (std::ostream &s)
• void get_confidence_intervals ()
  Calculate confidence intervals on estimated parameters.
Protected Attributes

- size_t numLeastSqTerms
  number of least squares terms
- LeastSq * prevLSqInstance
  pointer containing previous value of leastSqInstance
- bool weightFlag
  flag indicating whether weighted least squares is active
- RealVector confBoundsLower
  lower bounds for confidence intervals on calibration parameters
- RealVector confBoundsUpper
  upper bounds for confidence intervals on calibration parameters

Static Protected Attributes

- static LeastSq * leastSqInstance
  pointer to LeastSq instance used in static member functions

Private Member Functions

- void weight_model ()
  Wrap iteratedModel in a RecastModel that weights the residuals.

Static Private Member Functions

- static void primary_resp_weighter (const Variables &unweighted_vars, const Variables &weighted_vars,
  const Response &unweighted_response, Response &weighted_response)
  Recast callback function to weight least squares residuals, gradients, and Hessians.

Additional Inherited Members

13.68.1 Detailed Description

Base class for the nonlinear least squares branch of the iterator hierarchy.

The LeastSq class provides common data and functionality for least squares solvers (including NL2OL, NLSSOLLeastSq, and SNLLLeastSq).

13.68.2 Constructor & Destructor Documentation

LeastSq ( ProblemDescDB & problem_db, Model & model ) [protected]

standard constructor

This constructor extracts the inherited data for the least squares branch and performs sanity checking on gradient and constraint settings.

References Dakota::abort_handler(), Iterator::bestVariablesArray, Minimizer::calibrationDataFlag, Variables::copy(), Model::current_variables(), Minimizer::data_transform_model(), Iterator::iteratedModel, Iterator::methodName, LeastSq::numLeastSqTerms, Minimizer::numTotalCalibTerms, Minimizer::optimizationFlag, Model::primary_fn_type(), Minimizer::scale_model(), Minimizer::scaleFlag, LeastSq::weight_model(), and LeastSq::weightFlag.
13.68.3 Member Function Documentation

void initialize_run( ) [protected], [virtual]

This function should be invoked (or reimplemented) by any derived implementations of initialize_run() (which would otherwise hide it).

Reimplemented from Iterator.
Reimplemented in SNLLLeastSq.
References Minimizer::initialize_run(), Iterator::iteratedModel, LeastSq::leastSqInstance, Iterator::myModelLayers, LeastSq::prevLSqInstance, and Model::update_from_subordinate_model().
Referenced by SNLLLeastSq::initialize_run().

void post_run ( std::ostream & s ) [protected], [virtual]

Implements portions of post_run specific to LeastSq for scaling back to native variables and functions. This function should be invoked (or reimplemented) by any derived implementations of post_run() (which would otherwise hide it). transform variables back to inbound model, before any potential lookup

Reimplemented from Iterator.
Reimplemented in SNLLLeastSq.
References Dakota::abort_handler(), Iterator::bestResponseArray, Iterator::bestVariablesArray, Minimizer::calibrationDataFlag, Variables::continuous_variables(), ScalingModel::cv_scaled2native(), Minimizer::expData, Response::function_value(), Response::function_values(), Response::function_values_view(), LeastSq::get_confidence_intervals(), ExperimentData::interpolate_flag(), Iterator::iteratedModel, Minimizer::local_recast_retrieve(), Model::model_rep(), LeastSq::numLeastSqTerms, Minimizer::numUserPrimaryFns, Minimizer::post_run(), Model::primary_response_fn_weights(), ExperimentData::recover_model(), ScalingModel::resp_scaled2native(), Minimizer::scaleFlag, Minimizer::scalingModel, Model::subordinate_model(), and LeastSq::weightFlag.

void finalize_run( ) [inline], [protected], [virtual]

utility function to perform common operations following post_run(): deallocation and resetting of instance pointers

Optional: perform finalization phases of run sequence, like deallocating memory and resetting instance pointers. Commonly used in sub-iterator executions. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s finalize_run(), typically after performing its own implementation steps.

Reimplemented from Iterator.
Reimplemented in SNLLLeastSq.
References Minimizer::finalize_run(), LeastSq::leastSqInstance, and LeastSq::prevLSqInstance.
Referenced by SNLLLeastSq::finalize_run().

void print_results ( std::ostream & s ) [protected], [virtual]

Redefines default iterator results printing to include nonlinear least squares results (residual terms and constraints).
Reimplemented from Iterator.
References Iterator::activeSet, Minimizer::archive_allocate_best(), Minimizer::archive_best(), Iterator::bestResponseArray, Iterator::bestVariablesArray, Minimizer::calibrationDataFlag, LeastSq::confBoundsLower, LeastSq::confBoundsUpper, Model::continuous_variable_labels(), Response::copy(), Model::current_response(), Dakota::data_pairs, DataTransformModel::data_transform_response(), Minimizer::dataTransformModel, Model::interface_id(), Iterator::iteratedModel, Dakota::lookup_by_val(), Model::model_rep(), Model::num_functions(), Minimizer::numContinuousVars, Minimizer::numNonlinearConstraints, Minimizer::numTotalCalibTerms, Minimizer::numUserPrimaryFns, Minimizer::original_model(), Model::primary_response_fn_weights(), Minimizer::print_model_res(), Minimizer::print_residuals(), ActiveSet::request_values(), Model::subordinate_model(), and Dakota::write_precision.
void get_confidence_intervals() [protected]

Calculate confidence intervals on estimated parameters.

Calculate individual confidence intervals for each parameter. These bounds are based on a linear approximation of the nonlinear model.

References Iterator::activeSet, Iterator::bestResponseArray, Iterator::bestVariablesArray, Minimizer::calibrationDataFlag, LeastSq::confBoundsLower, LeastSq::confBoundsUpper, Model::continuous_variables(), Response::copy(), Model::current_response(), DataTransformModel::data_transform_response(), Minimizer::dataTransformModel, Model::evaluate(), Response::function_gradients(), Iterator::iteratedModel, Model::model_rep(), Minimizer::numContinuousVars, LeastSq::numLeastSqTerms, ActiveSet::request_values(), Minimizer::scaleFlag, and Minimizer::vendorNumericalGradFlag.

Referenced by LeastSq::post_run(), and SNLLLeastSq::post_run().

void weight_model() [private]

Wrap iteratedModel in a RecastModel that weights the residuals.

Setup Recast for weighting model. The weighting transformation doesn’t resize, so use numUserPrimaryFns. No vars, active set or secondary mapping. All indices are one-to-one mapped (no change in counts).

References Model::assign_rep(), Model::current_response(), Response::function_gradients(), Response::hessians(), Iterator::iteratedModel, Iterator::myModelLayers, Minimizer::numContinuousVars, LeastSq::numLeastSqTerms, Minimizer::numNonlinearConstraints, Minimizer::numNonlinearIneqConstraints, Iterator::outputLevel, LeastSq::primary_resp_weighter(), Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), and Model::subordinate_model().

Referenced by LeastSq::LeastSq().

void primary_resp_weighter(const Variables &unweighted_vars, const Variables &weighted_vars, const Response &unweighted_response, Response &weighted_response) [static], [private]

Recast callback function to weight least squares residuals, gradients, and Hessians.

Apply weights to least squares residuals

References Dakota::NPOS, Response::active_set_derivative_vector(), Response::active_set_request_vector(), Variables::acv(), Variables::all_continuous_variable_ids(), Variables::continuous_variable_ids(), Variables::cv(), Dakota::find_index(), Response::function_gradients(), Response::function_gradients_view(), Response::function_hessian(), Response::function_hessian_view(), Response::function_values(), Response::function_values_view(), Variables::icv(), Variables::inactive_continuous_variable_ids(), Iterator::iteratedModel, LeastSq::leastSqInstance, LeastSq::numLeastSqTerms, Iterator::outputLevel, Model::primary_response_fn_weights(), and Model::subordinate_model().

Referenced by LeastSq::weight_model().

The documentation for this class was generated from the following files:

- DakotaLeastSq.hpp
- DakotaLeastSq.cpp

### 13.69 LibraryEnvironment Class Reference

**Environment** corresponding to execution as an embedded library.

Inheritance diagram for LibraryEnvironment:
Public Member Functions

- **LibraryEnvironment ()**
  
  *default constructor*

- **LibraryEnvironment (ProgramOptions prog_opts, bool check_bcast_construct=true, DbCallbackFunctionPtr callback=NULL, void *callback_data=NULL)**
  
  *Primary constructor: program options typically specifies an input file or input string. Optionally specify a callback function to be invoked after parsing. Set check_bcast_construct if performing late updates and later calling done_modifying_db().*

- **LibraryEnvironment (MPI_Comm dakota_mpi_comm, ProgramOptions prog_opts=ProgramOptions(), bool check_bcast_construct=true, DbCallbackFunctionPtr callback=NULL, void *callback_data=NULL)**
  
  *Alternate constructor accepting communicator, same options as primary.*

- **~LibraryEnvironment ()**
  
  *destructor*

- **void insert_nodes (Dakota::DataMethod &dme, Dakota::DataModel &dmo, Dakota::DataVariables &dv, Dakota::DataInterface &di, Dakota::DataResponses &dr)**
  
  *Insert DB nodes for a {Method,Model,Variables,Interface,Responses} set.*

- **void done_modifying_db ()**
  
  *Check database contents, broadcast, and construct iterators.*

- **bool plugin_interface (const String &model_type, const String &interf_type, const String &an_driver, Interface *plugin_iface)**
  
  *Plug-in the passed interface into any interface matching the specified (possibly empty) model, interface, and driver strings; returns true if a plugin was performed.*

- **InterfaceList filtered_interface_list (const String &interf_type, const String &an_driver)**
  
  *Filter the available Interface instances based on matching interface type and analysis drivers (empty String matches any)*

- **ModelList filtered_model_list (const String &model_type, const String &interf_type, const String &an_driver)**
  
  *Filter the available Model instances based on matching model type, interface type, and analysis drivers (empty String matches any)*

Additional Inherited Members

13.69.1 Detailed Description

**Environment** corresponding to execution as an embedded library.

This environment corresponds to use of Dakota as a library within another application, e.g., within library_mode.cpp. It sets up the ParallelLibrary and ProblemDescDB objects without access to command line arguments.
13.69.2 Constructor & Destructor Documentation

LibraryEnvironment ( ProgramOptions *prog_opts, bool check_bcast_construct = true,
DbCallbackFunctionPtr *callback = NULL, void *callback_data = NULL )

Primary constructor: program options typically specifies an input file or input string. Optionally specify a callback
function to be invoked after parsing. Set check_bcast_construct if performing late updates and later calling done_modifying_db().

Construct library environment, optionally performing check/bcast of database and iterator construction.
References Environment::construct(), OutputManager::output_startup_message(), Environment::outputManager, and Environment::parse().

LibraryEnvironment ( MPI_Comm *mpi_comm, ProgramOptions *prog_opts = ProgramOptions (),
bool check_bcast_construct = true, DbCallbackFunctionPtr *callback = NULL, void *callback_data = NULL )

Alternate constructor accepting communicator, same options as primary.
Construct library environment on passed MPI Comm, optionally performing check/bcast of database and iterator construction. MPI Comm is first argument so client doesn’t have to pass all args.
References Environment::construct(), OutputManager::output_startup_message(), Environment::outputManager, and Environment::parse().

13.69.3 Member Function Documentation

InterfaceList filtered_interface_list ( const String &interface_type, const String &an_driver )

filter the available Interface instances based on matching interface type and analysis drivers (empty String matches any)

This convenience function helps clients locate and plugin to the right Interface instance for simple cases. Pass an empty string to match any instead of a specific instance.
References Interface::analysis_drivers(), Dakota::contains(), Interface::interface_type(), ProblemDescDB::model_list(), and Environment::probDescDB.

ModelList filtered_model_list ( const String &model_type, const String &interface_type, const String &an_driver )

filter the available Model instances based on matching model type, interface type, and analysis drivers (empty String matches any)

This convenience function helps clients locate and plugin to the right Interface instance for cases where the parallel configuration is needed in constructing a parallel plugin. Pass an empty string to match any instead of a specific instance.
References Interface::analysis_drivers(), Dakota::contains(), Interface::interface_type(), ProblemDescDB::model_list(), and Environment::probDescDB.

Referenced by parallel_interface_plugin(), LibraryEnvironment::plugin_interface(), run_dakota(), and run_dakota_mixed().
The documentation for this class was generated from the following files:

• LibraryEnvironment.hpp
• LibraryEnvironment.cpp
CHAPTER 13. CLASS DOCUMENTATION

13.70 LightWtBaseConstructor Struct Reference

Dummy struct for overloading constructors used in on-the-fly Model instantiations.

Public Member Functions

- **LightWtBaseConstructor** (int=0)
  
  *C++ structs can have constructors.*

13.70.1 Detailed Description

Dummy struct for overloading constructors used in on-the-fly Model instantiations.

*LightWtBaseConstructor* is used to overload the constructor used for on-the-fly Model instantiations. Putting this struct here avoids circular dependencies.

The documentation for this struct was generated from the following file:

- dakota_global_defs.hpp

13.71 MatchesWC Struct Reference

Predicate that returns true when the passed path matches the wild_card with which it was configured. Currently supports * and ?.

Public Member Functions

- **MatchesWC** (const bfs::path &wild_card)
  
  *ctor that builds and stores the regular expression*

- **bool operator()** (const bfs::path &dir_entry)
  
  *return true is dir_entry matches wildCardRegEx*

Public Attributes

- boost::basic_regex
  
  *< bfs::path::value_type > wildCardRegEx
  
  *archived RegEx; wchar-based on Windows*

13.71.1 Detailed Description

Predicate that returns true when the passed path matches the wild_card with which it was configured. Currently supports * and ?.

The documentation for this struct was generated from the following file:

- WorkdirHelper.hpp
13.72 MatlabInterface Class Reference

Inheritance diagram for MatlabInterface:

```
    Interface
     |     |
     v     v
ApplicationInterface
     |     |
     v     v
DirectApplicInterface
     |     |
     v     v
MatlabInterface
```

**Public Member Functions**

- **MatlabInterface (const ProblemDescDB &problem_db)**
  
  Constructor: start Matlab engine.

- **~MatlabInterface ()**
  
  Destructor: close Matlab engine.

**Protected Member Functions**

- **virtual int derived_map_ac (const String &ac_name)**
  
  execute an analysis code portion of a direct evaluation invocation

- **int matlab_engine_run (const Dakota::String &ac_name)**
  
  Helper function supporting derived_map_ac. Sends data to Matlab, executes analysis, collects return data.

- **int matlab_field_prep (mxArray *dakota_matlab, const char *field_name)**
  
  check that the dakota_matlab structure has the specified field_name and add if necessary; free structure memory in preparation for new alloc

**Protected Attributes**

- **engine * matlabEngine**
  
  pointer to the MATLAB engine used for direct evaluations

**13.72.1 Detailed Description**

Specialization of DirectApplicInterface to link to Matlab analysis drivers. Includes convenience functions to map data to/from Matlab.

**13.72.2 Member Function Documentation**

```
int derived_map_ac ( const String & ac_name ) [protected], [virtual]
```

execute an analysis code portion of a direct evaluation invocation

Matlab specialization of derived analysis components.
CHAPTER 13. CLASS DOCUMENTATION

Reimplemented from DirectApplicInterface. References ApplicationInterface::analysisServerId, and MatlabInterface::matlab_engine_run().

```cpp
int matlab_engine_run ( const Dakota::String & ac_name ) [protected]
```

Helper function supporting derived_map_ac. Sends data to Matlab, executes analysis, collects return data. Direct interface to Matlab through Mathworks external API. m-file executed is specified through analysis_drivers, extra strings through analysis_components. (Original BMA 11/28/2005)

Special thanks to Lee Peterson for substantial enhancements 12/15/2007: Added output buffer for the MATLAB command response and error messages Made the Dakota variable persistent in the MATLAB engine workspace Added robustness to the user deleting required Dakota fields

References Dakota::abort_handler(), DirectApplicInterface::analysisComponents, DirectApplicInterface::analysisDriverIndex, Interface::currEvalId, DirectApplicInterface::directFnASV, DirectApplicInterface::directFnDVV, Dakota::FIELD_NAMES, DirectApplicInterface::fnGrads, DirectApplicInterface::fnHessians, Interface::fnLabels, DirectApplicInterface::fnVals, DirectApplicInterface::gradFlag, DirectApplicInterface::hessFlag, MatlabInterface::matlab_field_prep(), MatlabInterface::matlabEngine, DirectApplicInterface::numACV, DirectApplicInterface::numADV, DirectApplicInterface::numADR, Dakota::NUMBER_OF_FIELDS, DirectApplicInterface::numDerivVars, DirectApplicInterface::numFns, DirectApplicInterface::numVars, Interface::outputLevel, DirectApplicInterface::xC, DirectApplicInterface::xCLabels, DirectApplicInterface::xDI, DirectApplicInterface::xDILabels, DirectApplicInterface::xDR, and DirectApplicInterface::xDRLabels.

Referenced by MatlabInterface::derived_map_ac().

The documentation for this class was generated from the following files:

- MatlabInterface.hpp
- MatlabInterface.cpp

13.73 MetaIterator Class Reference

Base class for meta-iterators.

Inheritance diagram for MetaIterator:

```
public

```

```
CollabHybridMetaIterator ConcurrentMetaIterator EmbedHybridMetaIterator SeqHybridMetaIterator
```

Public Member Functions

- `bool resize()`  
  reinitializes iterator based on new variable size

Protected Member Functions

- MetaIterator (ProblemDescDB &problem_db) standard constructor
- MetaIterator (ProblemDescDB &problem_db, Model &model)
13.73. METAITERATOR CLASS REFERENCE

alternate constructor

• \texttt{\sim \text{MetaIterator}()} ()
  destructor

• \texttt{void post\_run (std::ostream &s)}
  post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables-/Responses and perform final analysis phase in a standalone way

• \texttt{bool new\_model (const String &method\_ptr, const String &model\_ptr)}
  identify presence of a new model specification identified by pointer, necessitating a new instantiation

• \texttt{void check\_model (const String &method\_ptr, const String &model\_ptr)}
  check that any model identified by pointer has the same id as the passed iteratedModel

• \texttt{void allocate\_by\_pointer (const String &method\_ptr, Iterator &the\_iterator, Model &the\_model)}
  initialize the\_iterator and the\_model based on method\_ptr

• \texttt{void allocate\_by\_name (const String &method\_string, const String &model\_ptr, Iterator &the\_iterator, Model &the\_model)}
  initialize the\_iterator based on method\_string

• \texttt{std::pair< int, int > estimate\_by\_pointer (const String &method\_ptr, Iterator &the\_iterator, Model &the\_model)}
  estimate minimum and maximum processors per iterator needed for init\_iterator\_parallelism(); instantiates the\_iterator and the\_model as needed, but on minimal processor ranks (is later augmented by allocate\_by\_pointer())

• \texttt{std::pair< int, int > estimate\_by\_name (const String &method\_string, const String &model\_ptr, Iterator &the\_iterator, Model &the\_model)}
  estimate minimum and maximum processors per iterator needed for init\_iterator\_parallelism(); instantiates the\_iterator and the\_model as needed, but on minimal processor ranks (is later augmented by allocate\_by\_name())

Protected Attributes

• \texttt{IteratorScheduler iterSched}
  scheduler for concurrent execution of Iterators

• \texttt{int maxIteratorConcurrency}
  maximum number of concurrent sub-iterator executions

Additional Inherited Members

13.73.1 Detailed Description

Base class for meta-iterators.

This base class shares code for concurrent and hybrid meta-iterators, where the former supports multi-start and Pareto set iteration and the latter supports sequential, embedded, and collaborative hybrids.

13.73.2 Member Function Documentation

\texttt{void post\_run ( std::ostream &s ) [protected], [virtual]}

post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables-/Responses and perform final analysis phase in a standalone way

Post-run phase, which a derived iterator may optionally reimplement; when not present, post-run is likely integrated into run. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s \texttt{post\_run()}, typically \texttt{after} performing its own implementation steps.
Reimplemented from `Iterator`.
References `MetaIterator::iterSched`, `IteratorScheduler::lead_rank()`, and `Iterator::print_results()`.
The documentation for this class was generated from the following files:

- `MetaIterator.hpp`
- `MetaIterator.cpp`

### 13.74 Minimizer Class Reference

Base class for the optimizer and least squares branches of the iterator hierarchy.

Inheritance diagram for Minimizer:

![Inheritance Diagram](https://example.com/inheritance-diagram)

#### Public Member Functions

- **void** `constraint_tolerance`(Real constr_tol)
  
  *set the method constraint tolerance (constraintTol)*

- **Real** `constraint_tolerance`() const
  
  *return the method constraint tolerance (constraintTol)*

- **bool** `resize`()  
  *reinitializes iterator based on new variable size*

#### Protected Member Functions

- **Minimizer()**  
  *default constructor*

- **Minimizer(ProblemDescDB &problem_db, Model &model)**
standard constructor

- **Minimizer** (unsigned short method_name, Model &model)
  alternate constructor for "on the fly" instantiations

- **Minimizer** (unsigned short method_name, size_t num_lin_ineq, size_t num_lin_eq, size_t num_nonlin_ineq, size_t num_nonlin_eq)
  alternate constructor for "on the fly" instantiations

- ~Minimizer ()
  destructor

- void update_from_model (const Model &model)
  set inherited data attributes based on extractions from incoming model

- void initialize_run ()
  utility function to perform common operations prior to pre_run(); typically memory initialization; setting of instance pointers

- void post_run (std::ostream &s)
  post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way

- void finalize_run ()
  utility function to perform common operations following post_run(); deallocation and resetting of instance pointers

- const Model & algorithm_space_model () const
  Model original_model (unsigned short recasts_left=0)
  Return a shallow copy of the original model this Iterator was originally passed, optionally leaving recasts_left on top of it.

- void data_transform_model ()
  Wrap iteratedModel in a RecastModel that subtracts provided observed data from the primary response functions (variables and secondary responses are unchanged)

- void scale_model ()
  Wrap iteratedModel in a RecastModel that performs variable and/or response scaling.

- Real objective (const RealVector &fn_vals, const BoolDeque &max_sense, const RealVector &primary_wts) const
  compute a composite objective value from one or more primary functions

- Real objective (const RealVector &fn_vals, size_t num_fns, const BoolDeque &max_sense, const RealVector &primary_wts) const
  compute a composite objective with specified number of source primary functions, instead of userPrimaryFns

- void objective_gradient (const RealVector &fn_vals, const RealMatrix &fn_grads, const BoolDeque &max_sense, const RealVector &primary_wts, RealVector &obj_grad) const
  compute the gradient of the composite objective function

- void objective_gradient (const RealVector &fn_vals, size_t num_fns, const RealMatrix &fn_grads, const BoolDeque &max_sense, const RealVector &primary_wts, RealVector &obj_grad) const
  compute the gradient of the composite objective function

- void objective_hessian (const RealVector &fn_vals, const RealMatrix &fn_grads, const RealSymMatrixArray &fn_hessians, const BoolDeque &max_sense, const RealVector &primary_wts, RealSymMatrix &obj_hess) const
  compute the Hessian of the composite objective function

- void objective_hessian (const RealVector &fn_vals, size_t num_fns, const RealMatrix &fn_grads, const RealSymMatrixArray &fn_hessians, const BoolDeque &max_sense, const RealVector &primary_wts, RealSymMatrix &obj_hess) const
compute the Hessian of the composite objective function

- void archive_allocate_best (size_t num_points)
  allocate results arrays and labels for multipoint storage
- void archive_best (size_t index, const Variables &best_vars, const Response &best_resp)
  archive the best point into the results array
- void resize_best_vars_array (size_t newsize)
  Safely resize the best variables array to newsize taking into account the envelope-letter design pattern and any recasting.
- void resize_best_resp_array (size_t newsize)
  Safely resize the best response array to newsize taking into account the envelope-letter design pattern and any recasting.
- Real sum_squared_residuals (size_t num_pri_fns, const RealVector &residuals, const RealVector &weights)
  return weighted sum of squared residuals
- void print_residuals (size_t num_terms, const RealVector &best_terms, const RealVector &weights, size_t num_best, size_t best_index, std::ostream &s)
  print num_terms residuals and misfit for final results
- void print_model_resp (size_t num_pri_fns, const RealVector &best_fns, size_t num_best, size_t best_index, std::ostream &s)
  print the original user model resp in the case of data transformations
- void local_recast_retrieve (const Variables &vars, Response &response) const
  infers MOO/NLS solution from the solution of a single-objective optimizer

Protected Attributes

- size_t numFunctions
  number of response functions
- size_t numContinuousVars
  number of active continuous vars
- size_t numDiscreteIntVars
  number of active discrete integer vars
- size_t numDiscreteStringVars
  number of active discrete string vars
- size_t numDiscreteRealVars
  number of active discrete real vars
- Real constraintTol
  optimizer/least squares constraint tolerance
- Real bigRealBoundSize
  cutoff value for inequality constraint and continuous variable bounds
- int bigIntBoundSize
  cutoff value for discrete variable bounds
- size_t numNonlinearIneqConstraints
  number of nonlinear inequality constraints
- size_t numNonlinearEqConstraints
  number of nonlinear equality constraints
13.74. MINIMIZER CLASS REFERENCE

- `size_t numLinearIneqConstraints`
  number of linear inequality constraints
- `size_t numLinearEqConstraints`
  number of linear equality constraints
- `size_t numNonlinearConstraints`
  total number of nonlinear constraints
- `size_t numLinearConstraints`
  total number of linear constraints
- `size_t numConstraints`
  total number of linear and nonlinear constraints
- `bool optimizationFlag`
  flag for use where optimization and NLS must be distinguished
- `size_t numUserPrimaryFns`
  number of objective functions or least squares terms in the inbound model; always initialize at Minimizer, even if overridden later
- `size_t numIterPrimaryFns`
  number of objective functions or least squares terms in iterator’s view, after transformations; always initialize at Minimizer, even if overridden later
- `bool boundConstraintFlag`
  convenience flag for denoting the presence of user-specified bound constraints. Used for method selection and error checking.
- `bool speculativeFlag`
  flag for speculative gradient evaluations
- `bool calibrationDataFlag`
  flag indicating whether user-supplied calibration data is active
- `ExperimentData expData`
  Container for experimental data to which to calibrate model using least squares or other formulations which minimize SSE.
- `size_t numExperiments`
  number of experiments
- `size_t numTotalCalibTerms`
  number of total calibration terms (sum over experiments of number of experimental data per experiment, including field data)
- `Model dataTransformModel`
  Shallow copy of the data transformation model, when present (cached in case further wrapped by other transformations)
- `bool scaleFlag`
  whether Iterator-level scaling is active
- `Model scalingModel`
  Shallow copy of the scaling transformation model, when present (cached in case further wrapped by other transformations)
- `Minimizer * prevMinInstance`
  pointer containing previous value of minimizerInstance
- `bool vendorNumericalGradFlag`
  convenience flag for gradient_type == numerical & method_source == vendor
CHAPTER 13. CLASS DOCUMENTATION

Static Protected Attributes

- static Minimizer * minimizerInstance
  
  pointer to Minimizer used in static member functions

Friends

- class SOLBase
  
  the SOLBase class is not derived the iterator hierarchy but still needs access to iterator hierarchy data (to avoid attribute replication)

- class SNLLBase
  
  the SNLLBase class is not derived the iterator hierarchy but still needs access to iterator hierarchy data (to avoid attribute replication)

Additional Inherited Members

13.74.1 Detailed Description

Base class for the optimizer and least squares branches of the iterator hierarchy.

The Minimizer class provides common data and functionality for Optimizer and LeastSq.

13.74.2 Constructor & Destructor Documentation

Minimizer ( ProblemDescDB & problem_db, Model & model ) [protected]

standard constructor

This constructor extracts inherited data for the optimizer and least squares branches and performs sanity checking on constraint settings.

References Iterator::iteratedModel, Iterator::maxIterations, Iterator::methodName, Iterator::numFinalSolutions, and Minimizer::update from model().

13.74.3 Member Function Documentation

void initialize_run( ) [protected], [virtual]

utility function to perform common operations prior to pre_run(); typically memory initialization; setting of instance pointers

Perform initialization phases of run sequence, like allocating memory and setting instance pointers. Commonly used in sub-iterator executions. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s initialize_run(), typically before performing its own implementation steps.

Reimplemented from Iterator.

Reimplemented in SNLLOptimizer, NLPQLPOptimizer, SNLLastSq, DOTOptimizer, and Optimizer.

References Model::all_continuous_variables(), Model::all_discrete_int_variables(), Model::all_discrete_real_variables(), Iterator::bestVariablesArray, Model::initialize_mapping(), Model::is_null(), Iterator::iteratedModel, Model::mapping_initialized(), Iterator::methodPCIter, Minimizer::minimizerInstance, Iterator::myModelLayers, Minimizer::prevMinInstance, Minimizer::resize(), Model::set_evaluation_reference(), Iterator::subIterFlag, Model::subordinate_model(), and Iterator::summaryOutputFlag.

Referenced by LeastSq::initialize_run(), and Optimizer::initialize_run().
void post_run ( std::ostream & s ) [protected], [virtual]

post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way

Post-run phase, which a derived iterator may optionally re-implement; when not present, post-run is likely integrated into run. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s post_run(), typically after performing its own implementation steps.

Reimplemented from Iterator.
Reimplemented in SNLLOptimizer, SNLLLeastSq, and Optimizer.
References Model::is_null(), Iterator::iteratedModel, Model::print_evaluation_summary(), Iterator::print_results(), Iterator::resultsDB, Iterator::summaryOutputFlag, and ResultsManager::write_databases().

Referenced by LeastSq::post_run(), Optimizer::post_run(), and SNLLLeastSq::post_run().

void finalize_run ( ) [inline], [protected], [virtual]

utility function to perform common operations following post_run(); deallocation and resetting of instance pointers

Optional: perform finalization phases of run sequence, like deallocating memory and resetting instance pointers. Commonly used in sub-iterator executions. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s finalize_run(), typically after performing its own implementation steps.

Reimplemented from Iterator.
Reimplemented in SNLLOptimizer, SNLLLeastSq, and Optimizer.
References Iterator::finalize_run(), Minimizer::minimizerInstance, and Minimizer::prevMinInstance.

Referenced by LeastSq::finalize_run(), and Optimizer::finalize_run().

const Model & algorithm_space_model ( ) const [inline], [protected], [virtual]

default definition that gets redefined in selected derived Minimizers

Reimplemented from Iterator.
Reimplemented in EffGlobalMinimizer.
References Iterator::iteratedModel.

void data_transform_model ( ) [protected]

Wrap iteratedModel in a RecastModel that subtracts provided observed data from the primary response functions (variables and secondary responses are unchanged)

Reads observation data to compute least squares residuals. Does not change size of responses, and is the first wrapper, therefore sizes are based on iteratedModel.

References Dakota::abort_handler(), Iterator::activeSet, Iterator::assign_rep(), Minimizer::dataTransformModel, Minimizer::expData, ProblemDescDB::get_sizet(), Iterator::iteratedModel, ExperimentData::load_data(), Iterator::myModelLayers, Model::num_functions(), Model::num_primary_fns(), Minimizer::numExperiments, Minimizer::numFunctions, Minimizer::numIterPrimaryFns, Minimizer::numTotalCalibTerms, Iterator::outputLevel, Iterator::probDescDB, and ActiveSet::request_vector().

Referenced by LeastSq::LeastSq(), and Optimizer::Optimizer().

void scale_model ( ) [protected]

Wrap iteratedModel in a RecastModel that performs variable and/or response scaling.

Wrap the iteratedModel in a scaling transformation, such that iteratedModel now contains a scaling recast model. Potentially affects variables, primary, and secondary responses

References Model::assign_rep(), Iterator::iteratedModel, Iterator::myModelLayers, and Minimizer::scalingModel.
CHAPTER 13. CLASS DOCUMENTATION

Referenced by LeastSq::LeastSq(), and Optimizer::Optimizer().

Real objective ( const RealVector & fn_vals, const BoolDeque & max_sense, const RealVector & primary_wts ) const [protected]
compute a composite objective value from one or more primary functions
The composite objective computation sums up the contributions from one or more primary functions using the primary response fn weights.
References Minimizer::numUserPrimaryFns.
Referenced by SurrBasedLocalMinimizer::approx_subprob_objective_eval(), SurrBasedMinimizer::augmented_lagrangianMerit(), EffGlobalMinimizer::expected_improvement(), SurrBasedMinimizer::lagrangian_merit(), Optimizer::objective_reduction(), SurrBasedMinimizer::penalty_merit(), COLINOptimizer::post_run(), SurrBasedMinimizer::update_filter(), and SurrBasedLocalMinimizer::update_penalty().

Real objective ( const RealVector & fn_vals, size_t num_fns, const BoolDeque & max_sense, const RealVector & primary_wts ) const [protected]
compute a composite objective with specified number of source primary functions, instead of userPrimaryFns
This "composite" objective is a more general case of the previous objective(), but doesn’t presume a reduction map from user to iterated space. Used to apply weights and sense in COLIN results sorting. Leaving as a duplicate implementation pending resolution of COLIN lookups.
References Minimizer::optimizationFlag.

void objective_gradient ( const RealVector & fn_vals, size_t num_fns, const RealMatrix & fn_grads, const BoolDeque & max_sense, const RealVector & primary_wts, RealVector & obj_grad ) const [protected]
compute the gradient of the composite objective function
The composite objective gradient computation combines the contributions from one of more primary function gradients, including the effect of any primary function weights. In the case of a linear mapping (MOO), only the primary function gradients are required, but in the case of a nonlinear mapping (NLS), primary function values are also needed. Within RecastModel::set_mapping(), the active set requests are automatically augmented to make values available when needed, based on nonlinearRespMapping settings.
References Minimizer::numContinuousVars, and Minimizer::optimizationFlag.

void objective_hessian ( const RealVector & fn_vals, size_t num_fns, const RealMatrix & fn_grads, const RealSymMatrixArray & fn_hessians, const BoolDeque & max_sense, const RealVector & primary_wts, RealSymMatrix & obj_hess ) const [protected]
compute the Hessian of the composite objective function
The composite objective Hessian computation combines the contributions from one of more primary function Hessians, including the effect of any primary function weights. In the case of a linear mapping (MOO), only the primary function Hessians are required, but in the case of a nonlinear mapping (NLS), primary function values and gradients are also needed in general (gradients only in the case of a Gauss-Newton approximation). Within the default RecastModel::set_mapping(), the active set requests are automatically augmented to make values and gradients available when needed, based on nonlinearRespMapping settings.
References Dakota::abort_handler(), Minimizer::numContinuousVars, and Minimizer::optimizationFlag.
void resize_best_vars_array ( size_t newsize ) [protected]

Safely resize the best variables array to newsize taking into account the envelope-letter design pattern and any recasting.

Uses data from the innermost model, should any Minimizer recasts be active. Called by multipoint return solvers. Do not directly call resize on the bestVariablesArray object unless you intend to share the internal content (letter) with other objects after assignment.

References Iterator::bestVariablesArray, Variables::copy(), Model::current_variables(), and Minimizer::original_model().

Referenced by COLINOptimizer::post_run().

void resize_best_resp_array ( size_t newsize ) [protected]

Safely resize the best response array to newsize taking into account the envelope-letter design pattern and any recasting.

Uses data from the innermost model, should any Minimizer recasts be active. Called by multipoint return solvers. Do not directly call resize on the bestResponseArray object unless you intend to share the internal content (letter) with other objects after assignment.

References Iterator::bestResponseArray, Response::copy(), Model::current_response(), and Minimizer::original_model().

Referenced by COLINOptimizer::post_run().

void local_recast_retrieve ( const Variables & vars, Response & response ) const [protected]

infers MOO/NLS solution from the solution of a single-objective optimizer

Retrieve a MOO/NLS response based on the data returned by a single objective optimizer by performing a data_pairs search. This may get called even for a single user-specified function, since we may be recasting a single NLS residual into a squared objective. Always returns best data in the space of the original inbound Model.

References Response::active_set(), Dakota::data_pairs, Model::interface_id(), Iterator::iteratedModel, Dakota::lookup_by_val(), and Response::update().

Referenced by LeastSq::post_run(), and Optimizer::post_run().

The documentation for this class was generated from the following files:

- DakotaMinimizer.hpp
- DakotaMinimizer.cpp

13.75 MixedVarConstraints Class Reference

Derived class within the Constraints hierarchy which separates continuous and discrete variables (no domain type array merging).

Inheritance diagram for MixedVarConstraints:

```
+--- Constraints
    +--- MixedVarConstraints
```
Public Member Functions

- `MixedVarConstraints (const SharedVariablesData &svd)`
  lightweight constructor
- `MixedVarConstraints (const ProblemDescDB &problem_db, const SharedVariablesData &svd)`
  standard constructor
- `~MixedVarConstraints ()`
  destructor
- `void write (std::ostream &s) const`
  write a variable constraints object to an std::ostream
- `void read (std::istream &s)`
  read a variable constraints object from an std::istream

Additional Inherited Members

13.75.1 Detailed Description

Derived class within the Constraints hierarchy which separates continuous and discrete variables (no domain type array merging).

Derived variable constraints classes take different views of the design, uncertain, and state variable types and the continuous and discrete domain types. The MixedVarConstraints derived class separates the continuous and discrete domain types (see Variables::get_variables(problem_db) for variables type selection; variables type is passed to the Constraints constructor in Model).

13.75.2 Constructor & Destructor Documentation

`MixedVarConstraints (const ProblemDescDB & problem_db, const SharedVariablesData & svd)`

standard constructor

In this class, mixed continuous/discrete variables are used. Most iterators/strategies use this approach, which is the default in Constraints::get_constraints().

References Constraints::allContinuousLowerBnds, Constraints::allContinuousUpperBnds, Constraints::allDiscreteIntLowerBnds, Constraints::allDiscreteIntUpperBnds, Constraints::allDiscreteRealLowerBnds, Constraints::allDiscreteRealUpperBnds, Dakota::copy_data_partial(), ProblemDescDB::get_iv(), ProblemDescDB::get_rv(), Constraints::sharedVarsData, and SharedVariablesData::view().

The documentation for this class was generated from the following files:

- MixedVarConstraints.hpp
- MixedVarConstraints.cpp

13.76 MixedVariables Class Reference

Derived class within the Variables hierarchy which separates continuous and discrete variables (no domain type array merging).

Inheritance diagram for MixedVariables:
13.76. MIXEDVARIABLES CLASS REFERENCE

Public Member Functions

- **MixedVariables** (const ProblemDescDB &problem_db, const std::pair< short, short > &view)
  Standard constructor
- **MixedVariables** (const SharedVariablesData &svd)
  Lightweight constructor
- **~MixedVariables** ()
  Destructor

Protected Member Functions

- void **read** (std::istream &s)
  Read a variables object from an std::istream
- void **write** (std::ostream &s) const
  Write a variables object to an std::ostream, e.g., the console
- void **write_aprepro** (std::ostream &s) const
  Write a variables object to an std::ostream in aprepro format, e.g., a parameters file
- void **read_tabular** (std::istream &s, bool active_only=false)
- void **write_tabular** (std::ostream &s, bool active_only=false) const
  Write a variables object in tabular format to an std::ostream
- void **write_tabular_labels** (std::ostream &s, bool active_only=false) const
  Write the labels in input spec order to a std::ostream
- template<typename Reader >
  void **read_core** (std::istream &s, Reader read_handler, const SizetArray &vc_totals)
  Implementation of reading various formats using the specified read handler.
- template<typename Writer >
  void **write_core** (std::ostream &s, Writer write_handler, const SizetArray &vc_totals) const
  Implementation of writing various formats using the specified write handler.

Additional Inherited Members

13.76.1 Detailed Description

Derived class within the Variables hierarchy which separates continuous and discrete variables (no domain type array merging).

Derived variables classes take different views of the design, uncertain, and state variable types and the continuous and discrete domain types. The MixedVariables derived class separates the continuous and discrete domain types (see Variables::get_variables(problem_db)).
13.76.2 Constructor & Destructor Documentation

MixedVariables ( const ProblemDescDB & problem_db, const std::pair< short, short > & view )

standard constructor

In this class, the distinct approach is used (design, uncertain, and state variable types and continuous and discrete domain types are distinct). Most iterators/strategies use this approach.

References Variables::allContinuousVars, Variables::allDiscreteIntVars, Variables::allDiscreteRealVars, Variables::allDiscreteStringVars, Dakota::copy_data_partial(), ProblemDescDB::get_iv(), ProblemDescDB::get_rv(), ProblemDescDB::get_sa(), Variables::sharedVarsData, and SharedVariablesData::view().

13.76.3 Member Function Documentation

void read_tabular ( std::istream & s, bool active_only = false ) [protected], [virtual]

Tabular reader that reads data in order design, aleatory, epistemic, state according to counts in vc_totals (extract in order: cdv/ddiv/ddrv, cauv/dauv/daurv, ceuv/deuv/deurv, csv/dsiv/dsrv, which might reflect active or all depending on context. Assumes container sized, since might be a view into a larger array.

Reimplemented from Variables.

References SharedVariablesData::active_components_totals(), SharedVariablesData::components_totals(), MixedVariables::read_core(), and Variables::sharedVarsData.

void read_core ( std::istream & s, Reader read_handler, const SizetArray & vc_totals ) [protected]

Implementation of reading various formats using the specified read handler.

Reordering is required in all read/write cases that will be visible to the user since all derived vars classes should use the same CDV/DDV/UV/CSV/DSV ordering for clarity. Neutral file I/O, binary streams, and packed buffers do not need to reorder (so long as read/write are consistent) since this data is not intended for public consumption.

References Variables::all_continuous_variable_labels(), Variables::all_discrete_int_variable_labels(), Variables::all_discrete_real_variable_labels(), Variables::all_discrete_string_variable_labels(), Variables::allContinuousVars, Variables::allDiscreteIntVars, Variables::allDiscreteRealVars, and Variables::allDiscreteStringVars.

Referenced by MixedVariables::read(), and MixedVariables::read_tabular().

The documentation for this class was generated from the following files:

- MixedVariables.hpp
- MixedVariables.cpp

13.77 Model Class Reference

Base class for the model class hierarchy.

Inheritance diagram for Model:

```
Model
  |      |
  v      v
NestedModel | RecastModel | SimulationModel | SurrogateModel
  |      |
ActiveSubspaceModel | DataTransformModel | ProbabilityTransformationModel | RandomFieldModel | ScalingModel | DataFitSurrModel | HierarchicalModel
```
Public Member Functions

- **Model ()**
  
  *default constructor*

- **Model (ProblemDescDB &problem_db)**
  
  *standard constructor for envelope*

- **Model (const Model &model)**
  
  *copy constructor*

- **virtual ~Model ()**
  
  *destructor*

- **Model operator= (const Model &model)**
  
  *assignment operator*

- **virtual Iterator & subordinate_iterator ()**
  
  *return the sub-iterator in nested and surrogate models*

- **virtual Model & subordinate_model ()**
  
  *return a single sub-model defined from subModel in nested and recast models and truth_model() in surrogate models; used for a directed dive through model recursions that may bypass some components.*

- **virtual Model & surrogate_model ()**
  
  *return the active approximation sub-model in surrogate models*

- **virtual void surrogate_model_indices (size_t lf_model_index, size_t lf_soln_lev_index=NPOS)**
  
  *set the indices that define the active approximation sub-model within surrogate models*

- **virtual void surrogate_model_indices (const SizetSizetPair &lf_form_level)**
  
  *set the index pair that defines the active approximation sub-model within surrogate models*

- **virtual const SizetSizetPair & surrogate_model_indices () const**
  
  *return the indices of the active approximation sub-model within surrogate models*

- **virtual Model & truth_model ()**
  
  *return the active truth sub-model within surrogate models*

- **virtual void truth_model_indices (size_t hf_model_index, size_t hf_soln_lev_index=NPOS)**
  
  *set the indices that define the active truth sub-model within surrogate models*

- **virtual void truth_model_indices (const SizetSizetPair &hf_form_level)**
  
  *set the index pair that defines the active truth sub-model within surrogate models*

- **virtual const SizetSizetPair & truth_model_indices () const**
  
  *return the indices of the active truth sub-model within surrogate models*

- **virtual void derived_subordinate_models (ModelList &ml, bool recurse_flag)**
  
  *portion of subordinate_models() specific to derived model classes*

- **virtual void update_from_subordinate_model (size_t depth=std::numeric_limits<size_t>::max())**
  
  *propagate vars/labels/bounds/targets from the bottom up*

- **virtual Interface & derived_interface ()**
  
  *return the interface employed by the derived model class, if present: SimulationModel::userDefinedInterface, DataFitSurfModel::approxInterface, or NestedModel::optionalInterface*

- **virtual size_t solution_levels () const**
  
  *number of discrete levels within solution control (SimulationModel)*

- **virtual void solution_level_index (size_t index)**
  
  *activate a particular level within the solution level control and return the cost estimate (SimulationModel)*
• virtual RealVector \textit{solution\_level\_cost} ( ) const
  
  return ordered cost estimates across solution levels (SimulationModel)

• virtual void \textit{primary\_response\_fn\_weights} (const RealVector &wts, bool recurse\_flag=true)

  set the relative weightings for multiple objective functions or least squares terms

• virtual void \textit{surrogate\_function\_indices} (const IntSet &surr\_fn\_indices)

  set the (currently active) surrogate function index set

• virtual bool \textit{initialize\_mapping} (ParLevLIter pl\_iter)

  initialize model mapping, returns true if the variables size has changed

• virtual bool \textit{finalize\_mapping} ()

  finalize model mapping, returns true if the variables size has changed

• virtual bool \textit{mapping\_initialized} ()

  return true if mapping has been fully initialized, false otherwise.

• virtual void \textit{build\_approximation} ()

  build a new SurrogateModel approximation

• virtual bool \textit{build\_approximation} (const Variables &vars, const IntResponsePair &response\_pr)

  build a new SurrogateModel approximation using/enforcing anchor response at vars; rebuild if needed

• virtual void \textit{update\_approximation} (bool rebuild\_flag)

  replace the approximation data within an existing surrogate based on data updates propagated elsewhere

• virtual void \textit{update\_approximation} (const Variables &vars, const IntResponsePair &response\_pr, bool rebuild\_flag)

  replace the anchor point data within an existing surrogate

• virtual void \textit{update\_approximation} (const VariablesArray &vars\_array, const IntResponseMap &resp\_map, bool rebuild\_flag)

  replace the data points within an existing surrogate

• virtual void \textit{update\_approximation} (const RealMatrix &samples, const IntResponseMap &resp\_map, bool rebuild\_flag)

  replace the data points within an existing surrogate

• virtual void \textit{append\_approximation} (bool rebuild\_flag)

  append to the existing approximation data within a surrogate based on data updates propagated elsewhere

• virtual void \textit{append\_approximation} (const Variables &vars, const IntResponsePair &response\_pr, bool rebuild\_flag)

  append a single point to an existing surrogate’s data

• virtual void \textit{append\_approximation} (const VariablesArray &vars\_array, const IntResponseMap &resp\_map, bool rebuild\_flag)

  append multiple points to an existing surrogate’s data

• virtual void \textit{append\_approximation} (const RealMatrix &samples, const IntResponseMap &resp\_map, bool rebuild\_flag)

  append multiple points to an existing surrogate’s data

• virtual void \textit{pop\_approximation} (bool save\_surr\_data, bool rebuild\_flag=false)

  remove the previous data set addition to a surrogate (e.g., due to a previous \textit{append\_approximation}() call); flag manages storing of surrogate data for use in a subsequent \textit{push\_approximation}() call

• virtual void \textit{push\_approximation} ()

  push a previous approximation data state; reverse of \textit{pop\_approximation}

• virtual bool \textit{push\_available} ()


13.77. MODEL CLASS REFERENCE

query for whether a trial increment is restorable within a surrogate

• virtual void finalize_approximation ()
  finalize an approximation by applying all previous trial increments

• virtual void store_approximation (size_t index=NPOS)
  move the current approximation into storage for later combination; the index of the stored set can be passed to
  allow replacement instead of augmentation (default is push_back)

• virtual void restore_approximation (size_t index=NPOS)
  return an approximation from storage; the index identifies a particular stored data set (default is pop_back from
  stored)

• virtual void remove_stored_approximation (size_t index=NPOS)
  remove a stored approximation, due to redundancy with the current approximation, prior to combination (default
  for no index is pop_back)

• virtual void combine_approximation (short corr_type)
  combine the current approximation with previously stored data sets

• virtual void run_dace_iterator (bool rebuild_flag)
  execute the DACE iterator, append the approximation data, and rebuild the approximation if indicated

• virtual bool force_rebuild ()
  determine whether a surrogate model rebuild should be forced based on changes in the inactive data

• virtual SharedApproxData & shared_approximation ()
  retrieve the shared approximation data within the ApproximationInterface of a DataFitSurrModel

• virtual std::vector<Approximation> & approximations ()
  retrieve the set of Approximations within the ApproximationInterface of a DataFitSurrModel

• virtual const Pecos::SurrogateData & approximation_data (size_t index)
  retrieve the approximation data from a particular Approximation instance within the ApproximationInterface of a
  DataFitSurrModel

• virtual const RealVectorArray & approximation_coefficients (bool normalized=false)
  retrieve the approximation coefficients from each Approximation within a DataFitSurrModel

• virtual void approximation_coefficients (const RealVectorArray &approx_coeffs, bool normalized=false)
  set the approximation coefficients for each Approximation within a DataFitSurrModel

• virtual const RealVector & approximation_variances (const Variables &vars)
  retrieve the approximation variances from each Approximation within a DataFitSurrModel

• virtual void surrogate_response_mode (short mode)
  set response computation mode used in SurrogateModels for forming currentResponse

• virtual short surrogate_response_mode () const
  return response computation mode used in SurrogateModels for forming currentResponse

• virtual DiscrepancyCorrection & discrepancy_correction ()
  return the DiscrepancyCorrection object used by SurrogateModels

• virtual void component_parallel_mode (short mode)
  update component parallel mode for supporting parallelism in a model’s interface component, sub-model compo-
  nent, or neither component [componentParallelMode = 0 (none), 1 (INTERFACE/APPROX_INTERFACE/OPTI-
  ONAL_INTERFACE/LF_MODEL/SURROGATE_MODEL), or 2 (SUB_MODEL/ACTUAL_MODEL/HF_MODEL/-
  TRUTH_MODEL)].

• virtual IntIntPair estimate_partition_bounds (int max_eval_concurrency)
virtual size_t mi_parallel_level_index() const
    return the index for the metaiterator-iterator parallelism level within ParallelConfiguration::miPLIters that is active for use in a particular Model at runtime

virtual short local_eval_synchronization() const
    return derived model synchronization setting

virtual int local_eval_concurrency() const
    return derived model asynchronous evaluation concurrency

virtual void serve_run(ParLevIter pl_iter, int max_eval_concurrency)
    Service job requests received from the master. Completes when a termination message is received from stop_servers().

virtual void stop_servers()
    Executed by the master to terminate all server operations for a particular model when iteration on the model is complete.

virtual bool derived_master_overload() const
    Return a flag indicating the combination of multiprocessor evaluations and a dedicated master iterator scheduling. Used in synchronous evaluate functions to prevent the error of trying to run a multiprocessor job on the master.

virtual void inactive_view(short view, bool recurse_flag=true)
    update the Model's inactive view based on higher level (nested) context

virtual const String & interface_id() const
    return the interface identifier

virtual int evaluation_id() const
    Return the value of the evaluation id counter for the Model.

virtual bool evaluation_cache() const
    Indicates the usage of an evaluation cache by the Model.

virtual void set_evaluation_reference()
    Set the reference points for the evaluation counters within the Model.

virtual void fine_grained_evaluation_counters()
    Request fine-grained evaluation reporting within the Model.

virtual void print_evaluation_summary(std::ostream &s, bool minimal_header=false, bool relative_count=true)
    const
    Print an evaluation summary for the Model.

virtual void eval_tag_prefix(const String &eval_id_str)
    set the hierarchical eval ID tag prefix

virtual bool db_lookup(const Variables &search_vars, const ActiveSet &search_set, Response &found_resp)
    search the eval database (during derivative estimation); derived may need to reimplement due to problem transformations (RecastModel); return true if found in DB

virtual void stop_init_mapping(ParLevIter pl_iter)
    called from IteratorScheduler::run_iterator() for iteratorComm rank 0 to terminate serve_init_mapping() on other iteratorComm processors

virtual int serve_init_mapping(ParLevIter pl_iter)
    called from IteratorScheduler::run_iterator() for iteratorComm rank != 0 to balance resize() calls on iteratorComm processors

virtual void stop_finalize_mapping(ParLevIter pl_iter)
called from IteratorScheduler::run_iterator() for iteratorComm rank 0 to terminate serve_finalize_mapping() on other iteratorComm processors

- virtual int serve_finalize_mapping (ParLevLIter pl_iter)
  called from IteratorScheduler::run_iterator() for iteratorComm rank != 0 to balance resize() calls on iteratorComm rank 0

- ModelList & subordinate_models (bool recurse_flag=true)
  return the sub-models in nested and surrogate models

- void evaluate ()
  Compute the Response at currentVariables (default ActiveSet).

- void evaluate (const ActiveSet &set)
  Compute the Response at currentVariables (specified ActiveSet).

- void evaluate_nowait ()
  Spawn an asynchronous job (or jobs) that computes the value of the Response at currentVariables (default ActiveSet).

- void evaluate_nowait (const ActiveSet &set)
  Spawn an asynchronous job (or jobs) that computes the value of the Response at currentVariables (specified ActiveSet).

- const IntResponseMap & synchronize ()
  Execute a blocking scheduling algorithm to collect the complete set of results from a group of asynchronous evaluations.

- const IntResponseMap & synchronize_nowait ()
  Execute a nonblocking scheduling algorithm to collect all available results from a group of asynchronous evaluations.

- void init_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  allocate communicator partitions for a model and store configuration in modelPCIterMap

- void init_serial ()
  for cases where init_communicators() will not be called, modify some default settings to behave properly in serial.

- void set_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  set active parallel configuration for the model (set modelPCIter from modelPCIterMap)

- void free_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  deallocate communicator partitions for a model

- MPI_Comm analysis_comm () const
  retrieve the MPI communicator on which this model is configured to conduct function evaluation analyses (provided for library clients)

- void stop_init_communicators (ParLevLIter pl_iter)
  called from IteratorScheduler::init_iterator() for iteratorComm rank 0 to terminate serve_init_communicators() on other iteratorComm processors

- int serve_init_communicators (ParLevLIter pl_iter)
  called from IteratorScheduler::init_iterator() for iteratorComm rank != 0 to balance init_communicators() calls on iteratorComm rank 0

- void estimate_message_lengths ()
  estimate messageLengths for a model

- void assign_rep (Model *model_rep, bool ref_count_incr=true)
  replaces existing letter with a new one

- size_t tv () const
returns total number of vars
• size_t cv() const
  returns number of active continuous variables
• size_t div() const
  returns number of active discrete integer vars
• size_t dsv() const
  returns number of active discrete string vars
• size_t drv() const
  returns number of active discrete real vars
• size_t icv() const
  returns number of inactive continuous variables
• size_t idiv() const
  returns number of inactive discrete integer vars
• size_t idsv() const
  returns number of inactive discrete string vars
• size_t idrv() const
  returns number of inactive discrete real vars
• size_t acv() const
  returns total number of continuous variables
• size_t adiv() const
  returns total number of discrete integer vars
• size_t adsv() const
  returns total number of discrete string vars
• size_t adrv() const
  returns total number of discrete real vars
• void active_variables(const Variables &vars)
  set the active variables in currentVariables
• const RealVector & continuous_variables() const
  return the active continuous variables from currentVariables
• Real continuous_variable(size_t i) const
  return an active continuous variable from currentVariables
• void continuous_variables(const RealVector &c_vars)
  set the active continuous variables in currentVariables
• void continuous_variable(Real c_var, size_t i)
  set an active continuous variable in currentVariables
• const IntVector & discrete_int_variables() const
  return the active discrete integer variables from currentVariables
• int discrete_int_variable(size_t i) const
  return an active discrete integer variable from currentVariables
• void discrete_int_variables(const IntVector &d_vars)
  set the active discrete integer variables in currentVariables
• void discrete_int_variable(int d_var, size_t i)
  set an active discrete integer variable in currentVariables
• StringMultiArrayConstView discrete_string_variables () const
  return the active discrete string variables from currentVariables
• const String & discrete_string_variable (size_t i) const
  return an active discrete string variable from currentVariables
• void discrete_string_variables (StringMultiArrayConstView d_vars)
  set the active discrete string variables in currentVariables
• void discrete_string_variable (const String &d_var, size_t i)
  set an active discrete string variable in currentVariables
• const RealVector & discrete_real_variables () const
  return the active discrete real variables from currentVariables
• Real discrete_real_variable (size_t i) const
  return an active discrete real variable from currentVariables
• void discrete_real_variables (const RealVector &d_vars)
  set the active discrete real variables in currentVariables
• void discrete_real_variable (Real d_var, size_t i)
  set an active discrete real variable in currentVariables
• UShortMultiArrayConstView continuous_variable_types () const
  return the active continuous variable types from currentVariables
• void continuous_variable_types (UShortMultiArrayConstView cv_types)
  set the active continuous variable types in currentVariables
• void continuous_variable_type (unsigned short cv_type, size_t i)
  set an active continuous variable type in currentVariables
• UShortMultiArrayConstView discrete_int_variable_types () const
  return the active discrete variable types from currentVariables
• void discrete_int_variable_types (UShortMultiArrayConstView div_types)
  set the active discrete variable types in currentVariables
• void discrete_int_variable_type (unsigned short div_type, size_t i)
  set an active discrete variable type in currentVariables
• UShortMultiArrayConstView discrete_string_variable_types () const
  return the active discrete variable types from currentVariables
• void discrete_string_variable_types (UShortMultiArrayConstView div_types)
  set the active discrete variable types in currentVariables
• void discrete_string_variable_type (unsigned short div_type, size_t i)
  set an active discrete variable type in currentVariables
• UShortMultiArrayConstView discrete_real_variable_types () const
  return the active discrete variable types from currentVariables
• void discrete_real_variable_types (UShortMultiArrayConstView drv_types)
  set the active discrete variable types in currentVariables
• void discrete_real_variable_type (unsigned short drv_type, size_t i)
  set an active discrete variable type in currentVariables
• SizetMultiArrayConstView continuous_variable_ids () const
  return the active continuous variable identifiers from currentVariables
• void continuous_variable_ids (SizetMultiArrayConstView cv_ids)
set the active continuous variable identifiers in currentVariables

• void continuous_variable_id (size_t cv_id, size_t i)
  set an active continuous variable identifier in currentVariables

• const RealVector & inactive_continuous_variables () const
  return the inactive continuous variables in currentVariables

• void inactive_continuous_variables (const RealVector &i_c_vars)
  set the inactive continuous variables in currentVariables

• const IntVector & inactive_discrete_int_variables () const
  return the inactive discrete variables in currentVariables

• void inactive_discrete_int_variables (const IntVector &i_d_vars)
  set the inactive discrete variables in currentVariables

• StringMultiArrayConstView inactive_discrete_string_variables () const
  return the inactive discrete variables in currentVariables

• void inactive_discrete_string_variables (StringMultiArrayConstView i_d_vars)
  set the inactive discrete variables in currentVariables

• const RealVector & inactive_discrete_real_variables () const
  return the inactive discrete variables in currentVariables

• void inactive_discrete_real_variables (const RealVector &i_d_vars)
  set the inactive discrete variables in currentVariables

• UShortMultiArrayConstView inactive_continuous_variable_types () const
  return the inactive continuous variable types from currentVariables

• SizetMultiArrayConstView inactive_continuous_variable_ids () const
  return the inactive continuous variable identifiers from currentVariables

• const RealVector & all_continuous_variables () const
  return all continuous variables in currentVariables

• void all_continuous_variables (const RealVector &a_c_vars)
  set all continuous variables in currentVariables

• void all_continuous_variable (Real a_c_var, size_t i)
  set a variable within the all continuous variables in currentVariables

• const IntVector & all_discrete_int_variables () const
  return all discrete variables in currentVariables

• void all_discrete_int_variables (const IntVector &a_d_vars)
  set all discrete variables in currentVariables

• void all_discrete_int_variable (int a_d_var, size_t i)
  set a variable within the all discrete variables in currentVariables

• StringMultiArrayConstView all_discrete_string_variables () const
  return all discrete variables in currentVariables

• void all_discrete_string_variables (StringMultiArrayConstView a_d_vars)
  set all discrete variables in currentVariables

• void all_discrete_string_variable (const String &a_d_var, size_t i)
  set a variable within the all discrete variables in currentVariables

• const RealVector & all_discrete_real_variables () const
  return all discrete variables in currentVariables
• void all_discrete_real_variables (const RealVector &a_d_vars)
  set all discrete variables in currentVariables
• void all_discrete_real_variable (Real a_d_var, size_t i)
  set a variable within the all discrete variables in currentVariables
• UShortMultiArrayConstView all_continuous_variable_types () const
  return all continuous variable types from currentVariables
• UShortMultiArrayConstView all_discrete_int_variable_types () const
  return all discrete variable types from currentVariables
• UShortMultiArrayConstView all_discrete_string_variable_types () const
  return all discrete variable types from currentVariables
• UShortMultiArrayConstView all_discrete_real_variable_types () const
  return all discrete variable types from currentVariables
• SizetMultiArrayConstView all_continuous_variable_ids () const
  return all continuous variable identifiers from currentVariables
• const IntSetArray & discrete_design_set_int_values () const
  return the sets of values available for each of the discrete design set integer variables
• void discrete_design_set_int_values (const IntArray &isa)
  define the sets of values available for each of the discrete design set integer variables
• const StringSetArray & discrete_design_set_string_values () const
  return the sets of values available for each of the discrete design set string variables
• void discrete_design_set_string_values (const StringSetArray &ssa)
  define the sets of values available for each of the discrete design set string variables
• const RealSetArray & discrete_design_set_real_values () const
  return the sets of values available for each of the discrete design set real variables
• void discrete_design_set_real_values (const RealSetArray &rsa)
  define the sets of values available for each of the discrete design set real variables
• const IntSetArray & discrete_state_set_int_values () const
  return the sets of values available for each of the discrete state set integer variables
• void discrete_state_set_int_values (const IntSetArray &isa)
  define the sets of values available for each of the discrete state set integer variables
• const StringSetArray & discrete_state_set_string_values () const
  return the sets of values available for each of the discrete state set string variables
• void discrete_state_set_string_values (const StringSetArray &ssa)
  define the sets of values available for each of the discrete state set string variables
• const RealSetArray & discrete_state_set_real_values () const
  return the sets of values available for each of the discrete state set real variables
• void discrete_state_set_real_values (const RealSetArray &rsa)
  define the sets of values available for each of the discrete state set real variables
• const BitArray & discrete_int_sets ()
  define and return discreteIntSets using active view from currentVariables
• const BitArray & discrete_int_sets (short active_view)
  define and return discreteIntSets using passed active view
• const IntSetArray & discrete_set_int_values ()
return the sets of values available for each of the active discrete set integer variables (aggregated in activeDiscSetIntValues)

- const IntSetArray & discrete_set_int_values (short active_view)
  return the sets of values available for each of the active discrete set integer variables (aggregated in activeDiscSetIntValues)

- const StringSetArray & discrete_set_string_values ()
  return the sets of values available for each of the active discrete set string variables (aggregated in activeDiscSetStringValues)

- const StringSetArray & discrete_set_string_values (short active_view)
  return the sets of values available for each of the active discrete set string variables (aggregated in activeDiscSetStringValues)

- const RealSetArray & discrete_set_real_values ()
  return the sets of values available for each of the active discrete set real variables (aggregated in activeDiscSetRealValues)

- const RealSetArray & discrete_set_real_values (short active_view)
  return the sets of values available for each of the active discrete set real variables (aggregated in activeDiscSetRealValues)

- Pecos::AleatoryDistParams & aleatory_distribution_parameters ()
  return aleatDistParams

- const Pecos::AleatoryDistParams & aleatory_distribution_parameters () const
  return aleatDistParams

- void aleatory_distribution_parameters (const Pecos::AleatoryDistParams &adp)
  set aleatDistParams

- Pecos::EpistemicDistParams & epistemic_distribution_parameters ()
  return epistDistParams

- const Pecos::EpistemicDistParams & epistemic_distribution_parameters () const
  return epistDistParams

- void epistemic_distribution_parameters (const Pecos::EpistemicDistParams &edp)
  set epistDistParams

- StringMultiArrayConstView continuous_variable_labels () const
  return the active continuous variable labels from currentVariables

- void continuous_variable_labels (StringMultiArrayConstView c_v_labels)
  set the active continuous variable labels in currentVariables

- StringMultiArrayConstView discrete_int_variable_labels () const
  return the active discrete variable labels from currentVariables

- void discrete_int_variable_labels (StringMultiArrayConstView d_v_labels)
  set the active discrete variable labels in currentVariables

- StringMultiArrayConstView discrete_string_variable_labels () const
  return the active discrete variable labels from currentVariables

- void discrete_string_variable_labels (StringMultiArrayConstView d_v_labels)
  set the active discrete variable labels in currentVariables

- StringMultiArrayConstView discrete_real_variable_labels () const
  return the active discrete variable labels from currentVariables

- void discrete_real_variable_labels (StringMultiArrayConstView d_v_labels)
set the active discrete variable labels in currentVariables

- StringMultiArrayConstView **inactive_discrete_int_variable_labels** () const
  return the inactive discrete variable labels in currentVariables
- void **inactive_discrete_int_variable_labels** (StringMultiArrayConstView i_d_v_labels)
  set the inactive discrete variable labels in currentVariables
- StringMultiArrayConstView **inactive_discrete_string_variable_labels** () const
  return the inactive discrete variable labels in currentVariables
- void **inactive_discrete_string_variable_labels** (StringMultiArrayConstView i_d_v_labels)
  set the inactive discrete variable labels in currentVariables
- StringMultiArrayConstView **inactive_discrete_real_variable_labels** () const
  return the inactive discrete variable labels in currentVariables
- void **inactive_discrete_real_variable_labels** (StringMultiArrayConstView i_d_v_labels)
  set the inactive discrete variable labels in currentVariables
- StringMultiArrayConstView **all_discrete_int_variable_labels** () const
  return all discrete variable labels in currentVariables
- void **all_discrete_int_variable_labels** (StringMultiArrayConstView a_d_v_labels)
  set all discrete variable labels in currentVariables
- void **all_discrete_int_variable_label** (const String &a_d_v_label, size_t i)
  set a label within the all discrete labels in currentVariables
- StringMultiArrayConstView **all_discrete_string_variable_labels** () const
  return all discrete variable labels in currentVariables
- void **all_discrete_string_variable_labels** (StringMultiArrayConstView a_d_v_labels)
  set all discrete variable labels in currentVariables
- void **all_discrete_string_variable_label** (const String &a_d_v_label, size_t i)
  set a label within the all discrete labels in currentVariables
- StringMultiArrayConstView **all_discrete_real_variable_labels** () const
  return all discrete variable labels in currentVariables
- void **all_discrete_real_variable_labels** (StringMultiArrayConstView a_d_v_labels)
  set all discrete variable labels in currentVariables
- void **all_discrete_real_variable_label** (const String &a_d_v_label, size_t i)
  set a label within the all discrete labels in currentVariables
- const StringArray & **response_labels** () const
  return the response labels from currentResponse
CHAPTER 13. CLASS DOCUMENTATION

- **void** response_labels (const StringArray &resp_labels)
  
  set the response labels in currentResponse

- **const RealVector & continuous_lower_bounds () const**
  return the active continuous lower bounds from userDefinedConstraints

- **Real continuous_lower_bound (size_t i) const**
  return an active continuous lower bound from userDefinedConstraints

- **void continuous_lower_bound (const RealVector &c_l_bnds)**
  set the active continuous lower bounds in userDefinedConstraints

- **void continuous_lower_bound (Real c_l_bnd, size_t i)**
  set the i-th active continuous lower bound in userDefinedConstraints

- **const RealVector & continuous_upper_bounds () const**
  return the active continuous upper bounds from userDefinedConstraints

- **Real continuous_upper_bound (size_t i) const**
  return an active continuous upper bound from userDefinedConstraints

- **void continuous_upper_bound (const RealVector &c_u_bnds)**
  set the active continuous upper bounds in userDefinedConstraints

- **void continuous_upper_bound (Real c_u_bnd, size_t i)**
  set the i-th active continuous upper bound in userDefinedConstraints

- **const IntVector & discrete_int_lower_bounds () const**
  return the active discrete int lower bounds from userDefinedConstraints

- **int discrete_int_lower_bound (size_t i) const**
  return an active discrete int lower bound from userDefinedConstraints

- **void discrete_int_lower_bounds (const IntVector &d_l_bnds)**
  set the active discrete int lower bounds in userDefinedConstraints

- **void discrete_int_lower_bound (int d_l_bnd, size_t i)**
  set the i-th active discrete int lower bound in userDefinedConstraints

- **const IntVector & discrete_int_upper_bounds () const**
  return the active discrete int upper bounds from userDefinedConstraints

- **int discrete_int_upper_bound (size_t i) const**
  return an active discrete int upper bound from userDefinedConstraints

- **void discrete_int_upper_bounds (const IntVector &d_u_bnds)**
  set the active discrete int upper bounds in userDefinedConstraints

- **void discrete_int_upper_bound (int d_u_bnd, size_t i)**
  set the i-th active discrete int upper bound in userDefinedConstraints

- **const RealVector & discrete_real_lower_bounds () const**
  return the active discrete real lower bounds from userDefinedConstraints

- **Real discrete_real_lower_bound (size_t i) const**
  return an active discrete real lower bound from userDefinedConstraints

- **void discrete_real_lower_bounds (const RealVector &d_l_bnds)**
  set the active discrete real lower bounds in userDefinedConstraints

- **void discrete_real_lower_bound (Real d_l_bnd, size_t i)**
  set the i-th active discrete real lower bound in userDefinedConstraints

- **const RealVector & discrete_real_upper_bounds () const**
return the active discrete real upper bounds from userDefinedConstraints

- Real discrete_real_upper_bound (size_t i) const
  return an active discrete real upper bound from userDefinedConstraints
- void discrete_real_upper_bounds (const RealVector &d_u_bnds)
  set the active discrete real upper bounds in userDefinedConstraints
- void discrete_real_upper_bound (Real d_u_bnd, size_t i)
  set the i-th active discrete real upper bound in userDefinedConstraints
- const RealVector & inactive_continuous_lower_bounds () const
  return the inactive continuous lower bounds in userDefinedConstraints
- void inactive_continuous_lower_bounds (const RealVector &i_c_l_bnds)
  set the inactive continuous lower bounds in userDefinedConstraints
- const RealVector & inactive_continuous_upper_bounds () const
  return the inactive continuous upper bounds in userDefinedConstraints
- void inactive_continuous_upper_bounds (const RealVector &i_c_u_bnds)
  set the inactive continuous upper bounds in userDefinedConstraints
- const IntVector & inactive_discrete_int_lower_bounds () const
  return the inactive discrete lower bounds in userDefinedConstraints
- void inactive_discrete_int_lower_bounds (const IntVector &i_d_l_bnds)
  set the inactive discrete lower bounds in userDefinedConstraints
- const IntVector & inactive_discrete_int_upper_bounds () const
  return the inactive discrete upper bounds in userDefinedConstraints
- void inactive_discrete_int_upper_bounds (const IntVector &i_d_u_bnds)
  set the inactive discrete upper bounds in userDefinedConstraints
- const RealVector & inactive_discrete_real_lower_bounds () const
  return the inactive discrete real lower bounds in userDefinedConstraints
- void inactive_discrete_real_lower_bounds (const RealVector &i_d_l_bnds)
  set the inactive discrete real lower bounds in userDefinedConstraints
- const RealVector & inactive_discrete_real_upper_bounds () const
  return the inactive discrete real upper bounds in userDefinedConstraints
- void inactive_discrete_real_upper_bounds (const RealVector &i_d_u_bnds)
  set the inactive discrete real upper bounds in userDefinedConstraints
- const RealVector & all_continuous_lower_bounds () const
  return all continuous lower bounds in userDefinedConstraints
- void all_continuous_lower_bounds (const RealVector &a_c_l_bnds)
  set all continuous lower bounds in userDefinedConstraints
- void all_continuous_lower_bound (Real a_c_l_bnd, size_t i)
  set a lower bound within continuous lower bounds in userDefinedConstraints
- const RealVector & all_continuous_upper_bounds () const
  return all continuous upper bounds in userDefinedConstraints
- void all_continuous_upper_bounds (const RealVector &a_c_u_bnds)
  set all continuous upper bounds in userDefinedConstraints
- void all_continuous_upper_bound (Real a_c_u_bnd, size_t i)
  set an upper bound within all continuous upper bounds in userDefinedConstraints
CHAPTER 13. CLASS DOCUMENTATION

- const IntVector & all_discrete_int_lower_bounds () const
  return all discrete lower bounds in userDefinedConstraints
- void all_discrete_int_lower_bounds (const IntVector &a_d_l_bnds)
  set all discrete lower bounds in userDefinedConstraints
- void all_discrete_int_lower_bound (int a_d_l_bnd, size_t i)
  set a lower bound within all discrete lower bounds in userDefinedConstraints
- const IntVector & all_discrete_int_upper_bounds () const
  return all discrete upper bounds in userDefinedConstraints
- void all_discrete_int_upper_bounds (const IntVector &a_d_u_bnds)
  set all discrete upper bounds in userDefinedConstraints
- void all_discrete_int_upper_bound (int a_d_u_bnd, size_t i)
  set an upper bound within all discrete upper bounds in userDefinedConstraints
- const RealVector & all_discrete_real_lower_bounds () const
  return all discrete lower bounds in userDefinedConstraints
- void all_discrete_real_lower_bounds (const RealVector &a_d_l_bnds)
  set all discrete lower bounds in userDefinedConstraints
- void all_discrete_real_lower_bound (Real a_d_l_bnd, size_t i)
  set a lower bound within all discrete lower bounds in userDefinedConstraints
- const RealVector & all_discrete_real_upper_bounds () const
  return all discrete upper bounds in userDefinedConstraints
- void all_discrete_real_upper_bounds (const RealVector &a_d_u_bnds)
  set all discrete upper bounds in userDefinedConstraints
- void all_discrete_real_upper_bound (Real a_d_u_bnd, size_t i)
  set an upper bound within all discrete upper bounds in userDefinedConstraints
- size_t num_linear_ineq_constraints () const
  return the number of linear inequality constraints
- size_t num_linear_eq_constraints () const
  return the number of linear equality constraints
- const RealMatrix & linear_ineq_constraint_coeffs () const
  return the linear inequality constraint coefficients
- void linear_ineq_constraint_coeffs (const RealMatrix &lin_ineq_coeffs)
  set the linear inequality constraint coefficients
- const RealVector & linear_ineq_constraint_lower_bounds () const
  return the linear inequality constraint lower bounds
- void linear_ineq_constraint_lower_bounds (const RealVector &lin_ineq_l_bnds)
  set the linear inequality constraint lower bounds
- const RealVector & linear_ineq_constraint_upper_bounds () const
  return the linear inequality constraint upper bounds
- void linear_ineq_constraint_upper_bounds (const RealVector &lin_ineq_u_bnds)
  set the linear inequality constraint upper bounds
- const RealMatrix & linear_eq_constraint_coeffs () const
  return the linear equality constraint coefficients
- void linear_eq_constraint_coeffs (const RealMatrix &lin_eq_coeffs)
set the linear equality constraint coefficients

- const RealVector & linear_eq_constraint_targets () const
  return the linear equality constraint targets

- void linear_eq_constraint_targets (const RealVector & lin_eq_targets)
  set the linear equality constraint targets

- size_t num_nonlinear_ineq_constraints () const
  return the number of nonlinear inequality constraints

- size_t num_nonlinear_eq_constraints () const
  return the number of nonlinear equality constraints

- const RealVector & nonlinear_ineq_constraint_lower_bounds () const
  return the nonlinear inequality constraint lower bounds

- void nonlinear_ineq_constraint_lower_bounds (const RealVector & nln_ineq_l_bnds)
  set the nonlinear inequality constraint lower bounds

- const RealVector & nonlinear_ineq_constraint_upper_bounds () const
  return the nonlinear inequality constraint upper bounds

- void nonlinear_ineq_constraint_upper_bounds (const RealVector & nln_ineq_u_bnds)
  set the nonlinear inequality constraint upper bounds

- const RealVector & nonlinear_eq_constraint_targets () const
  return the nonlinear equality constraint targets

- void nonlinear_eq_constraint_targets (const RealVector & nln_eq_targets)
  set the nonlinear equality constraint targets

- const Variables & current_variables () const
  return the current variables (currentVariables) as const reference (preferred)

- Variables & current_variables ()
  return the current variables (currentVariables) in mutable form (special cases)

- const Constraints & user_defined_constraints () const
  return the user-defined constraints (userDefinedConstraints)

- const Response & current_response () const
  return the current response (currentResponse)

- ProblemDescDB & problem_description_db () const
  return the problem description database (probDescDB)

- ParallelLibrary & parallel_library () const
  return the parallel library (parallelLib)

- const String & model_type () const
  return the model type (modelType)

- const String & surrogate_type () const
  return the surrogate type (surrogateType)

- const String & model_id () const
  return the model identifier (modelId)

- size_t num_functions () const
  return number of functions in currentResponse

- size_t num_primary_fns () const
  return number of primary functions (total less nonlinear constraints)
const String & gradient_type () const
return the gradient evaluation type (gradientType)

const String & method_source () const
return the numerical gradient evaluation method source (methodSource)

const String & interval_type () const
return the numerical gradient evaluation interval type (intervalType)

bool ignore_bounds () const
option for ignoring bounds when numerically estimating derivatives

bool central_hess () const
option for using old 2nd-order scheme when computing finite-diff Hessian

const RealVector & fd_gradient_step_size () const
return the finite difference gradient step size (fdGradStepSize)

const String & fd_gradient_step_type () const
return the finite difference gradient step type (fdGradStepType)

const IntSet & gradient_id_analytic () const
return the mixed gradient analytic IDs (gradIdAnalytic)

const IntSet & gradient_id_numerical () const
return the mixed gradient numerical IDs (gradIdNumerical)

const String & hessian_type () const
return the Hessian evaluation type (hessianType)

const String & quasi_hessian_type () const
return the Hessian evaluation type (quasiHessType)

const RealVector & fd_hessian_by_grad_step_size () const
return gradient-based finite difference Hessian step size (fdHessByGradStepSize)

const RealVector & fd_hessian_by_fn_step_size () const
return function-based finite difference Hessian step size (fdHessByFnStepSize)

const String & fd_hessian_step_type () const
return the finite difference Hessian step type (fdHessStepType)

const IntSet & hessian_id_analytic () const
return the mixed Hessian analytic IDs (hessIdAnalytic)

const IntSet & hessian_id_numerical () const
return the mixed Hessian analytic IDs (hessIdNumerical)

const IntSet & hessian_id_quasi () const
return the mixed Hessian analytic IDs (hessIdQuasi)

void primary_response_fn_sense (const BoolDeque &sense)
set the optimization sense for multiple objective functions

const BoolDeque & primary_response_fn_sense () const
get the optimization sense for multiple objective functions

const RealVector & primary_response_fn_weights () const
get the relative weightings for multiple objective functions or least squares terms

const ScalingOptions & scaling_options () const
user-provided scaling options

short primary_fn_type () const
get the primary response function type (generic, objective, calibration)

- void primary_fn_type (short type)
  set the primary response function type, e.g., when recasting

- bool derivative_estimation ()
  indicates potential usage of estimate_derivatives() based on gradientType/hessianType

- void supports_derivative_estimation (bool sed_flag)
  set whether this model should perform or pass on derivative estimation

- void init_comms_bcast_flag (bool icb_flag)
  set initCommsBcastFlag

- int evaluation_capacity () const
  return the evaluation capacity for use in iterator logic

- int derivative_concurrency () const
  return the gradient concurrency for use in parallel configuration logic

- bool asynch_flag () const
  return the asynchronous evaluation flag (asynchEvalFlag)

- void asynch_flag (const bool flag)
  set the asynchronous evaluation flag (asynchEvalFlag)

- short output_level () const
  return the outputLevel

- void output_level (const short level)
  set the outputLevel

- const IntArray & message_lengths () const
  return the array of MPI packed message buffer lengths (messageLengths)

- void parallel_configuration_iterator (ParConfigLIter pc_iter)
  set modelPCIter

- ParConfigLIter parallel_configuration_iterator () const
  return modelPCIter

- void auto_graphics (const bool flag)
  set modelAutoGraphicsFlag to activate posting of graphics data within evaluate/synchronize functions (automatic graphics posting in the model as opposed to graphics posting at the strategy level).

- bool is_null () const
  function to check modelRep (does this envelope contain a letter)

- Model * model_rep () const
  returns modelRep for access to derived class member functions that are not mapped to the top Model level

**Protected Member Functions**

- Model (BaseConstructor, ProblemDescDB &problem_db)
  constructor initializing the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

- Model (LightWtBaseConstructor, ProblemDescDB &problem_db, ParallelLibrary &parallel_lib, const Shared-VariablesData &svd, const SharedResponseData &srd, const ActiveSet &set, short output_level)
  constructor initializing base class for derived model class instances constructed on the fly

- Model (LightWtBaseConstructor, ProblemDescDB &problem_db, ParallelLibrary &parallel_lib)
constructor initializing base class for recast model instances

- virtual void derived_evaluate (const ActiveSet &set)
  portion of evaluate() specific to derived model classes
- virtual void derived_evaluate_nowait (const ActiveSet &set)
  portion of evaluate_nowait() specific to derived model classes
- virtual const IntResponseMap & derived_synchronize ()
  portion of synchronize() specific to derived model classes
- virtual const IntResponseMap & derived_synchronize_nowait ()
  portion of synchronize_nowait() specific to derived model classes
- virtual void derived_init_communicators (ParLevLLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  portion of init_communicators() specific to derived model classes
- virtual void derived_init_serial ()
  portion of init_serial() specific to derived model classes
- virtual void derived_set_communicators (ParLevLLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  portion of set_communicators() specific to derived model classes
- virtual void derived_free_communicators (ParLevLLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  portion of free_communicators() specific to derived model classes
- virtual void derived_set_asynchronous_mode (int max_eval_concurrency)
  default logic for defining asynchEvalFlag and evaluationCapacity based on ie_pl settings
- void string_variable_max (const StringSetArray &ssa, size_t offset, Variables &vars)
  set the current value of each string variable offset + i to the longest string value found in the admissible string set ssa[i]
- void string_variable_max (const StringRealMapArray &srma, size_t offset, Variables &vars)
  set the current value of each string variable offset + i to the longest string value found in the admissible string map srma[i]
- SizetMultiArrayConstView initialize_x0_bounds (const SizetArray &original_dv, bool &active_derivs, bool &inactive_derivs, RealVector &x0, RealVector &fd_lb, RealVector &fd_ub) const
  Initialize data needed for computing finite differences (active/inactive, center point, and bounds)
- Real forward_grad_step (size_t num_deriv_vars, size_t xj_index, Real x0_j, Real lb_j, Real ub_j)
  Compute the forward step for a finite difference gradient; updates shortStep.

Protected Attributes

- Variables currentVariables
  the set of current variables used by the model for performing function evaluations
- size_t numDerivVars
  the number of active continuous variables used in computing most response derivatives (i.e., in places such as quasi-Hessians and response corrections where only the active continuous variables are supported)
- Response currentResponse
  the set of current responses that holds the results of model function evaluations
- size_t numFns
  the number of functions in currentResponse
- Constraints userDefinedConstraints
Explicit constraints on variables are maintained in the Constraints class hierarchy. Currently, this includes linear constraints and bounds, but could be extended in the future to include other explicit constraints which (1) have their form specified by the user, and (2) are not catalogued in Response since their form and coefficients are published to an iterator at startup.

- **String modelId**
  model identifier string from the input file
- **String modelType**
  type of model: simulation, nested, or surrogate
- **String surrogateType**
  type of surrogate model: local, multipoint, global, or hierarchical
- **String gradientType**
  type of gradient data: analytic, numerical, mixed, or none
- **String methodSource**
  source of numerical gradient routine: dakota or vendor
- **String intervalType**
  type of numerical gradient interval: central or forward
- **String hessianType**
  type of Hessian data: analytic, numerical, quasi, mixed, or none
- **RealVector fdGradStepSize**
  relative finite difference step size for numerical gradients
- **String fdGradStepType**
  type of finite difference step to use for numerical gradient: relative - step length is relative to x absolute - step length is what is specified bounds - step length is relative to range of x
- **RealVector fdHessByGradStepSize**
  relative finite difference step size for numerical Hessians estimated using first-order differences of gradients
- **RealVector fdHessByFnStepSize**
  relative finite difference step size for numerical Hessians estimated using second-order differences of function values
- **String fdHessStepType**
  type of finite difference step to use for numerical Hessian: relative - step length is relative to x absolute - step length is what is specified bounds - step length is relative to range of x
- **bool ignoreBounds**
  option to ignore bounds when computing finite diffs
- **bool centralHess**
  option to use old 2nd-order finite diffs for Hessians
- **bool supportsEstimDerivs**
  whether model should perform or forward derivative estimation
- **String quasiHessType**
  quasi-Hessian type: bfgs, damped_bfgs, sr1
- **IntSet gradIdAnalytic**
  analytic id’s for mixed gradients
- **IntSet gradIdNumerical**
  numerical id’s for mixed gradients
- **IntSet hessIdAnalytic**
  analytic id’s for mixed Hessians
• IntSet hessIdNumerical
  numerical id’s for mixed Hessians
• IntSet hessIdQuasi
  quasi id’s for mixed Hessians
• IntArray messageLengths
  length of packed MPI buffers containing vars, vars/set, response, and PRPair
• ProblemDescDB & probDescDB
  class member reference to the problem description database
• ParallelLibrary & parallelLib
  class member reference to the parallel library
• ParConfigLIter modelPCIter
  the ParallelConfiguration node used by this Model instance
• short componentParallelMode
  the component parallelism mode: 0 (none), 1 (INTERFACE/LF_MODEL), or 2 (SUB_MODEL/HF_MODEL/TRUTH_MODEL)
• bool asynchEvalFlag
  flags asynch evaluations (local or distributed)
• int evaluationCapacity
  capacity for concurrent evaluations supported by the Model
• short outputLevel
  output verbosity level: \{SILENT, QUIET, NORMAL, VERBOSE, DEBUG\}.OUTPUT
• ModelList modelList
  used to collect sub-models for subordinate_models()
• IntSetArray discreteDesignSetIntValues
  array of IntSet’s, each containing the set of allowable integer values corresponding to a discrete design integer set variable
• StringSetArray discreteDesignSetStringValues
  array of IntSet’s, each containing the set of allowable integer values corresponding to a discrete design string set variable
• RealSetArray discreteDesignSetRealValues
  array of RealSet’s, each containing the set of allowable real values corresponding to a discrete design real set variable
• IntSetArray discreteStateSetIntValues
  array of IntSet’s, each containing the set of allowable integer values corresponding to a discrete state integer set variable
• StringSetArray discreteStateSetStringValues
  array of IntSet’s, each containing the set of allowable integer values corresponding to a discrete state string set variable
• RealSetArray discreteStateSetRealValues
  array of RealSet’s, each containing the set of allowable real values corresponding to a discrete state real set variable
• Pecos::AleatoryDistParams aleatDistParams
  container for aleatory random variable distribution parameters
• Pecos::EpistemicDistParams epistDistParams

CHAPTER 13. CLASS DOCUMENTATION
container for epistemic random variable distribution parameters

- BoolDeque primaryRespFnSense
  array of flags (one per primary function) for switching the sense to maximize the primary function (default is minimize)

- RealVector primaryRespFnWts
  primary response function weightings (either weights for multiobjective optimization or weighted least squares)

- bool hierarchicalTagging
  whether to perform hierarchical evalID tagging of params/results

- ScalingOptions scalingOpts
  user-provided scaling data from the problem DB, possibly modified by Recasting

- String evalTagPrefix
  cached evalTag Prefix from parents to use at evaluate time

Private Member Functions

- Model * get_model (ProblemDescDB &problem_db)
  Used by the envelope to instantiate the correct letter class.

- int estimate_derivatives (const ShortArray &map_asv, const ShortArray &fd_grad_asv, const ShortArray &fd_hess_asv, const ShortArray &quasi_hess_asv, const ActiveSet &original_set, const bool asynch_flag)
  evaluate numerical gradients using finite differences. This routine is selected with "method source dakota" (the default method source) in the numerical gradient specification.

- void synchronize_derivatives (const Variables &vars, const IntResponseMap &fd_responses, Response &new_response, const ShortArray &fd_grad_asv, const ShortArray &fd_hess_asv, const ShortArray &quasi_hess_asv, const ActiveSet &original_set)
  combine results from an array of finite difference response objects (fd_grad_responses) into a single response (new_response)

- void update_response (const Variables &vars, Response &new_response, const ShortArray &fd_grad_asv, const ShortArray &fd_hess_asv, const ShortArray &quasi_hess_asv, const ActiveSet &original_set, Response &initial_map_response, const RealMatrix &new_fn_grads, const RealSymMatrixArray &new_fn_hessians)
  overlay results to update a response object

- void update_quasi_hessians (const Variables &vars, Response &new_response, const ActiveSet &original_set)
  perform quasi-Newton Hessian updates

- Real finite_difference_lower_bound (UShortMultiArrayConstView cv_types, const RealVector &global_c_l_bnds, size_t cv_index) const
  return the lower bound for a finite difference offset, drawn from global or distribution bounds

- Real finite_difference_upper_bound (UShortMultiArrayConstView cv_types, const RealVector &global_c_u_bnds, size_t cv_index) const
  return the upper bound for a finite difference offset, drawn from global or distribution bounds

- bool manage_asv (const ActiveSet &original_set, ShortArray &map_asv_out, ShortArray &fd_grad_asv_out, ShortArray &fd_hess_asv_out, ShortArray &quasi_hess_asv_out)
  Coordinates usage of estimate_derivatives() calls based on asv.in.

- Real initialize_h (Real x_j, Real lb_j, Real ub_j, Real step_size, String step_type) const
  function to determine initial finite difference h (before step length adjustment) based on type of step desired
• Real $\text{FDstep1}$ ($\text{Real } x_0, \text{Real } lb, \text{Real } ub, \text{Real } h_{\text{mag}}$)
  
  function returning finite-difference step size (affected by bounds)

• Real $\text{FDstep2}$ ($\text{Real } x_0, \text{Real } lb, \text{Real } ub, \text{Real } h$)
  
  function returning second central-difference step size (affected by bounds)

**Private Attributes**

• int $\text{modelEvalCntr}$
  
  evaluation counter for top-level $\text{evaluate()}$ and $\text{evaluate\_nowait()}$ calls. Differs from lower level counters in case of numerical derivative estimation (several lower level evaluations are assimilated into a single higher level evaluation)

• bool $\text{estDerivsFlag}$
  
  flags presence of estimated derivatives within a set of calls to $\text{evaluate\_nowait()}$

• bool $\text{shortStep}$
  
  flags finite-difference step size adjusted by bounds

• std::map $\langle$ SizetIntPair, ParConfigIter $\rangle$ $\text{modelPCIterMap}$
  
  map $\langle\rangle$ used for tracking modelPCIter instances using depth of parallelism level and max evaluation concurrency as the lookup keys

• bool $\text{initCommsBcastFlag}$
  
  flag for determining need to bcast the max concurrency from $\text{init\_communicators()}$; set from IteratorScheduler::$\text{init\_iterator()}$

• bool $\text{modelAutoGraphicsFlag}$
  
  flag for posting of graphics data within $\text{evaluate()}$ (automatic graphics posting in the model as opposed to graphics posting at the strategy level)

• VariablesList $\text{varsList}$
  
  history of vars populated in $\text{evaluate\_nowait()}$ and used in $\text{synchronize()}$.

• std::list $\langle$ ShortArray $\rangle$ $\text{asvList}$
  
  if $\text{estimate\_derivatives()}$ is used, transfers ASVs from $\text{evaluate\_nowait()}$ to $\text{synchronize()}$

• std::list $\langle$ ActiveSet $\rangle$ $\text{setList}$
  
  if $\text{estimate\_derivatives()}$ is used, transfers ActiveSets from $\text{evaluate\_nowait()}$ to $\text{synchronize()}$

• BoolList $\text{initialMapList}$
  
  transfers initial_map flag values from $\text{estimate\_derivatives()}$ to $\text{synchronize\_derivatives()}$

• BoolList $\text{dbCaptureList}$
  
  transfers db_capture flag values from $\text{estimate\_derivatives()}$ to $\text{synchronize\_derivatives()}$

• ResponseList $\text{dbResponseList}$
  
  transfers database captures from $\text{estimate\_derivatives()}$ to $\text{synchronize\_derivatives()}$

• RealList $\text{deltaList}$
  
  transfers deltas from $\text{estimate\_derivatives()}$ to $\text{synchronize\_derivatives()}$

• IntIntMap $\text{numFDEvalsMap}$
  
  tracks the number of evaluations used within $\text{estimate\_derivatives()}$. Used in $\text{synchronize()}$ as a key for combining finite difference responses into numerical gradients.

• IntIntMap $\text{rawEvalIdMap}$
  
  maps from the raw evaluation ids returned by $\text{derived\_synchronize()}$ and $\text{derived\_synchronize\_nowait()}$ to the corresponding modelEvalCntr id. Used for rekeying responseMap.
• RealVectorArray $x_{\text{Prev}}$
  previous parameter vectors used in computing $s$ for quasi-Newton updates

• RealMatrix $f_{\text{GradsPrev}}$
  previous gradient vectors used in computing $y$ for quasi-Newton updates

• RealSymMatrixArray quasiHessians
  quasi-Newton Hessian approximations

• SizetArray numQuasiUpdates
  number of quasi-Newton Hessian updates applied

• IntResponseMap responseMap
  used to return a map of responses for asynchronous evaluations in final concatenated form. The similar map in Interface contains raw responses.

• IntResponseMap graphicsRespMap
  used to cache the data returned from derived synchronize_nowait() prior to sequential input into the graphics

• IntSetArray activeDiscSetIntValues
  aggregation of the admissible value sets for all active discrete set integer variables

• StringSetArray activeDiscSetStringValue
  aggregation of the admissible value sets for all active discrete set string variables

• RealSetArray activeDiscSetRealValues
  aggregation of the admissible value sets for all active discrete set real variables

• BitArray discreteIntSets
  key for identifying discrete integer set variables within the active discrete integer variables

• Model * modelRep
  pointer to the letter (initialized only for the envelope)

• int referenceCount
  number of objects sharing modelRep

Friends

• bool operator==(const Model &m1, const Model &m2)
  equality operator (detect same letter instance)

• bool operator!=(const Model &m1, const Model &m2)
  inequality operator (detect different letter instances)

13.77.1 Detailed Description

Base class for the model class hierarchy.

The Model class is the base class for one of the primary class hierarchies in DAKOTA. The model hierarchy contains a set of variables, an interface, and a set of responses, and an iterator operates on the model to map the variables into responses using the interface. For memory efficiency and enhanced polymorphism, the model hierarchy employs the "letter/envelope idiom" (see Coplien "Advanced C++", p. 133), for which the base class (Model) serves as the envelope and one of the derived classes (selected in Model::get_model()) serves as the letter.
13.77.2 Constructor & Destructor Documentation

Model ( )

default constructor

The default constructor is used in vector<Model> instantiations and for initialization of Model objects contained in Iterator and derived Strategy classes. modelRep is NULL in this case (a populated problem_db is needed to build a meaningful Model object). This makes it necessary to check for NULL in the copy constructor, assignment operator, and destructor.

Model ( ProblemDescDB & problem_db )

standard constructor for envelope

Used in model instantiations within strategy constructors. Envelope constructor only needs to extract enough data to properly execute get_model, since Model(BaseConstructor, problem_db) builds the actual base class data for the derived models.

References Dakota::abort_handler(), Model::get_model(), and Model::modelRep.

Model ( const Model & model )

copy constructor

Copy constructor manages sharing of modelRep and incrementing of referenceCount.

References Model::modelRep, and Model::referenceCount.

~Model ( ) [virtual]

destructor

Destructor decrements referenceCount and only deletes modelRep when referenceCount reaches zero.

References Model::modelRep, and Model::referenceCount.

Model ( BaseConstructor, ProblemDescDB & problem_db ) [protected]

constructor initializing the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

This constructor builds the base class data for all inherited models. get_model() instantiates a derived class and the derived class selects this base class constructor in its initialization list (to avoid the recursion of the base class constructor calling get_model() again). Since the letter IS the representation, its representation pointer is set to NULL (an uninitialized pointer causes problems in ~Model).

References Dakota::abort_handler(), Model::currentResponse, Model::fdGradStepSize, Model::fdHessByGradStepSize, Model::fdHessByFnStepSize, ProblemDescDB::get_sa(), Model::gradIdNumerical, Model::gradientType, Model::hessianType, Model::hessIdNumerical, Response::num_functions(), Constraints::num_nonlinear_eq_constraints(), Constraints::num_nonlinear_ineq_constraints(), Model::primaryRespFnSense, Dakota::strbegins(), Dakota::strtolower(), and Model::userDefinedConstraints.

Model ( LightWtBaseConstructor, ProblemDescDB & problem_db, ParallelLibrary & parallel_lib ) [protected]

constructor initializing base class for recast model instances

This constructor also builds the base class data for inherited models. However, it is used for recast models which are instantiated on the fly. Therefore it only initializes a small subset of attributes.
13.77.3 Member Function Documentation

Model operator=( const Model & model )

assignment operator


References Model::modelRep, and Model::referenceCount.

Iterator & subordinate_iterator( ) [virtual]

return the sub-iterator in nested and surrogate models

return by reference requires use of dummy objects, but is important to allow use of assign_rep() since this operation must be performed on the original envelope object.

Reimplemented in RecastModel, DataFitSurrModel, and NestedModel.

References Dakota::dummy_iterator, Model::modelRep, and Model::subordinate_iterator().

Reimplemented by NonDPolynomialChaos::append_expansion(), NonDExpansion::compute_expansion(), NonDExpansion::compute_print_converged_results(), NonDExpansion::compute_print_iteration_results(), SurrBasedLocalMinimizer::core_run(), SurrBasedGlobalMinimizer::core_run(), NonDExpansion::finalize_sets(), NonDGlobalReliability::get_best_sample(), NonDPolynomialChaos::increment_grid_from_order(), NonDPolynomialChaos::increment_sample_sequence(), NonDExpansion::increment_sets(), NonDPolynomialChaos::increment_specification_sequence(), NonDExpansion::increment_specification_sequence(), DOTOptimizer::initialize(), CONMNOptimizer::initialize(), NCSUOptimizer::initialize(), NLPQLP Optimizer::initialize(), NonDExpansion::initialize_expansion(), NonDExpansion::initialize_sets(), NonDStochCollocation::initialize_u_space_model(), NonDPolynomialChaos::initialize_u_space_model(), NonDExpansion::initialize_u_space_model(), NonDPolynomialChaos::multilevel_regression(), NonDLocalInterval::NonDLocalInterval(), NonDLocalReliability::NonDLocalReliability(), NonDExpansion::refine_expansion(), SOLBase::SOLBase(), Model::subordinate_iterator(), RecastModel::subordinate_iterator(), NonDStochCollocation::update_expansion(), and NonDQUESOBayesCalibration::update_model().

Model & subordinate_model( ) [virtual]

return a single sub-model defined from subModel in nested and recast models and truth_model() in surrogate models; used for a directed dive through model recursions that may bypass some components.

return by reference requires use of dummy objects, but is important to allow use of assign_rep() since this operation must be performed on the original envelope object.

Reimplemented in RecastModel, NestedModel, and SurrogateModel.

References Dakota::dummy_model, Model::modelRep, and Model::subordinate_model().

Reimplemented by NonDGlobalReliability::expected_feasibility(), NonDGlobalReliability::expected_improvement(), SurrogateModel::force_rebuild(), NonDExpansion::initialize_expansion(), Minimizer::initialize_run(), NonDExpansion::initialize_u_space_model(), NonDGlobalReliability::optimize_gaussian_process(), Minimizer::original_model(), LeastSq::post_run(), COLINOptimizer::post_run(), Optimizer::primary_resp_reducer(), LeastSq::primary_resp_weighter(), LeastSq::print_results(), Model::subordinate_model(), DataFitSurrModel::update_global(), and LeastSq::weight_model().

Model & surrogate_model( ) [virtual]

return the active approximation sub-model in surrogate models

return by reference requires use of dummy objects, but is important to allow use of assign_rep() since this operation must be performed on the original envelope object.

Reimplemented in RecastModel, DataFitSurrModel, and HierarchSurrModel.

References Dakota::dummy_model, Model::modelRep, and Model::surrogate_model().
Referenced by NonDAdaptiveSampling::calc_score_delta_y(), NonDAdaptiveSampling::calc_score_topo_alm_hybrid(), NonDAdaptiveSampling::calc_score_topo_avg_persistence(), NonDAdaptiveSampling::calc_score_topo_bottleneck(), NonDMultilevelSampling::control_variate_mc(), SurrBasedLocalMinimizer::core_run(), SurrBasedGlobalMinimizer::core_run(), SurrBasedLocalMinimizer::find_center_approx(), NonDMultilevelSampling::multilevel_control_variate_mc(), NonDMultilevelSampling::NonDMultilevelSampling(), NonDAdaptiveSampling::output_round_data(), SurrBasedLocalMinimizer::SurrBasedLocalMinimizer(), Model::surrogate_model(), and RecastModel::surrogate_model().

Model & truth_model() [virtual]
return the active truth sub-model in surrogate models
return by reference requires use of dummy objects, but is important to allow use of assign_rep() since this operation must be performed on the original envelope object.
Reimplemented in RecastModel, DataFitSurrModel, and HierarchSurrModel.
References Dakota::dummy_model, Model::modelRep, and Model::truth_model().

Referenced by NonDMultilevelSampling::control_variate_mc(), SurrBasedLocalMinimizer::core_run(), SurrBasedGlobalMinimizer::core_run(), SurrogateModel::force_rebuild(), SurrogateModel::force_rebuild(), SurrogateModel::initialize_graphics(), NonDPolynomialChaos::multifidelity_expansion(), NonDMultilevelSampling::multilevel_control_variate_mc(), NonDMultilevelSampling::multilevel_mc(), NonDLocalReliability::NonDLocalReliability(), NonDMultilevelSampling::NonDMultilevelSampling(), SurrogateModel::print_results(), NonDMultilevelSampling::print_results(), SurrogateModel::subordinate_model(), SurrBasedGlobalMinimizer::SurrBasedGlobalMinimizer(), SurrBasedLocalMinimizer::SurrBasedLocalMinimizer(), Model::truth_model(), and RecastModel::truth_model().

void update_from_subordinate_model(size_t depth = std::numeric_limits<size_t>::max()) [virtual]
propagate vars/labels/bounds/targets from the bottom up
used only for instantiate-on-the-fly model recursions (all RecastModel instantiations and alternate DataFitSurrModel instantiations). Simulation, Hierarchical, and Nested Models do not redefine the function since they do not support instantiate-on-the-fly. This means that the recursion will stop as soon as it encounters a Model that was instantiated normally, which is appropriate since ProblemDescDB-constructed Models use top-down information flow and do not require bottom-up updating.
Reimplemented in RecastModel, and DataFitSurrModel.
References Model::modelRep, and Model::update_from_subordinate_model().

Referenced by NonDGlobalInterval::core_run(), NonDLocalInterval::core_run(), NonDLocalReliability::initialize_class_data(), NonDExpansion::initialize_expansion(), LeastSq::initialize_run(), Optimizer::initialize_run(), EffectiveGlobalMinimizer::initialize_surrogates_on_model(), NonDGlobalReliability::optimize_gaussian_process(), DataFitSurrModel::update_from_subordinate_model(), Model::update_from_subordinate_model(), and RecastModel::update_from_subordinate_model().

Interface & derived_interface() [virtual]
return the interface employed by the derived model class, if present: SimulationModel::userDefinedInterface, DataFitSurrModel::approxInterface, or NestedModel::optionalInterface
return by reference requires use of dummy objects, but is important to allow use of assign_rep() since this operation must be performed on the original envelope object.
Reimplemented in RecastModel, DataFitSurrModel, NestedModel, and SimulationModel.
References Model::derived_interface(), Dakota::dummy_interface, and Model::modelRep.
Referenced by SurrBasedGlobalMinimizer::core_run(), Model::derived_interface(), and RecastModel::derived_interface().

```cpp
size_t solution_levels() const [virtual]
```

number of discrete levels within solution control (SimulationModel)
return the number of levels within a solution / discretization hierarchy.
Reimplemented in SimulationModel.
References Model::modelRep, and Model::solution_levels().
Referenced by NonDPolynomialChaos::multifidelity_expansion(), NonDMultilevelSampling::multilevel_control_variate_mc(), NonDMultilevelSampling::multilevel_mc(), NonDPolynomialChaos::multilevel_regression(), NonDMultilevelSampling::NonDMultilevelSampling(), and Model::solution_levels().

```cpp
void solution_level_index(size_t index) [virtual]
```

activate a particular level within the solution level control and return the cost estimate (SimulationModel)
activate a particular level within a solution / discretization hierarchy and return the cost estimate.
Reimplemented in SimulationModel.
References Dakota::abort_handler(), Model::modelRep, and Model::solution_level_index().
Referenced by HierarchSurrModel::build_approximation(), HierarchSurrModel::derived_evaluate(), HierarchSurrModel::derived_evaluate_nowait(), and Model::solution_level_index().

```cpp
short local_eval_synchronization() [virtual]
```

return derived model synchronization setting

*SimulationModels and HierarchSurrModels redefine this virtual function.*
*A default value of "synchronous" prevents async local operations for:*

- NestedModels: a subIterator can support message passing parallelism, but not async local.
- DataFitSurrModels: while async evals on approximations will work due to some added bookkeeping, avoiding them is preferable.

Reimplemented in RecastModel, NestedModel, and SimulationModel.
References Model::local_eval_synchronization(), and Model::modelRep.
Referenced by Model::init_serial(), RecastModel::local_eval_synchronization(), Model::local_eval_synchronization(), and Model::set_ie_asynchronous_mode().

```cpp
int local_eval_concurrency() [virtual]
```

return derived model asynchronous evaluation concurrency

*SimulationModels and HierarchSurrModels redefine this virtual function.*
*Reimplemented in RecastModel, NestedModel, and SimulationModel.*
*References Model::local_eval_concurrency(), and Model::modelRep.*
*Referenced by RecastModel::local_eval_concurrency(), Model::local_eval_concurrency(), and Model::set_ie_asynchronous_mode().*
const String & interface_id() const [virtual]
return the interface identifier

return by reference requires use of dummy objects, but it is important to allow use of assign_rep() since this operation must be performed on the original envelope object.

Reimplemented in RecastModel, DataFitSurrModel, NestedModel, and SimulationModel.
References Dakota::dummy_interface, Interface::interface_id(), Model::interface_id(), and Model::modelRep.

Referenced by NonDQUESOBayesCalibration::aggregate_acceptance_chain(), NonDDREAMBayesCalibration::archive_acceptance_chain(), DataFitSurrModel::build_global(), SurrBasedLocalMinimizer::core_run(), DataFitSurrModel::DataFitSurrModel(), Model::db_lookup(), Model::estimate_message_lengths(), Model::evaluate(), SurrBasedLocalMinimizer::find_center_approx(), RecastModel::interface_id(), Model::interface_id(), Minimizer::local_recast_retrieve(), SNLLLeastSq::post_run(), Analyzer::pre_output(), PebbldMinimizer::print_results(), SurrBasedMinimizer::print_results(), LeastSq::print_results(), Optimizer::print_results(), SeqHybridMetaIterator::run_sequential(), DiscrepancyCorrection::search_db(), Model::synchronize(), Model::synchronize_nowait(), Analyzer::update_best(), ConcurrentMetaIterator::update_local_results(), SeqHybridMetaIterator::update_local_results(), and NonDLocalReliability::update_mpp_search_data().

bool evaluation_cache() const [virtual]
Indicates the usage of an evaluation cache by the Model.

Only Models including ApplicationInterfaces support an evaluation cache: surrogate, nested, and recast mappings are not stored in the cache. Possible exceptions: HierarchSurrModel, NestedModel::optionalInterface.

Reimplemented in SimulationModel.
References Model::evaluation_cache(), and Model::modelRep.

Referenced by DataFitSurrModel::DataFitSurrModel(), and Model::evaluation_cache().

void eval_tag_prefix(const String & eval_id_str) [virtual]
set the hierarchical eval ID tag prefix

Derived classes containing additional models or interfaces should implement this function to pass along to their sub Models/Interfaces.

Reimplemented in RecastModel, and SimulationModel.
References Model::eval_tag_prefix(), Model::evalTagPrefix, and Model::modelRep.

Referenced by HierarchSurrModel::build_approximation(), HierarchSurrModel::derived_evaluate(), DataFitSurrModel::derived_evaluate(), HierarchSurrModel::derived_evaluate_nowait(), DataFitSurrModel::derived_evaluate_nowait(), Iterator::eval_tag_prefix(), RecastModel::eval_tag_prefix(), and Model::eval_tag_prefix().

ModelList & subordinate_models(bool recurse_flag = true)
return the sub-models in nested and surrogate models

since modelList is built with list insertions (using envelope copies), these models may not be used for model.assign_rep() since this operation must be performed on the original envelope object. They may, however, be used for letter-based operations (including assign_rep() on letter contents such as an interface).

References Model::derived_subordinate_models(), Model::modelList, Model::modelRep, and Model::subordinate_models().

Referenced by DTOptimizer::initialize(), CONMINOptimizer::initialize(), NCSUOptimizer::initialize(), NLPOLQPOptimizer::initialize(), DataFitSurrModel::manage_data_recastings(), NonDPolynomialChaos::multifidelity_expansion(), NonDExpansion::multifidelity_expansion(), NonDLocalInterval::NonDLocalInterval(), NonDLocalReliability::NonDLocalReliability(), NonDMultilevelSampling::NonDMultilevelSampling(), SOLBase::SOLBase(), Model::subordinate_models(), and SurrBasedLocalMinimizer::SurrBasedLocalMinimizer().
void init_communicators ( ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag = true )

allocate communicator partitions for a model and store configuration in modelPCIterMap

The init_communicators() and derived_init_communicators() functions are structured to avoid performing the messageLengths estimation more than once. init_communicators() (not virtual) performs the estimation and then forwards the results to derived_init_communicators (virtual) which uses the data in different contexts.

References ParallelLibrary::bcast(), Model::derived_init_communicators(), Model::estimate_message_lengths(), ParallelLibrary::increment_parallel_configuration(), Model::init_communicators(), Model::initCommsBcastFlag, Model::messageLengths, Model::modelPCIter, Model::modelPCIterMap, Model::modelRep, ParallelLibrary::parallel_configuration_iterator(), ParallelLibrary::parallel_level_index(), and Model::parallelLib.

Referenced by SurrBasedMinimizer::derived_init_communicators(), NonDGlobalReliability::derived_init_communicators(), NonDLocalInterval::derived_init_communicators(), NonDGlobalInterval::derived_init_communicators(), NonDExpansion::derived_init_communicators(), NonDAdaptImpSampling::derived_init_communicators(), NonDGPImpSampling::derived_init_communicators(), NonDLocalReliability::derived_init_communicators(), NonDAdaptiveSampling::derived_init_communicators(), NonDPolynomialChaos::derived_init_communicators(), NonDBayesCalibration::derived_init_communicators(), ActiveSubspaceModel::derived_init_communicators(), DataFitSurrModel::derived_init_communicators(), RecastModel::derived_init_communicators(), Iterator::derived_init_communicators(), DataFitSurrModel::derived_set_communicators(), Model::init_communicators(), and Model::serve_init_communicators().

void init_serial ( )

for cases where init_communicators() will not be called, modify some default settings to behave properly in serial.

The init_serial() and derived_init_serial() functions are structured to separate base class (common) operations from derived class (specialized) operations.

References Model::asynchEvalFlag, Model::derived_init_serial(), Model::init_serial(), Model::local_eval_synchronization(), and Model::modelRep.

Referenced by NestedModel::derived_init_serial(), HierarchSurrModel::derived_init_serial(), DataFitSurrModel::derived_init_serial(), RecastModel::derived_init_serial(), and Model::init_serial().

void estimate_message_lengths ( )

estimate messageLengths for a model

This functionality has been pulled out of init_communicators() and defined separately so that it may be used in those cases when messageLengths is needed but model.init_communicators() is not called, e.g., for the master processor in the self-scheduling of a concurrent iterator strategy.

References Response::active_set_derivative_vector(), Model::aleatDistParams, Response::copy(), Variables::copy(), Model::currentResponse, Model::currentVariables, Variables::cv(), Model::discreteDesignSetStringValues, Model::discreteStateSetStringValues, Model::epistDistParams, Model::estimate_message_lengths(), Variables::icv(), Model::interface_id(), Model::messageLengths, Model::modelRep, ParallelLibrary::mpirun_flag(), Model::numFns, Model::parallelLib, MPIPackBuffer::reset(), MPIPackBuffer::size(), and Model::string_variable_max().

Referenced by Model::estimate_message_lengths(), Model::init_communicators(), RandomFieldModel::initialize_mapping(), ProbabilityTransformModel::initialize_mapping(), ConcurrentMetaIterator::pre_run(), Iterator::resize_communicators(), and ActiveSubspaceModel::serve_init_mapping().

void assign_rep ( Model * model_rep, bool ref_count_incr = true )

replaces existing letter with a new one

Similar to the assignment operator, the assign_rep() function decrements referenceCount for the old modelRep and assigns the new modelRep. It is different in that it is used for publishing derived class letters to existing envelopes, as opposed to sharing representations among multiple envelopes (in particular, assign_rep is passed a
letter object and operator= is passed an envelope object). Letter assignment supports two models as governed by ref_count_incr:

- ref_count_incr = true (default): the incoming letter belongs to another envelope. In this case, increment the reference count in the normal manner so that deallocation of the letter is handled properly.
- ref_count_incr = false: the incoming letter is instantiated on the fly and has no envelope. This case is modeled after get_model(): a letter is dynamically allocated using new and passed into assign_rep, the letter’s reference count is not incremented, and the letter is not remotely deleted (its memory management is passed over to the envelope).

References Dakota::abort_handler(), Model::model_rep(), Model::modelRep, and Model::referenceCount.

References Dakota::contains(), Model::derivative_concurrency(), Model::gradIdAnalytic, Model::gradientType, Model::hessianType, Model::hessIdNumerical, Model::intervalType, Model::methodSource, Model::modelRep, and Model::numDerivVars.

References ProblemDescDB::get_string(), Model::model_type(), and Model::modelType.

References by ActiveSubspaceModel::ActiveSubspaceModel(), Model::derivative_concurrency(), HierarchySurrModel::derived_free_communicators(), DataFitSurrModel::estimate_partition_bounds(), NonDExpansion::initialize_u_space_model(), Analyzer::num_samples(), HierarchSurrModel::serve_run(), and Iterator::update_from_model().

Model * get_model ( ProblemDescDB & problem_db ) [private]

Used by the envelope to instantiate the correct letter class.

Used only by the envelope constructor to initialize modelRep to the appropriate derived type, as given by the modelType attribute.

References ProblemDescDB::get_string(), Model::model_type(), and Model::modelType.

References by Model::Model().

int estimate_derivatives ( const ShortArray & asv, const ShortArray & fd_grad_asv, const ShortArray & fd_hess_asv, const ShortArray & quasi_hess_asv, const ActiveSet & original_set, const bool async_flag ) [private]

evaluate numerical gradients using finite differences. This routine is selected with “method_source dakota” (the default method_source) in the numerical gradient specification.

Estimate derivatives by computing finite difference gradients, finite difference Hessians, and/or quasi-Newton Hessians. The total number of finite difference evaluations is returned for use by synchronize() to track response arrays, and it could be used to improve management of max_function_evaluations within the iterators. New logic
References Variables::all_continuous_variables(), Model::centralHess, Variables::continuous_variables(), Model::currentResponse, Model::currentVariables, Model::db_lookup(), Model::dbCaptureList, Model::dbResponseList, Model::deltaList, ActiveSet::derivative_vector(), Model::derived_evaluate(), Model::derived_evaluate_nowait(), Model::fdHessByFnStepSize, Model::fdHessByGradStepSize, Model::fdHessStepType, Model::FDstep1(), Model::FDstep2(), Dakota::find_index(), Model::forward_grad_step(), Response::function_gradients(), Response::function_values(), Model::ignoreBounds, Variables::inactive_continuous_variables(), Model::initialize_h(), Model::initialize_x0_bounds(), Model::initialMapList, Model::intervalType, Model::numFns, Model::outputLevel, ActiveSet::request_vector(), Response::shared_data(), Model::shortStep, and Model::update_response().

Referenced by Model::evaluate(), and Model::evaluate_nowait().

```cpp
void synchronize_derivatives ( const Variables & vars, const IntResponseMap & fd_responses, Response & new_response, const ShortArray & fd_grad_asv, const ShortArray & fd_hess_asv, const ShortArray & quasi_hess_asv, const ActiveSet & original_set ) [private]
```

combine results from an array of finite difference response objects (fd_grad_responses) into a single response (new_response)

- Merge an array of fd_responses into a single new_response. This function is used both by synchronous evaluate() for the case of asynchronous estimate_derivatives() and by synchronize() for the case where one or more evaluate_nowait() calls have employed asynchronous estimate_derivatives().

References Model::acv(), Variables::all_continuous_variable_ids(), Model::centralHess, Variables::continuous_variable_ids(), Model::currentResponse, Model::currentVariables, Model::cv(), Model::dbCaptureList, Model::dbResponseList, Model::deltaList, ActiveSet::derivative_vector(), Dakota::find_index(), Response::function_gradients(), Response::function_values(), Model::icv(), Variables::inactive_continuous_variable_ids(), Model::initialize_h(), Model::initialize_x0_bounds(), Model::initialMapList, Model::intervalType, Model::numFns, Response::shared_data(), and Model::update_response().

Referenced by Model::evaluate(), and Model::synchronize().

```cpp
void update_response ( const Variables & vars, Response & new_response, const ShortArray & fd_grad_asv, const ShortArray & fd_hess_asv, const ShortArray & quasi_hess_asv, const ActiveSet & original_set, Response & initial_map_response, const RealMatrix & new_fn_grads, const RealSymMatrixArray & new_fn_hessians ) [private]
```

overlay results to update a response object

- Overlay the initial_map_response with numerically estimated new_fn_grads and new_fn_hessians to populate new_response as governed by asv vectors. Quasi-Newton secant Hessian updates are also performed here, since this is where the gradient data needed for the updates is first consolidated. Convenience function used by estimate_derivatives() for the synchronous case and by synchronize_derivatives() for the asynchronous case.

References Response::active_set_request_vector(), Variables::continuous_variable_ids(), Response::copy(), Model::currentResponse, Model::currentVariables, ActiveSet::derivative_vector(), Response::function_gradients(), Response::function_values(), Model::hessianType, Model::hessIdQuasi, Response::is_null(), Model::numFns, Model::outputLevel, Model::quasiHessians, ActiveSet::request_vector(), Response::reset_inactive(), Model::supportsEstimDerivs, Model::surrogate_response_mode(), and Model::update_quasi_hessians().

Referenced by Model::estimate_derivatives(), and Model::synchronize_derivatives().

```cpp
void update_quasi_hessians ( const Variables & vars, Response & new_response, const ActiveSet & original_set ) [private]
```

perform quasi-Newton Hessian updates

- Quasi-Newton updates are performed for approximating response function Hessians using BFGS or SR1 formulations. These Hessians are supported only for the active continuous variables, and a check is performed on the DVV prior to invoking the function.
References Dakota::contains(), Variables::continuous_variables(), Dakota::copy_data(), Model::fnGradsPrev, Response::function_gradients(), Model::hessianType, Model::hessIdQuasi, Model::modelType, Model::numDerivVars, Model::numFns, Model::numQuasiUpdates, Model::outputLevel, Model::quasiHessians, Model::quasiHessType, ActiveSet::request_vector(), and Model::xPrev.

Referenced by Model::update_response().

bool manage_asv ( const ActiveSet & original_set, ShortArray & map_asv_out, ShortArray & fd_grad_asv_out, ShortArray & fd_hess_asv_out, ShortArray & quasi_hess_asv_out ) [private]

Coordinates usage of estimate_derivatives() calls based on asv_in.

Splits asv_in total request into map_asv_out, fd_grad_asv_out, fd_hess_asv_out, and quasi_hess_asv_out as governed by the responses specification. If the returned use_est_deriv is true, then these asv outputs are used by estimate_derivatives() for the initial map, finite difference gradient evals, finite difference Hessian evals, and quasi-Hessian updates, respectively. If the returned use_est_deriv is false, then only map_asv_out is used.

References Dakota::abort_handler(), Dakota::contains(), ActiveSet::derivative_vector(), Model::FDstep2(), Dakota::find_index(), Model::forward_grad_step(), Model::gradIdAnalytic, Model::gradIdNumerical, Model::gradientType, Model::hessianType, Model::hessIdAnalytic, Model::hessIdNumerical, Model::hessIdQuasi, Model::ignoreBounds, Model::initialize_x0bounds(), Model::intervalType, Model::methodSource, ActiveSet::request_vector(), Model::shortStep, Model::supportsEstimDerivs, and Model::surrogate_response_mode().

Referenced by Model::evaluate(), and Model::evaluate_nowait().

Real initialize_h ( Real x_j, Real lb_j, Real ub_j, Real step_size, String step_type ) const [private]

function to determine initial finite difference h (before step length adjustment) based on type of step desired.

Auxiliary function to determine initial finite difference h (before step length adjustment) based on type of step desired.

Referenced by Model::estimate_derivatives(), and Model::forward_grad_step().

Real FDstep1 ( Real x0_j, Real lb_j, Real ub_j, Real h_mag ) [private]

function returning finite-difference step size (affected by bounds)

Auxiliary function to compute forward or first central-difference step size, honoring bounds. The first step is away from zero, when possible. Flips the direction or updates shortStep if can’t take the full requested step h_mag.

References Model::ignoreBounds, and Model::shortStep.

Referenced by Model::estimate_derivatives(), and Model::forward_grad_step().

Real FDstep2 ( Real x0_j, Real lb_j, Real ub_j, Real h ) [private]

function returning second central-difference step size (affected by bounds)

Auxiliary function to compute the second central-difference step size, honoring bounds.

References Model::ignoreBounds, and Model::shortStep.

Referenced by Model::estimate_derivatives(), and Model::manage_asv().

13.77.4 Member Data Documentation

RealVector fdGradStepSize [protected]

relative finite difference step size for numerical gradients

A scalar value (instead of the vector fd_gradient_step_size spec) is used within the iterator hierarchy since this attribute is only used to publish a step size to vendor numerical gradient algorithms.
13.78. MPIManager Class Reference

Class MPIManager to manage Dakota’s MPI world, which may be a subset of MPI_COMM_WORLD.

Public Member Functions

- MPIManager()
  
  Default constructor; Dakota will not call MPI_Init.

- MPIManager(int argc, char **argv)
  
  Command-line constructor; parses MPI arguments during call to MPI_Init.

- MPIManager(MPI_Comm dakota_mpi_comm)
  
  Construct on specified MPI_Comm.

- ~MPIManager()
  
  destructor: calls finalize if Dakota owns MPI

- MPI_Comm dakota_mpi_comm () const
CHAPTER 13. CLASS DOCUMENTATION

get the MPI_Comm on which *Dakota* is running

- **int world_rank() const**
  get the rank of this process in *Dakota’s MPI_Comm*

- **int world_size() const**
  get the size of the MPI_Comm on which *Dakota* is running

- **bool mpirun_flag() const**
  true when *Dakota* is running in MPI mode

**Static Public Member Functions**

- static bool detect_parallel_launch(int argc, char **argv)
  detect parallel launch of Dakota using mpirun/mpiexec/poe/etc. based on command line arguments and environment variables

**Private Attributes**

- MPI_Comm dakotaMPIComm
  MPI_Comm on which DAKOTA is running.

- int dakotaWorldRank
  rank in MPI_Comm in which DAKOTA is running

- int dakotaWorldSize
  size of MPI_Comm in which DAKOTA is running

- bool mpirunFlag
  flag for a parallel mpirun/yod launch

- bool ownMPIFlag
  flag for ownership of MPI_Init/MPI_Finalize

13.78.1 Detailed Description

Class *MPIManager* to manage *Dakota*’s MPI world, which may be a subset of MPI_COMM_WORLD. The documentation for this class was generated from the following files:

- MPIManager.hpp
- MPIManager.cpp

13.79 MPIPackBuffer Class Reference

Class for packing MPI message buffers.

**Public Member Functions**

- **MPIPackBuffer(int size_=1024)**
  Constructor, which allows the default buffer size to be set.

- **~MPIPackBuffer()**
  Destructor.

- **const char *buf()**
Returns a pointer to the internal buffer that has been packed.

- **int size ()**
  The number of bytes of packed data.

- **int capacity ()**
  the allocated size of Buffer.

- **void reset ()**
  Resets the buffer index in order to reuse the internal buffer.

- **void pack (const int *data, const int num=1)**
  Pack one or more int's.

- **void pack (const u_int *data, const int num=1)**
  Pack one or more unsigned int’s.

- **void pack (const long *data, const int num=1)**
  Pack one or more long’s.

- **void pack (const u_long *data, const int num=1)**
  Pack one or more unsigned long’s.

- **void pack (const short *data, const int num=1)**
  Pack one or more short’s.

- **void pack (const u_short *data, const int num=1)**
  Pack one or more unsigned short’s.

- **void pack (const char *data, const int num=1)**
  Pack one or more char’s.

- **void pack (const u_char *data, const int num=1)**
  Pack one or more unsigned char’s.

- **void pack (const double *data, const int num=1)**
  Pack one or more double’s.

- **void pack (const float *data, const int num=1)**
  Pack one or more float’s.

- **void pack (const bool *data, const int num=1)**
  Pack one or more bool’s.

- **void pack (const int &data)**
  Pack a int.

- **void pack (const u_int &data)**
  Pack a unsigned int.

- **void pack (const long &data)**
  Pack a long.

- **void pack (const u_long &data)**
  Pack a unsigned long.

- **void pack (const short &data)**
  Pack a short.

- **void pack (const u_short &data)**
  Pack a unsigned short.

- **void pack (const char &data)**
  Pack a char.
CHAPTER 13. CLASS DOCUMENTATION

- void pack (const uchar &data)
  Pack a unsigned char.
- void pack (const double &data)
  Pack a double.
- void pack (const float &data)
  Pack a float.
- void pack (const bool &data)
  Pack a bool.

Protected Member Functions
- void resize (const int newsize)
  Resizes the internal buffer.

Protected Attributes
- char * Buffer
  The internal buffer for packing.
- int Index
  The index into the current buffer.
- int Size
  The total size that has been allocated for the buffer.

13.79.1 Detailed Description
Class for packing MPI message buffers.
A class that provides a facility for packing message buffers using the MPI_Pack facility. The MPIPackBuffer class dynamically resizes the internal buffer to contain enough memory to pack the entire object. When deleted, the MPIPackBuffer object deletes this internal buffer. This class is based on the Dakota_Version_3_0 version of utilib::PackBuffer from utilib/src/io/PackBuf.[cpp,h]
The documentation for this class was generated from the following files:
- MPIPackBuffer.hpp
- MPIPackBuffer.cpp

13.80 MPIUnpackBuffer Class Reference
Class for unpacking MPI message buffers.

Public Member Functions
- void setup (char *buf, int size, bool flag=false)
  Method that does the setup for the constructors.
- MPIUnpackBuffer ()
  Default constructor.
- MPIUnpackBuffer (int size)
Constructor that specifies the size of the buffer:

- `MPIUnpackBuffer (char *buf, int size, bool flag=false)`

Constructor that sets the internal buffer to the given array:

- `~MPIUnpackBuffer ()`

Destructor.

- `void resize (const int newsize)`

Resizes the internal buffer.

- `const char * buf ()`

Returns a pointer to the internal buffer.

- `int size ()`

Returns the length of the buffer.

- `int curr ()`

Returns the number of bytes that have been unpacked from the buffer.

- `void reset ()`

Resets the index of the internal buffer.

- `void unpack (int *data, const int num=1)`

Unpack one or more `int's`.

- `void unpack (u_int *data, const int num=1)`

Unpack one or more `unsigned int's`.

- `void unpack (long *data, const int num=1)`

Unpack one or more `long's`.

- `void unpack (u_long *data, const int num=1)`

Unpack one or more `unsigned long's`.

- `void unpack (short *data, const int num=1)`

Unpack one or more `short's`.

- `void unpack (u_short *data, const int num=1)`

Unpack one or more `unsigned short's`.

- `void unpack (char *data, const int num=1)`

Unpack one or more `char's`.

- `void unpack (u_char *data, const int num=1)`

Unpack one or more `unsigned char's`.

- `void unpack (double *data, const int num=1)`

Unpack one or more `double's`.

- `void unpack (float *data, const int num=1)`

Unpack one or more `float's`.

- `void unpack (bool *data, const int num=1)`

Unpack one or more `bool's`.

- `void unpack (int &data)`

Unpack a `int`.

- `void unpack (u_int &data)`

Unpack a `unsigned int`.

- `void unpack (long &data)`

Unpack a `long`.
• void unpack (ulong &data)
  Unpack an unsigned long.
• void unpack (short &data)
  Unpack a short.
• void unpack (ushort &data)
  Unpack an unsigned short.
• void unpack (char &data)
  Unpack a char.
• void unpack (uchar &data)
  Unpack an unsigned char.
• void unpack (double &data)
  Unpack a double.
• void unpack (float &data)
  Unpack a float.
• void unpack (bool &data)
  Unpack a bool.

Protected Attributes

• char * Buffer
  The internal buffer for unpacking.
• int Index
  The index into the current buffer.
• int Size
  The total size that has been allocated for the buffer.
• bool ownFlag
  If TRUE, then this class owns the internal buffer.

13.80.1 Detailed Description

Class for unpacking MPI message buffers.

A class that provides a facility for unpacking message buffers using the MPI_Unpack facility. This class is based on the Dakota_Version_3.0 version of utilib::UnPackBuffer from utilib/src/io/PackBuf.[cpp,h]

The documentation for this class was generated from the following files:

• MPIPackBuffer.hpp
• MPIPackBuffer.cpp

13.81 NCSUOptimizer Class Reference

Wrapper class for the NCSU DIRECT optimization library.

Inheritance diagram for NCSUOptimizer:
Public Member Functions

- **NCSUOptimizer (ProblemDescDB &problem_db, Model &model)**
  
  *standard constructor*

- **NCSUOptimizer (Model &model, const int &max_iter, const int &max_eval, double min_box_size=-1., double vol_box_size=-1., double solution_target=DBL_MAX)**

  *alternate constructor for instantiations "on the fly"

- **NCSUOptimizer (Model &model)**

  *alternate constructor for Iterator instantiations by name*

- **NCSUOptimizer (const RealVector &var_l_bnds, const RealVector &var_u_bnds, const int &max_iter, const int &max_eval, double(*user_obj_eval)(const RealVector &x), double min_box_size=-1., double vol_box_size=-1., double solution_target=DBL_MAX)**

  *alternate constructor for instantiations "on the fly"

- **~NCSUOptimizer ()**

  *destructor*

- **void core_run ()**

  *core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post*

Private Member Functions

- **void initialize ()**

  *shared code among model-based constructors*

- **void check_inputs ()**

  *verify problem respects NCSU DIRECT Fortran limits*

Static Private Member Functions

- **static int objective_eval (int *, double c[], double l[], double u[], int point[], int *maxI, int *start, int *maxfunc, double fvec[], int *iisize, double ddata[], int *idsize, char cdata[], int *icsize)**

  *'fep' in Griffin-modified NCSUDirect: computes the value of the objective function (potentially at multiple points, passed by function pointer to NCSUDirect). Include unscaling from DIRECT."
Private Attributes

- short setUpType
  controls iteration mode: SETUP_MODEL (normal usage) or SETUP_USERFUNC (user-supplied functions mode for "on the fly" instantiations). See enum in NCSUOptimizer.cpp. NonDGlobalReliability currently uses the model mode. GaussProcApproximation currently uses the user functions mode.

- Real minBoxSize
  holds the minimum boxsize

- Real volBoxSize
  hold the minimum volume boxsize

- Real solutionTarget
  holds the solution target minimum to drive towards

- RealVector lowerBounds
  holds variable lower bounds passed in for "user functions" mode.

- RealVector upperBounds
  holds variable upper bounds passed in for "user functions" mode.

- double(\*userObjectiveEval)(const RealVector &x)
  holds function pointer for objective function evaluator passed in for "user functions" mode.

Static Private Attributes

- static NCSUOptimizer * ncsudirectInstance
  pointer to the active object instance used within the static evaluator functions in order to avoid the need for static data

Additional Inherited Members

13.81.1 Detailed Description

Wrapper class for the NCSU DIRECT optimization library.

The NCSUOptimizer class provides a wrapper for a Fortran 77 implementation of the DIRECT algorithm developed at North Carolina State University. It uses a function pointer approach for which passed functions must be either global functions or static member functions. Any attribute used within static member functions must be either local to that function or accessed through a static pointer.

The user input mappings are as follows:

13.81.2 Constructor & Destructor Documentation

NCSUOptimizer ( ProblemDescDB & problemDb, Model & model )

standard constructor
This is the standard constructor with method specification support.
References NCSUOptimizer::check_inputs(), and NCSUOptimizer::initialize().
NCSUOptimizer ( Model & model, const int & max_iter, const int & max_eval, double min_box_size = -1., double vol_box_size = -1., double solution_target = -DBL_MAX )

alternate constructor for instantiations "on the fly"
This is an alternate constructor for instantiations on the fly using a Model but no ProblemDescDB.
References NCSUOptimizer::check_inputs(), NCSUOptimizer::initialize(), Iterator::maxFunctionEvals, and Iterator::maxIterations.

NCSUOptimizer ( Model & model )
alternate constructor for Iterator instantiations by name
This is an alternate constructor for Iterator instantiations by name using a Model but no ProblemDescDB.
References NCSUOptimizer::check_inputs(), and NCSUOptimizer::initialize().

NCSUOptimizer ( const RealVector & var_lbnds, const RealVector & var_ubnds, const int & max_iter, const int & max_eval, double (*)(const RealVector & x) user_obj_eval, double min_box_size = -1., double vol_box_size = -1., double solution_target = -DBL_MAX )

alternate constructor for instantiations "on the fly"
This is an alternate constructor for performing an optimization using the passed in objective function pointer.
References NCSUOptimizer::check_inputs(), Iterator::maxFunctionEvals, and Iterator::maxIterations.

13.81.3 Member Function Documentation

void core_run( ) [virtual]
core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post run function for the iterator class hierarchy. All derived classes need to redefine it.
Reimplemented from Iterator.
References Dakota::abort_handler(), Iterator::bestResponseArray, Iterator::bestVariablesArray, Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::continuous_variables(), Iterator::convergenceTol, Dakota::copy_data(), Iterator::iteratedModel, Optimizer::localObjectiveRecast, NCSUOptimizer::lowerBounds, Iterator::maxFunctionEvals, Iterator::maxIterations, NCSUOptimizer::minBoxSize, NCSUOptimizer::ncsudirectInstance, Minimizer::numContinuousVars, Minimizer::numFunctions, NCSUOptimizer::objective_eval(), Iterator::outputLevel, Model::primary_response_fn_sense(), NCSUOptimizer::setUpType, NCSUOptimizer::solutionTarget, NCSUOptimizer::upperBounds, and NCSUOptimizer::volBoxSize.

int objective_eval ( int * n, double c[], double l[], double u[], int * point[], int * maxI, int * start, int * maxfunc, double fvec[], int iidata[], int * isize, double ddata[], int * isize, char cdata[], int * icsize ) [static], [private]

'fep' in Griffin-modified NCSUDirect: computes the value of the objective function (potentially at multiple points, passed by function pointer to NCSUDirect). Include unscaling from DIRECT.
Modified batch evaluator that accepts multiple points and returns corresponding vector of functions in fvec. Must be used with modified DIRECT src (DIRbatch.f).
References Model::asynch_flag(), Model::continuous_variables(), Model::current_response(), Model::evaluate(), Model::evaluate_nowait(), Response::function_value(), Iterator::iteratedModel, NCSUOptimizer::nsudirectInstance, Model::primary_response_fn_sense(), NCSUOptimizer::setUpType, Model::synchronize(), and NCSUOptimizer::userObjectiveEval.
References by NCSUOptimizer::core_run().
The documentation for this class was generated from the following files:
13.82 NestedModel Class Reference

Derived model class which performs a complete sub-iterator execution within every evaluation of the model.

Inheritance diagram for NestedModel:

```
  Model  
 /\     /
|     |
V     V
  NestedModel
```

Public Member Functions

- **NestedModel (ProblemDescDB &problem_db)**
  constructor
- **~NestedModel ()**
  destructor

Protected Member Functions

- **void derived_evaluate (const ActiveSet &set)**
  portion of evaluate() specific to NestedModel
- **void derived_evaluate_nowait (const ActiveSet &set)**
  portion of evaluate_nowait() specific to NestedModel
- **const IntResponseMap & derived_synchronize ()**
  portion of synchronize() specific to NestedModel
- **Iterator & subordinate_iterator ()**
  return subIterator
- **Model & subordinate_model ()**
  return subModel
- **void derived_subordinate_models (ModelList &ml, bool recurse_flag)**
  return subModel
- **Interface & derived_interface ()**
  return optionalInterface
- **void surrogate_response_mode (short mode)**
  pass a bypass request on to the subModel for any lower-level surrogates
- **void component_parallel_mode (short mode)**
  update component parallel mode for supporting parallelism in optionalInterface and subModel
- **size_t mi_parallel_level_index () const**
  return subIteratorSched.miPLIndex
- **short local_eval_synchronization ()**
return optionalInterface synchronization setting

- int local_eval_concurrency ()

return optionalInterface asynchronous evaluation concurrency

- bool derived_master_overload () const
  flag which prevents overloading the master with a multiprocessor evaluation (forwarded to optionalInterface)

- std::IntIntPair estimate_partition_bounds (int max_eval_concurrency)
  estimate the minimum and maximum partition sizes that can be utilized by this Model

- void derived_init_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  set up optionalInterface and subModel for parallel operations

- void derived_init_serial ()
  set up optionalInterface and subModel for serial operations.

- void derived_set_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  set active parallel configuration within subModel

- void derived_free_communicators (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  deallocate communicator partitions for the NestedModel (forwarded to optionalInterface and subModel)

- void serve_run (ParLevLIter pl_iter, int max_eval_concurrency)
  Service optionalInterface and subModel job requests received from the master. Completes when a termination
  message is received from stop_servers().

- void stop_servers ()
  Executed by the master to terminate server operations for subModel and optionalInterface when iteration on the
  NestedModel is complete.

- const String & interface_id () const
  return the optionalInterface identifier

- int evaluation_id () const
  Return the current evaluation id for the NestedModel.

- void set_evaluation_reference ()
  set the evaluation counter reference points for the NestedModel (request forwarded to optionalInterface and sub-
  Model)

- void fine_grained_evaluation_counters ()
  request fine-grained evaluation reporting within optionalInterface and subModel

- void print_evaluation_summary (std::ostream &s, bool minimal_header=false, bool relative_count=true) const
  print the evaluation summary for the NestedModel (request forwarded to optionalInterface and subModel)

- void initialize_iterator (int job_index)

- void pack_parameters_buffer (MPIPackBuffer &send_buffer, int job_index)

- void unpack_parameters_buffer (MPIUnpackBuffer &recv_buffer)

- void unpack_parameters_initialize (MPIUnpackBuffer &recv_buffer)

- void pack_results_buffer (MPIPackBuffer &send_buffer, int job_index)

- void unpack_results_buffer (MPIUnpackBuffer &recv_buffer, int job_index)

- void update_local_results (int job_index)
Private Member Functions

- void update_sub_iterator()
  update sub_iterator with mapping data and set subIterator-based counts
- void initialize_iterator (const Variables &vars, const ActiveSet &set, int eval_id)
  lower level function shared by initialize_iterator(int) and unpack_parameters.initialize()
- void unpack (MPIUnpackBuffer &recv_buffer, Variables &vars, ActiveSet &set, int &eval_id)
  lower level function shared by unpack_parameters.buffer() and unpack_parameters.initialize()
- void resolve_real_variable_mapping (const String &map1, const String &map2, size_t curr_index, short &inactive_sm_view)
  for a named real mapping, resolve primary index and secondary target
- void resolve_integer_variable_mapping (const String &map1, const String &map2, size_t curr_index, short &inactive_sm_view)
  for a named integer mapping, resolve primary index and secondary target
- void resolve_string_variable_mapping (const String &map1, const String &map2, size_t curr_index, short &inactive_sm_view)
  for a named string mapping, resolve primary index and secondary target
- size_t sm_acv_index_map (size_t pacvm_index, short sacvm_target)
  offset pacvm_index based on sacvm_target to create mapped_index
- size_t sm_adiv_index_map (size_t padivm_index, short sadivm_target)
  offset padivm_index based on sadivm_target to create mapped_index
- size_t sm_adsv_index_map (size_t padsvm_index, short sadsvm_target)
  offset padsvm_index based on sadsvm_target to create mapped_index
- size_t sm_adrv_index_map (size_t padrvm_index, short sadrvm_target)
  offset padrvm_index based on sadrvm_target to create mapped_index
- size_t cv_index_map (size_t cv_index, const Variables &vars)
  offset cv_index to create index into aggregated primary/secondary arrays
- size_t div_index_map (size_t div_index, const Variables &vars)
  offset div_index to create index into aggregated primary/secondary arrays
- size_t dsv_index_map (size_t dsv_index, const Variables &vars)
  offset dsv_index to create index into aggregated primary/secondary arrays
- size_t drv_index_map (size_t drv_index, const Variables &vars)
  offset drv_index to create index into aggregated primary/secondary arrays
- size_t ccv_index_map (size_t ccv_index, const Variables &vars)
  offset active complement ccv_index to create index into all continuous arrays
- size_t cdv_index_map (size_t cdv_index, const Variables &vars)
  offset active complement cdv_index to create index into all discrete int arrays
- size_t cdivsv_index_map (size_t cdsv_index, const Variables &vars)
  offset active complement cdsv_index to create index into all discrete string arrays
- size_t cdrv_index_map (size_t cdrv_index, const Variables &vars)
  offset active complement cdrv_index to create index into all discrete real arrays
- void real_variable_mapping (const Real &r_var, size_t mapped_index, short svm_target)
  insert r_var into appropriate recipient
- void integer_variable_mapping (const int &i_var, size_t mapped_index, short svm_target)
13.82. NESTEDMODEL CLASS REFERENCE

- **void string_variable_mapping** (const String &s_var, size_t mapped_index, short svm_target)  
  insert s_var into appropriate recipient
- **void set_mapping** (const ActiveSet &mapped_set, ActiveSet &interface_set, bool &opt_interface_map, ActiveSet &sub_iterator_set, bool &sub_iterator_map)  
  define the evaluation requirements for the optionalInterface (interface_set) and the subIterator (sub_iterator_set) from the total model evaluation requirements (mapped_set)
- **void response_mapping** (const Response &interface_response, const Response &sub_iterator_response, Response &mapped_response)  
  combine the response from the optional interface evaluation with the response from the sub-iteration using the primaryCoeffs/secondaryCoeffs mappings to create the total response for the model
- **void interface_response_overlay** (const Response &opt_interface_response, Response &mapped_response)  
  assign the response from the optional interface evaluation within the total response for the model
- **void iterator_response_overlay** (const Response &sub_iterator_response, Response &mapped_response)  
  overlay the sub-iteration response within the total response for the model using the primaryCoeffs/secondaryCoeffs mappings
- **Response & find_nested_response** (int nested_cntr)  
  locate existing or allocate new entry in nestedResponseMap
- **void check_response_map** (const ShortArray &mapped_asv)  
  check function counts for the mapped_asv
- **void update_inactive_view** (short new_view, short &view)  
  update inactive variables view for subIterator based on new_view
- **void update_inactive_view** (unsigned short type, short &view)  
  update inactive variables view for subIterator based on type
- **void update_sub_model** (const Variables &vars, const Constraints &cons)  
  update subModel with current variable values/bounds/labels

**Private Attributes**

- **int nestedModelEvalCntr**  
  number of calls to derived_evaluate()/derived_evaluate_nowait()
- **bool firstUpdate**  
  boolean to trigger one-time updates on first call to update_sub_model()
- **IntResponseMap nestedResponseMap**  
  used to return a map of nested responses (including subIterator and optionalInterface contributions) for aggregation and rekeying at the base class level
- **size_t outerMIPLIndex**  
  the miPLIndex for the outer parallelism context, prior to any subIterator partitioning
- **Iterator subIterator**  
  the sub-iterator that is executed on every evaluation of this model
- **String subMethodPointer**  
  the sub-method pointer from the nested model specification
- **Model subModel**  
  the sub-model used in sub-iterator evaluations
- **PRPQueue subIteratorPRPQueue**
job queue for asynchronous execution of subIterator jobs

- **IteratorScheduler** `subIteratorSched`
  scheduling object for concurrent iterator parallelism
- **int** `subIteratorJobCnt`
  subIterator job counter since last `synchronize()`
- **IntIntMap** `subIteratorIdMap`
  mapping from subIterator evaluation counter to nested model counter (different when subIterator evaluations do not occur on every nested model evaluation due to variable ASV content)
- **size_t** `numSubIterFns`
  number of sub-iterator response functions prior to mapping
- **size_t** `numSubIterMappedIneqCon`
  number of top-level inequality constraints mapped from the sub-iteration results
- **size_t** `numSubIterMappedEqCon`
  number of top-level equality constraints mapped from the sub-iteration results
- **Interface** `optionalInterface`
  the optional interface contributes nonnested response data to the total model response
- **String** `optInterfacePointer`
  the optional interface pointer from the nested model specification
- **Response** `optInterfaceResponse`
  the response object resulting from optional interface evaluations
- **IntIntMap** `optInterfaceIdMap`
  mapping from optionalInterface evaluation counter to nested model counter (different when optionalInterface evaluations do not occur on every nested model evaluation due to variable ASV content)
- **size_t** `numOptInterfPrimary`
  number of primary response functions (objective/least squares/generic functions) resulting from optional interface evaluations
- **size_t** `numOptInterfIneqCon`
  number of inequality constraints resulting from optional interface evaluations
- **size_t** `numOptInterfEqCon`
  number of equality constraints resulting from the optional interface evaluations
- **SizeArray** `active1ACVarMapIndices`
  "primary" variable mappings for inserting active continuous `currentVariables` within all continuous `subModel` variables. If there are no secondary mappings defined, then the insertions replace the `subModel` variable values.
- **SizeArray** `active1ADIVarMapIndices`
  "primary" variable mappings for inserting active discrete int `currentVariables` within all discrete int `subModel` variables. No secondary mappings are defined for discrete int variables, so the active variables replace the `subModel` variable values.
- **SizeArray** `active1ADSVarMapIndices`
  "primary" variable mappings for inserting active discrete string `currentVariables` within all discrete string `subModel` variables. No secondary mappings are defined for discrete string variables, so the active variables replace the `subModel` variable values.
- **SizeArray** `active1ADRVarMapIndices`
  "primary" variable mappings for inserting active discrete real `currentVariables` within all discrete real `subModel` variables. No secondary mappings are defined for discrete real variables, so the active variables replace the `subModel` variable values.
• ShortArray active2ACVarMapTargets
  "secondary" variable mappings for inserting active continuous currentVariables into sub-parameters (e.g., distribution parameters for uncertain variables or bounds for continuous design/state variables) within all continuous subModel variables.

• ShortArray active2ADIVarMapTargets
  "secondary" variable mappings for inserting active discrete int currentVariables into sub-parameters (e.g., bounds for discrete design/state variables) within all discrete int subModel variables.

• ShortArray active2ADSVarMapTargets
  "secondary" variable mappings for inserting active discrete string currentVariables into sub-parameters (e.g., bounds for discrete design/state variables) within all discrete string subModel variables.

• ShortArray active2ADRVarMapTargets
  "secondary" variable mappings for inserting active discrete real currentVariables into sub-parameters (e.g., bounds for discrete design/state variables) within all discrete real subModel variables.

• SizetArray complement1ACVarMapIndices
  "primary" variable mappings for inserting the complement of the active continuous currentVariables within all continuous subModel variables

• SizetArray complement1ADIVarMapIndices
  "primary" variable mappings for inserting the complement of the active discrete int currentVariables within all discrete int subModel variables

• SizetArray complement1ADSVarMapIndices
  "primary" variable mappings for inserting the complement of the active discrete string currentVariables within all discrete string subModel variables

• SizetArray complement1ADRVarMapIndices
  "primary" variable mappings for inserting the complement of the active discrete real currentVariables within all discrete real subModel variables

• BitArray extraCVarsData
  flags for updating subModel continuous bounds and labels, one for each active continuous variable in currentVariables

• BitArray extraDIVarsData
  flags for updating subModel discrete int bounds and labels, one for each active discrete int variable in currentVariables

• BitArray extraDSVarsData
  flags for updating subModel discrete string labels, one for each active discrete string variable in currentVariables

• BitArray extraDRVarsData
  flags for updating subModel discrete real bounds and labels, one for each active discrete real variable in currentVariables

• RealMatrix primaryRespCoeffs
  "primary" response mapping matrix applied to the sub-iterator response functions. For OUU, the matrix is applied to UQ statistics to create contributions to the top-level objective functions/least squares/generic response terms.

• RealMatrix secondaryRespCoeffs
  "secondary" response mapping matrix applied to the sub-iterator response functions. For OUU, the matrix is applied to UQ statistics to create contributions to the top-level inequality and equality constraints.

Friends

• class IteratorScheduler
  protect scheduler callback functions from general access
Additional Inherited Members

13.82.1 Detailed Description

Derived model class which performs a complete sub-iterator execution within every evaluation of the model.

The NestedModel class nests a sub-iterator execution within every model evaluation. This capability is most commonly used for optimization under uncertainty, in which a nondeterministic iterator is executed on every optimization function evaluation. The NestedModel also contains an optional interface, for portions of the model evaluation which are independent from the sub-iterator, and a set of mappings for combining sub-iterator and optional interface data into a top level response for the model.

13.82.2 Member Function Documentation

void derived_evaluate ( const ActiveSet & set ) [protected], [virtual]

portion of evaluate() specific to NestedModel

Update subModel’s inactive variables with active variables from currentVariables, compute the optional interface and sub-iterator responses, and map these to the total model response.

Reimplemented from Model.

References NestedModel::active2ACVarMapTargets, Response::active_set(), ParallelLibrary::bcast(), ParallelLibrary::bcast_hst(), NestedModel::component_parallel_mode(), Model::currentResponse, Model::currentVariables, Interface::eval_tag_prefix(), Iterator::eval_tag_prefix(), Model::evalTagPrefix, Model::hierarchicalTagging, NestedModel::interface_response_overlay(), NestedModel::iterator_response_overlay(), IteratorScheduler::iteratorCommSize, IteratorScheduler::iteratorScheduling, Interface::map(), IteratorScheduler::messagePass, IteratorScheduler::miPLIndex, Model::modelPCIter, NestedModel::nestedModelEvalCntr, NestedModel::optInterfaceResponse, NestedModel::optionalInterface, Model::parallelLib, IteratorScheduler::peerAssignJobs, Response::reset(), Iterator::response_results_active_set(), Iterator::run(), IteratorScheduler::run_iterator(), NestedModel::set_mapping(), IteratorScheduler::stop_iterator_servers(), NestedModel::subIterator, NestedModel::subIteratorSched, NestedModel::update_sub_model(), and Model::userDefinedConstraints.

void derived_evaluate_nowait ( const ActiveSet & set ) [protected], [virtual]

portion of evaluate_nowait() specific to NestedModel

Asynchronous execution of subIterator on subModel and, optionally, optionalInterface.

Reimplemented from Model.

References Response::active_set(), Model::currentResponse, Model::currentVariables, Interface::evaluation_id(), Interface::map(), Iterator::method_id(), NestedModel::nestedModelEvalCntr, NestedModel::optInterfaceIdMap, NestedModel::optInterfaceResponse, NestedModel::optionalInterface, Iterator::response_results_active_set(), Iterator::run(), IteratorScheduler::run_iterator(), NestedModel::set_mapping(), NestedModel::subIterator, NestedModel::subIteratorIdMap, NestedModel::subIteratorJobCntr, and NestedModel::subIteratorPRPQueue.

const IntResponseMap & derived_synchronize ( ) [protected], [virtual]

portion of synchronize() specific to NestedModel

Recovery of asynchronous subIterator executions and, optionally, asynchronous optionalInterface mappings.

Reimplemented from Model.

References NestedModel::component_parallel_mode(), NestedModel::find_nested_response(), NestedModel::interface_response_overlay(), NestedModel::iterator_response_overlay(), Model::modelPCIter, NestedModel::nestedResponseMap, IteratorScheduler::numIteratorJobs, NestedModel::optInterfaceIdMap, NestedModel::optInterfacePointer, NestedModel::optionalInterface, ParallelLibrary::parallel_configuration_iterator(), Model::parallelLib, Iterator-
Scheduler::scheduleIterators(), NestedModel::subIterator, NestedModel::subIteratorIdMap, NestedModel::subIteratorJobCnt, NestedModel::subIteratorPRPQueue, NestedModel::subIteratorSched, and Interface::synch().

short localEvalSynchronization( ) [inline], [protected], [virtual]
return optionalInterface synchronization setting
Used in setting Model::asynchEvalFlag. subModel synchronization is used for setting asynchEvalFlag within subModel.
Reimplemented from Model.
References Interface::asynch_local_evaluation_concurrency(), Interface::interface_synchronization(), NestedModel::optInterfacePointer, and NestedModel::optionalInterface.

int localEvalConcurrency( ) [inline], [protected], [virtual]
return optionalInterface asynchronous evaluation concurrency
Used in setting Model::evaluationCapacity. subModel concurrency is used for setting evaluationCapacity within subModel.
Reimplemented from Model.
References Interface::asynch_local_evaluation_concurrency(), NestedModel::optInterfacePointer, and NestedModel::optionalInterface.

bool derivedMasterOverload( ) const [inline], [protected], [virtual]
flag which prevents overloading the master with a multiprocessor evaluation (forwarded to optionalInterface)
Derived master overload for subModel is handled separately in subModel.evaluate() within subIterator.run().
Reimplemented from Model.
References Iterator::isNull(), Interface::iterator_eval_dedicated_master(), IteratorScheduler::iteratorScheduling, Interface::multi_proc_eval(), NestedModel::optInterfacePointer, NestedModel::optionalInterface, IteratorScheduler::procsPerIterator, NestedModel::subIterator, and NestedModel::subIteratorSched.

void derivedInitCommunicators( ParLevLIter plIter, int max_eval_concurrency, bool recurse_flag = true ) [protected], [virtual]
set up optionalInterface and subModel for parallel operations
Asynchronous flags need to be initialized for the subModel. In addition, max_eval_concurrency is the outer
level iterator concurrency, not the subIterator concurrency that subModel will see, and recomputing the message
lengths on the subModel is probably not a bad idea either. Therefore, recompute everything on subModel using
initCommunicators().
Reimplemented from Model.
References Response::activeSet(), IteratorScheduler::configure(), Model::currentVariables, ProblemDescDB::get_db_method_node(), ProblemDescDB::get_db_model_node(), Interface::initCommunicators(), IteratorScheduler::initIterator(), Iterator::isNull(), IteratorScheduler::iterator_message_lengths(), IteratorScheduler::iteratorServerId, Model::messageLengths, IteratorScheduler::messagePass, Model::modelPCTIter, IteratorScheduler::numIteratorServers, NestedModel::optInterfacePointer, NestedModel::optionalInterface, ParallelLibrary::parallel_configuration_iterator(), Model::parallelLib, IteratorScheduler::partition(), Model::probDescDB, MPIPackBuffer::reset(), Iterator::responseResults(), ProblemDescDB::set_db_list_nodes(), ProblemDescDB::set_db_method_node(), ProblemDescDB::set_db_model_nodes(), MPIPackBuffer::size(), NestedModel::subIterator, NestedModel::subIteratorSched, NestedModel::subMethodPointer, NestedModel::subModel, IteratorScheduler::update(), and NestedModel::update_sub_iterator().
int evaluation_id() const [inline], [protected], [virtual]

Return the current evaluation id for the NestedModel.
return the top level nested evaluation count. To get the lower level eval count, the subModel must be explicitly queried. This is consistent with the eval counter definitions in surrogate models.
Reimplemented from Model.
References NestedModel::nestedModelEvalCntr.

size_t cv_index_map ( size_t cv_index, const Variables & vars ) [private]

offset cv_index to create index into aggregated primary/secondary arrays
maps index within active continuous variables to index within aggregated active continuous/discrete-int/discrete-string/discrete-real variables.
References SharedVariablesData::aleatory_uncertain_counts(), SharedVariablesData::design_counts(), SharedVariablesData::epistemic_uncertain_counts(), Variables::shared_data(), Dakota::svd(), and SharedVariablesData::view().
Referenced by NestedModel::NestedModel(), and NestedModel::update_sub_model().

size_t div_index_map ( size_t div_index, const Variables & vars ) [private]

offset div_index to create index into aggregated primary/secondary arrays
maps index within active discrete int variables to index within aggregated active continuous/discrete-int/discrete-string/discrete-real variables.
References SharedVariablesData::aleatory_uncertain_counts(), Variables::cv(), SharedVariablesData::design_counts(), SharedVariablesData::epistemic_uncertain_counts(), Variables::shared_data(), SharedVariablesData::state_counts(), Dakota::svd(), and SharedVariablesData::view().
Referenced by NestedModel::NestedModel(), and NestedModel::update_sub_model().

size_t dsv_index_map ( size_t dsv_index, const Variables & vars ) [private]

offset dsv_index to create index into aggregated primary/secondary arrays
maps index within active discrete string variables to index within aggregated active continuous/discrete-int/discrete-string/discrete-string variables.
References SharedVariablesData::aleatory_uncertain_counts(), Variables::cv(), SharedVariablesData::design_counts(), Variables::div(), SharedVariablesData::epistemic_uncertain_counts(), Variables::shared_data(), SharedVariablesData::state_counts(), Dakota::svd(), and SharedVariablesData::view().
Referenced by NestedModel::NestedModel(), and NestedModel::update_sub_model().

size_t drv_index_map ( size_t drv_index, const Variables & vars ) [private]

offset drv_index to create index into aggregated primary/secondary arrays
maps index within active discrete real variables to index within aggregated active continuous/discrete-int/discrete-string/discrete-real variables.
References SharedVariablesData::aleatory_uncertain_counts(), Variables::cv(), SharedVariablesData::design_counts(), Variables::div(), Variables::dsv(), SharedVariablesData::epistemic_uncertain_counts(), Variables::shared_data(), SharedVariablesData::state_counts(), Dakota::svd(), and SharedVariablesData::view().
Referenced by NestedModel::NestedModel(), and NestedModel::update_sub_model().
size_t ccv_index_map ( size_t ccv_index, const Variables & vars ) [private]

offset active complement ccv_index to create index into all continuous arrays.
- Maps index within complement of active continuous variables to index within all continuous variables.
- References: Dakota::abort_handler(), SharedVariablesData::aleatory_uncertain_counts(), SharedVariablesData::design_counts(), SharedVariablesData::epistemic_uncertain_counts(), Variables::shared_data(), Dakota::svd(), and SharedVariablesData::view().
- Referenced by NestedModel::NestedModel(), and NestedModel::update_sub_model().

size_t cdiv_index_map ( size_t cdiv_index, const Variables & vars ) [private]

offset active complement cdiv_index to create index into all discrete int arrays.
- Maps index within complement of active discrete int variables to index within all discrete int variables.
- References: Dakota::abort_handler(), SharedVariablesData::aleatory_uncertain_counts(), SharedVariablesData::design_counts(), SharedVariablesData::epistemic_uncertain_counts(), Variables::shared_data(), Dakota::svd(), and SharedVariablesData::view().
- Referenced by NestedModel::NestedModel(), and NestedModel::update_sub_model().

size_t cdsv_index_map ( size_t cdsv_index, const Variables & vars ) [private]

offset active complement cdsv_index to create index into all discrete string arrays.
- Maps index within complement of active discrete string variables to index within all discrete string variables.
- References: Dakota::abort_handler(), SharedVariablesData::aleatory_uncertain_counts(), SharedVariablesData::design_counts(), SharedVariablesData::epistemic_uncertain_counts(), Variables::shared_data(), Dakota::svd(), and SharedVariablesData::view().
- Referenced by NestedModel::NestedModel(), and NestedModel::update_sub_model().

size_t cdrv_index_map ( size_t cdrv_index, const Variables & vars ) [private]

offset active complement cdrv_index to create index into all discrete real arrays.
- Maps index within complement of active discrete real variables to index within all discrete real variables.
- References: Dakota::abort_handler(), SharedVariablesData::aleatory_uncertain_counts(), SharedVariablesData::design_counts(), SharedVariablesData::epistemic_uncertain_counts(), Variables::shared_data(), Dakota::svd(), and SharedVariablesData::view().
- Referenced by NestedModel::NestedModel(), and NestedModel::update_sub_model().

void response_mapping ( const Response & opt_interface_response, const Response & sub_iterator_response, Response & mapped_response ) [inline], [private]

Combine the response from the optional interface evaluation with the response from the sub-iteration using the primaryCoeffs/secondaryCoeffs mappings to create the total response for the model.

In the OUU case,

optionalInterface fns = {f}, {g} (deterministic primary functions, constraints)
subIterator fns = {S} (UQ response statistics)

Problem formulation for mapped functions:
- \[ \begin{align*}
  \text{minimize} & \quad \{f\} + [W]\{S\} \\
  \text{subject to} & \quad \{g_l\} \leq \{g\} \leq \{g_u\} \\
  & \quad \{a_l\} \leq [A]\{S\} \leq \{a_u\} \\
  & \quad \{g\} \equiv \{g_t\} \\
  & \quad [A]\{S\} \equiv \{a_t\}
\end{align*} \]
where \([W]\) is the primary mapping matrix user input (primaryRespCoeffs class attribute), \([A]\) is the secondary mapping matrix user input (secondaryRespCoeffs class attribute), \([\{g,l\},\{a,l\}]\) are the top level inequality constraint lower bounds, \([\{g,u\},\{a,u\}]\) are the top level inequality constraint upper bounds, and \([\{g,t\},\{a,t\}]\) are the top level equality constraint targets.

NOTE: optionalInterface/subIterator primary fns (obj/lsq/generic fns) overlap but optionalInterface/subIterator secondary fns (ineq/eq constraints) do not. The \([W]\) matrix can be specified so as to allow

- some purely deterministic primary functions and some combined: \([W]\) filled and \([W].\text{num\_rows()} < \{f\}.\text{length()}\) [combined first] \textit{or} \([W].\text{num\_rows()} == \{f\}.\text{length()}\) and \([W]\) contains rows of zeros [combined last]

- some combined and some purely stochastic primary functions: \([W]\) filled and \([W].\text{num\_rows()} > \{f\}.\text{length()}\)

- separate deterministic and stochastic primary functions: \([W].\text{num\_rows()} > \{f\}.\text{length()}\) and \([W]\) contains \{f\}.\text{length()} rows of zeros.

If the need arises, could change constraint definition to allow overlap as well: \(\{g,l\} \leq \{g\} + [A]\{S\} \leq \{g,u\}\)

with \([A]\) usage the same as for \([W]\) above.

In the UOO case, things are simpler, just compute statistics of each optimization response function: \([W] = [I], \{f\}/[g]/[A] \text{ are empty.}\)

References Response::active_set_request_vector(), NestedModel::check_response_map(), NestedModel::interface_response_overlay(), and NestedModel::iterator_response_overlay().

### 13.82.3 Member Data Documentation

#### Model subModel [private]

the sub-model used in sub-iterator evaluations

There are no restrictions on subModel, so arbitrary nestings are possible. This is commonly used to support surrogate-based optimization under uncertainty by having NestedModels contain SurrogateModels and vice versa.

Referenced by NestedModel::component_parallel_mode(), NestedModel::derived_init_communicators(), NestedModel::derived_init_serial(), NestedModel::derived_subordinate_models(), NestedModel::estimate_partition_bounds(), NestedModel::fine_grained_evaluation_counters(), NestedModel::integer_variable_mapping(), NestedModel::NestedModel(), NestedModel::print_evaluation_summary(), NestedModel::real_variable_mapping(), NestedModel::resolve_integer_variable_mapping(), NestedModel::resolve_real_variable_mapping(), NestedModel::resolve_string_variable_mapping(), NestedModel::serve_run(), NestedModel::set_mapping(), NestedModel::sm_acv_index_map(), NestedModel::sm_adiv_index_map(), NestedModel::string_variable_mapping(), NestedModel::subordinate_model(), NestedModel::surrogate_response_mode(), NestedModel::update_inactive_view(), and NestedModel::update_sub_model().

The documentation for this class was generated from the following files:

- NestedModel.hpp
- NestedModel.cpp

### 13.83 NIDRProblemDescDB Class Reference

The derived input file database utilizing the new IDR parser.

Inheritance diagram for NIDRProblemDescDB:
## NIDRProblemDescDB Class Reference

### Public Member Functions

- **NIDRProblemDescDB (ParallelLibrary &parallel_lib)**
  - Constructor
- **~NIDRProblemDescDB ()**
  - Destructor
- **void derived_parse_inputs (const ProgramOptions &prog_opts)**
  - Parses the input file and populates the problem description database using NIDR.
- **void derived_broadcast ()**
  - Perform any data processing that must be coordinated with DB buffer broadcasting (performed prior to broadcasting the DB buffer on rank 0 and after receiving the DB buffer on other processor ranks)
- **void derived_post_process ()**
  - Perform any additional data post-processing
- **KWH (iface_Real)**
- **KWH (iface_Rlit)**
- **KWH (iface_false)**
- **KWH (iface_ilit)**
- **KWH (iface_pint)**
- **KWH (iface_lit)**
- **KWH (iface_start)**
- **KWH (iface_stop)**
- **KWH (iface_str)**
- **KWH (iface_str2D)**
- **KWH (iface_strL)**
- **KWH (iface_true)**
- **KWH (iface_type)**
- **KWH (method_Ii)**
- **KWH (method_Real)**
- **KWH (method_Real01)**
- **KWH (method_RealDL)**
- **KWH (method_RealLlit)**
- **KWH (method_Realp)**
- **KWH (method_Realz)**
- **KWH (method_Ri)**
- **KWH (method_false)**
- **KWH (method_szarray)**
- **KWH (method_ilit2)**
- **KWH (method_ilit2p)**
- **KWH (method_int)**
• KWH (method_ivec)
• KWH (method_lit)
• KWH (method_litc)
• KWH (method_lit)
• KWH (method_litp)
• KWH (method_litr)
• KWH (method_litz)
• KWH (method_num_resplevs)
• KWH (method_piecewise)
• KWH (method_pint)
• KWH (method_pintz)
• KWH (method_resplevs)
• KWH (method_resplevs01)
• KWH (method_shint)
• KWH (method_sizet)
• KWH (method_slit2)
• KWH (method_start)
• KWH (method_stop)
• KWH (method_str)
• KWH (method_strL)
• KWH (method_true)
• KWH (method_tr_final)
• KWH (method_type)
• KWH (method_usharray)
• KWH (method_ushint)
• KWH (method_utype)
• KWH (method_augment_utype)
• KWH (method_utype_lit)
• KWH (model_Real)
• KWH (model_RealDL)
• KWH (model_ivec)
• KWH (model_false)
• KWH (model_int)
• KWH (model_intsetm1)
• KWH (model_lit)
• KWH (model_order)
• KWH (model_pint)
• KWH (model_shint)
• KWH (model_start)
• KWH (model_stop)
• KWH (model_str)
• KWH (model_strL)
• KWH (model_true)
• KWH (model_type)
• KWH (model_utype)
• KWH (model_augment_utype)
• KWH (resp_RealDL)
• KWH (resp_RealL)
• KWH (resp_false)
• KWH (resp_intset)
• KWH (resp_ivec)
• KWH (resp_lit)
• KWH (resp_sizet)
• KWH (resp_start)
• KWH (resp_stop)
• KWH (resp_str)
• KWH (resp_strL)
• KWH (resp_true)
• KWH (resp_utype)
• KWH (resp_augment_utype)
• KWH (env_int)
• KWH (env_start)
• KWH (env_str)
• KWH (env_strL)
• KWH (env_true)
• KWH (env_utype)
• KWH (env_augment_utype)
• KWH (var_RealLb)
• KWH (var_RealUb)
• KWH (var_IntLb)
• KWH (var_categorical)
• KWH (var_caulbl)
• KWH (var_daulbl)
• KWH (var_dauslbl)
• KWH (var_daurlbl)
• KWH (var_ceulbl)
• KWH (var_deuilbl)
• KWH (var_deuslbl)
• KWH (var_deurlbl)
• KWH (var_pintz)
• KWH (var_start)
• KWH (var_stop)
• KWH (var_str)
• KWH (var_strL)
• KWH (var_true)
• KWH (var_newiarray)
• KWH (var_newsarray)
• KWH (var_newivec)
• KWH (var_newrvec)
• KWH (var_rvec)
• KWH (var_type)
Static Public Member Functions

- static void botch (const char ∗fmt,...)
  print and error message and immediately abort
- static void check_variables (std::list<DataVariables> ∗)
  check each node in a list of DataVariables, first mapping DataVariables members back to flat NIDR arrays if needed.
- static void check_responses (std::list<DataResponses> ∗)
- static void check_descriptors (const StringArray &labels)
  Validate user-supplied descriptors.
- static void make_variable_defaults (std::list<DataVariables> ∗)
  Bounds and initial point check and inferred bounds generation.
- static void make_response_defaults (std::list<DataResponses> ∗)
- static void squawk (const char ∗fmt,...)
  print an error message and increment nerr, but continue
- static void warn (const char ∗fmt,...)
  print a warning

Static Public Attributes

- static NIDRProblemDescDB ∗pDDBInstance
  Pointer to the active object instance used within the static kwhandler functions in order to avoid the need for static data. Only initialized when parsing an input file; will be NULL for cases of direct DB population only.
- static int nerr = 0
  number of parse error encountered

Static Private Member Functions

- static void check_variables_node (void ∗v)
  check a single variables node; input argument v is Var_Info*
- static int check_driver (const String ∗an_driver, const StringArray ∗link_files, const StringArray ∗copy_files)
  tokenize and try to validate the presence of an analysis driver, potentially included in the linked or copied template files

Private Attributes

- std::list< void ∗ > VIL
  List of Var_Info pointers, one per Variables instance.

Additional Inherited Members

13.83.1 Detailed Description

The derived input file database utilizing the new IDR parser.

The NIDRProblemDescDB class is derived from ProblemDescDB for use by the NIDR parser in processing D-AKOTA input file data. For information on modifying the NIDR input parsing procedures, refer to Dakota/docs/-Dev_Spec_Change.dox. For more on the parsing technology, see "Specifying and Reading Program Input with
13.84. **NL2RES STRUCT REFERENCE**

NIDR” by David M. Gay (report SAND2008-2261P, which is available in PDF form as http://dakota.sandia.gov/papers/nidr08.pdf). Source for the routines declared herein is NIDRProblemDescDB.cpp, in which most routines are so short that a description seems unnecessary.

### 13.83.2 Member Function Documentation

#### void derived_parse_inputs ( const ProgramOptions & prog_opts ) [virtual]

parses the input file and populates the problem description database using NIDR.

Parse the input file using the Input Deck Reader (IDR) parsing system. IDR populates the IDRProblemDescDB object with the input file data.

Reimplemented from ProblemDescDB.

References Dakota::abort_handler(), NIDRProblemDescDB::botch(), ProblemDescDB::dataMethodList, DataMethodRep::dlDetails, DataMethodRep::dlLib, ProgramOptions::input_file(), ProgramOptions::input_string(), NIDRProblemDescDB::nerr, ProblemDescDB::parallel_library(), ProgramOptions::parser_options(), NIDRProblemDescDB::pDDDBInstance, and NIDRProblemDescDB::squawk().

#### int check_driver ( const String & an_driver, const StringArray & link_files, const StringArray & copy_files ) [static], [private]

tokenize and try to validate the presence of an analysis driver, potentially included in the linked or copied template files

returns 1 if not found, 2 if found, but not executable, 0 if found (no error) in case we want to return to error on not found...

References WorkdirHelper::find_driver(), NIDRProblemDescDB::squawk(), WorkdirHelper::tokenize_driver(), NIDRProblemDescDB::warn(), and WorkdirHelper::which().

#### void make_variable_defaults ( std::list<DataVariables> * dvl ) [static]

Bounds and initial point check and inferred bounds generation.

Size arrays for contiguous storage of aggregated uncertain types. For each variable type, call Vgen_* to generate inferred bounds and initial point, repairing initial if needed. size the aggregate arrays for uncertain (design and state are stored separately

References Dakota::DesignAndStateLabelsCheck, NIDRProblemDescDB::squawk(), Dakota::var_mp_drange, Dakota::VLUncertainInt, Dakota::VLUncertainReal, and Dakota::VLUncertainStr.

Referenced by NIDRProblemDescDB::derived_post_process().

The documentation for this class was generated from the following files:

- NIDRProblemDescDB.hpp
- NIDRProblemDescDB.cpp

## 13.84 NL2Res Struct Reference

Auxiliary information passed to calcr and calcj via ur.

### Public Attributes

- Real * r  
  
  residual \( r = r(x) \)
- Real * J
Jacobian $J = J(x)$

- **Real * x**
  
  corresponding parameter vector

- **int nf**
  
  function invocation count for $r(x)$

### 13.84.1 Detailed Description

Auxiliary information passed to calcr and calcj via ur.

The documentation for this struct was generated from the following file:

- **NL2SOLLeastSq.cpp**

### 13.85 NL2SOLLeastSq Class Reference

Wrapper class for the NL2SOL nonlinear least squares library.

Inheritance diagram for NL2SOLLeastSq:

```
Iterator
    Minimizer
        LeastSq
            NL2SOLLeastSq
```

**Public Member Functions**

- **NL2SOLLeastSq (ProblemDescDB &problem_db, Model &model)**
  
  standard constructor

- **NL2SOLLeastSq (Model &model)**
  
  alternate constructor

- **~NL2SOLLeastSq ()**
  
  destructor

- **void core_run ()**
  
  core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

**Static Private Member Functions**

- **static void calcr (int *np, int *pp, Real *x, int *nfp, Real *r, int *ui, void *ur, Vf vf)**
  
  evaluator function for residual vector

- **static void calcj (int *np, int *pp, Real *x, int *nfp, Real *J, int *ui, void *ur, Vf vf)**
  
  evaluator function for residual Jacobian
Private Attributes

- int auxprt
  auxiliary printing bits (see Dakota Ref Manual): sum of
  \(< 1 = x0prt (print initial guess) < 2 = solprt (print final solution) < 4 = statpr (print solution statistics) < 8 =
  parprt (print nondefault parameters) < 16 = dradpr (print bound constraint drops/adds) < debug/verbose/normal
  use default = 31 (everything), < quiet uses 3, silent uses 0.

- int outlev
  frequency of output summary lines in number of iterations
  \(< (debug/verbose/normal/quiet use default = 1, silent uses 0)

- Real dltfdj
  finite-diff step size for computing Jacobian approximation
  \(< (fd\_gradient\_step\_size)

- Real delta0
  finite-diff step size for gradient differences for \(H\)
  \(< (a\ component\ of\ some\ covariance\ approximations,\ if\ desired) < (fd\_hessian\_step\_size)

- Real dltfdc
  finite-diff step size for function differences for \(H\)
  \(< (fd\_hessian\_step\_size)

- int mxcal
  function-evaluation limit \((max\_function\_evaluations)\)

- int mxiter
  iteration limit \((max\_iterations)\)

- Real rfctol
  relative fn convergence tolerance \((convergence\_tolerance)\)

- Real afctol
  absolute fn convergence tolerance \((absolute\_conv\_tol)\)

- Real xctol
  \(x\)-convergence tolerance \((x\_conv\_tol)\)

- Real sctol
  singular convergence tolerance \((singular\_conv\_tol)\)

- Real lmaxs
  radius for singular-convergence test \((singular\_radius)\)

- Real xtol
  false-convergence tolerance \((false\_conv\_tol)\)

- int covreq
  kind of covariance required \((\c\ covariance):\)
  \(< 1\ or\ -1 ==\ >\ sigma^{2} H^{-1} J^{T} J H^{-1} < 2\ or\ -2 ==\ >\ sigma^{2} H^{-1} < 3\ or\ -3 ==\ >\ sigma^{2}\ (J^{T} J)^{-1}\)
  \(< 1\ or\ 2 ==\ >\ use\ gradient\ diffs\ to\ estimate\ \(H\ < -1\ or\ -2 ==\ >\ use\ function\ diffs\ to\ estimate\ \(H\ <\ default = 0\ (no\ covariance)\)

- int rdreq
  whether to compute the regression diagnostic vector
  \(< (regression\_diagnostics)\)

- Real fprec
  expected response function precision \((function\_precision)\)

- Real lmax0
  initial trust-region radius \((initial\_trust\_radius)\)
Static Private Attributes

- static NL2SOLLeastSq * nl2solInstance

  pointer to the active object instance used within the static evaluator functions

Additional Inherited Members

13.85.1 Detailed Description

Wrapper class for the NL2SOL nonlinear least squares library.

The NL2SOLLeastSq class provides a wrapper for NL2SOL (TOMS Algorithm 573), in the updated form of Port Library routines dn[fg][b ] from Bell Labs; see http://www.netlib.org/port/readme. The Fortran from Port has been turned into C by f2c. NL2SOL uses a function pointer approach for which passed functions must be either global functions or static member functions.

13.85.2 Member Function Documentation

void core_run ( ) [virtual]

core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post


Reimplemented from Iterator.

References NL2SOLLeastSq::afctol, NL2SOLLeastSq::auxprt, Iterator::bestResponseArray, Iterator::bestVariablesArray, Minimizer::boundConstraintFlag, NL2SOLLeastSq::calcj(), NL2SOLLeastSq::calcr(), Minimizer::calibrationDataFlag, Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::continuous_variables(), Dakota::copy_data(), NL2SOLLeastSq::covreq, NL2SOLLeastSq::delta0, NL2SOLLeastSq::dltfdc, NL2SOLLeastSq::dltfdj, Minimizer::expData, NL2SOLLeastSq::fprec, Model::gradient_type(), ExperimentData::interpolate_flag(), Iterator::iteratedModel, NL2SOLLeastSq::lmax0, NL2SOLLeastSq::lmaxs, NL2SOLLeastSq::maxcal, NL2SOLLeastSq::mxiter, NL2SOLLeastSq::mxsolv, NL2SOLLeastSq::mxsolvInstance, Minimizer::numContinuousVars, LeastSq::numLeastSqTerms, Minimizer::numUserPrimaryFns, NL2SOLLeastSq::rdreq, NL2SOLLeastSq::rctol, NL2SOLLeastSq::scctol, Minimizer::speculativeFlag, Minimizer::vendorNumericalGradFlag, NL2SOLLeastSq::xctol, and NL2SOLLeastSq::xtol.

The documentation for this class was generated from the following files:

- NL2SOLLeastSq.hpp
- NL2SOLLeastSq.cpp

13.86 NLPQLPOptimizer Class Reference

Wrapper class for the NLPQLP optimization library, Version 2.0.

Inheritance diagram for NLPQLPOptimizer:
Public Member Functions

- **NLPQLPOptimizer (ProblemDescDB &problem_db, Model &model)**
  standard constructor
- **NLPQLPOptimizer (Model &model)**
  alternate constructor
- **~NLPQLPOptimizer ()**
  destructor
- void **core_run ()**
  core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

Protected Member Functions

- void **initialize_run ()**
  performs run-time set up

Private Member Functions

- void **initialize ()**
  Shared constructor code.
- void **allocate_workspace ()**
  Allocates workspace for the optimizer.
- void **deallocate_workspace ()**
  Releases workspace memory.
- void **allocate_constraints ()**
  Allocates constraint mappings.

Private Attributes

- int **L**
  \( L \): Number of parallel systems, i.e. function calls during line search at predetermined iterates. HINT: If only less than 10 parallel function evaluations are possible, it is recommended to apply the serial version by setting \( L=1 \).
- int **numEqConstraints**
  \( numEqConstraints \): Number of equality constraints.
- int **MMAX**
CHAPTER 13. CLASS DOCUMENTATION

- **MMAX**: Row dimension of array DG containing Jacobian of constraints. MMAX must be at least one and greater or equal to M.

- **int N**
  - N: Number of optimization variables.

- **int NMAX**
  - NMAX: Row dimension of C. NMAX must be at least two and greater than N.

- **int MNN2**
  - MNN2: Must be equal to M+N+N+2.

- **double * X**
  - X(NMAX,L): Initially, the first column of X has to contain starting values for the optimal solution. On return, X is replaced by the current iterate. In the driving program the row dimension of X has to be equal to NMAX. X is used internally to store L different arguments for which function values should be computed simultaneously.

- **double * F**
  - F(L): On return, F(1) contains the final objective function value. F is used also to store L different objective function values to be computed from L iterates stored in X.

- **double * G**
  - G(MMAX,L): On return, the first column of G contains the constraint function values at the final iterate X. In the driving program the row dimension of G has to be equal to MMAX. G is used internally to store L different set of constraint function values to be computed from L iterates stored in X.

- **double * DF**
  - DF(NMAX): DF contains the current gradient of the objective function. In case of numerical differentiation and a distributed system (L>1), it is recommended to apply parallel evaluations of F to compute DF.

- **double * DG**
  - DG(MMAX,NMAX): DG contains the gradients of the active constraints (ACTIVE(J)=true.) at a current iterate X. The remaining rows are filled with previously computed gradients. In the driving program the row dimension of DG has to be equal to MMAX.

- **double * U**
  - U(MNN2): U contains the multipliers with respect to the actual iterate stored in the first column of X. The first M locations contain the multipliers of the M nonlinear constraints, the subsequent N locations the multipliers of the lower bounds, and the final N locations the multipliers of the upper bounds. At an optimal solution, all multipliers with respect to inequality constraints should be nonnegative.

- **double * C**
  - C(NMAX,NMAX): On return, C contains the last computed approximation of the Hessian matrix of the Lagrangian function stored in form of an LDL decomposition. C contains the lower triangular factor of an LDL factorization of the final quasi-Newton matrix (without diagonal elements, which are always one). In the driving program, the row dimension of C has to be equal to NMAX.

- **double * D**
  - D(NMAX): The elements of the diagonal matrix of the LDL decomposition of the quasi-Newton matrix are stored in the one-dimensional array D.

- **double ACC**
  - ACC: The user has to specify the desired final accuracy (e.g. 1.0D-7). The termination accuracy should not be smaller than the accuracy by which gradients are computed.

- **double ACCQP**
  - ACCQP: The tolerance is needed for the QP solver to perform several tests, for example whether optimality conditions are satisfied or whether a number is considered as zero or not. If ACCQP is less or equal to zero, then the machine precision is computed by NLPQLP and subsequently multiplied by 1.0D+4.

- **double STPMIN**
STPMIN: Minimum steplength in case of L>1. Recommended is any value in the order of the accuracy by which functions are computed. The value is needed to compute a steplength reduction factor by STPMIN**(1/L-1). If STPMIN<=0, then STPMIN=ACC is used.

- int MAXFUN
  MAXFUN: The integer variable defines an upper bound for the number of function calls during the line search (e.g. 20). MAXFUN is only needed in case of L=1, and must not be greater than 50.

- int MAXIT
  MAXIT: Maximum number of outer iterations, where one iteration corresponds to one formulation and solution of the quadratic programming subproblem, or, alternatively, one evaluation of gradients (e.g. 100).

- int MAX_NM
  MAX_NM: Stack size for storing merit function values at previous iterations for non-monotone line search (e.g. 10). In case of MAX_NM=0, monotone line search is performed.

- double TOL_NM
  TOL_NM: Relative bound for increase of merit function value, if line search is not successful during the very first step. Must be non-negative (e.g. 0.1).

- int IPRINT
  IPRINT: Specification of the desired output level. IPRINT = 0: No output of the program. IPRINT = 1: Only a final convergence analysis is given. IPRINT = 2: One line of intermediate results is printed in each iteration. IPRINT = 3: More detailed information is printed in each iteration step, e.g. variable, constraint and multiplier values. IPRINT = 4: In addition to 'IPRINT=3', merit function and steplength values are displayed during the line search.

- int MODE
  MODE: The parameter specifies the desired version of NLPQLP. MODE = 0: Normal execution (reverse communication!). MODE = 1: The user wants to provide an initial guess for the multipliers in U and for the Hessian of the Lagrangian function in C and D in form of an LDL decomposition.

- int IOUT
  IOUT: Integer indicating the desired output unit number, i.e. all write-statements start with 'WRITE(IOUT,... '.

- int IFAIL
  IFAIL: The parameter shows the reason for terminating a solution process. Initially IFAIL must be set to zero. On return IFAIL could contain the following values: IFAIL=-2: Compute gradient values w.r.t. the variables stored in first column of X, and store them in DF and DG. Only derivatives for active constraints ACTIVE(J)=.TRUE. need to be computed. Then call NLPQLP again, see below. IFAIL=-1: Compute objective fn and all constraint values subject the variables found in the first L columns of X, and store them in F and G. Then call NLPQLP again, see below. IFAIL = 0: The optimality conditions are satisfied. IFAIL = 1: The algorithm has been stopped after MAXIT iterations. IFAIL = 2: The algorithm computed an uphill search direction. IFAIL = 3: Underflow occurred when determining a new approximation matrix for the Hessian of the Lagrangian. IFAIL = 4: The line search could not be terminated successfully. IFAIL = 5: Length of a working array is too short. More detailed error information is obtained with 'IPRINT>0'. IFAIL = 6: There are false dimensions, for example M>MMAX, N>=NMAX, or MNN2<>M+N+N+2. IFAIL = 7: The search direction is close to zero, but the current iterate is still infeasible. IFAIL = 8: The starting point violates a lower or upper bound. IFAIL = 9: Wrong input parameter; i.e., MODE, LDL decomposition in D and C (in case of MODE=1), IPRINT, IOUT IFAIL = 10: Internal inconsistency of the quadratic subproblem, division by zero. IFAIL > 100: The solution of the quadratic programming subproblem has been terminated with an error message and IFAIL is set to IFQL+100, where IFQL denotes the index of an inconsistent constraint.

- double * WA
  WA(LWA): WA is a real working array of length LWA.

- int LWA
  LWA: LWA value extracted from NLPQLP20.f.

- int * KWA
KWA(LKWA) : The user has to provide working space for an integer array.

- int LKWA
  LKWA : LKWA should be at least N+10.

- int * ACTIVE
  ACTIVE(LACTIV) : The logical array shows a user the constraints, which NLPQLP considers to be active at the last computed iterate, i.e. G(J,X) is active, if and only if ACTIVE(J)=.TRUE., J=1,...,M.

- int LACTIVE
  LACTIV : The length LACTIV of the logical array should be at least 2*M+10.

- int LQL
  LQL : If LQL = .TRUE., the quadratic programming subproblem is to be solved with a full positive definite quasi-Newton matrix. Otherwise, a Cholesky decomposition is performed and updated, so that the subproblem matrix contains only an upper triangular factor.

- int numNlpqlConstr
  total number of constraints seen by NLPQL

- SizetList nonlinIneqConMappingIndices
  a list of indices for referencing the DAKOTA nonlinear inequality constraints used in computing the corresponding NLPQL constraints.

- RealList nonlinIneqConMappingMultipliers
  a list of multipliers for mapping the DAKOTA nonlinear inequality constraints to the corresponding NLPQL constraints.

- RealList nonlinIneqConMappingOffsets
  a list of offsets for mapping the DAKOTA nonlinear inequality constraints to the corresponding NLPQL constraints.

- SizetList linIneqConMappingIndices
  a list of indices for referencing the DAKOTA linear inequality constraints used in computing the corresponding NLPQL constraints.

- RealList linIneqConMappingMultipliers
  a list of multipliers for mapping the DAKOTA linear inequality constraints to the corresponding NLPQL constraints.

- RealList linIneqConMappingOffsets
  a list of offsets for mapping the DAKOTA linear inequality constraints to the corresponding NLPQL constraints.

Additional Inherited Members

13.86.1 Detailed Description

Wrapper class for the NLPQLP optimization library, Version 2.0.

An Implementation of a Sequential Quadratic Programming Method for Solving Nonlinear Optimization Problems by Distributed Computing and Non-Monotone Line Search

This subroutine solves the general nonlinear programming problem

\[
\begin{align*}
\text{minimize} & & F(X) \\
\text{subject to} & & G(J,X) = 0, \quad J=1,...,ME \\
& & G(J,X) \geq 0, \quad J=ME+1,...,M \\
& & XL \leq X \leq XU
\end{align*}
\]
and is an extension of the code NLPQLD. NLPQLP is specifically tuned to run under distributed systems. A new input parameter L is introduced for the number of parallel computers, that is the number of function calls to be executed simultaneously. In case of L=1, NLPQLP is identical to NLPQLD. Otherwise the line search is modified to allow L parallel function calls in advance. Moreover the user has the opportunity to use distributed function calls for evaluating gradients.

The algorithm is a modification of the method of Wilson, Han, and Powell. In each iteration step, a linearly constrained quadratic programming problem is formulated by approximating the Lagrangian function quadratically and by linearizing the constraints. Subsequently, a one-dimensional line search is performed with respect to an augmented Lagrangian merit function to obtain a new iterate. Also the modified line search algorithm guarantees convergence under the same assumptions as before.

For the new version, a non-monotone line search is implemented which allows to increase the merit function in case of instabilities, for example caused by round-off errors, errors in gradient approximations, etc.

The subroutine contains the option to predetermine initial guesses for the multipliers or the Hessian of the Lagrangian function and is called by reverse communication.

### 13.86.2 Member Function Documentation

```cpp
void core_run() [virtual]
```

core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post run.

Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.

Reimplemented from `Iterator`.

References `NLPQLPOptimizer::ACC`, `NLPQLPOptimizer::ACCQP`, `NLPQLPOptimizer::ACTIVE`, `Iterator::activeSet`, `Iterator::bestResponseArray`, `NLPQLPOptimizer::C`, `Model::continuous_lower_bounds()`, `Model::continuous_upper_bounds()`, `Model::continuous_variables()`, `Dakota::copy_data()`, `Model::current_response()`, `NLPQLPOptimizer::D`, `NLPQLPOptimizer::deallocate_workspace()`, `NLPQLPOptimizer::DF`, `NLPQLPOptimizer::DG`, `Model::evaluate()`, `NLPQLPOptimizer::F`, `Response::function_gradients()`, `Response::function_values()`, `NLPQLPOptimizer::G`, `NLPQLPOptimizer::IFAIL`, `NLPQLPOptimizer::IOUT`, `NLPQLPOptimizer::IPRINT`, `Iterator::iteratedModel`, `NLPQLPOptimizer::KWA`, `NLPQLPOptimizer::L`, `NLPQLPOptimizer::LACTIVE`, `Model::linear_eq_constraint_coeffs()`, `Model::linear_eq_constraint_targets()`, `Model::linear_ineq_constraint_coeffs()`, `NLPQLP::linIneqConMappingIndices`, `NLPQLP::linIneqConMappingMultipliers`, `NLPQLP::linIneqConMappingOffsets`, `NLPQLP::LKA`, `Optimizer::localObjectiveRecast`, `NLPQLP::LQL`, `NLPQLP::LWA`, `NLPQLP::MAX_NM`, `NLPQLP::MAXFUN`, `Optimizer::maxFunctionEvals`, `NLPQLP::MAXIT`, `NLPQLP::MMAX`, `NLPQLP::MNN2`, `NLPQLP::MODE`, `NLPQLP::N`, `NLPQLP::NMAX`, `Model::nonlinear_eq_constraint_targets()`, `NLPQLP::nonlinIneqConMappingIndices`, `NLPQLP::nonlinIneqConMappingMultipliers`, `nonlinIneqConMappingOffsets`, `Model::num_nonlinear_eq_constraints()`, `Model::num_nonlinear_ineq_constraints()`, `Minimizer::numContinuousVars`, `NLPQLP::numEqConstraints`, `Minimizer::numFunctions`, `NLPQLP::numNlpqlConstr`, `Optimizer::numObjectiveFns`, `Model::primary_response_fn_sense()`, `ActiveSet::request_value()`, `ActiveSet::request_values()`, `NLPQLP::STPMIN`, `NLPQLP::TOL_NM`, `NLPQLP::U`, `NLPQLP::WA`, and `NLPQLP::X`.

The documentation for this class was generated from the following files:

- NLPQLP::optimizer.hpp
- NLPQLP::optimizer.cpp

### 13.87 NLSSOLLeastSq Class Reference

Wrapper class for the NLSSOL nonlinear least squares library.

Inheritance diagram for NLSSOLLeastSq:
Public Member Functions

- **NLSSOLLeastSq (ProblemDescDB &problem_db, Model &model)**
  standard constructor
- **NLSSOLLeastSq (Model &model)**
  alternate constructor
- **~NLSSOLLeastSq ()**
  destructor
- **void core_run ()**
  core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

Static Private Member Functions

- **static void least_sq_eval (int &mode, int &m, int &n, int &nrowfj, double *x, double *f, double *gradf, int &nstate)**
  Evaluator for NLSSOL: computes the values and first derivatives of the least squares terms (passed by function pointer to NLSSOL).

Static Private Attributes

- **static NLSSOLLeastSq * nlssolInstance**
  pointer to the active object instance used within the static evaluator functions in order to avoid the need for static data

Additional Inherited Members

13.87.1 Detailed Description

Wrapper class for the NLSSOL nonlinear least squares library.

The NLSSOLLeastSq class provides a wrapper for NLSSOL, a Fortran 77 sequential quadratic programming library from Stanford University marketed by Stanford Business Associates. It uses a function pointer approach for which passed functions must be either global functions or static member functions. Any nonstatic attribute used within static member functions must be either local to that function or accessed through a static pointer.

The user input mappings are as follows: max_function_evaluations is implemented directly in NLSSOLLeastSq’s evaluator functions since there is no NLSSOL parameter equivalent, and max_iterations, convergence_tolerance, output verbosity, verify_level, function_precision, and linesearch_tol tolerance are mapped into NLSSOL's "Major Iteration Limit", "Optimality Tolerance", "Major Print Level"
(verbose: Major Print Level = 20; quiet: Major Print Level = 10), "Verify Level", "Function Precision", and "Linesearch Tolerance" parameters, respectively, using NLSSOL's npopt() subroutine (as wrapped by npoptn2() from the npoptn_wrapper.f file). Refer to [Gill, P.E., Murray, W., Saunders, M.A., and Wright, M.H., 1986] for information on NLSSOL's optional input parameters and the npopt() subroutine.

### 13.87.2 Constructor & Destructor Documentation

**NLSSOLLeastSq ( ProblemDescDB & problem_db, Model & model )**

standard constructor

This is the primary constructor. It accepts a Model reference.

References Minimizer::constraintTol, Iterator::convergenceTol, Model::fd_gradient_step_size(), ProblemDescDB::get_int(), ProblemDescDB::get_real(), Model::gradient_type(), Iterator::iteratedModel, Iterator::maxIterations, Iterator::outputLevel, Iterator::probDescDB, SOLBase::set_options(), Minimizer::speculativeFlag, and Minimizer::vendorNumericalGradFlag.

**NLSSOLLeastSq ( Model & model )**

alternate constructor

This is an alternate constructor which accepts a Model but does not have a supporting method specification from the ProblemDescDB.

References Minimizer::constraintTol, Iterator::convergenceTol, Model::fd_gradient_step_size(), Model::gradient_type(), Iterator::iteratedModel, Iterator::maxIterations, Iterator::outputLevel, SOLBase::set_options(), Minimizer::speculativeFlag, and Minimizer::vendorNumericalGradFlag.

### 13.87.3 Member Function Documentation

**void core_run ( ) [virtual]**

core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post steps. Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.

Reimplemented from Iterator.

References SOLBase::allocate_arrays(), SOLBase::allocate_workspace(), SOLBase::augment_bounds(), Iterator::bestResponseArray, Iterator::bestVariablesArray, Minimizer::calibrationDataFlag, SOLBase::cLambda, SOLBase::constraint_eval(), SOLBase::constraintJacMatrixF77, SOLBase::constraintState, SOLBase::constrOffset, Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::continuous_variables(), Dakota::copy_data(), Dakota::copy_data_partial(), SOLBase::deallocate_arrays(), Minimizer::expData, SOLBase::fnEvalCntnr, SOLBase::informResult, ExperimentData::interpolate_flag(), SOLBase::intWorkSpace, SOLBase::intWorkSpaceSize, Iterator::iteratedModel, NLSSOLLeastSq::least_sq_eval(), SOLBase::linConstraintArraySize, SOLBase::linConstraintMatrixF77, Model::linear_eq_constraint_coeffs(), Model::linear_eq_constraint_targets(), Model::linear_ineq_constraint_coeffs(), Model::linear_ineq_constraint_lower_bounds(), Model::linear_ineq_constraint_upper_bounds(), SOLBase::nlConstraintArraySize, NLSSOLLeastSq::nlssolInstance, Model::nonlinear_eq_constraint_targets(), Model::nonlinear_ineq_constraint_lower_bounds(), Model::nonlinear_ineq_constraint_upper_bounds(), SOLBase::numContinuousVars, LeastSq::numLeastSqTerms, Minimizer::numLinearConstraints, Minimizer::numNonlinearConstraints, Minimizer::numUserPrimaryFns, SOLBase::optLsqInstance, Minimizer::prevMinInstance, SOLBase::realWorkSpace, SOLBase::realWorkSpaceSize, SOLBase::solInstance, and SOLBase::upperFactorHessianF77.

The documentation for this class was generated from the following files:

- NLSSOLLeastSq.hpp
- NLSSOLLeastSq.cpp
13.88 NoDBBaseConstructor Struct Reference

Dummy struct for overloading constructors used in on-the-fly instantiations without ProblemDescDB support.

Public Member Functions

- **NoDBBaseConstructor (int=0)**
  
  *C++ structs can have constructors.*

13.88.1 Detailed Description

Dummy struct for overloading constructors used in on-the-fly instantiations without ProblemDescDB support. NoDBBaseConstructor is used to overload the constructor used for on-the-fly instantiations in which ProblemDescDB queries cannot be used. Putting this struct here avoids circular dependencies.

The documentation for this struct was generated from the following file:

- dakota_global_defs.hpp

13.89 NomadOptimizer Class Reference

Wrapper class for NOMAD Optimizer.

Inheritance diagram for NomadOptimizer:

```
   Iterator
   
   Minimizer
   
   Optimizer
   
   NomadOptimizer
```

Classes

- class **Evaluator**
  
  *NOMAD-based Evaluator class.*

Public Member Functions

- **NomadOptimizer (ProblemDescDB &problem_db, Model &model)**
  
  *Constructor.*

- **NomadOptimizer (Model &model)**
  
  *alternate constructor for Iterator instantiations without DB*

- **~NomadOptimizer ()**
  
  *Destructor.*

- **void core_run ()**
  
  *Calls the NOMAD solver.*
Private Member Functions

- void load_parameters (Model &model, NOMAD::Parameters &p)
  
  Convenience function for Parameter loading.

Private Attributes

- int numTotalVars
  
  Total across all types of variables.
- int numNomadNonlinearIneqConstraints
  
  Number of nonlinear inequality constraints after put into the format required by NOMAD.
- int randomSeed
  
  Algorithm control parameters passed to NOMAD.
- int maxBlackBoxEvals
- int maxIterations
- Real epsilon
- Real vns
- std::string outputFormat
  
  Output control parameters passed to NOMAD.
- std::string historyFile
- bool displayAll
- int numHops
  
  Parameters needed for categorical neighbor construction.
- BitArray discreteSetIntCat
- BitArray discreteSetRealCat
- RealMatrixArray discreteSetIntAdj
- RealMatrixArray discreteSetRealAdj
- RealMatrixArray discreteSetStrAdj
- RealMatrixArray categoricalAdjacency
- NOMAD::Point initialPoint
  
  Pointer to Nomad initial point.
- NOMAD::Point upperBound
  
  Pointer to Nomad upper bounds.
- NOMAD::Point lowerBound
  
  Pointer to Nomad lower bounds.
- std::vector< int > constraintMapIndices

  map from Dakota constraint number to Nomad constraint number
- std::vector< double > constraintMapMultipliers

  multipliers for constraint transformations
- std::vector< double > constraintMapOffsets

  offsets for constraint transformations
Additional Inherited Members

13.89.1 Detailed Description

Wrapper class for NOMAD Optimizer.

NOMAD (is a Nonlinear Optimization by Mesh Adaptive Direct search) is a simulation-based optimization package designed to efficiently explore a design space using Mesh Adaptive Search.

Mesh Adaptive Direct Search uses Meshes, discretizations of the domain space of variables. It generates multiple meshes, and as its name implies, it also adapts the refinement of the meshes in order to find the best solution of a problem.

The objective of each iteration is to find points in a mesh that improves the current solution. If a better solution is not found, the next iteration is done over a finer mesh.

Each iteration is composed of two steps: Search and Poll. The Search step finds any point in the mesh in an attempt to find an improvement; while the Poll step generates trial mesh points surrounding the current best current solution.

The NomadOptimizer is a wrapper for the NOMAD library. It features the following attributes: max_function_evaluations, display_format, display_all_evaluations, function_precision, max_iterations.

13.89.2 Constructor & Destructor Documentation

NomadOptimizer ( ProblemDescDB & problem_db, Model & model )

Constructor.

Parameters

model  DAKOTA Model object

References ProblemDescDB::get_val(), ProblemDescDB::get_bool(), ProblemDescDB::get_int(), ProblemDescDB::get_real(), ProblemDescDB::get_rma(), ProblemDescDB::get_string(), NomadOptimizer::numHops, NomadOptimizer::outputFormat, Iterator::probDescDB, and NomadOptimizer::randomSeed.

13.89.3 Member Function Documentation

void load_parameters ( Model & model, NOMAD::Parameters & p ) [private]

Convenience function for Parameter loading.

This function takes the Parameters provided by the user in the DAKOTA model.

Parameters

model  NOMAD Model object Variables for the stuff that must go in the parameters. Will be filled by calling load_parameters after the constructor to capture model recasts.

References Dakota::NPOS, Dakota::abort_handler(), Minimizer::bigIntBoundSize, Minimizer::bigRealBoundSize, NomadOptimizer::constraintMapIndices, NomadOptimizer::constraintMapMultipliers, NomadOptimizer::constraintMapOffsets, Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::continuous_variables(), Model::discrete_int_lower_bounds(), Model::discrete_int_sets(), Model::discrete_int_upper_bounds(), Model::discrete_int_variables(), Model::discrete_real_lower_bounds(), Model::discrete_real_upper_bounds(), Model::discrete_real_variables(), Model::discrete_set_int_values(), Model::discrete_set_real_values(), Model::discrete_set_string_values(), Model::discrete_string_variables(), NomadOptimizer::initialPoint, Iterator::iteratedModel, NomadOptimizer::lowerBound, Model::nonlinear_eq_constraint_targets(), Model::nonlinear_ineq_constraint_lower_bounds(), Model::nonlinear_ineq_constraint_upper_bounds(), Model::nonlinear_ineq_constraints(), Model::nonlinear_eq_constraint_targets(), Model::nonlinear_ineq_constraints(),
Model::nonlinear_ineq_constraint_upper_bounds(), Minimizer::numContinuousVars, Minimizer::numDiscreteInt-
Vars, Minimizer::numDiscreteRealVars, Minimizer::numDiscreteStringVars, NomadOptimizer::numNomadNonlinear-
IneqConstraints, Minimizer::numNonlinearEqConstraints, Minimizer::numNonlinearIneqConstraints, NomadOptimizer-
::numTotalVars, Dakota::set_value_to_index(), and NomadOptimizer::upperBound.

Referenced by NomadOptimizer::core_run().

The documentation for this class was generated from the following files:

- NomadOptimizer.hpp
- NomadOptimizer.cpp

## 13.90 NonD Class Reference

Base class for all nondeterministic iterators (the DAKOTA/UQ branch).

Inheritance diagram for NonD:

![Inheritance Diagram](image)

### Public Member Functions

- **void initialize_random_variables** (short u_space_type)
  
  initialize natafTransform based on distribution data from iteratedModel

- **void initialize_random_variables** (const Pecos::ProbabilityTransformation &transform, bool deep_copy=false)
  
  alternate form: initialize natafTransform based on incoming data
• void initialize_random_variable_transformation ()
  instantiate natafTransform

• void initialize_random_variable_types ()
  initializes ranVarTypesX within natafTransform (u-space not needed)

• void initialize_random_variable_types (short u_space_type)
  initializes ranVarTypesX and ranVarTypesU within natafTransform

• void initialize_random_variable_parameters ()
  initializes ranVarMeansX, ranVarStdDevsX, ranVarLowerBndsX, ranVarUpperBndsX, and ranVarAddtlParamsX within natafTransform

• void initialize_random_variable_correlations ()
  propagate iteratedModel correlations to natafTransform

• void verify_correlation_support (short u_space_type)
  verify that correlation warping is supported by Nataf for given variable types

• void transform_correlations ()
  perform correlation warping for variable types supported by Nataf

• void requested_levels (const RealVectorArray &req_resp_levels, const RealVectorArray &req_prob_levels, const RealVectorArray &req_rel_levels, const RealVectorArray &req_gen_rel_levels, short resp_level_tgt, short resp_level_target, bool cdf_flag, bool pdf_output)
  set requestedRespLevels, requestedProbLevels, requestedRelLevels, requestedGenRelLevels, respLevelTarget, cdfFlag, and pdfOutput (used in combination with alternate ctors)

• void distribution_parameter_derivatives (bool dist_param_derivs)
  set distParamDerivs

• void print_level_mappings (std::ostream &s) const
  prints the z/p/beta/beta∗ mappings reflected in \{requested,computed\}\{Resp,Prob,Rel,GenRel\}Levels for default qoi type and qoi labels

• void print_level_mappings (std::ostream &s, String qoi_type, const StringArray &qoi_labels) const
  prints the z/p/beta/beta∗ mappings reflected in \{requested,computed\}\{Resp,Prob,Rel,GenRel\}Levels

• bool resize ()
  reinitializes iterator based on new variable size

• bool pdf_output () const
  get pdfOutput

• void pdf_output (bool output)
  set pdfOutput

• Pecos::ProbabilityTransformation & variable_transformation ()
  return natafTransform

Protected Member Functions

• NonD (ProblemDescDB &problem_db, Model &model)
  constructor

• NonD (unsigned short method_name, Model &model)
  alternate constructor for sample generation and evaluation “on the fly”

• NonD (unsigned short method_name, const RealVector &lower_bnds, const RealVector &upper_bnds)
  alternate constructor for sample generation "on the fly"
• ~NonD()
  destructor
• void derived_set_communicators(ParLevLIter pl_iter)
  derived class contributions to setting the communicators associated with this Iterator instance
• void initialize_run()
  utility function to perform common operations prior to pre_run(); typically memory initialization; setting of instance pointers
• void finalize_run()
  utility function to perform common operations following post_run(); deallocation and resetting of instance pointers
• const Response & response_results() const
  return the final statistics from the nondeterministic iteration
• void response_results_active_set(const ActiveSet &set)
  set the active set within finalStatistics
• virtual void initialize_response_covariance()
  initializes respCovariance
• virtual void initialize_final_statistics()
  initializes finalStatistics for storing NonD final results
• virtual void update_final_statistics()
  update finalStatistics::functionValues
• void size()
  Size local variables.
• int generate_system_seed()
  create a system-generated unique seed (when a seed is unspecified)
• void initialize_final_statistics_gradients()
  initializes finalStatistics::functionGradients
• void update_aleatory_final_statistics()
  update finalStatistics::functionValues from momentStats and computed\{Prob,Rel,GenRel,Resp\}Levels
• void update_system_final_statistics()
  update system metrics from component metrics within finalStatistics
• void update_system_final_statistics_gradients()
  update finalStatistics::functionGradients
• void initialize_level_mappings()
  size computed\{Resp,Prob,Rel,GenRel\}Levels
• void compute_densities(const RealRealPairArray &min_max_fns, bool prob_refinement=false, bool all_levels_computed=false)
  compute the PDF bins from the CDF/CCDF values and store in computedPDF\{Abscissas,Ordinates\}
• void print_densities(std::ostream &s) const
  output the PDFs reflected in computedPDF\{Abscissas,Ordinates\} using default qoi_type and pdf_labels
• void print_densities(std::ostream &s, String qoi_type, const StringArray &pdf_labels) const
  output the PDFs reflected in computedPDF\{Abscissas,Ordinates\}
• void print_system_mappings(std::ostream &s) const
  print system series/parallel mappings for response levels
• void transform_model(Model &x_model, Model &u_model, bool truncated_bounds=false, Real bound=10.)
recast $x_{\text{model}}$ from $x$-space to $u$-space to create $u_{\text{model}}$

- **void** `construct_lhs` (Iterator &$u$ _space_sampler, Model &$u$ _model, unsigned short _sample_type, int num_samples, int seed, const String &rng, bool vary_pattern, short sampling_vars_mode=ACTIVE)

  assign a NonDLHSSampling instance within $u$ _space_sampler

- **void** `archive_allocate_mappings` ()

  allocate results array storage for distribution mappings

- **void** `archive_from_resp` (size_t fn_index)

  archive the mappings from specified response levels for specified fn

- **void** `archive_to_resp` (size_t fn_index)

  archive the mappings to computed response levels for specified fn

- **void** `archive_allocate_pdf` ()

  allocate results array storage for pdf histograms

- **void** `archive_pdf` (size_t fn_index)

  archive a single pdf histogram for specified function

### Static Protected Member Functions

- **static void** `vars_u_to_x_mapping` (const Variables &$u$ _vars, Variables &$x$ _vars)

  static function for RecastModels used for forward mapping of $u$-space variables from NonD Iterators to $x$-space variables for Model evaluations

- **static void** `vars_x_to_u_mapping` (const Variables &$x$ _vars, Variables &$u$ _vars)

  static function for RecastModels used for inverse mapping of $x$-space variables from data import to $u$-space variables for NonD Iterators

- **static void** `set_u_to_x_mapping` (const Variables &$u$ _vars, const ActiveSet &$u$ _set, ActiveSet &$x$ _set)

  static function for RecastModels used to map $u$-space ActiveSets from NonD Iterators to $x$-space ActiveSets for Model evaluations

- **static void** `resp_x_to_u_mapping` (const Variables &$x$ _vars, const Variables &$u$ _vars, const Response &$x$ _response, Response &$u$ _response)

  static function for RecastModels used to map $x$-space responses from Model evaluations to $u$-space responses for return to NonD Iterator.

### Protected Attributes

- **NonD** * prevNondInstance

  pointer containing previous value of nondInstance

- **Pecos::ProbabilityTransformation** natafTransform

  Nonlinear variable transformation that encapsulates the required data for performing transformations from $X \rightarrow Z \rightarrow U$ and back.

- **size_t** `numContDesVars`

  number of continuous design variables (modeled using uniform distribution for All view modes)

- **size_t** `numDiscIntDesVars`

  number of discrete integer design variables (modeled using discrete histogram distributions for All view modes)

- **size_t** `numDiscStringDesVars`

  number of discrete string design variables (modeled using discrete histogram distributions for All view modes)

- **size_t** `numDiscRealDesVars`
number of discrete real design variables (modeled using discrete histogram distributions for All view modes)

- size_t numDesignVars
  total number of design variables

- size_t numContStateVars
  number of continuous state variables (modeled using uniform distribution for All view modes)

- size_t numDiscIntStateVars
  number of discrete integer state variables (modeled using discrete histogram distributions for All view modes)

- size_t numDiscStringStateVars
  number of discrete string state variables (modeled using discrete histogram distributions for All view modes)

- size_t numDiscRealStateVars
  number of discrete real state variables (modeled using discrete histogram distributions for All view modes)

- size_t numStateVars
  total number of state variables

- size_t numNormalVars
  number of normal uncertain variables (native space)

- size_t numLognormalVars
  number of lognormal uncertain variables (native space)

- size_t numUniformVars
  number of uniform uncertain variables (native space)

- size_t numLoguniformVars
  number of loguniform uncertain variables (native space)

- size_t numTriangularVars
  number of triangular uncertain variables (native space)

- size_t numExponentialVars
  number of exponential uncertain variables (native space)

- size_t numBetaVars
  number of beta uncertain variables (native space)

- size_t numGammaVars
  number of gamma uncertain variables (native space)

- size_t numGumbelVars
  number of gumbel uncertain variables (native space)

- size_t numFrechetVars
  number of frechet uncertain variables (native space)

- size_t numWeibullVars
  number of weibull uncertain variables (native space)

- size_t numHistogramBinVars
  number of histogram bin uncertain variables (native space)

- size_t numPoissonVars
  number of Poisson uncertain variables (native space)

- size_t numBinomialVars
  number of binomial uncertain variables (native space)

- size_t numNegBinomialVars
  number of negative binomial uncertain variables (native space)
• `size_t numGeometricVars`  
  number of geometric uncertain variables (native space)

• `size_t numHyperGeomVars`  
  number of hypergeometric uncertain variables (native space)

• `size_t numHistogramPtIntVars`  
  number of histogram point integer uncertain variables (native space)

• `size_t numHistogramPtStringVars`  
  number of histogram point string uncertain variables (native space)

• `size_t numHistogramPtRealVars`  
  number of histogram point real uncertain variables (native space)

• `size_t numContIntervalVars`  
  number of continuous interval uncertain variables (native space)

• `size_t numDiscIntervalVars`  
  number of discrete interval uncertain variables (native space)

• `size_t numDiscSetIntUncVars`  
  number of discrete integer set uncertain variables (native space)

• `size_t numDiscSetStringUncVars`  
  number of discrete integer set uncertain variables (native space)

• `size_t numDiscSetRealUncVars`  
  number of discrete real set uncertain variables (native space)

• `size_t numContAleatUncVars`  
  total number of continuous aleatory uncertain variables (native space)

• `size_t numDiscIntAleatUncVars`  
  total number of discrete integer aleatory uncertain variables (native space)

• `size_t numDiscStringAleatUncVars`  
  total number of discrete string aleatory uncertain variables (native space)

• `size_t numDiscRealAleatUncVars`  
  total number of discrete real aleatory uncertain variables (native space)

• `size_t numAleatoryUncVars`  
  total number of aleatory uncertain variables (native space)

• `size_t numContEpistUncVars`  
  total number of continuous epistemic uncertain variables (native space)

• `size_t numDiscIntEpistUncVars`  
  total number of discrete integer epistemic uncertain variables (native space)

• `size_t numDiscStringEpistUncVars`  
  total number of discrete string epistemic uncertain variables (native space)

• `size_t numDiscRealEpistUncVars`  
  total number of discrete real epistemic uncertain variables (native space)

• `size_t numEpistemicUncVars`  
  total number of epistemic uncertain variables (native space)

• `size_t numUncertainVars`  
  total number of uncertain variables (native space)

• `bool epistemicStats`
flag for computing interval-type metrics instead of integrated metrics If any epistemic variables are active in a
metric evaluation, then this flag is set.

- **RealMatrix momentStats**
  moments of response functions (mean, std deviation, skewness, and kurtosis calculated in `compute_moments()`),
  indexed as `(moment,fn)`

- **RealVectorArray requestedRespLevels**
  requested response levels for all response functions

- **RealVectorArray computedProbLevels**
  output probability levels for all response functions resulting from `requestedRespLevels`

- **RealVectorArray computedRelLevels**
  output reliability levels for all response functions resulting from `requestedRespLevels`

- **RealVectorArray computedGenRelLevels**
  output generalized reliability levels for all response functions resulting from `requestedRespLevels`

- **short respLevelTarget**
  indicates mapping of `z->p` (PROBABILITIES), `z->beta` (RELIABILITIES), or `z->beta*` (GEN_RELIABILITIES)

- **short respLevelTargetReduce**
  indicates component or system series/parallel failure metrics

- **RealVectorArray requestedProbLevels**
  requested probability levels for all response functions

- **RealVectorArray requestedRelLevels**
  requested reliability levels for all response functions

- **RealVectorArray requestedGenRelLevels**
  requested generalized reliability levels for all response functions

- **RealVectorArray computedRespLevels**
  output response levels for all response functions resulting from `requestedProbLevels`, `requestedRelLevels`, or `requested-GenRelLevels`

- **size_t totalLevelRequests**
  total number of levels specified within `requestedRespLevels`, `requestedProbLevels`, and `requestedRelLevels`

- **bool cdfFlag**
  flag for type of probabilities/reliabilities used in mappings: cumulative/CDF (true) or complementary/CCDF (false)

- **bool pdfOutput**
  flag for managing output of response probability density functions (PDFs)

- **RealVectorArray computedPDFAbscissas**
  sorted response PDF intervals bounds extracted from min/max sample and `requested/computedRespLevels` (vector lengths = num bins + 1)

- **RealVectorArray computedPDFOrdinates**
  response PDF densities computed from bin counts divided by (unequal) bin widths (vector lengths = num bins)

- **Response finalStatistics**
  final statistics from the uncertainty propagation used in strategies: response means, standard deviations, and probabilities of failure

- **size_t miPLIndex**
  index for the active `ParallelLevel` within `ParallelConfiguration::miPLIter`
Static Protected Attributes

- static NonD * nondInstance
  
  pointer to the active object instance used within static evaluator functions in order to avoid the need for static data

Private Member Functions

- void distribute_levels (RealVectorArray &levels, bool ascending=true)
  
  convenience function for distributing a vector of levels among multiple response functions if a short-hand specification is employed.

- void level_mappings_file (size_t fn_index, const String &qoi_label) const
  
  Write level mappings to a file for a single response.

- void print_level_map (std::ostream &s, size_t fn_index, const String &qoi_label) const
  
  Print level mapping for a single response function to ostream.

- unsigned short pecos_to_dakota_variable_type (unsigned short pecos_var_type)
  
  convert from Pecos To Dakota variable enumeration type for continuous aleatory uncertain variables used in variable transformations

Private Attributes

- bool distParamDerivs
  
  flags calculation of derivatives with respect to distribution parameters s within resp_x_to_u_mapping() using the chain rule df/dx dx/ds. The default is to calculate derivatives with respect to standard random variables u using the chain rule df/dx dx/du.

13.90.1 Detailed Description

Base class for all nondeterministic iterators (the DAKOTA/UQ branch).

The base class for nondeterministic iterators consolidates uncertain variable data and probabilistic utilities for inherited classes.

13.90.2 Member Function Documentation

void initialize_random_variables ( short u_space_type )

initialize natafTransform based on distribution data from iteratedModel

Build ProbabilityTransformation::ranVar arrays containing the uncertain variable distribution types and their corresponding means/standard deviations. This function is used when the Model variables are in x-space.

References NonD::initialize_random_variable_correlations(), NonD::initialize_random_variable_parameters(), NonD::initialize_random_variable_transformation(), NonD::initialize_random_variable_types(), and NonD::verify_correlation_support().

Referenced by NonDExpansion::construct_expansion_sampler(), NonDLHSSampling::d_optimal_parameter_set(), NonDExpansion::initialize_u_space_model(), NonDAdaptImpSampling::NonDAdaptImpSampling(), NonDBayesCalibration::NonDBayesCalibration(), NonDGlobalReliability::NonDGlobalReliability(), and NonDLocalReliability::NonDLocalReliability().
void initialize_random_variables ( const Pecos::ProbabilityTransformation & transform, bool deep_copy = false )

alternate form: initialize natafTransform based on incoming data

This function is commonly used to publish transformation data when the Model variables are in a transformed space (e.g., u-space) and ProbabilityTransformation::ranVarTypes et al. may not be generated directly. This allows for the use of inverse transformations to return the transformed space variables to their original states.

References NonD::initialize_random_variable_transformation(), NonD::natafTransform, NonD::numContDesVars, NonD::numContEpistUncVars, NonD::numContIntervalVars, and NonD::numContStateVars.

void initialize_random_variable_types ( )

initializes ranVarTypesX within natafTransform (u-space not needed)

Build ProbabilityTransformation::ranVar arrays containing the uncertain variable distribution types and their corresponding means/standard deviations. This function is used when the Model variables are in x-space.

References Model::aleatory_distribution_parameters(), Model::cv(), Iterator::iteratedModel, NonD::natafTransform, NonD::numBetaVars, NonD::numBinomialVars, NonD::numContDesVars, NonD::numContIntervalVars, NonD::numContStateVars, NonD::numExponentialVars, NonD::numFrechetVars, NonD::numGammaVars, NonD::numGumbelVars, NonD::numHistogramBinVars, NonD::numHyperGeomVars, NonD::numLognormalVars, NonD::numLoguniformVars, NonD::numNegBinomialVars, NonD::numNormalVars, NonD::numPoissonVars, NonD::numTriangularVars, NonD::numUniformVars, and NonD::numWeibullVars.

Referenced by NonDExpansion::initialize(), NonD::initialize_random_variables(), NonDBayesCalibration::NonDBayesCalibration(), NonDIntegration::NonDIntegration(), NonDReliability::NonDReliability(), NonDLHSampling::pre_run(), and NonDReliability::resize().

void initialize_random_variable_types ( short u_space_type )

initializes ranVarTypesX and ranVarTypesU within natafTransform

Build ProbabilityTransformation::ranVar arrays containing the uncertain variable distribution types and their corresponding means/standard deviations. This function is used when the Model variables are in x-space.

References Dakota::abort_handler(), Model::aleatory_distribution_parameters(), Model::cv(), Model::div(), Model::drv(), Model::dsv(), Iterator::iteratedModel, NonD::natafTransform, NonD::numBetaVars, NonD::numBinomialVars, NonD::numContDesVars, NonD::numContIntervalVars, NonD::numContStateVars, NonD::numExponentialVars, NonD::numFrechetVars, NonD::numGammaVars, NonD::numGumbelVars, NonD::numHistogramBinVars, NonD::numHyperGeomVars, NonD::numLognormalVars, NonD::numLoguniformVars, NonD::numNormalVars, NonD::numPoissonVars, NonD::numTriangularVars, NonD::numUniformVars, and NonD::numWeibullVars.

void initialize_random_variable_parameters ( )

initializes ranVarMeansX, ranVarStdDevsX, ranVarLowerBndsX, ranVarUpperBndsX, and ranVarAddtlParamsX within natafTransform

Build ProbabilityTransformation::ranVar arrays containing the uncertain variable distribution types and their corresponding means/standard deviations. This function is used when the Model variables are in x-space.

References Model::aleatory_distribution_parameters(), Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::epistemic_distribution_parameters(), Iterator::iteratedModel, NonD::natafTransform, NonD::numAleatoryUncVars, NonD::numContDesVars, Analyzer::numContinuousVars, NonD::numContStateVars, and NonD::numEpistemicUncVars.

Referenced by NonDGlobalReliability::core_run(), NonDLHSampling::initialize_increment_lhs_set(), NonDExpansion::initialize_expansion(), NonDBayesCalibration::initialize_model(), NonD::initialize_random_variables(), NonDLocalReliability::mean_value(), and NonDLocalReliability::mpp_search().
void print_level_mappings ( std::ostream & s, String qoi_type, const StringArray & qoi_labels ) const

prints the z/p/beta/beta+ mappings reflected in \{requested,computed\}\{Resp,Prob,Rel,GenRel\}Levels

Print distribution mappings, including to file per response.

References NonD::level_mappings_file(), Analyzer::numFunctions, Iterator::outputLevel, NonD::print_densities(), NonD::print_level_map(), NonD::requestedGenRelLevels, NonD::requestedProbLevels, NonD::requestedRelLevels, NonD::requestedRespLevels, and Dakota::write_precision.

void initialize_run ( ) [inline], [protected], [virtual]

utility function to perform common operations prior to `pre_run();` typically memory initialization; setting of instance pointers

Perform initialization phases of run sequence, like allocating memory and setting instance pointers. Commonly used in sub-iterator executions. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s `initialize_run()`, typically before performing its own implementation steps.

Reimplemented from `Analyzer`.

References `Analyzer::initialize_run()`, NonD::nondInstance, and NonD::prevNondInstance.

void finalize_run ( ) [inline], [protected], [virtual]

utility function to perform common operations following `post_run();` deallocation and resetting of instance pointers

Optional: perform finalization phases of run sequence, like deallocating memory and resetting instance pointers. Commonly used in sub-iterator executions. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s `finalize_run()`, typically after performing its own implementation steps.

Reimplemented from `Analyzer`.

References `Iterator::finalize_run()`, NonD::nondInstance, and NonD::prevNondInstance.

void initialize_final_statistics ( ) [protected], [virtual]

initializes finalStatistics for storing NonD final results

Default definition of virtual function (used by sampling, reliability, and stochastic expansion methods) defines the set of statistical results to include means, standard deviations, and level mappings.

Reimplemented in NonDInterval.

References Dakota::abort_handler(), NonD::cdfFlag, Model::cv(), ActiveSet::derivative_vector(), NonD::epistemicStats, NonD::finalStatistics, Response::function_labels(), Model::inactive_continuous_variable_ids(), Iterator::iteratedModel, Analyzer::numFunctions, NonD::requestedGenRelLevels, NonD::requestedProbLevels, NonD::requestedRelLevels, NonD::requestedRespLevels, NonD::respLevelTarget, NonD::respLevelTargetReduce, and NonD::totalLevelRequests.

Reimplemented by NonDExpansion::NonDExpansion(), NonDIntegration::NonDIntegration(), NonDReliability::NonDReliability::NonDReliability(), NonDSampling::NonDSampling(), NonD::requested_levels(), and NonDReliability::resize().

void compute_densities ( const RealRealPairArray & min_max_fns, bool prob_refinement = false, bool all_levels_computed = false ) [protected]

compute the PDF bins from the CDF/CCDF values and store in computedPDF\{Abscissas,Ordinates\}

This function infers PDFs from the CDF/CCDF level mappings, in order to enable PDF computation after CDF/CCDF probability level refinement (e.g., from importance sampling).

prob_refinement alerts the routine to exclude inverse mappings from the PDF, since refinement only applies to z->p forward mappings and mixing refined and unrefined probability mappings results in an inconsistency (potentially manifesting as negative density values).
all_levels_computed is an option used by reliability methods where computed Levels are defined across the union of all requested levels.

References NonD::archive_allocate_pdf(), NonD::archive_pdf(), NonD::cdfFlag, NonD::computedGenRelLevels, NonD::computedPDFAbscissas, NonD::computedPDFOrdinates, NonD::computedProbLevels, NonD::computedRespLevels, Analyzer::numFunctions, NonD::pdfOutput, NonD::requestedGenRelLevels, NonD::requestedProbLevels, NonD::requestedRelLevels, NonD::requestedRespLevels, and NonD::respLevelTarget.

Referenced by NonDSampling::compute_level_mappings(), NonDExpansion::compute_numerical_statistics(), NonDAdaptImpSampling::core_run(), NonDLocalReliability::core_run(), and NonDGlobalReliability::importance_sampling().

```cpp
void vars_u_to_x_mapping ( const Variables & u_vars, Variables & x_vars ) [inline], [static], [protected]
```

static function for RecastModels used for forward mapping of u-space variables from NonD Iterators to x-space variables for Model evaluations

- Map the variables from iterator space (u) to simulation space (x).
- References Variables::continuous_variables(), Variables::continuous_variables_view(), NonD::natafTransform, and NonD::nondInstance.
- Referenced by NonD::transform_model().

```cpp
void vars_x_to_u_mapping ( const Variables & x_vars, Variables & u_vars ) [inline], [static], [protected]
```

static function for RecastModels used for inverse mapping of x-space variables from data import to u-space variables for NonD Iterators

- Map the variables from simulation space (x) to iterator space (u).
- References Variables::continuous_variables(), Variables::continuous_variables_view(), NonD::natafTransform, and NonD::nondInstance.
- Referenced by NonD::transform_model().

```cpp
void set_u_to_x_mapping ( const Variables & u_vars, const ActiveSet & u_set, ActiveSet & x_set ) [static], [protected]
```

static function for RecastModels used to map u-space ActiveSets from NonD Iterators to x-space ActiveSets for Model evaluations

- Define the DVV for x-space derivative evaluations by augmenting the iterator requests to account for correlations.
- References Dakota::NPOS, Variables::all_continuous_variable_ids(), Dakota::contains(), Variables::continuous_variable_ids(), ActiveSet::derivative_vector(), Dakota::find_index(), Variables::inactive_continuous_variable_ids(), NonD::natafTransform, and NonD::nondInstance.
- Referenced by NonD::transform_model().

```cpp
void level_mappings_file ( size_t fn_index, const String & qoi_label ) const [private]
```

Write level mappings to a file for a single response.

- Write distribution mappings to a file for a single response.
- References NonD::print_level_map(), and Dakota::write_precision.
- Referenced by NonD::print_level_mappings().
void print_level_map ( std::ostream & s, size_t fn_index, const String & qoi_label ) const  
[private]

Print level mapping for a single response function to ostream.
Print the distribution mapping for a single response function to the passed output stream. This base class version maps from one requested level type to one computed level type; some derived class implementations (e.g., local and global reliability) output multiple computed level types.

References NonD::cdfFlag, NonD::computedGenRelLevels, NonD::computedProbLevels, NonD::computedRelLevels, NonD::computedRespLevels, NonD::requestedGenRelLevels, NonD::requestedProbLevels, NonD::requestedRelLevels, NonD::requestedRespLevels, NonD::respLevelTarget, and Dakota::write_precision.

Referenced by NonD::level_mappings_file(), and NonD::print_level_mappings().
The documentation for this class was generated from the following files:

- DakotaNonD.hpp
- DakotaNonD.cpp

### 13.91 NonDAdaptImpSampling Class Reference

Class for the Adaptive Importance Sampling methods within DAKOTA.

Inheritance diagram for NonDAdaptImpSampling:

```
          Iterator
            |
            v
          Analyzer
            |
            v
          NonD
            |
            v
          NonDSampling
            |
            v
NonDAdaptImpSampling
```

#### Public Member Functions

- **NonDAdaptImpSampling** (ProblemDescDB &problem_db, Model &model)
  
  standard constructor
- **NonDAdaptImpSampling** (Model &model, unsigned short sample_type, int samples, int seed, const String &rng, bool vary_pattern, unsigned short is_type, bool cdf_flag, bool x_space_model, bool use_model_bounds, bool track_extreme)
  
  alternate constructor for on-the-fly instantiations
- **~NonDAdaptImpSampling** ()
  destructor
- **bool resize ()**
  reinitializes iterator based on new variable size
- **void derived_init_communicators** (ParLevIter pl_iter)
  derived class contributions to initializing the communicators associated with this Iterator instance
• void derived_set_communicators (ParLevLIter pl_iter)
  derived class contributions to setting the communicators associated with this Iterator instance

• void derived_free_communicators (ParLevLIter pl_iter)
  derived class contributions to freeing the communicators associated with this Iterator instance

• void core_run ()
  performs adaptive importance sampling and computes probability of failure

• void print_results (std::ostream &s)
  print the final statistics

• void initialize (const RealVectorArray &full_points, bool x_space_data, size_t resp_index, Real initial_prob, Real failure_threshold)
  initializes data needed for importance sampling: an initial set of points around which to sample, a failure threshold, an initial probability to refine, and flags to control transformations

• void initialize (const RealMatrix &full_points, bool x_space_data, size_t resp_index, Real initial_prob, Real failure_threshold)
  initializes data needed for importance sampling: an initial set of points around which to sample, a failure threshold, an initial probability to refine, and flags to control transformations

• void initialize (const RealVector &full_point, bool x_space_data, size_t resp_index, Real initial_prob, Real failure_threshold)
  initializes data needed for importance sampling: an initial point around which to sample, a failure threshold, an initial probability to refine, and flags to control transformations

• Real final_probability ()
  returns the final probability calculated by the importance sampling

• const RealRealPairArray & extreme_values () const

Private Member Functions

• void select_rep_points (const RealVectorArray &var_samples_u, const RealVector &fn_samples)
  select representative points from a set of samples

• void converge_statistics (bool cov_flag)
  iteratively generate samples and select representative points until probability and (optionally) coefficient of variation converge

• void generate_samples (RealVectorArray &var_samples_u)
  generate a set of samples based on multimodal sampling density

• void evaluate_samples (const RealVectorArray &var_samples_u, RealVector &fn_samples)
  evaluate the model at the sample points and store the responses

• void calculate_statistics (const RealVectorArray &var_samples_u, const RealVector &fn_samples, size_t total_samples, Real &sum_prob, Real &prob, bool compute_cov, Real &sum_var, Real &cov)
  calculate the probability of exceeding the failure threshold and the coefficient of variation (if requested)

• Real distance (const RealVector &a, const RealVector &b)
  compute Euclidean distance between points a and b

• Real recentered_density (const RealVector &sample_point)
  compute density between a representative point and a sample point, assuming standard normal
Private Attributes

- Model uSpaceModel
  
  Importance sampling is performed in standardized probability space. This u-space model is either passed in (alternate constructor for helper AIS) or constructed using transform_model() (standard constructor for stand-alone AIS)
- unsigned short importanceSamplingType
  
  Integration type (is, ais, mmais) provided by input specification
- bool initLHS
  
  Flag to identify if initial points are generated from an LHS sample
- bool useModelBounds
  
  Flag to control if the sampler should respect the model bounds
- bool invertProb
  
  Flag for inversion of probability values using 1 - p
- bool trackExtremeValues
  
  Flag for tracking min/max values encountered when evaluating samples
- int refineSamples
  
  Size of sample batch within each refinement iteration
- size_t respFnIndex
  
  The active response function index in the model to be sampled
- RealVector designPoint
  
  Design subset for which uncertain subset is being sampled
- RealVectorArray initPointsU
  
  The original set of u-space samples passed in initialize()
- RealVectorArray repPointsU
  
  The set of representative points in u-space around which to sample
- RealVector repWeights
  
  The weight associated with each representative point
- Real probEstimate
  
  The probability estimate that is iteratively refined by importance sampling
- Real failThresh
  
  The failure threshold (z-bar) for the problem.

Additional Inherited Members

13.91.1 Detailed Description

Class for the Adaptive Importance Sampling methods within DAKOTA.

The NonDAdaptImpSampling implements the multi-modal adaptive importance sampling used for reliability calculations. (eventually we will want to broaden this). Need to add more detail to this description.
13.91.2 Constructor & Destructor Documentation

NonDAdaptImpSampling ( ProblemDescDB & problem_db, Model & model )

standard constructor

This is the primary constructor. It accepts a Model reference. It will perform refinement for all response QOI
and all probability levels.

References Dakota::abort_handler(), ProblemDescDB::get_iv(), NonD::initialize_random_variables(), Iterator::iteratedModel, NonDSampling::numSamples, Iterator::probDescDB, NonDAdaptImpSampling::refineSamples, NonDSampling::sampleType, NonDSampling::statsFlag, NonD::transform_model(), NonDAdaptImpSampling::useModelBounds, and NonDAdaptImpSampling::uSpaceModel.

NonDAdaptImpSampling ( Model & model, unsigned short sample_type, int refine_samples, int refine_seed, const String & rng, bool vary_pattern, unsigned short is_type, bool cdf_flag, bool x_space_model, bool use_model_bounds, bool track_extreme )

alternate constructor for on-the-fly instantiations

This is an alternate constructor for instantiations on the fly using a Model but no ProblemDescDB. It will
perform refinement for one response QOI and one probability level (passed in initialize()).

References NonD::cdfFlag, NonDSampling::extremeValues, Iterator::maxEvalConcurrency, Analyzer::numFunctions, NonDAdaptImpSampling::refineSamples, NonDAdaptImpSampling::trackExtremeValues, NonD::transform_model(), NonDAdaptImpSampling::useModelBounds, and NonDAdaptImpSampling::uSpaceModel.

13.91.3 Member Function Documentation

void initialize ( const RealVectorArray & acv_points, bool x_space_data, size_t resp_index, Real initial_prob, Real failure_threshold )

initializes data needed for importance sampling: an initial set of points around which to sample, a failure threshold,
an initial probability to refine, and flags to control transformations.

Initializes data using a vector array of starting points.

References NonDAdaptImpSampling::designPoint, NonDAdaptImpSampling::failThresh, NonDAdaptImpSampling::initPointsU, NonDAdaptImpSampling::invertProb, NonD::natafTransform, NonD::numContDesVars, NonD::numUncertainVars, NonDAdaptImpSampling::probEstimate, and NonDAdaptImpSampling::respFnIndex.

Referenced by NonDExpansion::compute_numerical_stat_refinements(), NonDAdaptImpSampling::core_run(), and NonDGlobalReliability::importance_sampling().

void initialize ( const RealMatrix & acv_points, bool x_space_data, size_t resp_index, Real initial_prob, Real failure_threshold )

initializes data needed for importance sampling: an initial set of points around which to sample, a failure threshold,
an initial probability to refine, and flags to control transformations.

Initializes data using a matrix of starting points.

References NonDAdaptImpSampling::designPoint, NonDAdaptImpSampling::failThresh, NonDAdaptImpSampling::initPointsU, NonDAdaptImpSampling::invertProb, NonD::natafTransform, NonD::numContDesVars, NonD::numUncertainVars, NonDAdaptImpSampling::probEstimate, and NonDAdaptImpSampling::respFnIndex.
void initialize ( const RealVector & acv_point, bool x_space_data, size_t resp_index, Real initial_prob, Real failure_threshold )

initializes data needed for importance sampling: an initial point around which to sample, a failure threshold, an initial probability to refine, and flags to control transformations

Initializes data using only one starting point.

References NonDAdaptImpSampling::designPoint, NonDAdaptImpSampling::failThresh, NonDAdaptImpSampling::initPointsU, NonDAdaptImpSampling::invertProb, NonD::natafTransform, NonD::numContDesVars, NonD::numUncertainVars, NonDAdaptImpSampling::probEstimate, and NonDAdaptImpSampling::respFnIndex.

The documentation for this class was generated from the following files:

- NonDAdaptImpSampling.hpp
- NonDAdaptImpSampling.cpp

13.92 NonDAdaptiveSampling Class Reference

Class for testing various Adaptively sampling methods using geometric, statistical, and topological information of the surrogate.

Inheritance diagram for NonDAdaptiveSampling:

```
  NonDAdaptiveSampling
    NonDSampling
      NonD
        Analyzer
          Iterator
```

Public Member Functions

- NonDAdaptiveSampling (ProblemDescDB & problem_db, Model & model)
  standard constructor
- ~NonDAdaptiveSampling ()
  alternate constructor for sample generation and evaluation "on the fly" has not been implemented
- bool resize ()
  reinitializes iterator based on new variable size

Protected Member Functions

- void derived_init_communicators ( ParLevLIter pl_iter)
  derived class contributions to initializing the communicators associated with this Iterator instance
- void derived_set_communicators ( ParLevLIter pl_iter)
derived class contributions to setting the communicators associated with this *Iterator* instance

- **void derived_free_**communicators (ParLevLIter pl_iter)
  derived class contributions to freeing the communicators associated with this *Iterator* instance

- **void core_run ()
  core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

- **Real final_probability ()
  print the final iterator results

**Private Member Functions**

- **void calc_score alm ()
  Function to compute the ALM scores for the candidate points ALM score is the variance computed by the surrogate at the point.

- **void calc_score_delta_x ()
  Function to compute the Distance scores for the candidate points Distance score is the shortest distance between the candidate and an existing training point.

- **void calc_score_delta_y ()
  Function to compute the Gradient scores for the candidate points Gradient score is the function value difference between a candidate’s surrogate response and its nearest evaluated true response from the training set.

- **void calc_score_topo_bottleneck ()
  Function to compute the Bottleneck scores for the candidate points Bottleneck score is computed by determining the bottleneck distance between the persistence diagrams of two approximate Morse-Smale complices. The complices used include one built from only the training data, and another built from the training data and the single candidate.

- **void calc_score_topo_avg_persistence (int respFnCount)
  Function to compute the Average Change in Persistence scores for the candidate points Avg Persistence score is computed as the average change in persistence each point undergoes between two approximate Morse-Smale complices. The complices used include one built from only the training data, and another built from the training data and the single candidate.

- **void calc_score_topo_highest_persistence (int respFnCount)
  Function to compute the Highest Persistence scores for the candidate points Highest Persistence score is calculated as a ranking of a set of candidates by constructing an approximate Morse-Smale complex over the entire set of candidates, using their surrogate responses, and the training data, using their true responses, and ranking points based on the most topological significance as measured by their persistence values. In the case where there are no topologically significant points, the point will be chosen randomly TODO: It may be wiser to fall back to a scheme that ranks points based on proximity to extrema, or the most significant extremum?

- **void calc_score_topo_hybrid (int respFnCount)
  Function to compute the Hybrid scores for the candidate points Hybrid score is computed the same as Avg Persistence score except that instead of computing one score, three scores are computing not only a mean surface, but a mean +/- std. dev. surfaces and then averaging the three separate scores. The hope is that you strike a balance between selecting points in topologically important areas and areas of high uncertainty.

- **Real calc_score alm (int respFnCount, RealVector &test_point)
  Same as the other function of the same name, only this allows the user to specify the location of the candidate.

- **Real calc_score_delta_x (int respFnCount, RealVector &test_point)
  Same as the other function of the same name, only this allows the user to specify the location of the candidate.

- **Real calc_score_delta_y (int respFnCount, RealVector &test_point)
  Same as the other function of the same name, only this allows the user to specify the location of the candidate.
• **Real** `calc_score_topo_bottleneck` (int respFnCount, RealVector &test_point)
  
  *Same as the other function of the same name, only this allows the user to specify the location of the candidate.*

• **Real** `calc_score_topo_avg_persistence` (int respFnCount, RealVector &test_point)
  
  *Same as the other function of the same name, only this allows the user to specify the location of the candidate.*

• **Real** `calc_score_topo_alm_hybrid` (int respFnCount, RealVector &test_point)
  
  *Same as the other function of the same name, only this allows the user to specify the location of the candidate.*

• **Real** `compute_rmspe`()
  
  *Using the validationSet, compute the RMSE over the surface.*

• **void** `compare_complices` (int dim, std::ostream &output)
  
  *Using the validationSet, compute the approximate Morse-Smale complices of the true model over the validationSet as well as the surrogate model over the validationSet, and output some topological comparisons.*

• **void** `parse_options`()
  
  *Parse misc options specified in a user input deck.*

• **RealVectorArray** `drawNewX` (int this_k, int respFnCount=0)
  
  *function to pick the next X value to be evaluated by the Iterated model*

• **void** `output_round_data` (int round, int respFnCount=0)
  
  *Temporary function for dumping validation data to output files to be visualized in TopoAS.*

• **void** `update_amsc` (int respFnCount=0)
  
  *Update the approximate Morse-Smale complex based on the training points and selected candidates. Uses surrogate function responses.*

• **void** `constructfsu_sampler` (Iterator &u_space_sampler, Model &u_model, int num_samples, int seed, unsigned short sample_type)
  
  *Copy of construct_lhs only it allows for the construction of FSU sample designs. This can break the fsu_cvt, so it is not used at the moment, and these designs only affect the initial sample build not the candidate sets constructed at each round.*

• **void** `output_for_optimization` (int dim)
  
  *This function will write an input deck for a multi-start global optimization run of DAKOTA by extracting all of the local minima off the approximate Morse-Smale complex created from the validation set of the surrogate model.*

• **Real** `median` (const RealVector &sorted_data)
  
  *compute the median of the sorted values passed in*

• **void** `pick_new_candidates`()
  
  *Pick new candidates from Emulator.*

• **void** `score_new_candidates`()
  
  *Score New candidates based on the chosen metrics.*

**Private Attributes**

• **Iterator** `gpBuild`
  
  *LHS iterator for building the initial GP.*

• **Iterator** `gpEval`
  
  *LHS iterator for sampling on the GP.*

• **Iterator** `gpFinalEval`
  
  *LHS iterator for sampling on the final GP.*

• **Model** `gpModel`
GP model of response, one approximation per response function.

- int numRounds
  the number of rounds of additions of size batchSize to add to the original set of LHS samples

- int numPtsTotal
  the total number of points

- int numEmulEval
  the number of points evaluated by the GP each iteration

- int numFinalEmulEval
  number of points evaluated on the final GP

- int scoringMethod
  the type of scoring metric to use for sampling

- Real finalProb
  the final calculated probability (p)

- RealVectorArray gpCvars
  Vector to hold the current values of the current sample inputs on the GP.

- RealVectorArray gpMeans
  Vector to hold the current values of the current mean estimates for the sample values on the GP.

- RealVectorArray gpVar
  Vector to hold the current values of the current variance estimates for the sample values on the GP.

- RealVector emulEvalScores
  Vector to hold the scored values for the current GP samples.

- RealVector predictionErrors
  Vector to hold the RMSE after each round of adaptively fitting the model.

- RealVectorArray validationSet
  Validation point set used to determine predictionErrors above.

- RealVector yTrue
  True function responses at the values corresponding to validationSet.

- RealVector yModel
  Surrogate function responses at the values corresponding to validationSet.

- int validationSetSize
  Number of points used in the validationSet.

- int batchSize
  Number of points to add each round, default = 1.

- String batchStrategy
  String describing the type of batch addition to use. Allowable values are naive, distance, topology.

- String outputDir
  Temporary string for dumping validation files used in TopoAS visualization.

- String scoringMetric
  String describing the method for scoring candidate points. Options are: alm, distance, gradient, highest_persistence, avg_persistence, bottleneck, alm_topo_hybrid Note: alm and alm_topo_hybrid will fail when used with surrogates other than global_kriging as it is based on the variance of the surrogate. At the time of implementation, global_kriging is the only surrogate capable of yielding this information.

- unsigned short sampleDesign
enum describing the initial sample design. Options are: RANDOM_SAMPLING, FSU_CVT, FSU_HALTON, FSU_HAMMERSLEY

- String approx_type

String describing type of surrogate is used to fit the data. Options are: global_kriging, global_mars, global_neural_network, global_polynomial, global_moving_least_squares, global_radial_basis.

- MS_Complex * AMSC

The approximate Morse-Smale complex data structure.

- int numKneighbors

The number of approximate nearest neighbors to use in computing the AMSC.

- bool outputValidationData

Temporary variable for toggling writing of data files to be used by TopoAS.

Additional Inherited Members

13.92.1 Detailed Description

Class for testing various Adaptively sampling methods using geometric, statistical, and topological information of the surrogate.

NonDAdaptiveSampling implements an adaptive sampling method based on the work presented in Adaptive Sampling with Topological Scores by Dan Maljovec, Bei Wang, Ana Kupresanin, Gardar Johannesson, Valerio Pascucci, and Peer-Timo Bremer presented in IJUQ (insert issue). The method computes scores based on the topology of the known data and the topology of the surrogate model. A number of alternate adaption strategies are offered as well.

13.92.2 Constructor & Destructor Documentation

NonDAdaptiveSampling (ProblemDescDB & prob_db, Model & model)

standard constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification.

References Dakota::abort_handler(), Response::active_set(), NonDAdaptiveSampling::AMSC, NonDAdaptiveSampling::approx_type, Iterator::assign_rep(), Model::assign_rep(), NonDAdaptiveSampling::batchSize, NonDAdaptiveSampling::batchStrategy, NonDAdaptiveSampling::construct_fsu_sampler(), NonD::construct_lhs(), Model::current_response(), ProblemDescDB::get_bool(), ProblemDescDB::get_int(), ProblemDescDB::get_iv(), ProblemDescDB::get_sa(), ProblemDescDB::get_string(), ProblemDescDB::get_ushort(), NonDAdaptiveSampling::gpBuild, NonDAdaptiveSampling::gpEval, NonDAdaptiveSampling::gpFinalEval, NonDAdaptiveSampling::gpModel, Model::gradient_type(), Model::hessian_type(), Iterator::iteratedModel, Iterator::maxIterations, NonDAdaptiveSampling::numEmuEval, NonDAdaptiveSampling::numFinalEmuEval, NonDAdaptiveSampling::numKneighbors, NonDAdaptiveSampling::numRounds, NonDSampling::numSamples, NonDAdaptiveSampling::outputDir, Iterator::outputLevel, NonDAdaptiveSampling::outputValidationData, NonDAdaptiveSampling::parse_options(), Iterator::probDescDB, NonDSampling::randomSeed, ActiveSet::request_values(), NonDSampling::rngName, NonDAdaptiveSampling::sampleDesign, NonDSampling::sampleType, NonDAdaptiveSampling::scoringMetric, NonDSampling::vary_pattern(), and NonDSampling::varyPattern.
13.93. NONDBAYESCALIBRATION CLASS REFERENCE

~NonDAdaptiveSampling()

alternate constructor for sample generation and evaluation "on the fly" has not been implemented
destructor

13.92.3 Member Function Documentation

void core_run() [protected], [virtual]

core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post
Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.
Reimplemented from Iterator.
References Iterator::all_responses(), Model::append_approximation(), Model::approximation_data(), NonDAdaptiveSampling::batchSize, Model::build_approximation(), NonDAdaptiveSampling::compute_rmspe(), NonDAdaptiveSampling::compute_rmspe(), NonD::computedProbLevels, Model::continuous_variables(), Model::current_response(), Model::current_variables(), NonDAdaptiveSampling::drawNewX(), Model::evaluate(), Model::evaluation_id(), NonDAdaptiveSampling::gpCvars, NonDAdaptiveSampling::gpFinalEval, NonDAdaptiveSampling::gpMeans, NonDAdaptiveSampling::gpModel, NonDAdaptiveSampling::gpVar, NonD::initialize_level_mappings(), Iterator::iteratedModel, Iterator::methodPCIter, NonD::miPLIndex, NonDAdaptiveSampling::numEmulEval, NonDAdaptiveSampling::numEmulEval, Analyzer::numFunctions, NonDAdaptiveSampling::numPtsTotal, NonDAdaptiveSampling::numRounds, NonDSampling::numSamples, NonDAdaptiveSampling::output_round_data(), NonDAdaptiveSampling::pick_new_candidates(), NonDAdaptiveSampling::predictionErrors, NonD::requestedRespLevels, Iterator::run(), NonDAdaptiveSampling::score_new_candidates(), NonDAdaptiveSampling::scoringMetric, and NonDAdaptiveSampling::update_amscc().

void print_results(std::ostream & s) [protected], [virtual]

print the final iterator results
This virtual function provides additional iterator-specific final results outputs beyond the function evaluation
summary printed in finalize_run().
Reimplemented from Analyzer.
References NonD::print_level_mappings(), and NonDSampling::statsFlag.
The documentation for this class was generated from the following files:

- NonDAdaptiveSampling.hpp
- NonDAdaptiveSampling.cpp

13.93 NonDBayesCalibration Class Reference

Base class for Bayesian inference: generates posterior distribution on model parameters given experimental data.
Inheritance diagram for NonDBayesCalibration:
CHAPTER 13. CLASS DOCUMENTATION

Public Member Functions

- **NonDBayesCalibration** (ProblemDescDB &problem_db, Model &model)
  - *standard constructor*
- **~NonDBayesCalibration** ()
  - *destructor*
- template<typename VectorType>
  - Real prior_density (const VectorType &vec)
    - *compute the prior PDF for a particular MCMC sample*
- template<typename VectorType>
  - Real log_prior_density (const VectorType &vec)
    - *compute the log prior PDF for a particular MCMC sample*
- template<typename Engine>
  - void prior_sample (Engine &rng, RealVector &prior_samples)
    - *draw a multivariate sample from the prior distribution*

Static Public Member Functions

- static void get_positive_definite_covariance_from_hessian (const RealSymMatrix &hessian, const RealMatrix &prior_chol_fact, RealSymMatrix &covariance, short output_lev)
  - *Compute the proposal covariance C based on low-rank approximation to the prior-preconditioned misfit Hessian.*

Protected Member Functions

- void derived_init_communicators (ParLevLIter pl_iter)
  - *derived class contributions to initializing the communicators associated with this Iterator instance*
- void derived_set_communicators (ParLevLIter pl_iter)
  - *derived class contributions to setting the communicators associated with this Iterator instance*
- void derived_free_communicators (ParLevLIter pl_iter)
  - *derived class contributions to freeing the communicators associated with this Iterator instance*
- void print_results (std::ostream &s)
  - *print the final iterator results*
- const Model & algorithm_space_model () const
- void initialize_model ()
initialize emulator model and probability space transformations

- template<typename VectorType1 , typename VectorType2 >
  void augment_gradient_with_log_prior (VectorType1 &log_grad, const VectorType2 &vec)
  
  compute the (approximate) gradient of the negative log posterior by augmenting the (approximate) gradient of the negative log likelihood with the gradient of the negative log prior

- template<typename MatrixType , typename VectorType >
  void augment_hessian_with_log_prior (MatrixType &log_hess, const VectorType &vec)
  
  compute the (approximate) Hessian of the negative log posterior by augmenting the (approximate) Hessian of the negative log likelihood with the Hessian of the negative log prior

- Real log_likelihood (const RealVector &residuals, const RealVector &hyper_params)
  
  calculate log-likelihood from the passed residuals (assuming they are already sized and scaled by covariance / hyperparams...)

- void prior_cholesky_factorization ()
  
  compute priorCovCholFactor based on prior distributions for random variables and any hyperparameters

- void get_positive_definite_covariance_from_hessian (const RealSymMatrix &hessian, RealSymMatrix &covariance)
  
  member version forwards member data to static function

- void compute_statistics ()
  
  Compute final stats for MCMC chains.

- void export_chain ()
  
  export the acceptance chain in user space

- void filter_chain (RealMatrix &acceptance_chain, RealMatrix &filtered_chain)
  
  Perform chain filtering with burn-in and sub-sampling.

- void filter_fnvals (RealMatrix &accepted_fn_vals, RealMatrix &filtered_fn_vals)

- void compute_intervals (RealMatrix &acceptance_chain, RealMatrix &accepted_fn_vals, int num_filtered, size_t num_exp, size_t num_concatenated)

- void compute_col_means (RealMatrix &matrix, RealVector &avg_vals)

- void compute_col_stdevs (RealMatrix &matrix, RealVector &avg_vals, RealVector &std_devs)

- void print_filtered_tabular (RealMatrix &filteredChain, RealMatrix &filteredFnVals_for_intervals, RealMatrix &PredVals, int num_filtered, size_t num_exp)

- static function passed by pointer to negLogPostModel recast model

Static Protected Member Functions

- static void neg_log_post_resp_mapping (const Variables &model_vars, const Variables &nlpost_vars, const Response &model_resp, Response &nlpost_resp)
Protected Attributes

- **short emulatorType**
  the emulator type: NO_EMULATOR, GP_EMULATOR, PCE_EMULATOR, or SC_EMULATOR

- **Model mcmcModel**
  Model instance employed in the likelihood function; provides response function values from Gaussian processes, stochastic expansions (PCE/SC), or direct access to simulations (no surrogate option)

- **Model residualModel**
  DataTransformModel wrapping the mcmcModel.

- **Iterator mapOptimizer**
  SQP or NIP optimizer for pre-solving for the MAP point prior to MCMC. This is restricted to emulator cases for now, but as for derivative preconditioning, could be activated for no-emulator cases with a specification option (not active by default).

- **Model negLogPostModel**
  RecastModel for solving for MAP using negative log posterior.

- **Iterator stochExpIterator**
  NonDPolynomialChaos or NonDStochCollocation instance for defining a PCE/SC-based mcmcModel.

- **int chainSamples**
  number of samples in the chain (e.g. number of MCMC samples); for iterative update cycles, number of samples per update cycle

- **int chainCycles**
  number of update cycles for MCMC chain (implemented by restarting of short chains)

- **int randomSeed**
  random seed for MCMC process

- **RealMatrix priorCovCholFactor**
  the Cholesky factor of the prior covariance

- **unsigned short obsErrorMultiplierMode**
  mode for number of observation error multipliers to calibrate (default none)

- **int numHyperparams**
  calculated number of hyperparameters augmenting the calibration parameter set, e.g., due to calibrate observation error multipliers

- **RealVector invGammaAlphas**
  alphas for inverse gamma distribution on hyper-params

- **RealVector invGammaBetas**
  alphas for inverse gamma distribution on hyper-params

- **std::vector<Pecos::RandomVariable> invGammaDists**
  distributions for hyper-params

- **bool standardizedSpace**
  flag indicating use of a variable transformation to standardized probability space for the model or emulator

- **bool adaptPosteriorRefine**
  flag indicating usage of adaptive posterior refinement; currently makes sense for unstructured grids in GP and PCE least squares/CS

- **String proposalCovarType**
  approach for defining proposal covariance
13.93. NONDBAYESCALIBRATION CLASS REFERENCE

- RealVector proposalCovarData
  data from user input of proposal covariance
- String proposalCovarFilename
  filename for user-specified proposal covariance
- String proposalCovarInputType
  approach for defining proposal covariance
- RealMatrix acceptanceChain
  Post-processing-related controls.
- RealMatrix acceptedFnVals
  cached function values corresponding to acceptanceChain for final statistics reporting
- int burnInSamples
  number of MCMC samples to discard from acceptance chain
- int subSamplingPeriod
  period or skip in post-processing the acceptance chain
- RealMatrix chainStats
- RealMatrix fnStats
- RealMatrix predVals
  Compute credibility and prediction intervals of final chain.
- RealMatrix filteredFnVals
  cached filtered function values for printing
- String exportMCMCFilename
  output filename for the MCMC chain
- short exportMCMCFormat
  output formatting options for MCMC export
- short filteredMCMCFormat

Static Protected Attributes

- static NonDBayesCalibration * nonDBayesInstance
  Pointer to current class instance for use in static callback functions.

13.93.1 Detailed Description

Base class for Bayesian inference: generates posterior distribution on model parameters given experimental data.

This class will eventually provide a general-purpose framework for Bayesian inference. In the short term, it
only collects shared code between QUESO and GPMSA implementations.

13.93.2 Constructor & Destructor Documentation

NonDBayesCalibration ( ProblemDescDB & problem_db, Model & model )

standard constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes
has been called and probDescDB can be queried for settings from the method specification.
13.93.3 Member Function Documentation

**void print_results ( std::ostream & s ) [protected], [virtual]**

print the final iterator results

This virtual function provides additional iterator-specific final results outputs beyond the function evaluation summary printed in finalize_run().

Reimplemented from Analyzer.

Reimplemented in NonDDREAMBayesCalibration, NonDWASABIBayesCalibration, and NonDQUESOBayesCalibration.

References Model::continuous_variable_labels(), Dakota::copy_data(), Model::current_response(), NonBayesCalibration::filteredFnVals, Response::function_labels(), NonBayesCalibration::mcmcModel, NonDSampling::print_moments(), and NonBayesCalibration::residualModel.

Referenced by NonDQUESOBayesCalibration::print_results(), NonDWASABIBayesCalibration::print_results(), and NonDDREAMBayesCalibration::print_results().

**const Model & algorithm_space_model () const [inline], [protected], [virtual]**

default definition that gets redefined in selected derived Minimizers

Reimplemented from Analyzer.

References NonBayesCalibration::mcmcModel.

**Real log_likelihood ( const RealVector & residuals, const RealVector & all_params ) [protected]**

calculate log-likelihood from the passed residuals (assuming they are already sized and scaled by covariance / hyperparams...)

Calculate the log-likelihood, accounting for contributions from covariance and hyperparameters, as well as constant term:

\[
\log(L) = -1/2 \times Nr \times \log(2 \times \pi) - 1/2 \times \log(\det(Cov)) - 1/2 \times r(Cov^{-1}) \times r
\]
The passed residual_resp must already be size-adjusted, differenced with any data, if present, and scaled by covariance\(^{-1/2}\).

References NonDCalibration::expData, Dakota::HALF_LOG_2PI, ExperimentData::half_log_cov_determinant(), Analyzer::numContinuousVars, NonDBayesCalibration::numHyperparams, NonDCalibration::numTotalCalibTerms, and NonDBayesCalibration::obsErrorMultiplierMode.

Referenced by NonDQUESOBayesCalibration::dakotaLogLikelihood(), NonDBayesCalibration::neg_log_post_resp_mapping(), and NonDDREAMBayesCalibration::sample_likelihood().
Public Member Functions

- **NonDCalibration** (ProblemDescDB &problem_db, Model &model)
  
  Standard constructor

- **~NonDCalibration** ()
  
  Destructor

- **bool resize ()**
  
  Reinitializes iterator based on new variable size

Protected Member Functions

- void **set_configuration_vars** (Model &model, const RealVector &x)
  
  Set the passed configuration variables into the model's state vars

Protected Attributes

- **RealVector expStdDeviations**
  
  1 or numFunctions standard deviations

- **bool calibrationData**
  
  Flag indicating whether there is calibration data present

- **size_t numExperiments**
  
  Number of experiments to read from data file

- **size_t numExpConfigVars**
  
  Number of columns in data file which are state variables

- **StringArray varianceTypesRead**
  
  How many sigmas to read from the data file (1 or numFunctions)

- **ExperimentData expData**
  
  Container for experimental data to which to calibrate model.

- **size_t numTotalCalibTerms**
  
  Total number of calibration terms, after replicates/interpolation.
Private Member Functions

- bool find_state_index (unsigned short state_type, UShortMultiArrayConstView variable_types, std::string context_message, size_t &start_index)
  
  helper function to lookup a state_type enum variable type in the array of variables_types to find its start_index into the all array

Private Attributes

- size_t continuousConfigVars
  
  number of continuous configuration variables

- size_t discreteIntConfigVars
  
  number of discrete integer configuration variables

- size_t discreteRealConfigVars
  
  number of discrete real configuration variables

- size_t continuousConfigStart
  
  index of configuration variables in all continuous array

- size_t discreteIntConfigStart
  
  index of configuration variables in all discrete integer array

- size_t discreteRealConfigStart
  
  index of configuration variables in all discrete real array

Additional Inherited Members

13.94.1 Detailed Description

This class ...

13.94.2 Constructor & Destructor Documentation

NonDCalibration ( ProblemDescDB & problem_db, Model & model )

standard constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification.

References Dakota::abort_handler(), Model::all_continuous_variable_types(), Model::all_discrete_int_variable_types(), Model::all_discrete_real_variable_types(), NonDCalibration::calibrationData, NonDCalibration::continuousConfigStart, NonDCalibration::continuousConfigVars, NonDCalibration::discreteIntConfigStart, NonDCalibration::discreteIntConfigVars, NonDCalibration::discreteRealConfigStart, NonDCalibration::discreteRealConfigVars, NonDCalibration::expData, NonDCalibration::find_state_index(), ProblemDescDB::get_sizet(), Iterator::iteratedModel, ExperimentData::load_data(), ExperimentData::num_total_exppoints(), NonDCalibration::numExpConfigVars, NonDCalibration::numTotalCalibTerms, and Iterator::probDescDB.

The documentation for this class was generated from the following files:

- NonDCalibration.hpp
- NonDCalibration.cpp
13.95  NonDCubature Class Reference

Derived nondeterministic class that generates N-dimensional numerical cubature points for evaluation of expectation integrals.

Inheritance diagram for NonDCubature:

```
NonDCubature
  NonDIntegration
    NonD
      Analyzer
        Iterator
```

Public Member Functions

- `NonDCubature (Model &model, const Pecos::ShortArray &u_types, unsigned short cub_int_order)`
- `unsigned short integrand_order () const`

Protected Member Functions

- `NonDCubature (ProblemDescDB &problem_db, Model &model)`
- `~NonDCubature ()`
- `void initialize_grid (const std::vector<Pecos::BasisPolynomial> &poly_basis)`
- `void get_parameter_sets (Model &model)`
- `void sampling_reset (int min_samples, bool all_data_flag, bool stats_flag)`
- `void increment_grid ()`
- `int num_samples () const`

Private Member Functions

- `void check_integration (const Pecos::ShortArray &u_types, const Pecos::AleatoryDistParams &adp)`
- `void increment_reference ()`
Private Attributes

- Pecos::CubatureDriver * cubDriver
  
  *convenience pointer to the numIntDriver representation*

- unsigned short cubIntOrderRef
  
  *reference point for Pecos::CubatureDriver::cubIntOrder: the original user specification for the number of Gauss points per dimension, plus any refinements posted by increment_grid()*

- unsigned short cubIntRule
  
  *the isotropic cubature integration rule*

Additional Inherited Members

13.95.1 Detailed Description

Derived nondeterministic class that generates N-dimensional numerical cubature points for evaluation of expectation integrals.

This class is used by NonDPolynomialChaos, but could also be used for general numerical integration of moments. It employs Stroud cubature rules and extensions by D. Xiu.

13.95.2 Constructor & Destructor Documentation

NonDCubature ( Model & model, const Pecos::ShortArray & u_types, unsigned short cub_int_order )

This alternate constructor is used for on-the-fly generation and evaluation of numerical cubature points.

References Model::aleatory_distribution_parameters(), NonDCubature::check_integration(), NonDCubature::cubDriver, NonDCubature::cubIntOrderRef, Iterator::iteratedModel, and NonDIntegration::numIntDriver.

NonDCubature ( ProblemDescDB & problem_db, Model & model ) [protected]

*constructor*

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification. It is not currently used, as there is not yet a separate nond_cubature method specification.

References Model::aleatory_distribution_parameters(), NonDCubature::check_integration(), NonDIntegration::check_variables(), NonDCubature::cubDriver, NonDCubature::cubIntOrderRef, NonDCubature::cubIntRule, Iterator::iteratedModel, Iterator::maxEvalConcurrency, NonD::natafTransform, and NonDIntegration::numIntDriver.

13.95.3 Member Function Documentation

void sampling_reset ( int min_samples, bool all_data_flag, bool stats_flag ) [protected], [virtual]

used by DataFitSurrModel::build_global() to publish the minimum number of points needed from the cubature routine in order to build a particular global approximation.

Reimplemented from Iterator.

References NonDCubature::cubDriver, and NonDCubature::cubIntOrderRef.
void increment_grid_preference ( const RealVector & dim_pref ) [inline], [protected], [virtual]

Should not be used, but pure virtual must be defined.
Reimplemented from NonDIntegration.
References NonDCubature::increment_grid().

int num_samples() const [inline], [protected], [virtual]

Return current number of evaluation points. Since the calculation of samples, collocation points, etc. might be costly, provide a default implementation here that backs out from the maxEvalConcurrency.
Reimplemented from Analyzer.
References NonDCubature::cubDriver.

void increment_reference() [inline], [private]
increment each cubIntOrderRef entry by 1
   cubIntOrderRef is a reference point for CubatureDriver::cubIntOrder, e.g., a lower bound
References NonDCubature::cubIntOrderRef.
Referenced by NonDCubature::increment_grid().
The documentation for this class was generated from the following files:

• NonDCubature.hpp
• NonDCubature.cpp

13.96 NonDDREAMBayesCalibration Class Reference

Bayesian inference using the DREAM approach.
Inheritance diagram for NonDDREAMBayesCalibration:

Public Member Functions

• NonDDREAMBayesCalibration (ProblemDescDB &problem_db, Model &model)
   standard constructor
• ~NonDDREAMBayesCalibration ()
  destructor

Static Public Member Functions

• static void problem_size (int &chain_num, int &cr_num, int &gen_num, int &pair_num, int &par_num)
  initializer for problem size characteristics in DREAM
• static void problem_value (std::string *chain_filename, std::string *gr_filename, double &gr_threshold, int &jumpstep, double limits[], int par_num, int &printstep, std::string *restart_read_filename, std::string *restart_write_filename)
  Filename and data initializer for DREAM.
• static double prior_density (int par_num, double zp[])
  Compute the prior density at specified point zp.
• static double * prior_sample (int par_num)
  Sample the prior and return an array of parameter values.
• static double sample_likelihood (int par_num, double zp[])
  Likelihood function for call-back from DREAM to DAKOTA for evaluation.

Protected Member Functions

• void core_run ()
• void print_results (std::ostream &s)
  print the final iterator results
• void archive_acceptance_chain ()
  save the final x-space acceptance chain and corresponding function values

Static Protected Member Functions

• static void cache_chain (const double *const z)
  Callback to archive the chain from DREAM, potentially leaving it in u-space.

Protected Attributes

• RealVector paramMins
  lower bounds on calibrated parameters
• RealVector paramMaxs
  upper bounds on calibrated parameters
• int numChains
  number of concurrent chains
• int numGenerations
  number of generations
• int numCR
  number of CR-factors
• int crossoverChainPairs
  number of crossover chain pairs
CHAPTER 13. CLASS DOCUMENTATION

- Real grThreshold
  threshold for the Gelmin-Rubin statistic
- int jumpStep
  how often to perform a long jump in generations
- boost::mt19937 numGenerator
  random number engine for sampling the prior

Static Private Attributes

- static NonDDREAMBayesCalibration * nonDDREAMInstance
  Pointer to current class instance for use in static callback functions.

Additional Inherited Members

13.96.1 Detailed Description

Bayesian inference using the DREAM approach.

This class performed Bayesian calibration using the DREAM (Markov Chain Monte Carlo acceleration by Differential Evolution) implementation of John Burkhardt (FSU), adapted from that of Guannan Zhang (ORNL)

13.96.2 Constructor & Destructor Documentation

NonDDREAMBayesCalibration ( ProblemDescDB & problem db, Model & model )

standard constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification.

References NonDBayesCalibration::chainSamples, NonDDREAMBayesCalibration::crossoverChainPairs, NonDDREAMBayesCalibration::grThreshold, NonDDREAMBayesCalibration::jumpStep, NonDDREAMBayesCalibration::numChains, NonDDREAMBayesCalibration::numCR, and NonDDREAMBayesCalibration::numGenerations.

13.96.3 Member Function Documentation

void problem_size ( int & chain_num, int & cr_num, int & gen_num, int & pair_num, int & par_num ) [static]

initializer for problem size characteristics in DREAM

See documentation in DREAM examples)

References NonDDREAMBayesCalibration::crossoverChainPairs, NonDDREAMBayesCalibration::numGenerations, NonDDREAMBayesCalibration::numCR, and NonDDREAMBayesCalibration::numHyperparams.

void problem_value ( std::string * chain_filename, std::string * gr_filename, double & gr_threshold, int & jumpstep, double limits[], int par_num, int & printstep, std::string * restart_read_filename, std::string * restart_write_filename ) [static]

Filename and data initializer for DREAM.

See documentation in DREAM examples)
References NonDDREAMBayesCalibration::grThreshold, NonDDREAMBayesCalibration::jumpStep, NonDDREAMBayesCalibration::nonDDREAMInstance, NonDDREAMBayesCalibration::numChains, NonDDREAMBayesCalibration::paramMaxs, and NonDDREAMBayesCalibration::paramMins.

```cpp
double prior_density ( int par_num, double zp[] ) [static]
```
Compute the prior density at specified point zp.
See documentation in DREAM examples
References NonDBayesCalibration::nonDBayesInstance, and NonDBayesCalibration::prior_density().

```cpp
double * prior_sample ( int par_num ) [static]
```
Sample the prior and return an array of parameter values.
See documentation in DREAM examples
References NonDBayesCalibration::nonDBayesInstance, NonDDREAMBayesCalibration::nonDDREAMInstance, and NonDDREAMBayesCalibration::rnumGenerator.

```cpp
double sample_likelihood ( int par_num, double zp[] ) [static]
```
Likelihood function for call-back from DREAM to DAKOTA for evaluation.
Static callback function to evaluate the likelihood
References Model::continuous_variables(), Model::current_response(), Model::evaluate(), Response::function_values(), NonDBayesCalibration::log_likelihood(), NonDDREAMBayesCalibration::nonDDREAMInstance, NonDCalibration::numTotalCalibTerms, Iterator::outputLevel, and NonDBayesCalibration::residualModel.

```cpp
void core_run ( ) [protected], [virtual]
```
Perform the uncertainty quantification DREAM will callback to cache_chain to store the chain
Reimplemented from Iterator.
References Dakota::abort_handler(), NonDDREAMBayesCalibration::archive_acceptance_chain(), NonDDREAMBayesCalibration::cache_chain(), NonDCalibration::calibrationData, NonDBayesCalibration::chainSamples, NonDBayesCalibration::compute_statistics(), Model::continuous_variables(), NonDBayesCalibration::export_chain(), NonDBayesCalibration::exportMCMCFilename, NonDBayesCalibration::initialize_model(), NonDBayesCalibration::mcmcModel, NonD::natafTransform, NonDBayesCalibration::nonDBayesInstance, NonDDREAMBayesCalibration::nonDDREAMInstance, Analyzer::numContinuousVars, NonDBayesCalibration::numHyperparams, NonDBayesCalibration::obsErrorMultiplierMode, Iterator::outputLevel, NonDDREAMBayesCalibration::paramMaxs, NonDDREAMBayesCalibration::paramMins, NonDBayesCalibration::randomSeed, NonDDREAMBayesCalibration::rnumGenerator, and NonDBayesCalibration::standardizedSpace.

```cpp
void print_results ( std::ostream & s ) [protected], [virtual]
```
print the final iterator results
This virtual function provides additional iterator-specific final results outputs beyond the function evaluation summary printed in finalize_run().
Reimplemented from NonDBayesCalibration.
References NonDBayesCalibration::print_results().
void cache_chain ( const double * const z ) [static], [protected]

Callback to archive the chain from DREAM, potentially leaving it in u-space.

Archive the chain from DREAM. This default implementation is aggregating from the parallel chains in a round-robin fashion.

References NonDBayesCalibration::acceptanceChain, NonDDREAMBayesCalibration::nonDDREAMInstance, Analyzer::num_samples(), NonDDREAMBayesCalibration::numChains, Analyzer::numContinuousVars, NonDDREAMBayesCalibration::numGenerations, and NonDBayesCalibration::numHyperparams.

Referenced by NonDDREAMBayesCalibration::core_run().

The documentation for this class was generated from the following files:

- NonDDREAMBayesCalibration.hpp
- NonDDREAMBayesCalibration.cpp

### 13.97 NonDExpansion Class Reference

Base class for polynomial chaos expansions (PCE) and stochastic collocation (SC)

Inheritance diagram for NonDExpansion:

```
  Iterator
  |
  v
Analyzer
  |
  v
NonD
  |
  v
NonDExpansion
```

Public Member Functions

- **NonDExpansion** (ProblemDescDB &problem_db, Model &model)
  
  *standard constructor*

- **NonDExpansion** (unsigned short method_name, Model &model, short exp_coeffs_approach, short u_space_type, bool piecewise_basis, bool use_derivs)
  
  *alternate constructor*

- **∼NonDExpansion** ()
  
  *destructor*

- bool resize ()
  
  *reinitializes iterator based on new variable size*

- void derived_init_communicators (ParLevLIter pl_iter)
  
  *derived class contributions to initializing the communicators associated with this Iterator instance*

- void derived_set_communicators (ParLevLIter pl_iter)
  
  *derived class contributions to setting the communicators associated with this Iterator instance*
• void derived_free_communicators (ParLevLIter pl_iter)
  derived class contributions to freeing the communicators associated with this Iterator instance
• void core_run ()
  perform a forward uncertainty propagation using PCE/SC methods
• void print_results (std::ostream &s)
  print the final statistics
• const Model & algorithm_space_model () const
• virtual void select_refinement_points (const RealVectorArray &candidate_samples, unsigned short batch_size, RealMatrix &best_samples)
  evaluate allSamples for inclusion in the (PCE regression) approximation and retain the best set (well spaced) of size batch_size
• virtual void append_expansion (const RealMatrix &samples, const IntResponseMap &resp_map)
  append new data to uSpaceModel and update expansion order (PCE only)

Protected Member Functions

• virtual void resolve_inputs (short &u_space_type, short &data_order)
  perform error checks and mode overrides
• virtual void initialize_u_space_model ()
  initialize uSpaceModel polynomial approximations with PCE/SC data
• virtual void initialize_expansion ()
  initialize random variable definitions and final stats arrays
• virtual void compute_expansion ()
  form the expansion by calling uSpaceModel.build_approximation()
• virtual void increment_order_and_grid ()
  uniformly increment the expansion order and structured/unstructured grid (PCE only)
• virtual void increment_specification_sequence ()
  increment the input specification sequence (PCE only)
• virtual void update_expansion ()
  update an expansion; avoids overhead in compute_expansion()
• virtual void multifidelity_expansion ()
  construct a multifidelity expansion, across model forms or discretization levels
• virtual void print_coefficients (std::ostream &s)
  print expansion coefficients, as supported by derived instance
• virtual void archive_coefficients ()
  archive expansion coefficients, as supported by derived instance
• virtual Real compute_covariance_metric ()
  compute 2-norm of change in response covariance
• virtual Real compute_final_statistics_metric ()
  compute 2-norm of change in final statistics
• void initialize_response_covariance ()
  set covarianceControl defaults and shape respCovariance
• void update_final_statistics ()
  update function values within finalStatistics
CHAPTER 13. CLASS DOCUMENTATION

- void **update_final_statistics_gradients** ()
  update function gradients within finalStatistics
- void **initialize** (short u_space_type)
  common constructor code for initialization of natafTransform
- void **check_dimension_preference** (const RealVector &dim_pref) const
  check length and content of dimension preference vector
- void **refine_expansion** ()
  refine the reference expansion found by compute_expansion() using uniform/adaptive p-/h-refinement strategies
- void **construct_cubature** (Iterator &u_space_sampler, Model &g_u_model, unsigned short cub_int_order)
  assign a NonDCubature instance within u_space_sampler
- void **construct_quadrature** (Iterator &u_space_sampler, Model &g_u_model, const UShortArray &quad_order_seq, const RealVector &dim_pref)
  assign a NonDQuadrature instance within u_space_sampler based on a quad_order specification
- void **construct_quadrature** (Iterator &u_space_sampler, Model &g_u_model, int filtered_samples, const RealVector &dim_pref)
  assign a NonDQuadrature instance within u_space_sampler that generates a filtered tensor product sample set
- void **construct_quadrature** (Iterator &u_space_sampler, Model &g_u_model, int random_samples, int seed, const UShortArray &quad_order_seq, const RealVector &dim_pref)
  assign a NonDQuadrature instance within u_space_sampler that samples randomly from a tensor product multi-index
- void **construct_sparse_grid** (Iterator &u_space_sampler, Model &g_u_model, const UShortArray &ssg_level_seq, const RealVector &ssg_dim_pref)
  assign a NonDSparseGrid instance within u_space_sampler
- void **construct_expansion_sampler** (const String &import_approx_file, unsigned short import_build_format=TABULAR_ANNOTATED, bool import_build_active_only=false)
  construct the expansionSampler for evaluating samples on uSpaceModel
- void **compute_statistics** ()
  calculate analytic and numerical statistics from the expansion
- void **archive_moments** ()
  archive the central moments (numerical and expansion) to ResultsDB

Protected Attributes

- Model uSpaceModel
  Model representing the approximate response function in u-space, after u-space recasting and polynomial data fit recursions.
- short expansionCoeffsApproach
  method for collocation point generation and subsequent calculation of the expansion coefficients
- short expansionBasisType
  type of expansion basis: DEFAULT_BASIS or Pecos::\{NODAL,HIERARCHICAL\}_INTERPOLANT for SC or Pecos::\{TENSOR_PRODUCT,TOTAL_ORDER,ADAPTED\}_BASIS for PCE regression
- size_t numUncertainQuant
  number of invocations of core_run()
- int numSamplesOnModel
  number of truth samples performed on g_u_model to form the expansion
13.97. NONDEXPANSION CLASS REFERENCE

- int numSamplesOnExpansion
  number of approximation samples performed on the polynomial expansion in order to estimate probabilities
- bool nestedRules
  flag for indicating state of nested and non_nested overrides of default rule nesting, which depends on the type of integration driver
- bool piecewiseBasis
  flag for piecewise specification, indicating usage of local basis polynomials within the stochastic expansion
- bool useDerivs
  flag for use_derivatives specification, indicating usage of derivative data (with respect to expansion variables) to enhance the calculation of the stochastic expansion.
- short refineType
  refinement type: NO_REFINEMENT, P_REFINEMENT, or H_REFINEMENT
- short refineControl
  refinement control: NO_CONTROL, UNIFORM_CONTROL, LOCAL_ADAPTIVE_CONTROL, DIMENSION_ADAPTIVE_CONTROL_SOBOL, DIMENSION_ADAPTIVE_CONTROL_DECAY, or DIMENSION_ADAPTIVE_CONTROL_GENERALIZED
- unsigned short softConvLimit
  number of consecutive iterations within tolerance required to indicate soft convergence
- RealSymMatrix respCovariance
  symmetric matrix of analytic response covariance (full response covariance option)
- RealVector respVariance
  vector of response variances (diagonal response covariance option)
- RealVector initialPtU
  stores the initial variables data in u-space

Private Member Functions

- void reduce_total_sobol_sets (RealVector &avg_sobol)
  compute average of total Sobol’ indices (from VBD) across the response set for use as an anisotropy indicator
- void reduce_decay_rate_sets (RealVector &min_decay)
  compute minimum of spectral coefficient decay rates across the response set for use as an anisotropy indicator
- void initialize_sets ()
  initialization of adaptive refinement using generalized sparse grids
- Real increment_sets ()
  perform an adaptive refinement increment using generalized sparse grids
- void finalize_sets (bool converged_within_tol)
  finalization of adaptive refinement using generalized sparse grids
- void compute_analytic_statistics ()
  analytic portion of compute_statistics() from post-processing of expansion coefficients
- void compute_numerical_statistics ()
  numerical portion of compute_statistics() from sampling on the expansion
- void compute_numerical_stat_refinements (RealVectorArray &imp_sampler_stats, RealRealPairArray &min_max_fns)
  refinements to numerical probability statistics from importanceSampler
• void compute_covariance ()
  calculate the response covariance (diagonal or full matrix)
• void compute_diagonal_variance ()
  calculate respVariance or diagonal terms respCovariance(i,i)
• void compute_off_diagonal_covariance ()
  calculate respCovariance(i,j) for j<i
• void print_moments (std::ostream &s)
  print expansion and numerical moments
• void print_covariance (std::ostream &s)
  print respCovariance
• void print_sobol_indices (std::ostream &s)
  print global sensitivity indices
• void print_local_sensitivity (std::ostream &s)
  print local sensitivities evaluated at initialPtU
• void compute_print_increment_results ()
  manage print of results following a refinement increment
• void compute_print_iteration_results (bool initialize)
  manage print of results following a refinement increment
• void compute_print_converged_results (bool print_override=false)
  manage print of results following convergence of iterative refinement

Private Attributes
• short ruleNestingOverride
  user override of default rule nesting: NO_NESTING_OVERRIDE, NESTED, or NON_NESTED
• short ruleGrowthOverride
  user override of default rule growth: NO_GROWTH_OVERRIDE, RESTRICTED, or UNRESTRICTED
• Iterator expansionSampler
  Iterator used for sampling on the uSpaceModel to generate approximate probability/reliability/response level statistics. Currently this is an LHS sampling instance, but AIS could also be used.
• Iterator importanceSampler
  Iterator used to refine the approximate probability estimates generated by the expansionSampler using importance sampling.
• RealMatrix expGradsMeanX
  derivative of the expansion with respect to the x-space variables evaluated at the means (used as uncertainty importance metrics)
• bool vbdFlag
  flag indicating the activation of variance-based decomposition for computing Sobol’ indices
• unsigned short vbdOrderLimit
  limits the order of interactions within the component Sobol’ indices
• Real vbdDropTol
  tolerance for omitting output of small VBD indices
• short covarianceControl
13.97. NONEXPANSION CLASS REFERENCE

enumeration for controlling response covariance calculation and output: \{DEFAULT,DIAGONAL,FULL\}_COVARIANCE

- unsigned short integrationRefine
  integration refinement for expansion sampler
- String expansionRng
  random number generator for expansion sampler
- int origSeed
  seed for expansion sampler random number generator
- unsigned short expansionSampleType
  sample type for expansion sampler
- IntVector refinementSamples
  refinement samples for expansion sampler

Additional Inherited Members

13.97.1 Detailed Description

Base class for polynomial chaos expansions (PCE) and stochastic collocation (SC)

The NonDExpansion class provides a base class for methods that use polynomial expansions to approximate
the effect of parameter uncertainties on response functions of interest.

13.97.2 Member Function Documentation

const Model & algorithm_space_model( ) const [inline], [virtual]

default definition that gets redefined in selected derived Minimizers
Reimplemented from Analyzer.
References NonDExpansion::uSpaceModel.

void increment_specification_sequence( ) [protected], [virtual]

increment the input specification sequence (PCE only)
default implementation is overridden by PCE
Reimplemented in NonDPolynomialChaos.
References NonDIntegration::increment_specification_sequence(), Iterator::iterator_rep(), Model::subordinate_iterator(), and NonDExpansion::uSpaceModel.
Referenced by NonDPolynomialChaos::increment_specification_sequence(), and NonDExpansion::multifidelity_expansion().

Real compute_covariance_metric( ) [protected], [virtual]

compute 2-norm of change in response covariance
computes the default refinement metric based on change in respCovariance
Reimplemented in NonDStochCollocation.
References NonDExpansion::compute_covariance(), NonDExpansion::covarianceControl, NonDExpansion::respCovariance, and NonDExpansion::respVariance.
Referenced by NonDStochCollocation::compute_covariance_metric(), NonDExpansion::increment_sets(), and NonDExpansion::refine_expansion().
CHAPTER 13. CLASS DOCUMENTATION

Real compute_final_statistics_metric() [protected], [virtual]

calculate 2-norm of change in final statistics
computes a “goal-oriented” refinement metric employing finalStatistics
Reimplemented in NonDStochCollocation.
References NonDExpansion::compute_statistics(), NonD::finalStatistics, Response::function_values(), Analyzer::numFunctions, NonD::requestedGenRelLevels, NonD::requestedProbLevels, NonD::requestedRelLevels, and NonD::requestedRespLevels.
Referenced by NonDStochCollocation::compute_final_statistics_metric(), and NonDExpansion::increment_sets().

void compute_statistics() [protected]
calculate analytic and numerical statistics from the expansion
Calculate analytic and numerical statistics from the expansion and log results within final_stats for use in OUU.
References ResultsManager::active(), NonDExpansion::archive_coefficients(), NonDExpansion::archive_moments(), NonDExpansion::compute_analytic_statistics(), NonDExpansion::compute_numerical_statistics(), Model::continuous_variable_labels(), Model::continuous_variables(), NonDExpansion::expansionSampler, NonDExpansion::expGrads_MeanX, NonD::initialize_level_mappings(), NonDExpansion::initialPtU, ResultsManager::insert(), Iterator::is_null(), Iterator::iteratedModel, Analyzer::numContinuousVars, Analyzer::numFunctions, Iterator::outputLevel, Model::response_labels(), Iterator::resultsDB, Iterator::resultsNames, Iterator::run_identifier(), Iterator::subIteratorFlag, NonD::totalLevelRequests, and NonDExpansion::uSpaceModel.
Referenced by NonDStochCollocation::compute_final_statistics_metric(), NonDExpansion::compute_final_statistics_metric(), NonDExpansion::compute_print_converged_results(), NonDExpansion::compute_print_increment_results(), and NonDExpansion::compute_print_iteration_results().

13.97.3 Member Data Documentation

bool useDerivs [protected]
flag for use_derivatives specification, indicating usage of derivative data (with respect to expansion variables) to enhance the calculation of the stochastic expansion.
This is part of the method specification since the instantiation of the global data fit surrogate is implicit with no user specification. This behavior is distinct from the usage of response derivatives with respect to auxiliary variables (design, epistemic) for computing derivatives of aleatory expansion statistics with respect to these variables.
Referenced by NonDExpansion::compute_expansion(), NonDStochCollocation::initialize_u_space_model(), NonDPolynomialChaos::initialize_u_space_model(), NonDPolynomialChaos::ratio_samples_to_order(), NonDStochCollocation::resolve_inputs(), NonDPolynomialChaos::resolve_inputs(), NonDPolynomialChaos::terms_ratio_to_samples(), and NonDPolynomialChaos::terms_samples_to_ratio().
The documentation for this class was generated from the following files:
- NonDExpansion.hpp
- NonDExpansion.cpp

13.98 NonDGlobalEvidence Class Reference

Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ.
Inheritance diagram for NonDGlobalEvidence:
Public Member Functions

- `NonDGlobalEvidence (ProblemDescDB &problem_db, Model &model)`
  constructor
- `~NonDGlobalEvidence ()`
  destructor
- `void initialize ()`
  perform any required initialization
- `void set_cell_bounds ()`
  set the optimization variable bounds for each cell
- `void get_best_sample (bool maximize, bool eval_approx)`
  determine truthFnStar and approxFnStar
- `void post_process_cell_results (bool maximize)`
  post-process a cell minimization/maximization result
- `void post_process_response_fn_results ()`
  post-process the interval computed for a response function
- `void post_process_final_results ()`
  perform final post-processing

Additional Inherited Members

13.98.1 Detailed Description

Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ.

The NonDEvidence class implements the propagation of epistemic uncertainty using Dempster-Shafer theory of evidence. In this approach, one assigns a set of basic probability assignments (BPA) to intervals defined for the uncertain variables. Input interval combinations are calculated, along with their BPA. Currently, the response function is evaluated at a set of sample points, then a response surface is constructed which is sampled extensively to find the minimum and maximum within each input interval cell, corresponding to the belief and plausibility within that cell, respectively. This data is then aggregated to calculate cumulative distribution functions for belief and plausibility.

The documentation for this class was generated from the following files:
13.99 NonDGlobalInterval Class Reference

Class for using global nongradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.

Inheritance diagram for NonDGlobalInterval:

```
NonDGlobalInterval
  NonDInterval
    NonD
      Analyzer
        Iterator
```

Public Member Functions

- **NonDGlobalInterval (ProblemDescDB &problem_db, Model &model)**
  
  constructor

- **~NonDGlobalInterval ()**
  
  destructor

- **void derived_init_communicators (ParLevLIter pl_iter)**
  
  derived class contributions to initializing the communicators associated with this Iterator instance

- **void derived_set_communicators (ParLevLIter pl_iter)**
  
  derived class contributions to setting the communicators associated with this Iterator instance

- **void derived_free_communicators (ParLevLIter pl_iter)**
  
  derived class contributions to freeing the communicators associated with this Iterator instance

- **void core_run ()**
  
  Performs an optimization to determine interval bounds for an entire function or interval bounds on a particular statistical estimator.

Protected Member Functions

- **virtual void initialize ()**
  
  perform any required initialization
virtual void set_cell_bounds ()
set the optimization variable bounds for each cell
virtual void get_best_sample (bool maximize, bool eval approx)
determine truthFnStar and approxFnStar
virtual void post_process_cell_results (bool maximize)
post-process a cell minimization/maximization result
virtual void post_process_response_fn_results ()
post-process the interval computed for a response function
virtual void post_process_final_results ()
perform final post-processing
void post_process_run_results (bool maximize)
post-process an optimization execution: output results, update convergence controls, and update GP approximation
void evaluate_response_star_truth ()
evaluate the truth response at the optimal variables solution and update the GP with the new data

Protected Attributes

• Iterator daceIterator
  LHS iterator for constructing initial GP for all response functions.
• Model fHatModel
  GP model of response, one approximation per response function.
• Iterator intervalOptimizer
  optimizer for solving surrogate-based subproblem: NCSU DIRECT optimizer for maximizing expected improvement or mixed EA if discrete variables.
• Model intervalOptModel
  recast model which formulates the surrogate-based optimization subproblem (recasts as design problem; may assimilate mean and variance to enable max(expected improvement))
• Real approxFnStar
  approximate response corresponding to minimum/maximum truth response
• Real truthFnStar
  minimum/maximum truth response function value

Static Private Member Functions

• static void EIF_objective_min (const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)
  static function used as the objective function in the Expected Improvement Function (EIF) for minimizing the GP
• static void EIF_objective_max (const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)
  static function used as the objective function in the Expected Improvement Function (EIF) for maximizing the GP
• static void extract_objective (const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)
  static function used to extract the active objective function when optimizing for an interval lower or upper bound (non-EIF formulations). The sense of the optimization is set separately.
Private Attributes

- `const int seedSpec`
  the user seed specification (default is 0)
- `int numSamples`
  the number of samples used in the surrogate
- `String rngName`
  name of the random number generator
- `bool gpModelFlag`
  flag indicating use of GP surrogate emulation
- `bool eitFlag`
  flag indicating use of maximized expected improvement for GP iterate selection
- `unsigned short improvementConvergeCntr`
  counter for number of successive iterations that the iteration improvement is less than the convergenceTol
- `unsigned short improvementConvergeLimit`
  counter for number of successive iterations that the iteration improvement is less than the convergenceTol
- `Real distanceTol`
  tolerance for L_2 change in optimal solution
- `unsigned short distanceConvergeCntr`
  counter for number of successive iterations that the L_2 change in optimal solution is less than the convergenceTol
- `unsigned short distanceConvergeLimit`
  counter for number of successive iterations that the L_2 change in optimal solution is less than the convergenceTol
- `RealVector prevCVStar`
  stores previous optimal point for continuous variables; used for assessing convergence
- `IntVector prevDIVStar`
  stores previous optimal point for discrete integer variables; used for assessing convergence
- `RealVector prevDRVStar`
  stores previous optimal point for discrete real variables; used for assessing convergence
- `Real prevFnStar`
  stores previous solution value for assessing convergence
- `size_t sbIterNum`
  surrogate-based minimization/maximization iteration count
- `bool boundConverged`
  flag indicating convergence of a minimization or maximization cycle
- `bool allResponsesPerIter`
  flag for maximal response extraction (all response values obtained on each function call)
- `short dataOrder`
  order of the data used for surrogate construction, in ActiveSet request vector 3-bit format; user may override responses spec

Static Private Attributes

- `static NonDGlobalInterval * nondGIInstance`
  pointer to the active object instance used within the static evaluator functions in order to avoid the need for static data
Additional Inherited Members

13.99.1 Detailed Description

Class for using global non-gradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.

The NonDGlobalInterval class supports global non-gradient-based optimization approaches to determining interval bounds for epistemic UQ. The interval bounds may be on the entire function in the case of pure interval analysis (e.g. intervals on input = intervals on output), or the intervals may be on statistics of an “inner loop” aleatory analysis such as intervals on means, variances, or percentile levels. The preliminary implementation will use a Gaussian process surrogate to determine interval bounds.

13.99.2 Member Function Documentation

const Model & algorithm_space_model() const [inline], [virtual]

default definition that gets redefined in selected derived Minimizers

Reimplemented from Analyzer.

References NonDGlobalInterval::fHatModel.

The documentation for this class was generated from the following files:

- NonDGlobalInterval.hpp
- NonDGlobalInterval.cpp

13.100 NonDGlobalReliability Class Reference

Class for global reliability methods within DAKOTA/UQ.

Inheritance diagram for NonDGlobalReliability:

```
       Iterator
          |
          Analyzer
          |
          NonD
          |
       NonDReliability
       |
NonDGlobalReliability
```

Public Member Functions

- NonDGlobalReliability (ProblemDescDB &problem_db, Model &model)
  
  constructor

- ~NonDGlobalReliability ()
  
  destructor

- bool resize ()
reinitializes iterator based on new variable size

- **void derived_init_communicators**(ParLevLIter pl_iter)
  - derived class contributions to initializing the communicators associated with this *Iterator* instance

- **void derived_set_communicators**(ParLevLIter pl_iter)
  - derived class contributions to setting the communicators associated with this *Iterator* instance

- **void derived_free_communicators**(ParLevLIter pl_iter)
  - derived class contributions to freeing the communicators associated with this *Iterator* instance

- **void core_run**( )
  - core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

- **void print_results**( std::ostream &s)
  - print the final iterator results

**Private Member Functions**

- **void optimize_gaussian_process**( )
  - construct the GP using EGO/SKO

- **void importance_sampling**( )
  - perform multimodal adaptive importance sampling on the GP

- **void get_best_sample**( )
  - determine current best solution from among sample data for expected improvement function in Performance Measure Approach (PMA)

- **Real constraint_penalty**( const Real &constraint, const RealVector &c_variables)
  - calculate the penalty to be applied to the PMA constraint value

- **Real expected_improvement**( const RealVector &expected_values, const Variables &recast_vars)
  - expected improvement function for the GP

- **Real expected_feasibility**( const RealVector &expected_values, const Variables &recast_vars)
  - expected feasibility function for the GP

**Static Private Member Functions**

- **static void EIF_objective_eval**( const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)
  - static function used as the objective function in the Expected Improvement (EIF) problem formulation for PMA

- **static void EFF_objective_eval**( const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)
  - static function used as the objective function in the Expected Feasibility (EFF) problem formulation for RIA

**Private Attributes**

- **Real fnStar**
  - minimum penalized response from among true function evaluations

- **short meritFunctionType**
  - type of merit function used to penalize sample data

- **Real lagrangeMult**
  - Lagrange multiplier for standard Lagrangian merit function.
13.100. NONDGLOBALRELIABILITY CLASS REFERENCE

- Real `augLagrangeMult`
  
  Lagrange multiplier for augmented Lagrangian merit function.

- Real `penaltyParameter`
  
  penalty parameter for augmented Lagrangian merit function

- Real `lastConstraintViolation`
  
  constraint violation at last iteration, used to determine if the current iterate should be accepted (must reduce violation)

- bool `lastIterateAccepted`
  
  flag to determine if last iterate was accepted this controls update of parameters for augmented Lagrangian merit fn

- short `dataOrder`
  
  order of the data used for surrogate construction, in ActiveSet request vector 3-bit format; user may override responses spec

**Static Private Attributes**

- static `NonDGlobalReliability * nondGlobRelInstance`
  
  pointer to the active object instance used within the static evaluator functions in order to avoid the need for static data

**Additional Inherited Members**

**13.100.1 Detailed Description**

Class for global reliability methods within DAKOTA/UQ.

The `NonDGlobalReliability` class implements EGO/SKO for global MPP search, which maximizes an expected improvement function derived from Gaussian process models. Once the limit state has been characterized, a multimodal importance sampling approach is used to compute probabilities.

**13.100.2 Member Function Documentation**

**void core_run ( ) [virtual]**

core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.

Reimplemented from `Iterator`.

References `NonDGlobalReliability::importance_sampling()`, `NonD::initialize_random_variable_parameters()`, `NonDGlobalReliability::nondGlobRelInstance`, `NonDReliability::numRelAnalyses`, `NonDGlobalReliability::optimize_gaussian_process()`, and `NonD::transform_correlations()`.

**void print_results ( std::ostream & s ) [virtual]**

print the final iterator results

This virtual function provides additional iterator-specific final results outputs beyond the function evaluation summary printed in `finalize_run()`.

Reimplemented from `Analyzer`.

References `NonD::cdfFlag`, `NonD::computedGenRelLevels`, `NonD::computedProbLevels`, `NonD::computedRespLevels`, `Iterator::iteratedModel`, `Analyzer::numFunctions`, `NonD::print_densities()`, `Model::response_labels()`, and `Dakota::write_precision`.

The documentation for this class was generated from the following files:
13.101 NonDGlobalSingleInterval Class Reference

Class for using global nongradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.

Inheritance diagram for NonDGlobalSingleInterval:

```
+----------------+  +----------------+  +----------------+  +----------------+
|    Iterator    |  |    Analyzer     |  |    NonD         |  |    NonDInterval |
|                |  |                |  |                |  |                |
| NonDGlobalInterval | | NonDInterval    | |                | | NonDGlobalSingleInterval |
```

Public Member Functions

- **NonDGlobalSingleInterval (ProblemDescDB &problem_db, Model &model)**
  *
  constructor

- **~NonDGlobalSingleInterval ()**
  *
  destructor

Protected Member Functions

- **void initialize ()**
  *
  perform any required initialization

- **void post_process_cell_results (bool maximize)**
  *
  post-process a cell minimization/maximization result

- **void get_best_sample (bool maximize, bool eval_approx)**
  *
  determine truthFnStar and approxFnStar

Private Attributes

- **size_t statCntr**
  *
  counter for finalStatistics
Additional Inherited Members

13.101.1 Detailed Description

Class for using global nongradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.

The NonDGlobalSingleInterval class supports global nongradient-based optimization approaches to determining interval bounds for epistemic UQ. The interval bounds may be on the entire function in the case of pure interval analysis (e.g. intervals on input = intervals on output), or the intervals may be on statistics of an "inner loop" aleatory analysis such as intervals on means, variances, or percentile levels. The preliminary implementation will use a Gaussian process surrogate to determine interval bounds.

The documentation for this class was generated from the following files:

- NonDGlobalSingleInterval.hpp
- NonDGlobalSingleInterval.cpp

13.102 NonDGPImpSampling Class Reference

Class for the Gaussian Process-based Importance Sampling method.

Inheritance diagram for NonDGPImpSampling:

```
NonDGPImpSampling
   ^       
   |       
   |       
   v       
NonDSampling
   ^       
   |       
   |       
   v       
NonD
   ^       
   |       
   |       
   v       
Analyzer
   ^       
   |       
   |       
   v       
Iterator
```

Public Member Functions

- **NonDGPImpSampling (ProblemDescDB &problem_db, Model &model)**
  *standard constructor*
- **~NonDGPImpSampling ()**
  *destructor*
- **bool resize ()**
  *reinitializes iterator based on new variable size*
- **void derived_init_communicators (ParLevLIter pl_iter)**
  *derived class contributions to initializing the communicators associated with this Iterator instance*
- **void derived_set_communicators (ParLevLIter pl_iter)**
  *derived class contributions to setting the communicators associated with this Iterator instance*
- **void derived_free_communicators (ParLevLIter pl_iter)**
derived class contributions to freeing the communicators associated with this Iterator instance
• void \texttt{core\_run} ()
  \textit{perform the GP importance sampling and return probability of failure}
• void \texttt{print\_results} (std::ostream &s)
  \textit{print the final statistics}
• Real \texttt{final\_probability} ()
  \textit{returns the probability calculated by the importance sampling}

Private Member Functions

• RealVector \texttt{calcExpIndicator} (const int respFnCount, const Real respThresh)
  \textit{function to calculate the expected indicator probabilities}
• Real \texttt{calcExpIndPoint} (const int respFnCount, const Real respThresh, const RealVector this\_mean, const RealVector this\_var)
  \textit{function to calculate the expected indicator probabilities for one point}
• void \texttt{calcRhoDraw} ()
  \textit{function to update the rhoDraw data, adding x values and rho draw values}
• RealVector \texttt{drawNewX} (int this\_k)
  \textit{function to pick the next X value to be evaluated by the Iterated model}

Private Attributes

• Iterator \texttt{gpBuild}
  \textit{LHS iterator for building the initial GP.}
• Iterator \texttt{gpEval}
  \textit{LHS iterator for sampling on the GP.}
• Model \texttt{gpModel}
  \textit{GP model of response, one approximation per response function.}
• Iterator \texttt{sampleRhoOne}
  \textit{LHS iterator for sampling from the rhoOneDistribution.}
• int \texttt{numPtsAdd}
  \textit{the number of points added to the original set of LHS samples}
• int \texttt{numPtsTotal}
  \textit{the total number of points}
• int \texttt{numEmulEval}
  \textit{the number of points evaluated by the GP each iteration}
• Real \texttt{finalProb}
  \textit{the final calculated probability (p)}
• RealVectorArray \texttt{gpCvars}
  \textit{Vector to hold the current values of the current sample inputs on the GP.}
• RealVectorArray \texttt{gpMeans}
  \textit{Vector to hold the current values of the current mean estimates for the sample values on the GP.}
• RealVectorArray \texttt{gpVar}
  \textit{Vector to hold the current values of the current variance estimates for the sample values on the GP.}
- RealVector `expIndicator`  
  *Vector to hold the expected indicator values for the current GP samples.*
- RealVector `rhoDraw`  
  *Vector to hold the rhoDraw values for the current GP samples.*
- RealVector `normConst`  
  *Vector to hold the normalization constant calculated for each point added.*
- RealVector `indicator`  
  *IntVector to hold indicator for actual simulation values vs. threshold.*
- RealVectorArray `xDrawThis`  
  *xDrawThis, appended to locally to hold the X values of emulator points chosen*
- RealVector `expIndThis`  
  *expIndThis, appended locally to hold the expected indicator*
- RealVector `rhoDrawThis`  
  *rhoDrawThis, appended locally to hold the rhoDraw density for calculating draws*
- RealVector `rhoMix`  
  *rhoMix, mixture density*
- RealVector `rhoOne`  
  *rhoOne, original importance density*

**Additional Inherited Members**

### 13.102.1 Detailed Description

Class for the Gaussian Process-based Importance Sampling method.

The `NonDGPImpSampling` implements a method developed by Keith Dalbey that uses a Gaussian process surrogate in the calculation of the importance density. Specifically, the mean and variance of the GP prediction are used to calculate an expected value that a particular point fails, and that is used as part of the computation of the "draw distribution." The normalization constants and the mixture distribution used are defined in (need to get SAND report).

### 13.102.2 Constructor & Destructor Documentation

`NonDGPImpSampling ( ProblemDescDB & problem_db, Model & model )`

*standard constructor*

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification.

References `Response::active_set()`, `Iterator::assign_rep()`, `Model::assign_rep()`, `NonD::construct_lhs()`, `Model::current_response()`, `ProblemDescDB::get_bool()`, `ProblemDescDB::get_int()`, `ProblemDescDB::get_string()`, `ProblemDescDB::get_ushort()`, `NonDGPImpSampling::gpBuild`, `NonDGPImpSampling::gpEval`, `NonDGPImpSampling::gpModel`, `Model::gradient_type()`, `Model::hessian_type()`, `Iterator::iteratedModel`, `Iterator::maxIterations`, `NonDGPImpSampling::numEmulEval`, `NonDGPImpSampling::numPtsAdd`, `NonDSampling::numSamples`, `Iterator::outputLevel`, `Iterator::probDescDB`, `NonDSampling::randomSeed`, `ActiveSet::request_values()`, `NonDSampling::rngName`, `NonDGPImpSampling::sampleRhoOne`, `NonDSampling::sampleType`, `NonDSampling::samplingVarsMode`, `NonDSampling::statsFlag`, `NonDSampling::vary_pattern()`, and `NonDSampling::varyPattern`.
13.102.3 Member Function Documentation

```cpp
void core_run() [virtual]
```

perform the GP importance sampling and return probability of failure

Calculate the failure probabilities for specified probability levels using Gaussian process based importance sampling.
Reimplemented from Iterator.

References Model::acv(), Iterator::all_responses(), Analyzer::all_samples(), Iterator::all_samples(), Model::append_approximation(), Model::approximation_data(), Model::approximation_variances(), Model::build_approximation(), NonDGPImpSampling::calcExpIndicator(), NonDGPImpSampling::calcExpIndPoint(), NonDGPImpSampling::calcRhoDraw(), NonD::cdfFlag, NonD::computedProbLevels, Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::continuous_variables(), Model::current_response(), Model::current_variables(), NonDGPImpSampling::drawNewX(), Model::evaluate(), Model::evaluation_id(), NonDGPImpSampling::expIndicator, NonDGPImpSampling::expIndThis, NonDGPImpSampling::finalProb, Response::function_values(), NonDGPImpSampling::gpCvars, NonDGPImpSampling::gpEval, NonDGPImpSampling::gpMeans, NonDGPImpSampling::gpModel, NonDGPImpSampling::gpVar, NonDGPImpSampling::indicator, NonD::initialize_level_mappings(), Iterator::iteratedModel, Iterator::methodPCIter, NonD::miPLIndex, NonDGPImpSampling::normConst, NonDGPImpSampling::numEmulEval, Analyzer::numFunctions, NonDGPImpSampling::numPtsAdd, NonDGPImpSampling::numPtsTotal, NonDSampling::numSamples, Iterator::outputLevel, Model::pop_approximation(), NonD::requestedRespLevels, NonDGPImpSampling::rhoDraw, NonDGPImpSampling::rhoDrawThis, NonDGPImpSampling::rhoMix, NonDGPImpSampling::rhoOne, Iterator::run(), NonDGPImpSampling::sampleRhoOne, and NonDGPImpSampling::xDrawThis.

The documentation for this class was generated from the following files:

- NonDGPImpSampling.hpp
- NonDGPImpSampling.cpp

13.103 NonDGPMASA BayesCalibration Class Reference

Generates posterior distribution on model parameters given experiment data.

Inheritance diagram for NonDGPMASA BayesCalibration:
Public Member Functions

- **NonDGPMSABayesCalibration** (ProblemDescDB &problem_db, Model &model)
  constructor
- ∼**NonDGPMSABayesCalibration** ()
  destructor

Public Attributes

- **int buildSamples**
  number of samples of the simulation to construct the GP
- **bool calibrateSigmaFlag**
  flag to indicated if the sigma terms should be calibrated (default true)
- **String approxImportFile**
  name of file from which to import build points to build GP
- **unsigned short approxImportFormat**
  build data import tabular format
- **bool approxImportActiveOnly**
  import active variables only

Protected Member Functions

- **void derived_init_communicators** (ParLevLIter pl_iter)
  derived class contributions to initializing the communicators associated with this Iterator instance
- **void derived_set_communicators** (ParLevLIter pl_iter)
  derived class contributions to setting the communicators associated with this Iterator instance
- **void derived_free_communicators** (ParLevLIter pl_iter)
  derived class contributions to freeing the communicators associated with this Iterator instance
- **void core_run ()**
  performs a forward uncertainty propagation by using GPM/SA to generate a posterior distribution on parameters
given a set of simulation parameter/response data, a set of experimental data, and additional variables to be
specified here.

Private Attributes

- **Iterator lhsIter**
  LHS iterator for generating samples for GP.

Static Private Attributes

- **static NonDGPMSABayesCalibration * nonDGPMSAInstance**
  Pointer to current class instance for use in static callback functions.
Additional Inherited Members

13.103.1 Detailed Description

Generates posterior distribution on model parameters given experiment data.

This class provides a wrapper for the functionality provided in the Los Alamos National Laboratory code called GPM/SA (Gaussian Process Models for Simulation Analysis). Although this is a code that provides input/output mapping, it DOES NOT provide the mapping that we usually think of in the NonDeterministic class hierarchy in DAKOTA, where uncertainty in parameter inputs are mapped to uncertainty in simulation responses. Instead, this class takes a pre-existing set of simulation data as well as experimental data, and maps priors on input parameters to posterior distributions on those input parameters, according to a likelihood function. The goal of the MCMC sampling is to produce posterior values of parameter estimates which will produce simulation response values that "match well" to the experimental data. The MCMC is an integral part of the calibration. The data structures in GPM/SA are fairly detailed and nested. Part of this prototyping exercise is to determine what data structures need to be specified and initialized in DAKOTA and sent to GPM/SA, and what data structures will be returned.

13.103.2 Constructor & Destructor Documentation

NonDGPMSABayesCalibration ( ProblemDescDB & problem db, Model & model )

constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification.

References Dakota::abort_handler(), Iterator::assign_rep(), NonDGPMSABayesCalibration::buildSamples, ProblemDescDB::get_string(), NonDGPMSABayesCalibration::lhsIter, NonDBayesCalibration::mcmcModel, Iterator::probDescDB, and NonDBayesCalibration::randomSeed.

13.103.3 Member Function Documentation

void core_run ( ) [protected], [virtual]

performs a forward uncertainty propagation by using GPM/SA to generate a posterior distribution on parameters given a set of simulation parameter/response data, a set of experimental data, and additional variables to be specified here.

Perform the uncertainty quantification
Reimplemented from Iterator.

References Iterator::all_responses(), Analyzer::all_samples(), Iterator::all_samples(), NonDGPMSABayesCalibration::approxImportActiveOnly, NonDGPMSABayesCalibration::approxImportFile, NonDGPMSABayesCalibration::approxImportFormat, NonDGPMSABayesCalibration::buildSamples, NonDGPMSABayesCalibration::calibrateSigmaFlag, NonDBayesCalibration::chainSamples, ExperimentData::config_vars(), Model::continuous_variables(), NonDCalibration::expData, NonDBayesCalibration::initialize_model(), NonDGPMSABayesCalibration::lhsIter, NonDBayesCalibration::mcmcModel, Iterator::methodPCIter, NonD::miPLIndex, ParallelLibrary::mpirun_flag(), NonD::natafTransform, NonDBayesCalibration::nonDBayesInstance, NonDGPMSABayesCalibration::nonDGPMSAInstance, NonDCalibration::numExperiments, Analyzer::numFunctions, NonD::numUncertainVars, Iterator::outputLevel, Iterator::parallelLib, Iterator::run(), ExperimentData::scalar_data(), and NonDBayesCalibration::standardizedSpace.

The documentation for this class was generated from the following files:

- NonDGPMSABayesCalibration.hpp
- NonDGPMSABayesCalibration.cpp
13.104 NonDIntegration Class Reference

Derived nondeterministic class that generates N-dimensional numerical integration points for evaluation of expectation integrals.

Inheritance diagram for NonDIntegration:

```
NonDIntegration
   NonD
   NonDAnalyzer
   NonDIterator
```

NonDCubature
NonDQuadrature
NonDSparseGrid

Public Member Functions

- virtual void `initialize_grid` (const std::vector<Pecos::BasisPolynomial>& poly_basis)=0
  initialize integration grid by drawing from polynomial basis settings
- virtual void `increment_grid` ()=0
  increment SSG level/TPQ order
- virtual void `increment_grid_preference` (const RealVector &dim_pref)
  increment SSG level/TPQ order and update anisotropy
- virtual void `increment_grid_weights` (const RealVector &aniso_wts)
  increment SSG level/TPQ order and update anisotropy
- virtual void `increment_specification_sequence` ()
  increment sequenceIndex and update active orders/levels
- const Pecos::IntegrationDriver & `driver` () const
  return numIntDriver
- bool `resize` ()
  reinitializes iterator based on new variable size

Static Public Member Functions

- static void `dimension_preference_to_anisotropic_order` (unsigned short scalar_order_spec, const RealVector &dim_pref_spec, size_t num_v, UShortArray &aniso_order)
  convert scalar_order_spec and vector dim_pref_spec to vector aniso_order
- static void `anisotropic_order_to_dimension_preference` (const UShortArray &aniso_order, unsigned short &scalar_order, RealVector &dim_pref)
  convert vector aniso_order to scalar_order and vector dim_pref
CHAPTER 13. CLASS DOCUMENTATION

Protected Member Functions

- **NonDIntegration** (ProblemDescDB &problem_db, Model &model)
  
  constructor

- **NonDIntegration** (unsigned short method_name, Model &model)
  
  alternate constructor for instantiations "on the fly"

- **NonDIntegration** (unsigned short method_name, Model &model, const RealVector &dim_pref)
  
  alternate constructor for instantiations "on the fly"

- **~NonDIntegration** ()
  
  destructor

- void **core_run** ()
  
  core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

- void **check_variables** (const std::vector<Pecos::RandomVariable> &x_ran_vars)
  
  verify self-consistency of variables data

- void **print_points_weights** (const String &tabular_name)
  
  output integration points and weights to a tabular file

Protected Attributes

- Pecos::IntegrationDriver numIntDriver
  
  Pecos utility class for managing interface to tensor-product grids and VPISparseGrid utilities for Smolyak sparse grids and cubature.

- size_t numIntegrations
  
  counter for number of integration executions for this object

- size_t sequenceIndex
  
  index into NonDQuadrature::quadOrderSpec and NonDSparseGrid::ssgLevelSpec that defines the current instance of several possible refinement levels

- RealVector dimPrefSpec
  
  the user specification for anisotropic dimension preference

Additional Inherited Members

13.104.1 Detailed Description

Derived nondeterministic class that generates N-dimensional numerical integration points for evaluation of expectation integrals.

This class provides a base class for shared code among NonDQuadrature and NonDSparseGrid.

13.104.2 Constructor & Destructor Documentation

**NonDIntegration** ( ProblemDescDB & problem_db, Model & model ) [protected]

constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification. It is not currently used, as there are not yet separate nond_quadrature/nond_sparse_grid method specifications.

References Dakota::abort_handler(), NonD::initialize_final_statistics(), NonD::initialize_random_variable_correlations(), NonD::initialize_random_variable_transformation(), NonD::initialize_random_variable_types(), Analyzer::numDiscrete-IntVars, Analyzer::numDiscreteRealVars, Analyzer::numDiscreteStringVars, and NonD::verify_correlation_support().
NonDIntegration ( unsigned short method_name, Model & model ) [protected]

alternate constructor for instantiations "on the fly"
This alternate constructor is used for on-the-fly generation and evaluation of numerical integration points.

NonDIntegration ( unsigned short method_name, Model & model, const RealVector & dim_pref ) [protected]

alternate constructor for instantiations "on the fly"
This alternate constructor is used for on-the-fly generation and evaluation of numerical integration points.

13.104.3 Member Function Documentation

void dimension_preference_to_anisotropic_order ( unsigned short scalar_order_spec, const RealVector & dim_pref_spec, size_t num_v, UShortArray & aniso_order ) [static]

convert scalar_order_spec and vector dim_pref_spec to vector aniso_order
Converts a scalar order specification and a vector anisotropic dimension preference into an anisotropic order vector. It is used for initialization and does not enforce a reference lower bound (see also NonDQuadrature::update_anisotropic_order()).
Referenced by NonDPolynomialChaos::increment_specification_sequence(), NonDQuadrature::initialize_dimension_quadrature_order(), NonDPolynomialChaos::NonDPolynomialChaos(), and NonDPolynomialChaos::resize().

void anisotropic_order_to_dimension_preference ( const UShortArray & aniso_order, unsigned short & scalar_order, RealVector & dim_pref ) [static]

convert vector aniso_order to scalar order and vector dim_pref
Converts a vector anisotropic order into a scalar order and vector anisotropic dimension preference.
Referenced by NonDPolynomialChaos::NonDPolynomialChaos().

void core_run ( ) [protected], [virtual]
core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post
Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.
Reimplemented from Iterator.
References NonDIntegration::check_variables(), Analyzer::evaluate_parameter_sets(), Analyzer::get_parameter_sets(), Iterator::iteratedModel, NonD::natafTransform, and NonDIntegration::numIntegrations.

void check_variables ( const std::vector< Pecos::RandomVariable > & x_ran_vars ) [protected]
verify self-consistency of variables data
Virtual function called from probDescDB-based constructors and from NonDIntegration::core_run()
References Dakota::abort_handler(), NonD::numContAleatUncVars, NonD::numContDesVars, NonD::numContEpistUncVars, NonD::numContIntervalVars, Analyzer::numContinuousVars, and NonD::numContStateVars.
Referenced by NonDIntegration::core_run(), NonDCubature::NonDCubature(), NonDQuadrature::NonDQuadrature(), and NonDSparseGrid::NonDSparseGrid().
The documentation for this class was generated from the following files:
• NonDIntegration.hpp
• NonDIntegration.cpp
13.105 NonDInterval Class Reference

Base class for interval-based methods within DAKOTA/UQ.

Inheritance diagram for NonDInterval:

```
NonDInterval -> NonD -> Analyzer
```

Public Member Functions

- **NonDInterval (ProblemDescDB &problem_db, Model &model)**
  - *constructor*

- **∼NonDInterval ()**
  - *destructor*

- **void print_results (std::ostream &s)**
  - *print the cumulative distribution functions for belief and plausibility*

- **bool resize ()**
  - *reinitializes iterator based on new variable size*

Protected Member Functions

- **void initialize_final_statistics ()**
  - *initialize finalStatistics for belief/plausibility results sets*

- **void compute_evidence_statistics ()**
  - *method for computing belief and plausibility values for response levels or vice-versa*

- **void calculate_cells_and_bpas ()**
  - *computes the interval combinations (cells) and their bpas replaces CBPIIC_F77 from wrapper calculate_basic_prob_intervals()

- **void calculate_cbf_cpf (bool complementary=true)**
  - *function to compute (complementary) distribution functions on belief and plausibility replaces CCBFPF_F77 from wrapper calculate_cum_belief_plaus()*

Protected Attributes

- **bool singleIntervalFlag**
  - *flag for SingleInterval derived class*

- **RealVectorArray ccBelFn**
  - *Storage array to hold CCBF values.*

- **RealVectorArray ccPlausFn**
  - *Storage array to hold CCPF values.*
13.105. NONDINTERVAL CLASS REFERENCE

- RealVectorArray ccBelVal
  Storage array to hold CCB response values.
- RealVectorArray ccPlausVal
  Storage array to hold CCP response values.
- RealVectorArray cellContLowerBounds
  Storage array to hold cell lower bounds for continuous variables.
- RealVectorArray cellContUpperBounds
  Storage array to hold cell upper bounds for continuous variables.
- IntVectorArray cellIntRangeLowerBounds
  Storage array to hold cell lower bounds for discrete int range variables.
- IntVectorArray cellIntRangeUpperBounds
  Storage array to hold cell upper bounds for discrete int range variables.
- IntVectorArray cellIntSetBounds
  Storage array to hold cell values for discrete integer set variables.
- IntVectorArray cellRealSetBounds
  Storage array to hold cell value for discrete real set variables.
- RealVectorArray cellFnLowerBounds
  Storage array to hold cell min.
- RealVectorArray cellFnUpperBounds
  Storage array to hold cell max.
- RealVector cellBPA
  Storage array to hold cell bpa.
- size_t respFnCntr
  response function counter
- size_t cellCntr
  cell counter
- size_t numCells
  total number of interval combinations

Additional Inherited Members

13.105.1 Detailed Description

Base class for interval-based methods within DAKOTA/UQ.

The NonDInterval class implements the propagation of epistemic uncertainty using either pure interval propagation or Dempster-Shafer theory of evidence. In the latter approach, one assigns a set of basic probability assignments (BPA) to intervals defined for the uncertain variables. Input interval combinations are calculated, along with their BPA. Currently, the response function is evaluated at a set of sample points, then a response surface is constructed which is sampled extensively to find the minimum and maximum within each input interval cell, corresponding to the belief and plausibility within that cell, respectively. This data is then aggregated to calculate cumulative distribution functions for belief and plausibility.

The documentation for this class was generated from the following files:

- NonDInterval.hpp
- NonDInterval.cpp
13.106 NonDLHSEvidence Class Reference

Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ.

Inheritance diagram for NonDLHSEvidence:

```
NonDLHSEvidence
 |     |     |
 |     |     |
 |     |     |
NonDLHSInterval
 |     |     |
 |     |     |
NonDInterval
 |     |     |
 |     |     |
NonD
 |     |     |
 |     |     |
Analyzer
 |     |     |
 |     |     |
Iterator
```

Public Member Functions

- `NonDLHSEvidence (ProblemDescDB &problem_db, Model &model)`
  constructor
- `~NonDLHSEvidence ()`
  destructor
- `void initialize ()`
  perform any required initialization
- `void post_process_samples ()`
  post-process the output from executing lhsSampler

Additional Inherited Members

13.106.1 Detailed Description

Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ.

The NonDEvidence class implements the propagation of epistemic uncertainty using Dempster-Shafer theory of evidence. In this approach, one assigns a set of basic probability assignments (BPA) to intervals defined for the uncertain variables. Input interval combinations are calculated, along with their BPA. Currently, the response function is evaluated at a set of sample points, then a response surface is constructed which is sampled extensively to find the minimum and maximum within each input interval cell, corresponding to the belief and plausibility within that cell, respectively. This data is then aggregated to calculate cumulative distribution functions for belief and plausibility.

The documentation for this class was generated from the following files:

- NonDLHSEvidence.hpp
- NonDLHSEvidence.cpp
13.107 NonDLHSInterval Class Reference

Class for the LHS-based interval methods within DAKOTA/UQ.

Inheritance diagram for NonDLHSInterval:

```
NonDLHSInterval
  NonDInterval
  NonD
  Analyzer
  Iterator
  NonDLHSEvidence
  NonDLHSSingleInterval
```

**Public Member Functions**

- **NonDLHSInterval (ProblemDescDB &problem_db, Model &model)**
  
  *constructor*

- **~NonDLHSInterval ()**
  
  *destructor*

- **void derived_init_communicators (ParLevLIter pl_iter)**
  
  *derived class contributions to initializing the communicators associated with this Iterator instance*

- **void derived_set_communicators (ParLevLIter pl_iter)**
  
  *derived class contributions to setting the communicators associated with this Iterator instance*

- **void derived_free_communicators (ParLevLIter pl_iter)**
  
  *derived class contributions to freeing the communicators associated with this Iterator instance*

- **void core_run ()**
  
  *performs an epistemic uncertainty propagation using LHS samples*

**Protected Member Functions**

- **virtual void initialize ()**
  
  *perform any required initialization*

- **virtual void post_process_samples ()=0**
  
  *post-process the output from executing lhsSampler*
Protected Attributes

- Iterator lhsSampler
  the LHS sampler instance
- const int seedSpec
  the user seed specification (default is 0)
- int numSamples
  the number of samples used
- String rngName
  name of the random number generator

Additional Inherited Members

13.107.1 Detailed Description

Class for the LHS-based interval methods within DAKOTA/UQ. The NonDLHSInterval class implements the propagation of epistemic uncertainty using LHS-based methods. The documentation for this class was generated from the following files:

- NonDLHSInterval.hpp
- NonDLHSInterval.cpp

13.108 NonDLHSSampling Class Reference

Performs LHS and Monte Carlo sampling for uncertainty quantification. 
Inheritance diagram for NonDLHSSampling:

```
NonDLHSSampling
  NonDSampling
    NonD
      Analyzer
        Iterator
```

Public Member Functions

- NonDLHSSampling (ProblemDescDB &problem_db, Model &model)
  *standard constructor*
- NonDLHSSampling (Model &model, unsigned short sample_type, int samples, int seed, const String &rng, bool vary_pattern=true, short sampling_vars_mode=ACTIVE)
  *alternate constructor for sample generation and evaluation "on the fly"*
NonDLHSSampling (unsigned short sample_type, int samples, int seed, const String &rng, const RealVector &lower_bnds, const RealVector &upper_bnds)

alternate constructor for uniform sample generation "on the fly"

NonDLHSSampling (unsigned short sample_type, int samples, int seed, const String &rng, const RealVector &means, const RealVector &std_devs, const RealVector &lower_bnds, const RealVector &upper_bnds, RealSymMatrix &correl)

alternate constructor for sample generation of correlated normals "on the fly"

~NonDLHSSampling ()

destructor

Protected Member Functions

void sampling_increment ()

increment to next in sequence of refinement samples

void pre_run ()

generate LHS samples in non-VBD cases

void core_run ()

perform the evaluate parameter sets portion of run

void post_run (std::ostream &s)

generate statistics for LHS runs in non-VBD cases

void post_input ()

read tabular data for post-run mode

void compute_pca (std::ostream &s)

compute a principal components analysis on the sample set

void print_results (std::ostream &s)

print the final statistics

void d_optimal_parameter_set (int previous_samples, int new_samples, RealMatrix &full_samples)

generate a d-optimal parameter set, leaving the first previous_samples columns intact and adding new_samples new columns following them

void initial_increm_lhs_set (int new_samples, RealMatrix &full_samples, IntMatrix &full_ranks)

Populate the first new_samples columns of allSamples with an LHS design and update the stored ranks.

void increm_lhs_parameter_set (int previous_samples, int new_samples, RealMatrix &full_samples, IntMatrix &all_ranks)

generate a new batch that is Latin w.r.t. the previous samples

void store_ranks (const RealMatrix &sample_values, const IntMatrix &sample_ranks)

store the ranks of the last generated sample for continuous (based on sampleRanks) and calculate/store discrete ranks

void store_ranks (const IntMatrix &full_ranks)

store the combined ranks from sampleRanks to leading submatrix local cached ranks matrix

void combine_discrete_ranks (const RealMatrix &initial_values, const RealMatrix &increment_values)

merge the discrete ranks into a submatrix of sampleRanks

Static Protected Member Functions

static bool rank_sort (const int &x, const int &y)

sort algorithm to compute ranks for rank correlations
Private Attributes

- size_t numResponseFunctions
  number of response functions; used to distinguish NonD from opt/NLS usage
- IntVector refineSamples
  list of refinement sample batch sizes
- bool dOptimal
  whether to generate d-optimal point sets
- Real oversampleRatio
  oversampling ratio for d-optimal candidate set generation (default 10.0)
- bool varBasedDecompFlag
  flags computation of variance-based decomposition indices
- bool pcaFlag
  flag to specify the calculation of principal components
- Real percentVarianceExplained
  Threshold to keep number of principal components that explain this much variance.

Static Private Attributes

- static RealArray rawData
  static data used by static rank_sort() fn

Additional Inherited Members

13.108.1 Detailed Description

Performs LHS and Monte Carlo sampling for uncertainty quantification.

The Latin Hypercube Sampling (LHS) package from Sandia Albuquerque’s Risk and Reliability organization provides comprehensive capabilities for Monte Carlo and Latin Hypercube sampling within a broad array of user-specified probabilistic parameter distributions. It enforces user-specified rank correlations through use of a mixing routine. The NonDLHSSampling class provides a C++ wrapper for the LHS library and is used for performing forward propagations of parameter uncertainties into response statistics.

Batch generation options, including D-Optimal and incremental LHS are provided.

The incremental LHS sampling capability allows one to supplement an initial sample of size n to size 2n while maintaining the correct stratification of the 2n samples and also maintaining the specified correlation structure. The incremental version of LHS will return a sample of size n, which when combined with the original sample of size n, allows one to double the size of the sample.

13.108.2 Constructor & Destructor Documentation

NonDLHSSampling ( ProblemDescDB & problem_db, Model & model )

standard constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification.

References NonDLHSSampling::dOptimal, Model::num_primary_fns(), NonDLHSSampling::numResponse-Functions, Iterator::outputLevel, Model::primary_fn_type(), NonDLHSSampling::refineSamples, and NonDSampling-::sampleType.
NonDLHSSampling ( Model & model, unsigned short sample_type, int samples, int seed, const String & rng, bool vary_pattern = true, short sampling_vars_mode = ACTIVE )

alternate constructor for sample generation and evaluation "on the fly"

This alternate constructor is used for generation and evaluation of Model-based sample sets. A set_db_list_nodes has not been performed so required data must be passed through the constructor. It’s purpose is to avoid the need for a separate LHS specification within methods that use LHS sampling.

NonDLHSSampling ( unsigned short sample_type, int samples, int seed, const String & rng, const RealVector & lower_bnds, const RealVector & upper_bnds )

alternate constructor for uniform sample generation "on the fly"

This alternate constructor is used by ConcurrentStrategy for generation of uniform, uncorrelated sample sets. It is not a letter-envelope instantiation and a set_db_list_nodes has not been performed. It is called with all needed data passed through the constructor and is designed to allow more flexibility in variables set definition (i.e., relax connection to a variables specification and allow sampling over parameter sets such as multiobjective weights). In this case, a Model is not used and the object must only be used for sample generation (no evaluation).

References NonDSampling::get_parameter_sets().

NonDLHSSampling ( unsigned short sample_type, int samples, int seed, const String & rng, const RealVector & means, const RealVector & std_devs, const RealVector & lower_bnds, const RealVector & upper_bnds, RealSymMatrix & correl )

alternate constructor for sample generation of correlated normals "on the fly"

This alternate constructor is used to generate correlated normal sample sets. It is not a letter-envelope instantiation and a set_db_list_nodes has not been performed. It is called with all needed data passed through the constructor. In this case, a Model is not used and the object must only be used for sample generation (no evaluation).

References NonDSampling::get_parameter_sets().

13.108.3 Member Function Documentation

void core_run ( ) [protected], [virtual]

perform the evaluate parameter sets portion of run

Loop over the set of samples and compute responses. Compute statistics on the set of responses if statsFlag is set.

Reimplemented from Iterator.

References NonDSampling::allDataFlag, Analyzer::evaluate_parameter_sets(), Iterator::iteratedModel, Analyzer::numContinuousVars, Analyzer::numDiscreteIntVars, Analyzer::numDiscreteRealVars, NonDLHSSampling::numResponseFunctions, NonDSampling::numSamples, NonDSampling::statsFlag, NonDLHSSampling::varBasedDecompFlag, and Analyzer::variance_based_decomp().

void d_optimal_parameter_set ( int previous_samples, int new_samples, RealMatrix & full_samples ) [protected]

generate a d-optimal parameter set, leaving the first previous_samples columns intact and adding new_samples new columns following them

For now, when this function is called, numSamples is the number of new samples to generate.
References Model::aleatory_distribution_parameters(), NonDSampling::get_lhs_samples(), NonD::initialize_random_variables(), Iterator::iteratedModel, NonDSampling::mode_counts(), NonD::natafTransform, NonDLHSSampling::oversampleRatio, and NonDSampling::transform_samples().

Referenced by NonDLHSSampling::pre_run().

The documentation for this class was generated from the following files:

- NonDLHSSampling.hpp
- NonDLHSSampling.cpp

### 13.109 NonDLHSSingleInterval Class Reference

Class for pure interval propagation using LHS.

Inheritance diagram for NonDLHSSingleInterval:

```
    Iterator
     |
    Analyzer
     |
    NonD
     |
    NonDInterval
     |
    NonDLHSInterval
     |
    NonDLHSSingleInterval
```

#### Public Member Functions

- **NonDLHSSingleInterval (ProblemDescDB &problem_db, Model &model)**
  
  constructor

- **~NonDLHSSingleInterval ()**
  
  destructor

#### Protected Member Functions

- **void initialize ()**
  
  perform any required initialization

- **void post_process_samples ()**
  
  post-process the output from executing lhsSampler

#### Private Attributes

- **size_t statCntr**
  
  counter for finalStatistics
13.109.1 Detailed Description

Class for pure interval propagation using LHS.

The NonDSingleInterval class implements the propagation of epistemic uncertainty using ...

The documentation for this class was generated from the following files:
- NonDLHSSingleInterval.hpp
- NonDLHSSingleInterval.cpp

13.110 NonDLocalEvidence Class Reference

Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ.

Inheritance diagram for NonDLocalEvidence:

```
Analyzer
   
NonD
   
NonDInterval
   
NonDLocalInterval
   
NonDLocalEvidence
```

Public Member Functions

- **NonDLocalEvidence** (ProblemDescDB &problem_db, Model &model)
  
  constructor

- **~NonDLocalEvidence** ()
  
  destructor

Protected Member Functions

- void **initialize** ()
  
  perform any required initialization

- void **set_cell_bounds** ()
  
  set the optimization variable bounds for each cell

- void **truncate_to_cell_bounds** (RealVector &initial_pt)
  
  truncate initial_pt to respect current cell lower/upper bounds

- void **post_process_cell_results** (bool maximize)
post-process a cell minimization/maximization result

- void post_process_response_fn_results ()

post-process the interval computed for a response function

- void post_process_final_results ()

perform final post-processing

Additional Inherited Members

13.110.1 Detailed Description

Class for the Dempster-Shafer Evidence Theory methods within DAKOTA/UQ.

The NonDEvidence class implements the propagation of epistemic uncertainty using Dempster-Shafer theory of evidence. In this approach, one assigns a set of basic probability assignments (BPA) to intervals defined for the uncertain variables. Input interval combinations are calculated, along with their BPA. Currently, the response function is evaluated at a set of sample points, then a response surface is constructed which is sampled extensively to find the minimum and maximum within each input interval cell, corresponding to the belief and plausibility within that cell, respectively. This data is then aggregated to calculate cumulative distribution functions for belief and plausibility.

The documentation for this class was generated from the following files:

- NonDLocalEvidence.hpp
- NonDLocalEvidence.cpp

13.111 NonDLocalInterval Class Reference

Class for using local gradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.

Inheritance diagram for NonDLocalInterval:

```
NonDLocalEvidence
  NonDLocalSingleInterval
    NonDLocalInterval
      NonDInterval
        NonD
          Analyzer
            Iterator
```

Public Member Functions

- NonDLocalInterval (ProblemDescDB &problem_db, Model &model)
13.111. NONLOCALINTERVAL CLASS REFERENCE

- \~\text{NonDLocalInterval}()
- \text{void derived\_init\_communicators}(\text{ParLevLIter pl\_iter})
  derived class contributions to initializing the communicators associated with this \text{Iterator} instance
- \text{void derived\_set\_communicators}(\text{ParLevLIter pl\_iter})
  derived class contributions to setting the communicators associated with this \text{Iterator} instance
- \text{void derived\_free\_communicators}(\text{ParLevLIter pl\_iter})
  derived class contributions to freeing the communicators associated with this \text{Iterator} instance
- \text{void core\_run}()
  Performs a gradient-based optimization to determine interval bounds for an entire function or interval bounds on a particular statistical estimator.
- \text{unsigned short uses\_method}()\text{const}
  return name of active optimizer method
- \text{void method\_recourse}()
  perform an MPP optimizer method switch due to a detected conflict

Protected Member Functions

- virtual \text{void initialize}()\text{const}
  perform any required initialization
- virtual \text{void set\_cell\_bounds}()
  set the optimization variable bounds for each cell
- virtual \text{void truncate\_to\_cell\_bounds}(\text{RealVector &initial\_pt})
  truncate initial\_pt to respect current cell lower/upper bounds
- virtual \text{void post\_process\_cell\_results}(\text{bool maximize})
  post-process a cell minimization/maximization result
- virtual \text{void post\_process\_response\_fn\_results}()
  post-process the interval computed for a response function
- virtual \text{void post\_process\_final\_results}()
  perform final post-processing

Protected Attributes

- \text{Iterator minMaxOptimizer}
  local gradient-based optimizer
- \text{Model minMaxModel}
  recast model which extracts the active objective function

Static Private Member Functions

- static \text{void extract\_objective}(\text{const Variables &sub\_model\_vars}, \text{const Variables &recast\_vars}, \text{const Response &sub\_model\_response}, \text{Response &recast\_response})
  static function used to extract the active objective function when optimizing for an interval lower or upper bound
Private Attributes

- bool npsolFlag
  flag representing the gradient-based optimization algorithm selection (NPSOL SQP or OPT++ NIP)

Static Private Attributes

- static NonDLocalInterval * nondLIInstance
  pointer to the active object instance used within the static evaluator functions in order to avoid the need for static data

Additional Inherited Members

13.111.1 Detailed Description

Class for using local gradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.

The NonDLocalInterval class supports local gradient-based optimization approaches to determining interval bounds for epistemic UQ. The interval bounds may be on the entire function in the case of pure interval analysis (e.g. intervals on input = intervals on output), or the intervals may be on statistics of an "inner loop" aleatory analysis such as intervals on means, variances, or percentile levels.

The documentation for this class was generated from the following files:

- NonDLocalInterval.hpp
- NonDLocalInterval.cpp

13.112 NonDLocalReliability Class Reference

Class for the reliability methods within DAKOTA/UQ.

Inheritance diagram for NonDLocalReliability:

```
    Iterator
     |      |
    Analyzer
    |      |
    NonD
    |      |
NonDNonDLocalReliability
```

Public Member Functions

- NonDLocalReliability (ProblemDescDB &problem_db, Model &model)
  constructor
• ~NonDLocalReliability ()
  destructor
• void derived_init_communicators (ParLevLIter pl_iter)
  derived class contributions to initializing the communicators associated with this Iterator instance
• void derived_set_communicators (ParLevLIter pl_iter)
  derived class contributions to setting the communicators associated with this Iterator instance
• void derived_free_communicators (ParLevLIter pl_iter)
  derived class contributions to freeing the communicators associated with this Iterator instance
• void core_run ()
  performs an uncertainty propagation using analytical reliability methods which solve constrained optimization problems to obtain approximations of the cumulative distribution function of response
• void print_results (std::ostream &s)
  print the approximate mean, standard deviation, and importance factors when using the mean value method or the CDF/CCDF information when using MPP-search-based reliability methods
• unsigned short uses_method () const
  return name of active MPP optimizer
• void method_recourse ()
  perform an MPP optimizer method switch due to a detected conflict

Private Member Functions

• void initial_taylor_series ()
  convenience function for performing the initial limit state Taylor-series approximation
• void mean_value ()
  convenience function for encapsulating the simple Mean Value computation of approximate statistics and importance factors
• void mpp_search ()
  convenience function for encapsulating the reliability methods that employ a search for the most probable point (AMV, AMV+, FORM, SORM)
• void initialize_class_data ()
  convenience function for initializing class scope arrays
• void initialize_level_data ()
  convenience function for initializing/warm starting MPP search data for each response function prior to level 0
• void initialize_mpp_search_data ()
  convenience function for initializing/warm starting MPP search data for each z/p/beta level for each response function
• void update_mpp_search_data (const Variables &vars_star, const Response &resp_star)
  convenience function for updating MPP search data for each z/p/beta level for each response function
• void update_level_data ()
  convenience function for updating z/p/beta level data and final statistics following MPP convergence
• void pma_maximize (const RealVector &mpp_u, const RealVector &fn_grad_u, const RealSymMatrix &fn_hess_u)
  update pmaMaximizeG from prescribed probabilities or prescribed generalized reliabilities by inverting second-order integrations
• void update_limit_state_surrogate ()
void assign_mean_data ()
update mostProbPointX/U, computedRespLevel, fnGradX/U, and fnHessX/U from ranVarMeansX/U, fnValsMeanX,
fnGradsMeanX, and fnHessiansMeanX

void dg_ds_eval (const RealVector &x_vars, const RealVector &fn_grad_x, RealVector &final_stat_grad)
convenience function for evaluating dg/ds

Real dp2_dbeta_factor (Real beta, bool cdf_flag)
compute factor for derivative of second-order probability with respect to reliability index (from differentiating BR-
EITUNG or HOHENRACK expressions)

Real signed_norm (const RealVector &mpp_u, const RealVector &fn_grad_u, bool cdf_flag)
convert norm of mpp_u (u-space solution) to a signed reliability index

Real signed_norm (Real norm_mpp_u)
convert norm of u-space vector to a signed reliability index

Real signed_norm (Real norm_mpp_u, const RealVector &mpp_u, const RealVector &fn_grad_u, bool cdf_flag)
shared helper function

Real probability (Real beta)
Convert reliability to probability using a first-order integration.

Real probability (bool cdf_flag, const RealVector &mpp_u, const RealVector &fn_grad_u, const RealSym-
Matrix &fn_hess_u)
Convert computed reliability to probability using either a first-order or second-order integration.

Real probability (Real beta, bool cdf_flag, const RealVector &mpp_u, const RealVector &fn_grad_u, const Real-
SymMatrix &fn_hess_u)
Convert provided reliability to probability using either a first-order or second-order integration.

Real reliability (Real p)
Convert probability to reliability using the inverse of a first-order integration.

Real reliability (Real p, bool cdf_flag, const RealVector &mpp_u, const RealVector &fn_grad_u, const Real-
SymMatrix &fn_hess_u)
Convert probability to reliability using the inverse of a first-order or second-order integration.

bool reliability_residual (const Real &p, const Real &beta, const RealVector &kappa, Real &res)
compute the residual for inversion of second-order probability corrections using Newton’s method (called by reliabil-
ity(p))

Real reliability_residual_derivative (const Real &p, const Real &beta, const RealVector &kappa)
compute the residual derivative for inversion of second-order probability corrections using Newton’s method (called by reliability(p))

void principal_curvatures (const RealVector &mpp_u, const RealVector &fn_grad_u, const RealSymMatrix &fn_hess_u, RealVector &kappa_u)
Compute the kappa_u vector of principal curvatures from fnHessU.

void scale_curvature (Real beta, bool cdf_flag, const RealVector &kappa, RealVector &scaled_kappa)
scale copy of principal curvatures by -1 if needed; else take a view
Static Private Member Functions

- static void RIA_objective_eval (const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)

  static function used as the objective function in the Reliability Index Approach (RIA) problem formulation. This equality-constrained optimization problem performs the search for the most probable point (MPP) with the objective function of $(\text{norm } u)^2$.

- static void RIA_constraint_eval (const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)

  static function used as the constraint function in the Reliability Index Approach (RIA) problem formulation. This equality-constrained optimization problem performs the search for the most probable point (MPP) with the constraint of $G(u) = \text{response level}$.

- static void PMA_objective_eval (const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)

  static function used as the objective function in the Performance Measure Approach (PMA) problem formulation. This equality-constrained optimization problem performs the search for the most probable point (MPP) with the objective function of $G(u)$.

- static void PMA_constraint_eval (const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)

  static function used as the constraint function in the first-order Performance Measure Approach (PMA) problem formulation. This optimization problem performs the search for the most probable point (MPP) with the equality constraint of $(\text{norm } u)^2 = (\text{beta-bar})^2$.

- static void PMA2_constraint_eval (const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)

  static function used as the constraint function in the second-order Performance Measure Approach (PMA) problem formulation. This optimization problem performs the search for the most probable point (MPP) with the equality constraint of $\beta^* = \beta^*-\text{bar}$.

- static void PMA2_set_mapping (const Variables &recast_vars, const ActiveSet &recast_set, ActiveSet &sub_model_set)

  static function used to augment the sub-model ASV requests for second-order PMA

Private Attributes

- Real computedRespLevel

  output response level calculated

- Real computedRelLevel

  output reliability level calculated for RIA and 1st-order PMA

- Real computedGenRelLevel

  output generalized reliability level calculated for 2nd-order PMA

- RealVector fnGradX

  actual x-space gradient for current function from most recent response evaluation

- RealVector fnGradU

  u-space gradient for current function updated from fnGradX and Jacobian dx/du

- RealSymMatrix fnHessX

  actual x-space Hessian for current function from most recent response evaluation

- RealSymMatrix fnHessU

  u-space Hessian for current function updated from fnHessX and Jacobian dx/du
• RealVector kappaU
  principal curvatures derived from eigenvalues of orthonormal transformation of fnHessU
• RealVector fnValsMeanX
  response function values evaluated at mean x
• RealMatrix fnGradsMeanX
  response function gradients evaluated at mean x
• RealSymMatrixArray fnHessiansMeanX
  response function Hessians evaluated at mean x
• RealVector ranVarMeansX
  vector of means for all uncertain random variables in x-space
• RealVector ranVarStdDevsX
  vector of std deviations for all uncertain random variables in x-space
• RealVector ranVarMeansU
  vector of means for all uncertain random variables in u-space
• bool initialPtUserSpec
  flag indicating user specification of (any portion of) initialPtU
• RealVector initialPtUSpec
  user specification or default initial guess for local optimization
• RealVector initialPtU
  current starting point for MPP searches in u-space
• RealVector mostProbPointX
  location of MPP in x-space
• RealVector mostProbPointU
  location of MPP in u-space
• RealVectorArray prevMPPULev0
  array of converged MPP’s in u-space for level 0. Used for warm-starting initialPtU within RBDO.
• RealMatrix prevFnGradDLev0
  matrix of limit state sensitivities w.r.t. inactive/design variables for level 0. Used for warm-starting initialPtU within RBDO.
• RealMatrix prevFnGradULev0
  matrix of limit state sensitivities w.r.t. active/uncertain variables for level 0. Used for warm-starting initialPtU within RBDO.
• RealVector prevICVars
  previous design vector. Used for warm-starting initialPtU within RBDO.
• ShortArray prevCumASVLev0
  accumulation (using |) of all previous design ASV’s from requested finalStatistics. Used to detect availability of prevFnGradDLev0 data for warm-starting initialPtU within RBDO.
• bool npsolFlag
  flag representing the optimization MPP search algorithm selection (NPSOL SQP or OPT++ NIP)
• bool warmStartFlag
  flag indicating the use of warm starts
• bool nipModeOverrideFlag
  flag indicating the use of move overrides within OPT++ NIP
• bool curvatureDataAvailable
flag indicating that sufficient data (i.e., fnGradU, fnHessU, mostProbPointU) is available for computing principal curvatures

- `bool kappaUpdated`
  track when kappaU requires updating via principal_curvatures()

- `short integrationOrder`
  integration order (1 or 2) provided by integration specification

- `short secondOrderIntType`
  type of second-order integration: Breitung, Hohenbichler-Rackwitz, or Hong

- `Real curvatureThresh`
  cut-off value for 1/sqrt() term in second-order probability corrections.

- `short taylorOrder`
  order of Taylor series approximations (1 or 2) in MV/AMV/AMV+ derived from hessian type

- `RealMatrix impFactor`
  importance factors predicted by MV

- `int npsolDerivLevel`
  derivative level for NPSOL executions (1 = analytic grads of objective fn, 2 = analytic grads of constraints, 3 = analytic grads of both).

- `unsigned short warningBits`
  set of warnings accumulated during execution

### Static Private Attributes

- `static NonDLocalReliability * nondLocRelInstance`
  pointer to the active object instance used within the static evaluator functions in order to avoid the need for static data

### Additional Inherited Members

#### 13.112.1 Detailed Description

Class for the reliability methods within DAKOTA/UQ.

The `NonDLocalReliability` class implements the following reliability methods through the support of different limit state approximation and integration options: mean value (MVFSOM/MVFSOM), advanced mean value method (AMV, AMV^2) in x- or u-space, iterated advanced mean value method (AMV+, AMV^2+) in x- or u-space, two-point adaptive nonlinearity approximation (TANA) in x- or u-space, first order reliability method (FORM), and second order reliability method (SORM). All options except mean value employ an optimizer (currently NPSOL SQP or OPT++ NIP) to solve an equality-constrained optimization problem for the most probable point (MPP). The MPP search may be formulated as the reliability index approach (RIA) for mapping response levels to reliabilities/probabilities or as the performance measure approach (PMA) for performing the inverse mapping of reliability/probability levels to response levels.

#### 13.112.2 Member Function Documentation

```cpp
void RIA_objective_eval ( const Variables & sub_model_vars, const Variables & recast_vars, const Response & sub_model_response, Response & recast_response ) [static], [private]
```

static function used as the objective function in the Reliability Index Approach (RIA) problem formulation. This equality-constrained optimization problem performs the search for the most probable point (MPP) with the objective function of (norm u)^2.
This function recasts a G(u) response set (already transformed and approximated in other recursions) into an RIA objective function.

References Response::active_set_request_vector(), Variables::continuous_variables(), Response::function_gradient_view(), Response::function_hessian_view(), and Response::function_value().

Referenced by NonDLocalReliability::mpp_search().

```cpp
void RIA_constraint_eval ( const Variables & sub_model_vars, const Variables & recast_vars, const Response & sub_model_response, Response & recast_response ) [static], [private]
```

static function used as the constraint function in the Reliability Index Approach (RIA) problem formulation. This equality-constrained optimization problem performs the search for the most probable point (MPP) with the constraint of G(u) = response level.

This function recasts a G(u) response set (already transformed and approximated in other recursions) into an RIA equality constraint.

References Response::active_set_request_vector(), Response::function_gradient(), Response::function_gradient_view(), Response::function_hessian(), Response::function_value(), NonDLocalReliability::nondLocRelInstance, NonDReliability::requestedTargetLevel, and NonDReliability::respFnCount.

Referenced by NonDLocalReliability::mpp_search().

```cpp
void PMA_objective_eval ( const Variables & sub_model_vars, const Variables & recast_vars, const Response & sub_model_response, Response & recast_response ) [static], [private]
```

static function used as the objective function in the Performance Measure Approach (PMA) problem formulation. This equality-constrained optimization problem performs the search for the most probable point (MPP) with the objective function of G(u).

This function recasts a G(u) response set (already transformed and approximated in other recursions) into a PMA objective function.

References Response::active_set_request_vector(), Variables::continuous_variables(), NonDLocalReliability::curvatureDataAvailable, Response::function_gradient(), Response::function_gradient_view(), Response::function_hessian(), Response::function_hessian_view(), Response::function_value(), NonDLocalReliability::integrationOrder, NonDLocalReliability::kappaUpdated, NonDReliability::mppSearchType, NonDLocalReliability::nondLocRelInstance, NonDReliability::pmaMaximizeG, NonDReliability::respFnCount, and NonDLocalReliability::update_pma_maximize().

Referenced by NonDLocalReliability::mpp_search().

```cpp
void PMA_constraint_eval ( const Variables & sub_model_vars, const Variables & recast_vars, const Response & sub_model_response, Response & recast_response ) [static], [private]
```

static function used as the constraint function in the first-order Performance Measure Approach (PMA) problem formulation. This optimization problem performs the search for the most probable point (MPP) with the equality constraint of \((\|u\|_2)^2 = (\beta-bar)^2\).

This function recasts a G(u) response set (already transformed and approximated in other recursions) into a first-order PMA equality constraint on reliability index beta.

References Response::active_set_request_vector(), Variables::continuous_variables(), Response::function_gradient_view(), Response::function_hessian_view(), Response::function_value(), NonDLocalReliability::nondLocRelInstance, and NonDReliability::requestedTargetLevel.

Referenced by NonDLocalReliability::mpp_search().
void PMA2\_constraint\_eval ( const Variables & sub\_model\_vars, const Variables & recast\_vars, const Response & sub\_model\_response, Response & recast\_response ) [static], [private]

static function used as the constraint function in the second-order Performance Measure Approach (PMA) problem formulation. This optimization problem performs the search for the most probable point (MPP) with the equality constraint of $\beta^* = \beta^* - \text{bar}$.

This function recasts a $G(u)$ response set (already transformed and approximated in other recursions) into a second-order PMA equality constraint on generalized reliability index $\beta^*$.

References Dakota::abort\_handler(), Response::active\_set\_request\_vector(), NonD::cdfFlag, NonDLocalReliability::computedGenRelLevel, NonDLocalReliability::computedRelLevel, Variables::continuous\_variables(), NonDLocalReliability::dp2\_dbeta\_factor(), NonDLocalReliability::fnGradU, NonDLocalReliability::fnHessU, Response::function\_gradient\_view(), Response::function\_hessian(), Response::function\_value(), NonDLocalReliability::mostProbPoint\_U, NonDReliability::mppSearch\_Type, NonDLocalReliability::nonD\_Loc\_Rel\_Instance, NonDLocalReliability::probability(), NonDLocalReliability::reliability(), NonDReliability::requestedTarget\_Level, NonDReliability::respFnCount, and NonDLocalReliability::signed\_norm().

Referenced by NonDLocalReliability::mpp\_search().

void initial\_taylor\_series ( ) [private]

costum function for performing the initial limit state Taylor-series approximation

An initial first- or second-order Taylor-series approximation is required for MV/AMV/AMV+/TANA or for the case where momentStats (from MV) are required within finalStatistics for subIterator usage of NonDLocalReliability.

References Response::active\_set\_request\_vector(), Iterator::active\_Set, Model::component\_parallel\_mode(), Model::continuous\_variables(), Model::current\_response\_(), Model::evaluate\_(), NonD::finalStatistics, NonDLocalReliability::fnGradsMean\_X, NonDLocalReliability::fnHessiansMean\_X, NonDLocalReliability::fnVals\_Mean\_X, Response::function\_gradients\_(), Response::function\_hessians\_(), Response::function\_values\_(), Model::hessian\_type\_(), Iterator::iterated\_Model, NonD::momentStats, NonDReliability::mppSearch\_Type, NonD::natafTransform, Analyzer::num\_Functions, NonD::numUncertain\_Vars, NonDLocalReliability::fnGrads\_Mean\_X, NonDLocalReliability::fnHessians\_Mean\_X, NonDLocalReliability::fnVals\_Mean\_X, Active\_Set::request\_vector\_(), NonD::requestedGenRel\_Levels, NonD::requestedProb\_Levels, NonD::requestedRel\_Levels, NonD::requestedResp\_Levels, Iterator::subIterator\_Flag, NonDLocalReliability::taylor\_Order, and NonDReliability::uSpace\_Model.

Referenced by NonDLocalReliability::mean\_value\_(), and NonDLocalReliability::mpp\_search().

void initialize\_class\_data ( ) [private]

costum function for initializing class scope arrays

Initialize class-scope arrays and perform other start-up activities, such as evaluating median limit state responses.

References Response::active\_set\_derivative\_vector\_(), NonD::finalStatistics, NonDReliability::mpp\_Model, NonD::natafTransform, Analyzer::num\_Functions, NonDReliability::num\_Rel\_Analyses, NonD::numUncertain\_Vars, NonDLocalReliability::prevCum\_AS\_Level\_0, NonDLocalReliability::prevFnGrad\_D\_Level\_0, NonDLocalReliability::prevF\_Grad\_U\_Level\_0, NonDLocalReliability::prevMPP\_UL\_Level\_0, NonDLocalReliability::ranVar\_Means\_U, NonDLocalReliability::ranVar\_Means\_X, Iterator::subIterator\_Flag, Model::update\_from\_subordinate\_model\_(), and NonDLocalReliability::warmStart\_Flag.

Referenced by NonDLocalReliability::mpp\_search\_().

void initialize\_level\_data ( ) [private]

costum function for initializing/warm starting MPP search data for each response function prior to level 0
For a particular response function prior to the first z/p/beta level, initialize/warm-start optimizer initial guess (initialPtU), expansion point (mostProbPointX/U), and associated response data (computedRespLevel, fnGradX/U, and fnHessX/U).

References Iterator::activeSet, NonDLocalReliability::assign_mean_data(), Model::component_parallel_mode(), NonDLocalReliability::computedRespLevel, Model::continuous_variable_ids(), Model::continuous_variables(), Dakota::copy_data(), Model::current_response(), NonDLocalReliability::curvatureDataAvailable, Model::evaluate(), NonDLocalReliability::fnGradU, NonDLocalReliability::fnGradX, NonDLocalReliability::fnHessU, NonDLocalReliability::fnHessX, Response::function_gradient_copy(), Response::function_hessian(), Response::function_value(), Model::inactive_continuous_variables(), NonDLocalReliability::initialPtU, NonDLocalReliability::initialPtUSpec, Iterator::iteratedModel, NonDLocalReliability::kappaUpdated, NonDLocalReliability::mostProbPointU, NonDLocalReliability::mostProbPointX, NonDReliability::mppSearchType, NonD::natafTransform, NonDReliability::numRelAnalyses, NonD::numUncertainVars, NonDLocalReliability::prevCumASVLev0, NonDLocalReliability::prevFnGradDL0, NonDLocalReliability::prevFnGradUL0, NonDLocalReliability::prevICVars, NonDLocalReliability::prevMPUL0, ActiveSet::request_value(), ActiveSet::request_values(), NonD::requestedRespLevels, NonDReliability::respFnCount, Iterator::subIteratorFlag, Model::surrogate_function_indices(), NonDLocalReliability::taylorOrder, NonDLocalReliability::update_limit_state_surrogate(), NonDReliability::uSpaceModel, and NonDLocalReliability::warmStartFlag.

Referenced by NonDLocalReliability::mpp_search().

```cpp
void initialize_mpp_search_data() [private]
```

convenience function for initializing/warm starting MPP search data for each z/p/beta level for each response function

For a particular response function at a particular z/p/beta level, warm-start or reset the optimizer initial guess (initialPtU), expansion point (mostProbPointX/U), and associated response data (computedRespLevel, fnGradX/U, and fnHessX/U).

References NonDLocalReliability::assign_mean_data(), NonD::computedGenRelLevels, NonD::computedRelLevels, NonDLocalReliability::fnGradU, Model::hessian_type(), NonDLocalReliability::initialPtU, NonDLocalReliability::initialPtUSpec, NonDLocalReliability::integrationOrder, Iterator::iteratedModel, NonDReliability::levelCount, NonDLocalReliability::mostProbPointU, NonDReliability::mppSearchType, NonD::numUncertainVars, NonD::requestedProbLevels, NonD::requestedRelLevels, NonD::requestedRespLevels, NonDReliability::requestedTargetLevel, NonDReliability::respFnCount, NonDLocalReliability::taylorOrder, and NonDLocalReliability::warmStartFlag.

Referenced by NonDLocalReliability::mpp_search().

```cpp
void update_mpp_search_data ( const Variables & vars_star, const Response & resp_star ) [private]
```

convenience function for updating MPP search data for each z/p/beta level for each response function

Includes case-specific logic for updating MPP search data for the AMV/AMV+/TANA/NO_APPROX methods.

References Response::active_set(), Response::active_set_request_vector(), Iterator::activeSet, NonDReliability::approxConverged, NonDReliability::approxItrs, Model::component_parallel_mode(), NonDLocalReliability::computedRelLevel, NonDLocalReliability::computedRespLevel, Model::continuous_variable_ids(), Variables::continuous_variables(), Iterator::convergenceTol, Variables::copy(), Dakota::copy_data(), Model::current_response(), Model::current_variables(), NonDLocalReliability::curvatureDataAvailable, Dakota::data_pairs, Model::evaluate(), NonD::finalStatistics, NonDLocalReliability::fnGradU, NonDLocalReliability::fnGradX, NonDLocalReliability::fnHessU, NonDLocalReliability::fnHessX, Response::function_gradient_copy(), Response::function_hessian(), Response::function_value(), Response::function_values(), NonDLocalReliability::initialPtU, NonDLocalReliability::integrationOrder, Model::interface_id(), Iterator::iteratedModel, NonDLocalReliability::kappaUpdated, NonDLocalReliability::levelCount, Dakota::lookup_by_val(), Iterator::maxItrations, NonDLocalReliability::-
13.112. NONDLOCALRELIABILITY CLASS REFERENCE

::mostProbPointU, NonDLocalReliability::mostProbPointX, NonDReliability::mppSearchType, NonD::natafTransform, Analyzer::numFunctions, NonD::numNormalVars, NonD::numUncertainVars, NonDReliability::pmaMaximizeG, ActiveSet::request_value(), ActiveSet::request_values(), ActiveSet::request_vector(), NonD::requestedProbLevels, NonD::requestedRelLevels, NonD::requestedRespLevels, NonD::requestedGenRelLevels, NonD::numNormalVars, NonD::numUncertainVars, NonDReliability::respFnCount, NonDLocalReliability::signed_norm(), NonDReliability::statCount, NonDLocalReliability::taylorOrder, NonDLocalReliability::update_limit_state_surrogate(), NonDLocalReliability::update_pma_maximize(), NonDReliability::uSpaceModel, NonDLocalReliability::warmStartFlag, and NonDLocalReliability::warningBits.

Referenced by NonDLocalReliability::mpp_search().

void update_level_data ( ) [private]

convenience function for updating z/p/beta level data and final statistics following MPP convergence

Updates computedRespLevels/computedProbLevels/computedRelLevels, finalStatistics, warm start, and graphics data.

References Response::active_set_derivative_vector(), Response::active_set_request_vector(), Graphics::add_datapoint(), NonD::cdfFlag, NonDLocalReliability::computedGenRelLevel, NonD::computedGenRelLevels, NonD:: requestedProbLevels, NonDLocalReliability::computedRelLevel, NonD::computedRelLevels, NonD::computedRespLevels, NonDLocalReliability::dg_ds_eval(), NonDLocalReliability::dp2_dbeta_factor(), NonD::finalStatistics, NonDLocalReliability::fnGradU, NonDLocalReliability::fnGradX, NonDLocalReliability::fnHessU, Response::function_gradients(), OutputManager::graphics(), NonDLocalReliability::integrationOrder, NonDReliability::levelCount, NonDLocalReliability::mostProbPointU, NonDLocalReliability::mostProbPointX, Graphics::new_dataset(), Analyzer::numFunctions, NonD::numUncertainVars, ParallelLibrary::output_manager(), Iterator:: parallelLib, NonDLocalReliability::prevCumASVLev0, NonDLocalReliability::prevFnGradDLev0, NonDLocalReliability::prevFnGradULev0, NonDLocalReliability::prevMPPULev0, NonDLocalReliability::probability(), NonDLocalReliability::reliability(), NonD:: requestedGenRelLevels, NonD:: requestedProbLevels, NonD:: requestedRelLevels, NonD:: requestedRespLevels, NonD:: requestedGenRelLevels, NonD:: requestedProbLevels, NonD:: requestedRelLevels, NonD:: requestedRespLevels, NonD:: respLevelTarget, NonD:: respLevelTargetReduce, NonDReliability::statCount, Iterator::subIteratorFlag, NonD:: totalLevelRequests, and NonDLocalReliability::warmStartFlag.

Referenced by NonDLocalReliability::mpp_search().

void dg_ds_eval ( const RealVector & x_vars, const RealVector & fn_grad_x, RealVector & final_stat_grad ) [private]

convenience function for evaluating dg/ds

Computes dg/ds where s = design variables. Supports potentially overlapping cases of design variable augmentation and insertion.

References Response::active_set_derivative_vector(), Iterator::activeSet, Model::all_continuous_variable_ids(), Model::component_parallel_mode(), Dakota::contains(), Model::continuous_variable_ids(), Model::continuous_variable_ids(), Dakota::copy_data(), Model::current_response(), ActiveSet::derivative_vector(), Model::evaluate(), NonD::finalStatistics, Response::function_gradient_copy(), Response::function_gradients(), Model::inactive_continuous_variable_ids(), Iterator::iteratedModel, NonDReliability::mppSearchType, NonD::natafTransform, Iterator::primaryACVarMapIndices, ActiveSet::request_value(), ActiveSet::request_values(), NonDReliability::respFnCount, Iterator::secondaryACVarMapTargets, and NonDReliability::uSpaceModel.

Referenced by NonDLocalReliability::mean_value(), NonDLocalReliability::mpp_search(), and NonDLocalReliability::update_level_data().

Real dp2_dbeta_factor ( Real beta, bool cdf_flag ) [private]

compute factor for derivative of second-order probability with respect to reliability index (from differentiating BREITUNG or HOHENRACK expressions)
CHAPTER 13. CLASS DOCUMENTATION

Compute sensitivity of second-order probability w.r.t. beta for use in derivatives of p_2 or beta^+ w.r.t. auxilliary parameters s (design, epistemic) or derivatives of beta^+ w.r.t. u in PMA2_constraint_eval().

References Dakota::abort_handler(), NonDLocalReliability::curvatureDataAvailable, NonDLocalReliability::curvatureThresh, NonDLocalReliability::kappaU, NonD::numUncertainVars, NonDLocalReliability::probability(), NonDLocalReliability::scale_curvature(), NonDLocalReliability::secondOrderIntType, and NonDLocalReliability::warningBits.

Referenced by NonDLocalReliability::PMA2_constraint_eval(), and NonDLocalReliability::update_level_data().

Real probability ( Real beta, bool cdf_flag, const RealVector & mpp_u, const RealVector & fn_grad_u, const RealSymMatrix & fn_hess_u ) [private]

Convert provided reliability to probability using either a first-order or second-order integration.

Converts beta into a probability using either first-order (FORM) or second-order (SORM) integration. The SORM calculation first calculates the principal curvatures at the MPP (using the approach in Ch. 8 of Haldar & Mahadevan), and then applies correction formulations from the literature (Breitung, Hohenbichler-Rackwitz, or Hong).

References NonDLocalReliability::curvatureDataAvailable, NonDLocalReliability::curvatureThresh, NonDAdaptImpSampling::final_probability(), NonDReliability::importanceSampler, NonDLocalReliability::integrationOrder, NonDReliability::integrationRefinement, Iterator::iterator_rep(), NonDLocalReliability::kappaU, NonDLocalReliability::kappaUpdated, NonDLocalReliability::levelCount, Iterator::methodPCIter, NonD::miPLIndex, NonD::numUncertainVars, Iterator::outputLevel, NonDLocalReliability::principal_curvatures(), NonDLocalReliability::probability(), NonD::requestedRespLevels, NonDReliability::requestedTargetLevel, NonDReliability::respFnCount, Iterator::run(), NonDLocalReliability::scale_curvature(), NonDLocalReliability::secondOrderIntType, NonDLocalReliability::warningBits, and Dakota::write_precision.

The documentation for this class was generated from the following files:

- NonDLocalReliability.hpp
- NonDLocalReliability.cpp

13.113 NonDLocalSingleInterval Class Reference

Class for using local gradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.

Inheritance diagram for NonDLocalSingleInterval:

```
Iterator
   |
   Analyzer
   |
   NonD
   |
   NonDInterval
   |
   NonDLocalInterval
   |
   NonDLocalSingleInterval
```
Public Member Functions

- NonDLocalSingleInterval (ProblemDescDB &problem_db, Model &model)
  constructor
- ~NonDLocalSingleInterval ()
  destructor

Protected Member Functions

- void initialize ()
  perform any required initialization
- void post_process_cell_results (bool maximize)
  post-process a cell minimization/maximization result

Private Attributes

- size_t statCntr
  counter for finalStatistics

Additional Inherited Members

13.113.1 Detailed Description

Class for using local gradient-based optimization approaches to calculate interval bounds for epistemic uncertainty quantification.

The NonDLocalSingleInterval class supports local gradient-based optimization approaches to determining interval bounds for epistemic UQ. The interval bounds may be on the entire function in the case of pure interval analysis (e.g. intervals on input = intervals on output), or the intervals may be on statistics of an "inner loop" aleatory analysis such as intervals on means, variances, or percentile levels.

The documentation for this class was generated from the following files:

- NonDLocalSingleInterval.hpp
- NonDLocalSingleInterval.cpp

13.114 NonDMultilevelSampling Class Reference

Performs Multilevel Monte Carlo sampling for uncertainty quantification.

Inheritance diagram for NonDMultilevelSampling:
CHAPTER 13. CLASS DOCUMENTATION

---

Public Member Functions

- **NonDMultilevelSampling** (ProblemDescDB &problem_db, Model &model)
  - *standard constructor*
- **~NonDMultilevelSampling** ()
  - *destructor*
- **bool resize** ()
  - *reinitializes iterator based on new variable size*

Protected Member Functions

- **void pre_run** ()
  - *pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori*
- **void core_run** ()
- **void post_run** (std::ostream &s)
  - *post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way*
- **void print_results** (std::ostream &s)
  - *print the final iterator results*

Private Member Functions

- **void multilevel_mc** (size_t model_form)
  - *Perform multilevel Monte Carlo across the discretization levels for a particular model form.*
- **void control_variate_mc** (const SizetSizetPair &lf_form_level, const SizetSizetPair &hf_form_level)
  - *Perform control variate Monte Carlo across two model forms.*
- **void multilevel_control_variate_mc** (size_t lf_model_form, size_t hf_model_form)
  - *Perform multilevel Monte Carlo across levels in combination with control variate Monte Carlo across model forms at each level.*
- **void shared_increment** (size_t iter, const SizetSizetPair &lf_form_level, const SizetSizetPair &hf_form_level)
  - *perform a shared increment of LF and HF samples for purposes of computing/updating the evaluation ratio and the MSE ratio*
- **bool lf_increment** (Real avg_eval_ratio, size_t N_hf, size_t &delta_Nlf, size_t &Nlf)
  perform final LF sample increment as indicated by the evaluation ratio
- **void initialize_ml_sums** (IntRealMatrixMap &sum_Y, size_t numlev)
  initialize the CV bookkeeping for sums, means, variances, and covariances across fidelity levels
  initialize the CV bookkeeping for sums, means, variances, and covariances across fidelity levels
- **void initialize_cv_sums_moments** (IntRealMatrixMap &sum_L_shared, IntRealMatrixMap &sum_L_refined, IntRealMatrixMap &sum_LL, IntRealMatrixMap &sum_LH, size_t numlev)
  initialize the CV bookkeeping for sums, means, variances, and covariances across fidelity levels
- **void accumulate_cv_sums** (IntRealVectorMap &sum_map)
  update running sums for one model (sum_map) using set of model evaluations within allResponses
  update running sums for two models (sum_L, sum_H, and sum_LH) from set of low/high fidelity model evaluations within allResponses
- **void accumulate_cv_sums** (IntRealMatrixMap &sum_map, size_t lev)
  update running sums for one model (sum_map) using set of model evaluations within allResponses
  update running sums for two models (sum_L, sum_H, and sum_LH) from set of low/high fidelity model evaluations within lf/hf resp map
- **void accumulate_ml_sums** (IntRealMatrixMap &sum_Y, IntMatrix &sum YY, size_t lev)
  update accumulators for multilevel telescoping running sums using set of model evaluations within allResponses
- **Real eval_ratio** (const RealVector &sum_L_shared, const RealVector &sum_H, const RealVector &sum_HH, const RealVector &sum_LH, Real cost_ratio, RealVector &var_H, RealVector &rho2_LH, size_t N_shared)
  compute the LF/HF evaluation ratio, averaged over the QoI
- **Real eval_ratio** (RealMatrix &sum_L_shared, RealMatrix &sum_H, RealMatrix &sum_LL, RealMatrix &sum_LH, Real cost_ratio, size_t lev, RealMatrix &var_H, RealMatrix &rho2_LH, size_t N_shared)
  compute the LF/HF evaluation ratio, averaged over the QoI
- **Real MSE_ratio** (Real avg_eval_ratio, const RealVector &var_H, const RealVector &rho2_LH, size_t iter, size_t N_hf)
  compute ratio of MC and CVMC mean squared errors, averaged over the QoI
- **void cv_raw_moments** (IntRealVectorMap &sum_L_shared, IntRealVectorMap &sum_L_refined, IntRealVectorMap &sum_H, IntRealVectorMap &sum_LL, IntRealVectorMap &sum_LH, const RealVector &rho2_LH, size_t N_shared, size_t N_refined, RealMatrix &H_raw_mom)
  compute control variate parameter and estimate raw moments
  compute control variate parameter and estimate raw moments
• Real **average** (const RealVector &vec) const
  compute average of a set of observations
• Real **average** (const Real *vec, size_t vec_len) const
  compute average of a set of observations
• void **convert_moments** (const RealMatrix &raw_moments, RealMatrix &standard_moments)
  convert uncentered raw moments (multilevel expectations) to standardized moments

**Private Attributes**

• Sizet2DArray **NLev**
  total number of samples performed per model form, per discretization level, or both
• Sizet2DArray **deltaNLev**
  increment in number of samples required for each model form, discretization level, or both
• RealVector **mcMSEIter0**
  mean squared error of mean estimator from pilot sample MC on HF model
• Real **equivHFEvals**
  equivalent number of high fidelity evaluations accumulated using samples across multiple model forms and/or discretization levels

**Additional Inherited Members**

13.114.1 **Detailed Description**

Performs Multilevel Monte Carlo sampling for uncertainty quantification.

Multilevel Monte Carlo (MLMC) is a variance-reduction technique that utilizes lower fidelity simulations that have response QoI that are correlated with the high-fidelity response QoI.

13.114.2 **Constructor & Destructor Documentation**

NonDMultilevelSampling ( ProblemDescDB & problem_db, Model & model )

standard constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification.

References Dakota::abort_handler(), Dakota::copy_data_partial(), NonDMultilevelSampling::deltaNLev, ProblemDescDB::get_sza(), Iterator::iteratedModel, Iterator::maxEvalConcurrency, NonDMultilevelSampling::NLev, Iterator::probDescDB, NonDSampling::sampleType, Model::solution_levels(), Model::subordinate_models(), Model::surrogate_model(), Model::surrogate_response_mode(), Model::surrogate_type(), and Model::truth_model().

13.114.3 **Member Function Documentation**

void **pre_run** ( ) [protected], [virtual]

pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori

pre-run phase, which a derived iterator may optionally reimplement; when not present, pre-run is likely integrated into the derived run function. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s **pre_run()**, if implemented, typically before performing its own implementation steps.

Reimplemented from Analyzer.

References Analyzer::pre_run().
void core_run( ) [protected], [virtual]

The primary run function manages the general case: a hierarchy of model forms (from the ordered model fidelities within a HierarchSurrModel), each of which may contain multiple discretization levels.

Reimplemented from Iterator.

References NonDMultilevelSampling::control_variate_mc(), NonDMultilevelSampling::multilevel_control_variate_mc(), NonDMultilevelSampling::multilevel_mc(), and NonDMultilevelSampling::NLev.

void post_run ( std::ostream & s ) [protected], [virtual]

post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way

Post-run phase, which a derived iterator may optionally reimplement; when not present, post-run is likely integrated into run. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s post_run(), typically after performing its own implementation steps.

Reimplemented from Analyzer.

References Analyzer::post_run().

void print_results ( std::ostream & s ) [protected], [virtual]

print the final iterator results

This virtual function provides additional iterator-specific final results outputs beyond the function evaluation summary printed in finalize_run().

Reimplemented from Analyzer.

References NonDMultilevelSampling::equivHFEvals, Iterator::iteratedModel, NonDMultilevelSampling::NLev, NonDSampling::print_moments(), Model::response_labels(), NonDSampling::statsFlag, and Model::truth_model().

void multilevel_mc ( size_t model_form ) [private]

Perform multilevel Monte Carlo across the discretization levels for a particular model form.

This function performs ”geometrical” MLMC on a single model form with multiple discretization levels.

References NonDMultilevelSampling::accumulate_ml_sums(), Iterator::convergenceTol, NonDMultilevelSampling::convert_moments(), NonDMultilevelSampling::deltaNLev, NonDMultilevelSampling::equivHFEvals, Analyzer::evaluate_parameter_sets(), NonDSampling::get_parameter_sets(), NonDMultilevelSampling::initialize_ml_sums(), Iterator::iteratedModel, Iterator::maxIterations, NonD::momentStats, NonDMultilevelSampling::NLev, Analyzer::numFunctions, NonDSampling::numSamples, Iterator::outputLevel, Model::solution_level_cost(), Model::solution_levels(), Model::surrogate_model_indices(), Model::surrogate_response_mode(), Model::truth_model(), and Model::truth_model_indices().

Referenced by NonDMultilevelSampling::core_run().

void control_variate_mc ( const SizetSizetPair & lf_form_level, const SizetSizetPair & hf_form_level ) [private]

Perform control variate Monte Carlo across two model forms.

This function performs control variate MC on multiple model forms using a single discretization level.

References NonDMultilevelSampling::accumulate_cv_sums(), Iterator::convergenceTol, NonDMultilevelSampling::convert_moments(), NonDMultilevelSampling::cv_raw_moments(), NonDMultilevelSampling::deltaNLev, NonDMultilevelSampling::equivHFEvals, NonDMultilevelSampling::eval_ratio(), NonDMultilevelSampling::initialize_cv_sums_moments(), Iterator::iteratedModel, NonDMultilevelSampling::lf_increment(), Iterator::maxIterations,
NonD::momentStats, NonDMultilevelSampling::MSE_ratio(), NonDMultilevelSampling::NLev, Analyzer::numFunctions, NonDSampling::numSamples, NonDMultilevelSampling::shared_increment(), Model::solution_level_cost(), Model::surrogate_model(), Model::surrogate_model_indices(), Model::surrogate_response_mode(), Model::truth_model(), and Model::truth_model_indices.

Referenced by NonDMultilevelSampling::core_run().

```cpp
void multilevel_control_variate_mc ( size_t lf_model_form, size_t hf_model_form ) [private]
```

Perform multilevel Monte Carlo across levels in combination with control variate Monte Carlo across model forms at each level.

This function performs "geometrical" MLMC across discretization levels for the high fidelity model form where the discrepancy at each level employs CVMC across two model forms.

References NonDMultilevelSampling::accumulate_cv sums(), NonDMultilevelSampling::accumulate_ml sums(), Analyzer::allResponses, NonDMultilevelSampling::average(), Iterator::convergenceTol, NonDMultilevelSampling::convert_moments(), NonDMultilevelSampling::cv_raw moments(), NonDMultilevelSampling::deltaNLev, NonDMultilevelSampling::equivHFEvals, NonDMultilevelSampling::eval_ratio(), Analyzer::evaluate parameter sets(), NonDSampling::get parameter sets(), NonDMultilevelSampling::initialize_cv sums moments(), NonDMultilevelSampling::initialize_ml sums(), Iterator::iteratedModel, NonDMultilevelSampling::lf increment(), Iterator::maxIterations, NonD::momentStats, NonDMultilevelSampling::NLev, Analyzer::numFunctions, NonDSampling::numSamples, Iterator::outputLevel, Model::solution_level_cost(), Model::solution_levels(), Model::surrogate_model(), Model::surrogate_model_indices(), Model::surrogate_response_mode(), Model::truth_model(), and Model::truth_model_indices().

Referenced by NonDMultilevelSampling::core_run().

The documentation for this class was generated from the following files:

- NonDMultilevelSampling.hpp
- NonDMultilevelSampling.cpp

13.115 NonDPOFDarts Class Reference

Base class for POF Dart methods within DAKOTA/UQ.

Inheritance diagram for NonDPOFDarts:

```
    +------------------+
    |     Iterator     |
    |                 |
    v                 v
    +------------------+
    |      Analyzer    |
    |                 |
    v                 v
    +------------------+
    |        NonD      |
    |                 |
    v                 v
    +------------------+
    | NonDPOFDarts     |
```

Public Member Functions

- NonDPOFDarts (ProblemDescDB &problem_db, Model &model)

  constructor

- ~NonDPOFDarts ()
13.115. NONDPOFDARTS CLASS REFERENCE

**Destructor**

- `bool resize ()`

  reinitializes iterator based on new variable size

- `void core_run ()`

  perform POFDart analysis and return probability of failure

**Protected Member Functions**

- `void initiate_random_number_generator` (unsigned long x)

  *POF Darts Methods.*

- `double generate_a_random_number ()`

- `void init_pof_darts ()`

- `void exit_pof_darts ()`

- `void execute (size_t kd)`

- `void print_results (std::ostream &s)`

  print the final statistics

- `void classical_dart_throwing_games (size_t game_index)`

- `void line_dart_throwing_games (size_t game_index)`

- `bool valid_dart (double *x)`

- `bool valid_line_flat (size_t flat_dim, double *flat_dart)`

- `void add_point (double *x)`

- `void compute_response (double *x)`

- `void verify_neighbor_consistency ()`

- `bool add_neighbor (size_t ipoint, size_t ineighbor)`

- `void retrieve_neighbors (size_t ipoint, bool update_point_neighbors)`

- `void sample_furthest_vertex (size_t ipoint, double *fv)`

- `void update_global_L ()`

- `void assign_sphere_radius_POF (size_t isample)`

- `void shrink_big_spheres ()`

- `double area_triangle (double x1, double y1, double x2, double y2, double x3, double y3)`

- `void initialize_surrogates ()`

- `void add_surrogate_data` (const Variables &vars, const Response &resp)

- `void build_surrogate ()`

- `double eval_surrogate (size_t fn_index, double *vin)`

- `void estimate_pof_surrogate ()`

- `bool trim_line_using_Hyperplane (size_t num_dim, double *st, double *end, double *qH, double *nH)`

- `double f_true (double *x)`

- `void plot_vertices_2d (bool plot_true_function, bool plot_surrogate)`

- `void plot_neighbors ()`
Protected Attributes

- `int samples`
- `int seed`
- `int emulatorSamples`
- `String lipschitzType`
- `RealRealPairArray extremeValues`
- `double Q[1220]`
- `int indx`
- `double cc`
- `double c`
- `double xc`
- `double zc`
- `double zx`
- `double zy`
- `size_t qlen`
- `bool _eval_error`
- `size_t _test_function`
- `size_t _ndim`
- `double * _xmin`
- `double * _xmax`
- `double _diag`
- `double _failure_threshold`
- `double _num_darts`
- `double _num_successive_misses_p`
- `double _num_successive_misses_m`
- `double _max_num_successive_misses`
- `double _accepted_void_ratio`
- `size_t _num_inserted_points`
- `size_t _total_budget`
- `double ** _sample_points`
- `size_t ** _sample_neighbors`
- `double * _sample_vsize`
- `double _max_vsize`
- `double * _dart`
- `size_t _flat_dim`
- `size_t * _line_flat`
- `size_t _num_flat_segments`
- `double * _line_flat_start`
- `double * _line_flat_end`
- `double * _line_flat_length`
- `double _safety_factor`
- `double * _Lip`
- `double ** _fval`
- `size_t _active_response_function`
- `bool _use_local_L`
Additional Inherited Members

13.115.1 Detailed Description

Base class for POF Dart methods within DAKOTA/UQ.

The NonDPOFDart class implements the calculation of a failure probability for a specified threshold for a specified response function using the concepts developed by Mohamed Ebeida. The approach works by throwing down a number of Poisson disk samples of varying radii, and identifying each disk as either in the failure or safe region. The center of each disk represents a “true” function evaluation. kd-darts are used to place additional points, in such a way to target the failure region. When the disks cover the space sufficiently, Monte Carlo methods or a box volume approach is used to calculate both the lower and upper bounds on the failure probability.

The documentation for this class was generated from the following files:

- NonDPOFDarts.hpp
- NonDPOFDarts.cpp

13.116 NonDPolynomialChaos Class Reference

Nonintrusive polynomial chaos expansion approaches to uncertainty quantification.

Inheritance diagram for NonDPolynomialChaos:

```
NonDPolynomialChaos
    |         
    v         
NonDExpansion
    |         
    v         
Analyzer
    |         
    v         
Iterator
    |         
    v         
NonDPolynomialChaos
```

Public Member Functions

- **NonDPolynomialChaos (ProblemDescDB &problem_db, Model &model)**
  *standard constructor*

- **NonDPolynomialChaos (Model &model, short exp_coeffs_approach, const UShortArray &num_int_seq, const RealVector &dim_pref, short u_space_type, bool piecewise_basis, bool use_derivs)**
  *alternate constructor for numerical integration (tensor, sparse, cubature)*

- **NonDPolynomialChaos (Model &model, short exp_coeffs_approach, const UShortArray &exp_order_seq, const RealVector &dim_pref, const SizetArray &colloc_pts_seq, Real colloc_ratio, int seed, short u_space_type, bool piecewise_basis, bool use_derivs, bool cv_flag, const String &import_build_points_file, unsigned short import_build_format, bool import_build_active_only)**
  *alternate constructor for regression (least squares, CS, OLI)*

- **~NonDPolynomialChaos ()**
  *destructor*
• bool resize ()
  
  reinitializes iterator based on new variable size

Protected Member Functions

• void derived_init_communicators (ParLevLIter pl_iter)
  
  derived class contributions to initializing the communicators associated with this Iterator instance

• void derived_set_communicators (ParLevLIter pl_iter)
  
  derived class contributions to setting the communicators associated with this Iterator instance

• void derived_free_communicators (ParLevLIter pl_iter)
  
  derived class contributions to freeing the communicators associated with this Iterator instance

• void resolve_inputs (short &u_space_type, short &data_order)
  
  perform error checks and mode overrides

• void initialize_u_space_model ()
  
  initialize uSpaceModel polynomial approximations with PCE/SC data

• void increment_specification_sequence ()
  
  increment the input specification sequence (PCE only)

• void compute_expansion ()
  
  form or import an orthogonal polynomial expansion using PCE methods

• void multifidelity_expansion ()
  
  construct a multifidelity expansion, across model forms or discretization levels

• void select_refinement_points (const RealVectorArray &candidate_samples, unsigned short batch_size, RealMatrix &best_samples)
  
  evaluate allSamples for inclusion in the (PCE regression) approximation and retain the best set (well spaced) of size batch_size

• void select_refinement_points Deprecated (const RealVectorArray &candidate_samples, unsigned short batch_size, RealMatrix &best_samples)

• void append_expansion (const RealMatrix &samples, const IntResponseMap &resp_map)
  
  append new data to uSpaceModel and update expansion order (PCE only)

• void increment_order_and_grid ()

• void print_coefficients (std::ostream &s)
  
  print the PCE coefficient array for the orthogonal basis

• void archive_coefficients ()
  
  archive the PCE coefficient array for the orthogonal basis

• void multilevel_regression (size_t model_form)
  
  special case of multifidelity_expansion() for multilevel allocation of samples, mirroring NonDMultilevelSampling for least sq/compressed sensing

• void increment_sample_sequence (size_t new_samp, size_t total_samp)
  
  increment the sequence in numSamplesOnModel for multilevel_regression()

• void append_expansion ()
  
  generate new samples from numSamplesOnModel and update expansion
Private Member Functions

- void increment_grid_from_order ()
  define a grid increment that is consistent with an advancement in expansion order
- void increment_order_from_grid ()
  define an expansion order that is consistent with an advancement in structured/unstructured grid level/density
- int terms_ratio_to_samples (size_t num_exp_terms, Real colloc_ratio)
  convert number of expansion terms and collocation ratio to a number of collocation samples
- Real terms_samples_to_ratio (size_t num_exp_terms, int samples)
  convert number of expansion terms and number of collocation samples to a collocation ratio
- void ratio_samples_to_order (Real colloc_ratio, int num_samples, UShortArray &exp_order, bool less_than_or_equal)
  convert collocation ratio and number of samples to expansion order
- void order_to_dim_preference (const UShortArray &order, unsigned short &p, RealVector &dim_pref)
  convert an isotropic/anisotropic expansion order vector into a scalar plus a dimension preference vector

Private Attributes

- String expansionExportFile
  filename for export of chaos coefficients
- String expansionImportFile
  filename for import of chaos coefficients
- Real collocRatio
  factor applied to terms^termsOrder in computing number of regression points, either user specified or inferred
- Real termsOrder
  exponent applied to number of expansion terms for computing number of regression points
- int randomSeed
  seed for random number generator used for regression with LHS and sub-sampled tensor grids
- bool tensorRegression
  option for regression PCE using a filtered set tensor-product points
- bool crossValidation
  flag for use of cross-validation for selection of parameter settings in regression approaches
- bool crossValidNoiseOnly
  flag to restrict cross-validation to only estimate the noise tolerance in order to manage computational cost
- RealVector noiseTols
  noise tolerance for compressive sensing algorithms; vector form used in cross-validation
- Real l2Penalty
  L2 penalty for LASSO algorithm (elastic net variant)
- unsigned short numAdvance
  number of frontier expansions per iteration with the ADAPTED BASIS EXPANDING FRONT approach
- UShortArray expOrderSeqSpec
  user specification for expansion_order (array for multifidelity)
- RealVector dimPrefSpec
  user specification for dimension_preference
• SizetArray **collocPtsSeqSpec**  
  *user specification for collocation points (array for multifidelity)*

• SizetArray **expSamplesSeqSpec**  
  *user specification for expansion samples (array for multifidelity)*

• size_t **sequenceIndex**  
  *sequence index for \{expOrder, collocPts, expSamples\}SeqSpec*

• RealMatrix **pceGradsMeanX**  
  *derivative of the PCE with respect to the x-space variables evaluated at the means (used as uncertainty importance metrics)*

• bool **normalizedCoeffOutput**  
  *user request for use of normalization when outputting PCE coefficients*

• short **uSpaceType**  
  *user requested expansion type*

• UShortArray **quadOrderSeqSpec**  
  *user request of quadrature order*

• UShortArray **ssgLevelSeqSpec**  
  *user request of sparse grid level*

• unsigned short **cubIntSpec**  
  *cubature integrand*

• String **importBuildPointsFile**  
  *user specified import approx. points file*

• unsigned short **importBuildFormat**  
  *user specified import file format*

• bool **importBuildActiveOnly**  
  *user specified import build active only*

• bool **resizedFlag**  
  *local flag to signal a resizing occurred*

• bool **callResize**  
  *local flag to signal an explicit call to resize is necessary if resizedFlag is false*

**Additional Inherited Members**

**13.116.1 Detailed Description**

Nonintrusive polynomial chaos expansion approaches to uncertainty quantification. 

The NonDPolynomialChaos class uses a polynomial chaos expansion (PCE) approach to approximate the effect of parameter uncertainties on response functions of interest. It utilizes the OrthogPolyApproximation class to manage multiple types of orthogonal polynomials within a Wiener-Askey scheme to PCE. It supports PCE coefficient estimation via sampling, quadrature, point-collocation, and file import.
13.116.2 Constructor & Destructor Documentation

NonDPolynomialChaos ( ProblemDescDB & problem_db, Model & model )

standard constructor

This constructor is called for a standard letter-envelope iterator instantiation using the ProblemDescDB.

References Dakota::abort_handler(), Response::active_set(), NonDIntegration::anisotropic_order_to_dimension_preference(), Model::assign_rep(), NonExpansion::check_dimension_preference(), NonDPolynomialChaos::collocPtsSeqSpec, NonDPolynomialChaos::collocRatio, ParallelLibrary::command_line_check(), NonExpansion::construct_cubature(), NonExpansion::construct_expansion_sampler(), NonD::construct_lhs(), NonExpansion::construct_quadrature(), NonDPolynomialChaos::cubIntSpec, Model::current_response(), NonDIntegration::dimension_preference_to_anisotropic_order(), NonDPolynomialChaos::dimPrefSpec, NonExpansion::expansionBasisType, NonExpansion::expansionCoeffsApproach, NonDPolynomialChaos::importBuildActiveOnly, NonD::transform_model(), NonDExpansion::uSpaceModel, and Analyzer::vary_pattern().

NonDPolynomialChaos ( Model & model, short exp_coeffs_approach, const UShortArray & num_int_seq, const RealVector & dim_pref, short u_space_type, bool piecewise_basis, bool use_derivs )

alternate constructor for numerical integration (tensor, sparse, cubature)

This constructor is used for helper iterator instantiation on the fly that employ numerical integration (quadrature, sparse grid, cubature).

References Response::active_set(), Model::assign_rep(), NonExpansion::check_dimension_preference(), NonExpansion::construct_cubature(), NonExpansion::construct_quadrature(), NonExpansion::construct_sparse_grid(), Model::current_response(), NonDPolynomialChaos::dimPrefSpec, NonExpansion::expansionCoeffsApproach, NonExpansion::initialize(), NonDPolynomialChaos::initialize_u_space_model(), Iterator::iteratedModel, Iterator::maxEvalConcurrency, Analyzer::numContinuousVars, NonExpansion::numSamplesOnModel, Iterator::outputLevel, Iterator::parallelLib, Iterator::probDescDB, NonDPolynomialChaos::quadOrderSeqSpec, NonDPolynomialChaos::randomSeed, NonExpansion::refineControl, NonExpansion::refineType, ActiveSet::request_values(), NonDPolynomialChaos::resolve_inputs(), NonDPolynomialChaos::sequenceIndex, NonDPolynomialChaos::ssgLevelSeqSpec, NonDPolynomialChaos::tensorRegression, NonDPolynomialChaos::terms_ratio_to_samples(), NonDPolynomialChaos::terms_samples_to_ratio(), NonDPolynomialChaos::termsOrder, NonD::transform_model(), NonExpansion::uSpaceModel, and Analyzer::vary_pattern().

NonDPolynomialChaos ( Model & model, short exp_coeffs_approach, const UShortArray & exp_order_seq, const RealVector & dim_pref, const SizetArray & colloc_pts_seq, Real colloc_ratio, int seed, short u_space_type, bool piecewise_basis, bool use_derivs, bool cv_flag, const String & import_build_points_file, unsigned short import_build_format, bool import_build_active_only )

alternate constructor for regression (least squares, CS, OLI)

This constructor is used for helper iterator instantiation on the fly that employ regression (least squares, CS, OLI).

References Response::active_set(), Model::assign_rep(), NonExpansion::check_dimension_preference(), NonDPolynomialChaos::collocPtsSeqSpec, NonDPolynomialChaos::collocRatio, NonD::construct_lhs(), NonExpansion::construct_quadrature(), Model::current_response(), NonDIntegration::dimension_preference_to_anisotropic_order(),
13.116.3 Member Function Documentation

void increment specification sequence ( ) [protected], [virtual]
increment the input specification sequence (PCE only)
default implementation is overridden by PCE
Reimplemented from NonDExpansion.
References NonDPolynomialChaos::collocPtsSeqSpec, NonDPolynomialChaos::collocRatio, SharedApproxData::data_rep(), NonDIntegration::dimension_preference_to_anisotropic_order(), NonDPolynomialChaos::dimPrefSpec, SharedPecosApproxData::expansion_order(), NonDExpansion::expansionBasisType, NonDExpansion::expansionCoeffsApproach, NonDPolynomialChaos::expOrderSeqSpec, NonDPolynomialChaos::expSamplesSeqSpec, NonDExpansion::increment specification sequence(), Iterator::iterator_rep(), NonDQuadrature::mode(), Model::model_rep(), Analyzer::numContinuousVars, NonDExpansion::numSamplesOnModel, NonDQuadrature::quadrature order(), NonDQuadrature::samples(), Iterator::sampling_reference(), NonDPolynomialChaos::sequenceIndex, Model::shared_approximation(), Model::subordinate_iterator(), NonDPolynomialChaos::tensorRegression, NonDPolynomialChaos::terms_ratio_to_samples(), DataFitSurrModel::total_points(), NonDQuadrature::update(), and NonDExpansion::uSpaceModel.

void increment order and grid ( ) [protected], [virtual]
Used for uniform refinement of regression-based PCE.
Reimplemented from NonDExpansion.
References SharedApproxData::data_rep(), NonDPolynomialChaos::increment_grid_from_order(), SharedPecosApproxData::increment_order(), Model::shared_approximation(), and NonDExpansion::uSpaceModel.

void increment grid from order ( ) [private]
define a grid increment that is consistent with an advancement in expansion order
Used for uniform refinement of regression-based PCE.
References NonDPolynomialChaos::collocRatio, SharedApproxData::data_rep(), SharedPecosApproxData::expansion_order(), NonDExpansion::expansionBasisType, NonDQuadrature::increment_grid(), Iterator::iterator_rep(), NonDQuadrature::mode(), Model::model_rep(), NonDExpansion::numSamplesOnModel, NonDQuadrature::samples(), Iterator::sampling_reference(), Model::shared_approximation(), Model::subordinate_iterator(), NonDPolynomialChaos::tensorRegression, NonDPolynomialChaos::terms_ratio_to_samples(), DataFitSurrModel::total_points(), NonDQuadrature::update(), and NonDExpansion::uSpaceModel.
Referenced by NonDPolynomialChaos::increment order and grid().

void increment order from grid ( ) [private]
define an expansion order that is consistent with an advancement in structured/unstructured grid level/density
Used for uniform refinement of regression-based PCE.
References NonDPolynomialChaos::collocRatio, SharedApproxData::data_rep(), SharedPecosApproxData::expansion_order(), NonDExpansion::numSamplesOnModel, NonDPolynomialChaos::ratio_samples_to_order(), Model::shared_approximation(), and NonDExpansion::uSpaceModel.
13.117 NonDQuadrature Class Reference

Derived nondeterministic class that generates N-dimensional numerical quadrature points for evaluation of expectation integrals over uncorrelated standard normals/uniforms/exponentials/betas/gammas.

Inheritance diagram for NonDQuadrature:

```
NonDQuadrature
    NonDIntegration
        NonD
            NonDAnalyzer
                Iterator
```

Public Member Functions

- **NonDQuadrature** (Model &model, const UShortArray &quad_order_seq, const RealVector &dim_pref, short driver_mode)
  
  alternate constructor for instantiations "on the fly" based on a quadrature order specification
- **NonDQuadrature** (Model &model, int num_filt_samples, const RealVector &dim_pref, short driver_mode)
  
  alternate constructor for instantiations "on the fly" that generate a filtered tensor product sample set
- **NonDQuadrature** (Model &model, int num_rand_samples, int seed, const UShortArray &quad_order_seq, const RealVector &dim_pref, short driver_mode)
  
  alternate constructor for instantiations "on the fly" that sample randomly from a tensor product multi-index
- void increment_grid ()
  
  increment SSG level/TPQ order
- void update ()
  
  propagate any numSamples updates and/or grid updates/increments
- const Pecos::UShortArray & quadrature_order () const
  
  return Pecos::TensorProductDriver::quadOrder
- void quadrature_order (const Pecos::UShortArray &dim_quad_order)
  
  set dimQuadOrderRef and map to Pecos::TensorProductDriver::quadOrder
- void samples (size_t samples)
  
  set numSamples
- short mode () const
  
  return quadMode
Protected Member Functions

- **NonDQuadrature** (ProblemDescDB &prob_db, Model &model)
  - constructor
- ~**NonDQuadrature** ()
  - destructor
- void **initialize_grid** (const std::vector<Pecos::BasisPolynomial> &poly_basis)
  - Returns one block of samples (ndim * num_samples)
- void **reset** ()
  - restore initial state for repeated sub-iterator executions
- void **sampling_reset** (int min_samples, bool all_data_flag, bool stats_flag)
- void **increment_grid_preference** (const RealVector &dim_pref)
  - increment SSG level/TPQ order and update anisotropy
- void **increment_specification_sequence** ()
  - increment sequenceIndex and update active orders/levels
- int **num_samples** () const

Private Member Functions

- void **increment_grid** (UShortArray &dim_quad_order)
  - convenience function used to make **increment_grid()** more modular
- void **increment_grid_preference** (const RealVector &dim_pref, UShortArray &dim_quad_order)
  - convenience function used to make **increment_grid_preference()** more modular
- void **compute_minimum_quadrature_order** (size_t min_samples, const RealVector &dim_pref, UShortArray &dim_quad_order)
  - calculate smallest dim_quad_order with at least min_samples
- void **filter_parameter_sets** ()
  - prune allSamples back to size numSamples, retaining points with highest product weight
- void **update_anisotropic_order** (const RealVector &dim_pref, UShortArray &quad_order_ref)
  - update quad_order_ref based on an updated dimension preference, enforcing previous values as a lower bound
- void **initialize_dimension_quadrature_order** (unsigned short quad_order_spec, const RealVector &dim_pref_spec, UShortArray &dim_quad_order)
  - initialize dim_quad_order from quad_order_spec and dim_pref_spec
- void **increment_dimension_quadrature_order** (UShortArray &dim_quad_order)
  - increment each dim_quad_order entry by 1
- void **increment_dimension_quadrature_order** (const RealVector &dim_pref, UShortArray &dim_quad_order)
  - increment the dim_quad_order entry with maximum preference by 1 and then rebalance
Private Attributes

- Pecos::TensorProductDriver * tpqDriver
  convenience pointer to the numIntDriver representation
- bool nestedRules
  for studies involving refinement strategies, allow for use of nested quadrature rules such as Gauss-Patterson
- UShortArray quadOrderSeqSpec
  a sequence of scalar quadrature orders, one per refinement level
- UShortArray dimQuadOrderRef
  reference point for Pecos::TensorProductDriver::quadOrder: the original user specification for the number of
  Gauss points per dimension, plus any refinements posted by increment_grid()
- short quadMode
  point generation mode: FULL_TENSOR, FILTERED_TENSOR, RANDOM_TENSOR
- size_t numSamples
  size of a subset of tensor quadrature points (filtered based on product weight or sampled uniformly from the tensor
  multi-index); used by the regression PCE approach known as "probabilistic collocation"
- int randomSeed
  seed for the random number generator used in sampling of the tensor multi-index

Additional Inherited Members

13.117.1 Detailed Description

Derived nondeterministic class that generates N-dimensional numerical quadrature points for evaluation of expectation integrals over uncorrelated standard normals/uniforms/exponentials/betas/gammas.

This class is used by NonDPolynomialChaos, but could also be used for general numerical integration of moments. It employs Gauss-Hermite, Gauss-Legendre, Gauss-Laguerre, Gauss-Jacobi and generalized Gauss-Laguerre quadrature for use with normal, uniform, exponential, beta, and gamma density functions and integration bounds. The abscissas and weights for one-dimensional integration are extracted from the appropriate Orthogonal-Polynomial class and are extended to n-dimensions using a tensor product approach.

13.117.2 Constructor & Destructor Documentation

NonDQuadrature ( Model & model, const UShortArray & quad_order_seq, const RealVector & dim_pref, short driver_mode )

alternate constructor for instantiations "on the fly" based on a quadrature order specification

This alternate constructor is used for on-the-fly generation and evaluation of numerical quadrature points.

References NonDIntegration::numIntDriver, and NonDQuadrature::tpqDriver.

NonDQuadrature ( Model & model, int num_filt_samples, const RealVector & dim_pref, short driver_mode )

alternate constructor for instantiations "on the fly" that generate a filtered tensor product sample set

This alternate constructor is used for on-the-fly generation and evaluation of filtered tensor quadrature points.

References NonDIntegration::numIntDriver, and NonDQuadrature::tpqDriver.
NonDQuadrature ( Model & model, int num_rand_samples, int seed, const UShortArray & quad_order_seq, const RealVector & dim_pref, short driver_mode )

alternate constructor for instantiations “on the fly” that sample randomly from a tensor product multi-index.

This alternate constructor is used for on-the-fly generation and evaluation of random sampling from a tensor quadrature multi-index.

References NonDIntegration::numIntDriver, and NonDQuadrature::tpqDriver.

NonDQuadrature ( ProblemDescDB & problem_db, Model & model ) [protected]

constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification. It is not currently used, as there is not yet a separate nond_quadrature method specification.

References NonDIntegration::check_variables(), Iterator::convergenceTol, ProblemDescDB::get_bool(), ProblemDescDB::get_short(), ProblemDescDB::get_ushort(), Iterator::maxEvalConcurrency, Iterator::maxIterations, NonD::natafTransform, NonDQuadrature::nestedRules, NonDIntegration::numIntDriver, Iterator::outputLevel, Iterator::probDescDB, NonDQuadrature::reset(), and NonDQuadrature::tpqDriver.

13.117.3 Member Function Documentation

void initialize_grid ( const std::vector<Pecos::BasisPolynomial> & poly_basis ) [protected], [virtual]

Used in combination with alternate NonDQuadrature constructor.

Implements NonDIntegration.

References Iterator::maxEvalConcurrency, NonDQuadrature::nestedRules, Analyzer::numContinuousVars, NonDQuadrature::quadMode, NonDQuadrature::reset(), NonDQuadrature::tpqDriver, and NonDQuadrature::update().

void sampling_reset ( int min_samples, bool all_data_flag, bool stats_flag ) [protected], [virtual]

used by DataFitSurrModel::build_global() to publish the minimum number of points needed from the quadrature routine in order to build a particular global approximation.

Reimplemented from Iterator.

References NonDQuadrature::compute_minimum_quadrature_order(), NonDIntegration::dimPrefSpec, NonDQuadrature::dimQuadOrderRef, NonDQuadrature::nestedRules, Analyzer::numContinuousVars, and NonDQuadrature::tpqDriver.

Referenced by NonDQuadrature::update().

int num_samples ( ) const [inline], [protected], [virtual]

Return current number of evaluation points. Since the calculation of samples, collocation points, etc. might be costly, provide a default implementation here that backs out from the maxEvalConcurrency.

Reimplemented from Analyzer.

References NonDQuadrature::numSamples, NonDQuadrature::quadMode, and NonDQuadrature::tpqDriver.

The documentation for this class was generated from the following files:

- NonDQuadrature.hpp
- NonDQuadrature.cpp
13.118 NonDQUESOBayesCalibration Class Reference

Bayesian inference using the QUESO library from UT Austin.

Inheritance diagram for NonDQUESOBayesCalibration:

Public Member Functions

- **NonDQUESOBayesCalibration** (ProblemDescDB &problem_db, Model &model)
  standard constructor
- **\sim NonDQUESOBayesCalibration** ()
  destructor

Protected Member Functions

- void **core_run** ()
- void **print_results** (std::ostream &s)
  print the final iterator results
- void **init_queso_environment** ()
  initialize the QUESO FullEnvironment on the Dakota MPIComm
- void **init_precond_request_value** ()
  initialize the ASV value for preconditioned cases
- void **init_queso_solver** ()
  define variables, options, likelihood callback, and inverse problem
- void **precondition_proposal** ()
  use derivative information from the emulator to define the proposal covariance (inverse of misfit Hessian)
- void **run_queso_solver** ()
  perform the MCMC process
- void **run_chain_with_restarting** ()
  short term option to restart the MCMC chain with updated proposal density computed from the emulator at a new starting point
- void **accumulate_chain** (size_t update_cntr)
accumulate unique samples drawn from the acceptance chain

- **void aggregate_acceptance_chain** (size_t update_cntr)
  
  accumulate the acceptance chain across multiple restart cycles, including recovering corresponding function values

- **void filter_chain_by_probability** (size_t update_cntr, unsigned short batch_size)
  
  extract batch_size points from the MCMC chain and store final aggregated set within allSamples; unique points with highest posterior probability are selected

- **void filter_chain_by_conditioning** (size_t update_cntr, unsigned short batch_size)
  
  extract batch_size points from the MCMC chain and store final aggregated set within allSamples; unique points with best conditioning are selected, as determined by pivoted LU

- **void chain_to_local** (unsigned short batch_size, std::map<Real, size_t> &local_best)
  
  store indices of best batch_size samples from the current MCMC chain within the local_best array

- **void local_to_aggregated** (unsigned short batch_size, const std::map<Real, size_t> &local_best)
  
  update bestSamples aggregation using new contributions from the current MCMC chain

- **void aggregated_to_all** ()
  
  following aggregation cycles, copy bestSamples to allSamples

- **void local_to_all** (const std::map<Real, size_t> &local_best)
  
  in the absence of aggregation cycles, copy local_best to allSamples

- **void update_center** ()
  
  update the starting point for a restarted MCMC chain using last point from previous chain

- **void update_model** ()
  
  evaluates allSamples on iteratedModel and update the mcmcModel emulator with all\{Samples,Responses\}

- **Real assess_emulator_convergence** ()
  
  compute the L2 norm of the change in emulator coefficients

- **void init_parameter_domain** ()
  
  initialize the QUESO parameter space, min, max, initial, and domain

- **void prior_proposal_covariance** ()
  
  use covariance of prior distribution for setting proposal covariance

- **void user_proposal_covariance** (const String &input_fmt, const RealVector &cov_data, const String &cov_-filename)
  
  set proposal covariance from user-provided diagonal or matrix

- **void validate_proposal** ()

- **void set_ip_options** ()
  
  set inverse problem options callIpOptionsValues common to all solvers

- **void set_mh_options** ()
  
  set MH-specific inverse problem options callMhOptionsValues

- **void update_chain_size** (unsigned int size)
  
  update MH-specific inverse problem options callMhOptionsValues

- **void copy_gsl** (const QUESO::GslVector &qv, RealVector &rv)
  
  local copy_data utility from GslVector to RealVector

- **void copy_gsl** (const RealVector &rv, QUESO::GslVector &qv)
  
  local copy_data utility from RealVector to GslVector

- **void copy_gsl_partial** (const QUESO::GslVector &qv, size_t start, RealVector &rv)
  
  local copy_data utility from portion of GslVector to RealVector

- **void copy_gsl_partial** (const RealVector &rv, QUESO::GslVector &qv, size_t start)
13.118. NONDQUESOBAYESCALIBRATION CLASS REFERENCE

- **void** `copy_gsl` (const QUESO::GslVector &qv, RealMatrix &rm, int i)
  - Local copy data utility from RealVector to column in RealMatrix
- **bool** `equal_gsl` (const QUESO::GslVector &qv1, const QUESO::GslVector &qv2)
  - Equality tester for two GslVectors

**Static Protected Member Functions**

- **static double** `dakotaLogLikelihood` (const QUESO::GslVector &paramValues, const QUESO::GslVector *paramDirection, const void *functionDataPtr, QUESO::GslVector *gradVector, QUESO::GslMatrix *hessianMatrix, QUESO::GslVector *hessianEffect)
  - Log Likelihood function for call-back from QUESO to DAKOTA for evaluation.

**Protected Attributes**

- **String** `mcmcType`
  - MCMC type ("dram" or "delayed_rejection" or "adaptive_metropolis" or "metropolis_hastings" or "multilevel", within QUESO)
- **short** `precondRequestValue`
  - The active set request value to use in proposal preconditioning
- **bool** `logitTransform`
  - Flag indicating user activation of logit transform option

**Private Attributes**

- **boost::shared_ptr**
  - `<QUESO::EnvOptionsValues> envOptionsValues`
    - Options for setting up the QUESO Environment
- **boost::shared_ptr**
  - `<QUESO::FullEnvironment> qesoeEnv`
    - Top-level QUESO Environment
- **boost::shared_ptr**
  - `<QUESO::VectorSpace`
    - `<QUESO::GslVector, QUESO::GslMatrix>` `paramSpace`
    - QUESO parameter space based on number of calibrated parameters.
- **boost::shared_ptr**
  - `<QUESO::BoxSubset`
    - `<QUESO::GslVector, QUESO::GslMatrix>` `paramDomain`
    - QUESO parameter domain: hypercube based on min/max values.
- **boost::shared_ptr**
  - `<QUESO::GslVector> paramInitials`
    - Initial parameter values at which to start chain
- **boost::shared_ptr**
  - `<QUESO::GslMatrix> proposalCovMatrix`
• boost::shared_ptr
  < QUESO::SipOptionsValues > calIpOptionsValues
  general inverse problem options

• boost::shared_ptr
  < QUESO::MhOptionsValues > calIpMhOptionsValues
  MH-specific inverse problem options.

• boost::shared_ptr
  < QUESO::GenericScalarFunction
    QUESO::GslVector,
    QUESO::GslMatrix > > likelihoodFunctionObj

• boost::shared_ptr
  < QUESO::BaseVectorRV
    QUESO::GslVector,
    QUESO::GslMatrix > > priorRv

• boost::shared_ptr
  < QUESO::GenericVectorRV
    QUESO::GslVector,
    QUESO::GslMatrix > > postRv

• boost::shared_ptr
  < QUESO::StatisticalInverseProblem
    QUESO::GslVector,
    QUESO::GslMatrix > > inverseProb

• RealVectorArray uniqueSamples
  container for aggregating unique MCMC sample points collected across multiple (restarted) chains

• std::map< Real, QUESO::GslVector > bestSamples
  container for managing best MCMC samples (points and associated log posterior) collected across multiple (restarted) chains

• RealVectorArray prevCoeffs
  cache previous expansion coefficients for assessing convergence of emulator refinement process

• RealVector mapSoln
  store MAP estimate for warm-starting pre-solves

Static Private Attributes

• static NonDQUESOBayesCalibration * nonDQUESOInstance
  Pointer to current class instance for use in static callback functions.

Additional Inherited Members

13.118.1 Detailed Description

Bayesian inference using the QUESO library from UT Austin.

This class provides a wrapper to the QUESO library developed as part of the Predictive Science Academic Alliance Program (PSAAP), specifically the PECOS (Predictive Engineering and Computational Sciences) Center at UT Austin. The name QUESO stands for Quantification of Uncertainty for Estimation, Simulation, and Optimization.
13.118. Constructor & Destructor Documentation

NonDQUESOBayesCalibration ( ProblemDescDB & problem_db, Model & model )

standard constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification.

References Dakota::abort_handler(), NonDCalibration::calibrationData, NonDQUESOBayesCalibration::init_queso_environment(), and NonDBayesCalibration::obsErrorMultiplierMode.

13.118.3 Member Function Documentation

void core_run ( ) [protected], [virtual]

Perform the uncertainty quantification

Reimplemented from Iterator.

References Dakota::abort_handler(), NonDBayesCalibration::adaptPosteriorRefine, NonDQUESOBayesCalibration::assess_emulator_convergence(), Analyzer::compactMode, NonDBayesCalibration::compute_statistics(), Iterator::convergenceTol, NonDBayesCalibration::emulatorType, NonDBayesCalibration::export_chain(), NonDBayesCalibration::exportMCMCFilename, NonDQUESOBayesCalibration::init_parameter_domain(), NonDQUESOBayesCalibration::init_precond_request_value(), NonDQUESOBayesCalibration::init_queso_solver(), NonDBayesCalibration::initialize_model(), NonDBayesCalibration::invGammaDists, Iterator::maxIterations, NonDBayesCalibration::nonDBayesInstance, NonDQUESOBayesCalibration::nonDQUESOInstance, Analyzer::numContinuousVars, NonDBayesCalibration::numHyperparams, Iterator::outputLevel, NonDQUESOBayesCalibration::paramInitials, NonDQUESOBayesCalibration::paramSpace, NonDQUESOBayesCalibration::precondRequestValue, NonDBayesCalibration::prior_cholesky_factorization(), NonDQUESOBayesCalibration::prior_proposal_covariance(), NonDBayesCalibration::proposalCovData, NonDBayesCalibration::proposalCovarFilename, NonDBayesCalibration::proposalCovarInputType, NonDBayesCalibration::proposalCovarType, NonDQUESOBayesCalibration::proposalCovMatrix, NonDQUESOBayesCalibration::run_chain_with_restarting(), NonDQUESOBayesCalibration::update_model(), and NonDQUESOBayesCalibration::user_proposal_covariance().

void print_results ( std::ostream & s ) [protected], [virtual]

print the final iterator results

This virtual function provides additional iterator-specific final results outputs beyond the function evaluation summary printed in finalize_run().

Reimplemented from NonDBayesCalibration.

References NonDQUESOBayesCalibration::bestSamples, Model::continuous_variable_labels(), Dakota::copy_data(), NonDQUESOBayesCalibration::copy_gsl_partial(), NonDCalibration::expData, Dakota::HALF_LOG_2_PI, ExperimentData::half_log_cov_determinant(), Iterator::iteratedModel, NonDBayesCalibration::log_prior_density(), NonD::natafTransform, Analyzer::numContinuousVars, NonDBayesCalibration::numHyperparams, NonDCalibration::numTotalCalibTerms, NonDBayesCalibration::obsErrorMultiplierMode, NonDBayesCalibration::print_results(), NonDBayesCalibration::residualModel, NonDBayesCalibration::standardizedSpace, and Dakota::write_precision.

void aggregate_acceptance_chain ( size_t cycle_num ) [protected]

accumulate the acceptance chain across multiple restart cycles, including recovering corresponding function values

Populate a subset of acceptanceChain(num_params, chainSamples * chainCycles) and acceptedFnVals(num-Functions, chainSamples * chainCycles)
References NonDBayesCalibration::acceptanceChain, NonDBayesCalibration::acceptedFnVals, Response::active_set(), Model::active_variables(), NonDBayesCalibration::chainSamples, Variables::continuous_variables(), Response::copy(), Variables::copy(), NonDQUESOBayesCalibration::copy_gsl(), NonDQUESOBayesCalibration::copy_gsl_partial(), Model::current_response(), Model::current_variables(), Dakota::data_pairs, Model::evaluate(), Response::function_values(), Model::interface_id(), Dakota::lookup_by_val(), NonDBayesCalibration::mcmcModel, Model::model_type(), NonD::natafTransform, Analyzer::numContinuousVars, NonDBayesCalibration::numHyperparams, Iterator::outputLevel, NonDQUESOBayesCalibration::paramSpace, ActiveSet::request_values(), NonDBayesCalibration::standardizedSpace, and ParamResponsePair::variables.

Referenced by NonDQUESOBayesCalibration::run_chain_with_restarting().

```cpp
void prior_proposal_covariance() [protected]
```

use covariance of prior distribution for setting proposal covariance

Must be called after paramMins/paramMaxs set above.

References NonD::natafTransform, Analyzer::numContinuousVars, Iterator::outputLevel, NonDQUESOBayesCalibration::proposalCovMatrix, and NonDBayesCalibration::standardizedSpace.

Referenced by NonDQUESOBayesCalibration::core_run().

```cpp
void user_proposal_covariance(const String &input_fmt, const RealVector &cov_data, const String &cov_filename) [protected]
```

set proposal covariance from user-provided diagonal or matrix

This function will convert user-specified cov_type = "diagonal" | "matrix" data from either cov_data or cov_filename and populate a full QUESO::GslMatrix* in proposalCovMatrix with the covariance.

References Analyzer::numContinuousVars, NonDQUESOBayesCalibration::proposalCovMatrix, and NonDBayesCalibration::standardizedSpace.

Referenced by NonDQUESOBayesCalibration::core_run().

```cpp
void set_ip_options() [protected]
```

set inverse problem options callIpOptionsValues common to all solvers

set inverse problem options common to all solvers.

References NonDQUESOBayesCalibration::callIpOptionsValues.

Referenced by NonDQUESOBayesCalibration::init_queso_solver().

### 13.118.4 Member Data Documentation

####bool logitTransform [protected]

flag indicating user activation of logit transform option

this option is useful for preventing rejection or resampling for out-of-bounds samples by transforming bounded domains to [-inf,inf].

Referenced by NonDQUESOBayesCalibration::set_mh_options().

The documentation for this class was generated from the following files:

- NonDQUESOBayesCalibration.hpp
- NonDQUESOBayesCalibration.cpp
13.119  NonDReliability Class Reference

Base class for the reliability methods within DAKOTA/UQ.

Inheritance diagram for NonDReliability:

- Iterator
  - Analyzer
  - NonD
    - NonDReliability

Protected Member Functions

- NonDReliability (ProblemDescDB &problem_db, Model &model)
  constructor
- ~NonDReliability ()
  destructor
- void initialize_graphics (int iterator_server_id=1)
  initialize graphics customized for reliability methods
- const Model & algorithm_space_model () const

Protected Attributes

- Model uSpaceModel
  Model representing the limit state in u-space, after any recastings and data fits.
- Model mppModel
  RecastModel which formulates the optimization subproblem: RIA, PMA, EGO.
- Iterator mppOptimizer
  Iterator which optimizes the mppModel.
- unsigned short mppSearchType
  the MPP search type selection: MV, x/u-space AMV, x/u-space AMV+, x/u-space TANA, x/u-space EGO, or NO_A-PPROX
- Iterator importanceSampler
  importance sampling instance used to compute/refine probabilities
• unsigned short integrationRefinement
  integration refinement type (NO_INT_REFINE, IS, AIS, or MMAIS) provided by refinement specification
• size_t numRelAnalyses
  number of invocations of core_run()
• size_t approxIters
  number of approximation cycles for the current respFnCount/levelCount
• bool approxConverged
  indicates convergence of approximation-based iterations
• int respFnCount
  counter for which response function is being analyzed
• size_t levelCount
  counter for which response/probability level is being analyzed
• size_t statCount
  counter for which final statistic is being computed
• bool pmaMaximizeG
  flag indicating maximization of $G(u)$ within PMA formulation
• Real requestedTargetLevel
  the \{response, reliability, generalized reliability\} level target for the current response function

Additional Inherited Members

13.119.1 Detailed Description

Base class for the reliability methods within DAKOTA/UQ.

The NonDReliability class provides a base class for NonDLocalReliability, which implements traditional MPP-based reliability methods, and NonDGlobalReliability, which implements global limit state search using Gaussian process models in combination with multimodal importance sampling.

13.119.2 Member Function Documentation

const Model & algorithm_space_model() const [inline], [protected], [virtual]

default definition that gets redefined in selected derived Minimizers
  Reimplemented from Analyzer.
  References NonDReliability::uSpaceModel.
  The documentation for this class was generated from the following files:
  • NonDReliability.hpp
  • NonDReliability.cpp

13.120 NonDRKDDarts Class Reference

Base class for the Recursive k-d Dart methods within DAKOTA/UQ.

Inheritance diagram for NonDRKDDarts:
13.120. NONDRKDDARTS CLASS REFERENCE

Public Member Functions

- **NonDRKDDarts** (ProblemDescDB &problem_db, Model &model)
  
  *constructor*

- **~NonDRKDDarts** ()
  
  *destructor*

- bool resize ()
  
  *reinitializes iterator based on new variable size*

- void core_run ()

Protected Member Functions

- void pre_run ()
  
  *generate samples*

- void initiate_random_number_generator (unsigned long x)

- double generate_a_random_number ()

- void init_rkd_darts ()

- void create_rkd_containers (size_t expected_num_samples)

- void execute ()

- void create_initial_children (size_t parent)

- void create_new_sample (size_t parent, size_t left, size_t right, double position)

- void improve_parent_evaluation (size_t parent)

- void evaluate_1d_surrogate (size_t parent)

- double get_surrogate_interp_error (size_t parent)

- double estimate_surrogate_evaluation_err (size_t parent)

- void get_children (size_t parent, size_t *children)

- void get_neighbors (size_t sample, size_t &num_neighbors, size_t *neighbors)

- double interpolate_lagrange (size_t num_data_points, double *data_x, double *data_f, double x)

- double integrate_legendre_gauss (double xmin, double xmax, size_t num_data_points, double *data_x, double *data_f, double &err_est)

- double f_true (double *x)

- void initialize_surrogates ()

- void compute_response (double *x)

- void add_surrogate_data (const Variables &vars, const Response &resp)

- void build_surrogate ()
• double eval_surrogate (size_t fn_index, double *vin)
• void estimate_rkd_surrogate ()
• void post_run (std::ostream &s)

• void print_integration_results (std::ostream &s)
• void exit_rkd_darts ()
• void destroy_rkd_containers ()

Protected Attributes
• int samples
• int seed
• int emulatorSamples
• double Q [1220]
• int indx
• double cc
• double c
• double zc
• double zx
• double zy
• size_t qlen

Private Attributes
• double * _1_RKD
• bool _eval_error
• size_t _test_function
• size_t _num_inserted_points
• size_t _num_dim
• size_t _num_samples
• size_t _max_num_samples
• size_t _num_evaluations
• size_t _evaluation_budget
• size_t _max_num_neighbors
• double _bounding_box_volume
• double _discont_jump_threshold
• double * _xmin
• double * _xmax
• double ** _fval
• size_t * _sample_dim
• size_t * _sample_parent
• size_t * _sample_first_child
• size_t * _sample_num_children
• size_t * _sample_left
• size_t * _sample_right
• double * _sample_coord
• double * _sample_value
• double *_.sample_left_interp_err_
• double *_.sample_right_interp_err_
• double *_.sample_left_ev_err_
• double *_.sample_right_ev_err_

Additional Inherited Members

13.120.1 Detailed Description
Base class for the Recursive k-d Dart methods within DAKOTA/UQ.

The NonDRKDDart class recursively implements the numerical integration of a domain based on k-d flat samples.

13.120.2 Member Function Documentation

void core_run ( ) [virtual]
Loop over the set of samples and compute responses.
Reimplemented from Iterator.

void pre_run ( ) [protected], [virtual]
generate samples
Generate Parameter Sets.
Reimplemented from Analyzer.
References Analyzer::pre_run().

void post_run ( std::ostream & s ) [protected], [virtual]
genenerate statistics
Print function evaluation summary, and integration results.
Reimplemented from Analyzer.
References Iterator::iteratedModel, Analyzer::post_run(), and Model::print_evaluation_summary().
The documentation for this class was generated from the following files:

• NonDRKDDarts.hpp
• NonDRKDDarts.cpp

13.121 NonDSampling Class Reference
Base class for common code between NonDLHSSampling, NonDAadaptImpSampling, and other specializations.
Inheritance diagram for NonDSampling:
Public Member Functions

- **NonDSampling** (Model &model, const RealMatrix &sample_matrix)
  alternate constructor for evaluating and computing statistics for the provided set of samples
- void **compute_statistics** (const RealMatrix &vars_samples, const IntResponseMap &resp_samples)
  For the input sample set, computes mean, standard deviation, and probability/reliability/response levels (aleatory uncertainties) or intervals (epistemic or mixed uncertainties)
- void **compute_intervals** (RealRealPairArray &extreme_fns)
  called by **compute_statistics**() to calculate min/max intervals using allResponses
- void **compute_intervals** (const IntResponseMap &samples)
  called by **compute_statistics**() to calculate extremeValues from samples
- void **compute_intervals** (RealRealPairArray &extreme_fns, const IntResponseMap &samples)
  called by **compute_statistics**() to calculate min/max intervals using samples
- void **compute_moments** (const IntResponseMap &samples)
  called by **compute_statistics**() to calculate sample moments and confidence intervals
- void **compute_level_mappings** (const IntResponseMap &samples)
  called by **compute_statistics**() to calculate CDF/CCDF mappings of z to p/beta and of p/beta to z as well as PDFs
- void **print_statistics** (std::ostream &s) const
  prints the statistics computed in **compute_statistics**()
- void **print_intervals** (std::ostream &s) const
  prints the intervals computed in **compute_intervals**() with default qoi_type and moment_labels
- void **print_intervals** (std::ostream &s, String qoi_type, const StringArray &interval_labels) const
  prints the intervals computed in **compute_intervals**()
- void **print_moments** (std::ostream &s) const
  prints the moments computed in **compute_moments**() with default qoi_type and moment_labels
- void **print_moments** (std::ostream &s, String qoi_type, const StringArray &moment_labels) const
  prints the moments computed in **compute_moments**()
- void **update_final_statistics** ()
  update finalStatistics from minValues/maxValues, momentStats, and computedProbLevels/computedRelLevels/computed-RespLevels
- void **compute_moments** (const RealMatrix &samples)
  calculates sample moments for an array of observations for a set of QoI
- void **transform_samples** (bool x_to_u=true)
  transform allSamples imported by alternate constructor. This is needed since random variable distribution parameters are not updated until run time and an imported sample_matrix is typically in x-space.
• void transform_samples (RealMatrix &sample_matrix, bool x_to_u, int num_samples=0)
transform the specified samples matrix from x to u or u to x

Static Public Member Functions

• static void print_moments (std::ostream &s, const RealMatrix &moment_stats, const RealMatrix moment_cis, String qoi_type, const StringArray &moment_labels, bool print_cis)
core print moments that can be called without object
• static void compute_moments (const RealMatrix &samples, RealMatrix &moment_stats)
core compute moments that can be called without object
• static int compute_wilks_sample_size (unsigned short order, Real alpha, Real beta, bool twosided=false)
calculates the number of samples using the Wilks formula Static for now so I can test without instantiating a NonDSampling object - RWH

Protected Member Functions

• NonDSampling (ProblemDescDB &problem_db, Model &model)
constructor
• NonDSampling (unsigned short method_name, Model &model, unsigned short sample_type, int samples, int seed, const String &rng, bool vary_pattern, short sampling_vars_mode)
alternate constructor for sample generation and evaluation "on the fly"
• NonDSampling (unsigned short sample_type, int samples, int seed, const String &rng, const RealVector &lower_bnds, const RealVector &upper_bnds)
alternate constructor for sample generation "on the fly"
• NonDSampling (unsigned short sample_type, int samples, int seed, const String &rng, const RealVector &means, const RealVector &std_devs, const RealVector &lower_bnds, const RealVector &upper_bnds, RealSymMatrix &correl)
alternate constructor for sample generation of correlated normals "on the fly"
• ~NonDSampling ()
destructor
• void core_run ()
• int num_samples () const
• void sampling_reset (int min_samples, bool all_data_flag, bool stats_flag)
resets number of samples and sampling flags
• void sampling_reference (int samples_ref)
set reference number of samples, which is a lower bound during reset
• unsigned short sampling_scheme () const
return sampleType
• void vary_pattern (bool pattern_flag)
set varyPattern
• void get_parameter_sets (Model &model)
Uses lhsDriver to generate a set of samples from the distributions/bounds defined in the incoming model.
• void get_parameter_sets (const RealVector &lower_bnds, const RealVector &upper_bnds)
Uses lhsDriver to generate a set of uniform samples over lower_bnds/upper_bnds.
CHAPTER 13. CLASS DOCUMENTATION

- **void** `get_parameter_sets` (const RealVector &means, const RealVector &std_devs, const RealVector &lower_bnds, const RealVector &upper_bnds, RealSymMatrix &correl)

  Uses lhsDriver to generate a set of normal samples.

- **void** `update_model_from_sample` (Model &model, const Real *sample_vars)

  Override default update of continuous vars only.

- **void** `sample_to_variables` (const Real *sample_vars, Variables &vars)

  override default mapping of continuous variables only

- **void** `variables_to_sample` (const Variables &vars, Real *sample_vars)

- **void** `initialize_lhs` (bool write_message)

  increments numLHSRuns, sets random seed, and initializes lhsDriver

- **void** `view_design_counts` (const Model &model, size_t &num_cdv, size_t &num_ddiv, size_t &num_dsv, size_t &num_ddrv) const

  compute sampled subsets (all, active, uncertain) within all variables (acv/adiv/adrv) from samplingVarsMode and model

- **void** `view_aleatory_uncertain_counts` (const Model &model, size_t &num_cauv, size_t &num_dauiv, size_t &num_dausv, size_t &num_daurv) const

  compute sampled subsets (all, active, uncertain) within all variables (acv/adiv/adrv) from samplingVarsMode and model

- **void** `view_epistemic_uncertain_counts` (const Model &model, size_t &num_ceuv, size_t &num_deuiv, size_t &num_deusv, size_t &num_deurv) const

  compute sampled subsets (all, active, uncertain) within all variables (acv/adiv/adrv) from samplingVarsMode and model

- **void** `view_uncertain_counts` (const Model &model, size_t &num_cuv, size_t &num_duv, size_t &num_dusv, size_t &num_durv) const

  compute sampled subsets (all, active, uncertain) within all variables (acv/adiv/adrv) from samplingVarsMode and model

- **void** `view_state_counts` (const Model &model, size_t &num_csv, size_t &num_dsv, size_t &num_dssv, size_t &num_dsrv) const

  compute sampled subsets (all, active, uncertain) within all variables (acv/adiv/adrv) from samplingVarsMode and model

- **void** `mode_counts` (const Model &model, size_t &cv_start, size_t &num_cv, size_t &div_start, size_t &num_div, size_t &dsv_start, size_t &num_dsv, size_t &drv_start, size_t &num_drv) const

  compute sampled subsets (all, active, uncertain) within all variables (acv/adiv/adrv) from samplingVarsMode and model

- **void** `get_lhs_samples` (const Model &model, int num_samples, RealMatrix &design_matrix)

  Uses lhsDriver to generate a set of samples from the distributions/bounds defined in the incoming model and populates the specified design matrix.

**Protected Attributes**

- const int seedSpec

  the user seed specification (default is 0)

- int randomSeed

  the current seed

- const int samplesSpec

  initial specification of number of samples
13.121. NONDSAMPLING CLASS REFERENCE

- int samplesRef
  
  *reference number of samples updated for refinement*

- int numSamples
  
  *the current number of samples to evaluate*

- String rngName
  
  *name of the random number generator*

- unsigned short sampleType
  
  *the sample type: default, random, lhs, incremental random, or incremental lhs*

- bool wilksFlag

- int samplesIncrement
  
  *flags use of Wilks formula to calculate num samples*

- Pecos::LHSDriver lhsDriver
  
  *the C++ wrapper for the F90 LHS library*

- bool statsFlag
  
  *flags computation/output of statistics*

- bool allDataFlag
  
  *flags update of allResponses < (allVariables or allSamples already defined)*

- short samplingVarsMode
  
  *the sampling mode: ALEATORY\_UNCERTAIN\_\_UNIFORM, EPISTEMIC\_UNCERTAIN\_\_UNIFORM, UNCERTAIN\_\_UNIFORM, ACTIVE\_\_UNIFORM, or ALL\_\_UNIFORM. This is a secondary control on top of the variables view that allows sampling over subsets of variables that may differ from the view.*

- short sampleRanksMode
  
  *mode for input/output of LHS sample ranks: IGNORE\_RANKS, GET\_RANKS, SET\_RANKS, or SET\_GET\_RANKS*

- bool varyPattern
  
  *flag for generating a sequence of seed values within multiple get\_parameter\_sets() calls so that these executions (e.g., for SBO/SBNLS) are not repeated, but are still repeatable*

- RealMatrix sampleRanks
  
  *data structure to hold the sample ranks*

- SensAnalysisGlobal nonDSampCorr
  
  *initialize statistical post processing*

- bool backfillFlag
  
  *flags whether to use backfill to enforce uniqueness of discrete LHS samples*

- RealRealPairArray extremeValues
  
  *Minimum and maximum values of response functions for epistemic calculations (calculated in compute\_intervals()).*

**Private Attributes**

- size\_t numLHSRuns
  
  *counter for number of executions of get\_parameter\_sets() for this object*

- RealMatrix momentCIs
  
  *Matrix of confidence internals on moments, with rows for mean\_lower, mean\_upper, sd\_lower, sd\_upper (calculated in compute\_moments()).*
Additional Inherited Members

13.121.1 Detailed Description

Base class for common code between NonDLHSSampling, NonDAdaptImpSampling, and other specializations.

This base class provides common code for sampling methods which employ the Latin Hypercube Sampling (LHS) package from Sandia Albuquerque’s Risk and Reliability organization. NonDSampling now exclusively utilizes the 1998 Fortran 90 LHS version as documented in SAND98-0210, which was converted to a UNIX link library in

1. The 1970’s vintage LHS (that had been f2c’d and converted to incomplete classes) has been removed.

13.121.2 Constructor & Destructor Documentation

NonDSampling ( Model & model, const RealMatrix & sample_matrix )

alternate constructor for evaluating and computing statistics for the provided set of samples

This alternate constructor defines allSamples from an incoming sample matrix.

References Analyzer::allSamples, Analyzer::compactMode, Iterator::maxEvalConcurrency, NonDSampling::numSamples, NonDSampling::samplesRef, NonDSampling::samplesSpec, and Iterator::subIteratorFlag.

NonDSampling ( ProblemDescDB & problem_db, Model & model ) [protected]

constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification.

References Dakota::abort_handler(), NonDSampling::compute_wilks_sample_size(), NonD::epistemicStats, ProblemDescDB::get_real(), ProblemDescDB::get_short(), ProblemDescDB::get_ushort(), NonD::initialize_final_statistics(), Iterator::maxEvalConcurrency, Analyzer::numFunctions, NonDSampling::numSamples, Iterator::probDescDB, NonD::requestedProbLevels, NonDSampling::samplesRef, NonDSampling::sampleType, and NonD::totalLevel-Requests.

NonDSampling ( unsigned short method_name, Model & model, unsigned short sample_type, int samples, int seed, const String & rng, bool vary_pattern, short sampling_vars_mode ) [protected]

alternate constructor for sample generation and evaluation “on the fly”

This alternate constructor is used for generation and evaluation of on-the-fly sample sets.

References NonD::epistemicStats, Iterator::maxEvalConcurrency, NonD::numEpistemicUncVars, NonDSampling::numSamples, NonDSampling::sampleType, NonDSampling::samplingVarsMode, and Iterator::subIteratorFlag.

NonDSampling ( unsigned short sample_type, int samples, int seed, const String & rng, const RealVector & lower_bnds, const RealVector & upper_bnds ) [protected]

alternate constructor for sample generation “on the fly”

This alternate constructor is used by ConcurrentStrategy for generation of uniform, uncorrelated sample sets.

References Iterator::maxEvalConcurrency, NonDSampling::numSamples, NonDSampling::sampleType, and Iterator::subIteratorFlag.
NonDSampling (unsigned short sample_type, int samples, int seed, const String &rng, const RealVector &means, const RealVector &std_devs, const RealVector &lower_bnds, const RealVector &upper_bnds, RealSymMatrix &correl) [protected]

alternate constructor for sample generation of correlated normals "on the fly"
This alternate constructor is used by ConcurrentStrategy for generation of normal, correlated sample sets.
References Iterator::maxEvalConcurrency, NonDSampling::numSamples, NonDSampling::sampleType, and Iterator::subIteratorFlag.

13.121.3 Member Function Documentation

void compute_level_mappings(const IntResponseMap &samples)
called by compute_statistics() to calculate CDF/CCDF mappings of z to p/beta and of p/beta to z as well as PDFs
Computes CDF/CCDF based on sample binning. A PDF is inferred from a CDF/CCDF within compute_densities() after level computation.
References Dakota::abort_handler(), NonD::archive_allocate_mappings(), NonD::archive_from RESP(), NonD::archive_to RESP(), NonD::cdfFlag, NonD::compute_densities(), NonD::computedGenRelLevels, NonD::computedProbLevels, NonD::computedRespLevels, NonD::computedRespLevels, NonD::extremeValues, NonD::initialize_level_mappings(), Iterator::iteratedModel, NonD::momentStats, Analyzer::numFunctions, NonD::pdfOutput, NonD::requestedGenRelLevels, NonD::requestedProbLevels, NonD::requestedRespLevels, NonD::respLevelTarget, and Model::response_labels().
Referenced by NonDExpansion::compute_numerical_statistics(), and NonDSampling::compute_statistics().

void core_run() [protected], [virtual]
Default implementation generates allResponses from either allSamples or allVariables.
Reimplemented from Iterator.
References NonDSampling::allDataFlag, Analyzer::evaluate_parameter_sets(), Iterator::iteratedModel, and NonDSampling::statsFlag.

int num_samples() const [inline], [protected], [virtual]
Return current number of evaluation points. Since the calculation of samples, collocation points, etc. might be costly, provide a default implementation here that backs out from the maxEvalConcurrency.
Reimplemented from Analyzer.
References NonDSampling::numSamples.
Referenced by NonDAadaptImpSampling::evaluate_samples(), NonDSampling::getlhs_samples(), NonDAadaptImpSampling::select_rep_points(), NonDLHSSampling::store_ranks(), and NonDSampling::transform_samples().

void sampling_reset(int min_samples, bool all_data_flag, bool stats_flag) [inline], [protected], [virtual]
resets number of samples and sampling flags
used by DataFitSurrModel::build_global() to publish the minimum number of samples needed from the sampling routine (to build a particular global approximation) and to set allDataFlag and statsFlag. In this case, allDataFlag is set to true (vectors of variable and response sets must be returned to build the global approximation) and statsFlag is set to false (statistics computations are not needed).
Reimplemented from Iterator.
References NonDSampling::allDataFlag, NonDSampling::numSamples, NonDSampling::samplesIncrement, NonDSampling::samplesRef, and NonDSampling::statsFlag.
void get_parameter_sets ( Model & model ) [protected], [virtual]

Uses lhsDriver to generate a set of samples from the distributions/bounds defined in the incoming model.

This version of get_parameter_sets() extracts data from the user-defined model in any of the four sampling modes and populates class member allSamples.

Reimplemented from Analyzer.

References Analyzer::allSamples, NonDSampling::get_lhs_samples(), and NonDSampling::numSamples.

Referenced by NonDLHSSampling::compute_pca(), NonDAdaptImpSampling::core_run(), NonDMultilevel-Sampling::lf_increment(), NonDMultilevelSampling::multilevel_control_variate_mc(), NonDMultilevelSampling::multilevel_mc(), NonDLHSSampling::NonDLHSSampling(), and NonDMultilevelSampling::shared_increment().

void get_parameter_sets ( const RealVector & lower_bnds, const RealVector & upper_bnds ) [protected]

Uses lhsDriver to generate a set of uniform samples over lower_bnds/upper_bnds.

This version of get_parameter_sets() does not extract data from the user-defined model, but instead relies on the incoming bounded region definition. It only support a UNIFORM sampling mode, where the distinction of ACTIVE_UNIFORM vs. ALL_UNIFORM is handled elsewhere.

References Analyzer::allSamples, NonDSampling::initialize_lhs(), NonDSampling::lhsDriver, and NonDSampling::numSamples.

void get_parameter_sets ( const RealVector & means, const RealVector & std_devs, const RealVector & lower_bnds, const RealVector & upper_bnds, RealSymMatrix & correl ) [protected]

Uses lhsDriver to generate a set of normal samples.

This version of get_parameter_sets() does not extract data from the user-defined model, but instead relies on the incoming definition. It only support the sampling of normal variables.

References Analyzer::allSamples, NonDSampling::initialize_lhs(), NonDSampling::lhsDriver, and NonDSampling::numSamples.

void variables_to_sample ( const Variables & vars, Real * sample_vars ) [protected], [virtual]

Map the active variables from vars to sample_vars (column in allSamples)

Reimplemented from Analyzer.

References Variables::continuous_variables(), Variables::discrete_int_variables(), Variables::discrete_real_variables(), Model::discrete_set_string_values(), Variables::discrete_string_variables(), Iterator::iteratedModel, Analyzer::numContinuousVars, Analyzer::numDiscreteIntVars, Analyzer::numDiscreteRealVars, Analyzer::numDiscreteStringVars, Dakota::set_value_to_index(), and Variables::view().

void view_design_counts ( const Model & model, size_t & num_cdv, size_t & num_ddiv, size_t & num_ddsv, size_t & num_ddrv ) const [protected]

compute sampled subsets (all, active, uncertain) within all variables (acv/adiv/adrv) from samplingVarsMode and model

This function computes total design variable counts, not active counts, for use in defining offsets and counts within all variables arrays.

References Model::current_variables(), Variables::cv_start(), SharedVariablesData::design_counts(), Variables::div_start(), Variables::drv_start(), Variables::dsv_start(), NonD::numContDesVars, NonD::numDiscIntDesVars, NonD::numDiscRealDesVars, NonD::numDiscStringDesVars, Variables::shared_data(), and Variables::view().

Referenced by NonDSampling::mode_counts().
void view_aleatory_uncertain_counts ( const Model & model, size_t & num_cauv, size_t & num_dauiv, size_t & num_dausv, size_t & num_daurv ) const [protected]

compute sampled subsets (all, active, uncertain) within all variables (acv/adiv/adrv) from samplingVarsMode and model

This function computes total aleatory uncertain variable counts, not active counts, for use in defining offsets and counts within all variables arrays.

References SharedVariablesData::aleatory_uncertain_counts(), Model::current_variables(), NonD::numContAleatUncVars, NonD::numDiscIntAleatUncVars, NonD::numDiscRealAleatUncVars, NonD::numDiscStringAleatUncVars, Variables::shared_data(), and Variables::view().

Referenced by NonDSampling::mode_counts().

void view_epistemic_uncertain_counts ( const Model & model, size_t & num_ceuv, size_t & num_deuiv, size_t & num_deusv, size_t & num_deurv ) const [protected]

compute sampled subsets (all, active, uncertain) within all variables (acv/adiv/adrv) from samplingVarsMode and model

This function computes total epistemic uncertain variable counts, not active counts, for use in defining offsets and counts within all variables arrays.

References Model::current_variables(), SharedVariablesData::epistemic_uncertain_counts(), NonD::numContEpistUncVars, NonD::numDiscIntEpistUncVars, NonD::numDiscRealEpistUncVars, NonD::numDiscStringEpistUncVars, Variables::shared_data(), and Variables::view().

Referenced by NonDSampling::mode_counts().

void view_uncertain_counts ( const Model & model, size_t & num_cuv, size_t & num_duiv, size_t & num_dusv, size_t & num_durv ) const [protected]

compute sampled subsets (all, active, uncertain) within all variables (acv/adiv/adrv) from samplingVarsMode and model

This function computes total uncertain variable counts, not active counts, for use in defining offsets and counts within all variables arrays.

References Model::current_variables(), Variables::cv(), Variables::div(), Variables::drv(), Variables::dsv(), NonD::numContAleatUncVars, NonD::numContEpistUncVars, NonD::numDiscIntAleatUncVars, NonD::numDiscIntEpistUncVars, NonD::numDiscRealAleatUncVars, NonD::numDiscRealEpistUncVars, NonD::numDiscStringAleatUncVars, NonD::numDiscStringEpistUncVars, Variables::shared_data(), SharedVariablesData::uncertain_counts(), and Variables::view().

Referenced by NonDSampling::mode_counts().

void mode_counts ( const Model & model, size_t & cv_start, size_t & num_cvs, size_t & div_start, size_t & num_divs, size_t & dsv_start, size_t & num_dsvs, size_t & drv_start, size_t & num_drvs ) const [protected]

compute sampled subsets (all, active, uncertain) within all variables (acv/adiv/adrv) from samplingVarsMode and model

This function and its helpers to follow are needed since NonDSampling supports a richer set of sampling modes than just the active variable subset. mode_counts() manages the samplingVarsMode setting, while its helper functions (view_\{design,aleatory_uncertain,epistemic_uncertain, uncertain,state\}_counts) manage the active variables view. Similar to the computation of starts and counts in creating active variable views, the results of this function are starts and counts for use within model.all_*( ) set/get functions.
References Model::acv(), Model::adiv(), Model::adr(), Model::adsv(), Model::current_variables(), Variables::cv(), Variables::cv_start(), Variables::div(), Variables::div_start(), Variables::dr(), Variables::drv(), Variables::dsv(), Variables::dsv_start(), NonDSampling::samplingVarsMode, NonDSampling::view_aleatory_uncertain_counts(), NonDSampling::view_design_counts(), NonDSampling::view_epistemic_uncertain_counts(), and NonDSampling::view_uncertain_counts().

Referenced by NonDSampling::compute_statistics(), NonDLHSSampling::dOptimalParameterSet(), NonDSampling::get_lhs_samples(), NonDLHSSampling::post_input(), NonDLHSSampling::pre_run(), NonDSampling::print_statistics(), NonDSampling::sample_to_variables(), and NonDSampling::update_model_from_sample() in NonDSampling::get_lhs_samples (const Model &model, int num_samples, RealMatrix &design_matrix) [protected]

Uses lhsDriver to generate a set of samples from the distributions/bounds defined in the incoming model and populates the specified design matrix.

This version of getParameterSets() extracts data from the user-defined model in any of the four sampling modes and populates the specified design matrix.

References Dakota::abort_handler(), Model::acv(), Model::adiv(), Model::aleatory_distribution_parameters(), Model::all_continuous_lower_bounds(), Model::all_continuous_upper_bounds(), Model::all_discrete_int_lower_bounds(), Model::all_discrete_int_upper_bounds(), NonDSampling::backfillFlag, Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::current_variables(), Model::discrete_design_set_int_values(), Model::discrete_design_set_real_values(), Model::discrete_design_set_string_values(), Model::discrete_state_set_int_values(), Model::discrete_state_set_real_values(), Model::discrete_state_set_string_values(), Model::epistemic_distribution_parameters(), NonDSampling::initialize_lhs(), NonDSampling::lhsDriver, NonDSampling::mode_counts(), NonDSampling::num_samples(), NonD::numContDesVars, NonD::numContStateVars, NonD::numDiscIntDesVars, NonD::numDiscIntStateVars, NonD::numDiscRealDesVars, NonD::numDiscRealStateVars, NonD::numDiscStringDesVars, NonD::numDiscStringStateVars, NonDSampling::sampleRanks, NonDSampling::samplingVarsMode, and Variables::view().

Referenced by NonDLHSSampling::dOptimalParameterSet(), NonDSampling::getParameterSets(), NonDLHSSampling::increment_lhsParameterSet(), NonDLHSSampling::initial_increment_lhs_set(), and NonDLHSSampling::pre_run().

### 13.121.4 Member Data Documentation

**int samplesIncrement [protected]**

flags use of Wilks formula to calculate num samples

  - current increment in a sequence of samples

  Referenced by NonDLHSSampling::sampling_increment(), and NonDSampling::sampling_reset().

  The documentation for this class was generated from the following files:

  - NonDSampling.hpp
  - NonDSampling.cpp

### 13.122 NonDSparseGrid Class Reference

Derived nondeterministic class that generates N-dimensional Smolyak sparse grids for numerical evaluation of expectation integrals over independent standard random variables.

Inheritance diagram for NonDSparseGrid:
Public Member Functions

- **NonDSparseGrid** (Model &model, const UShortArray &ssg_level_seq, const RealVector &dim_pref, short exp_coeffs_sln Approach, short driver_mode, short growth_rate=Pecos::MODERATE, short refine_control=Pecos::NO_CONTROL, bool track_uniq_prod_wts=true, bool track_colloc_indices=true)
- void increment_grid ()
  
  increment ssgDriver::ssgLevel
- void increment_grid_weights (const RealVector &aniso_wts)
  
  update ssgDriver::ssgAnisoLevelWts and increment ssgDriver::ssgLevel based on specified anisotropic weighting
- void increment_specification_sequence ()
  
  advance to next level in ssgLevelSeqSpec sequence
- const std::set<UShortArray> & active_multi_index () const
  
  returns SparseGridDriver::active_multi_index()
- void print_smolyak_multi_index () const
  
  invokes SparseGridDriver::print_smolyak_multi_index()
- void initialize_sets ()
  
  invokes SparseGridDriver::initialize_sets()
- void update_reference ()
  
  invokes SparseGridDriver::update_reference()
- void increment_set (const UShortArray &set)
  
  invokes SparseGridDriver::push_trial_set()
- int increment_size () const
  
  invokes SparseGridDriver::unique_trial_points()
- void restore_set ()
  
  invokes SparseGridDriver::restore_set()
- void evaluate_set ()
  
  invokes SparseGridDriver::compute_trial_grid()
- void decrement_set ()
  
  invokes SparseGridDriver::pop_trial_set()
- void update_sets (const UShortArray &set_star)
  
  invokes SparseGridDriver::update_sets()
• void finalize_sets (bool output_sets, bool converged_within_tol)
  invokes SparseGridDriver::finalize_sets()
• void evaluate_grid_increment ()
  invokes SparseGridDriver::evaluate_grid_increment()
• int num_samples () const

Protected Member Functions
• NonDSparseGrid (ProblemDescDB &problem_db, Model &model)
  constructor
• ~NonDSparseGrid ()
  destructor
• void initialize_grid (const std::vector<Pecos::BasisPolynomial> &poly_basis)
  initialize integration grid by drawing from polynomial basis settings
• void get_parameter_sets (Model &model)
  Returns one block of samples (ndim * num_samples)
• void reset ()
  restore initial state for repeated sub-iterator executions
• void sampling_reset (int min_samples, bool all_data_flag, bool stats_flag)

Private Attributes
• Pecos::SparseGridDriver * ssgDriver
  convenience pointer to the numIntDriver representation
• UShortArray ssgLevelSeqSpec
  the user specification for the Smolyak sparse grid level, defining a sequence of refinement levels.
• unsigned short ssgLevelRef
  reference point (e.g., lower bound) for the Smolyak sparse grid level maintained within ssgDriver

Additional Inherited Members

13.122.1 Detailed Description
Derived nondeterministic class that generates N-dimensional Smolyak sparse grids for numerical evaluation of expectation integrals over independent standard random variables.

This class is used by NonDPolynomialChaos and NonDStochCollocation, but could also be used for general numerical integration of moments. It employs 1-D Clenshaw-Curtis and Gaussian quadrature rules within Smolyak sparse grids.

13.122.2 Constructor & Destructor Documentation
NonDSparseGrid (Model & model, const UShortArray & ssg_level_seq, const RealVector & dim_pref, short exp_coeffs_soln, short driver_mode, short growth_rate = Pecos::MODERATE_RESTRICTED_GROWTH, short refine_control = Pecos::NO_CONTROL, bool track_uniq_prod_wts = true, bool track_colloc_indices = true)

This alternate constructor is used for on-the-fly generation and evaluation of sparse grids within PCE and SC.

References NonDIntegration::numIntDriver, and NonDSparseGrid::ssgDriver.
NonDSparseGrid (ProblemDescDB & problem_db, Model & model) [protected]

Constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification. It is not currently used, as there is not a separate sparse_grid method specification.

References Model::aleatory_distribution_parameters(), NonDIntegration::check_variables(), Iterator::convergence-Tol, NonDIntegration::dimPrefSpec, ProblemDescDB::get_bool(), ProblemDescDB::get_short(), ProblemDescDB::get_ushort(), NonDSparseGrid::initialize_grid(), Iterator::iteratedModel, Iterator::maxEvalConcurrency, Iterator::maxIterations, NonD::natafTransform, NonDIntegration::numIntDriver, Iterator::outputLevel, Iterator::probDescDB, NonDSparseGrid::ssgDriver, and NonDSparseGrid::ssgLevelRef.

13.122.3 Member Function Documentation

int num_samples() const [inline], [virtual]

Return current number of evaluation points. Since the calculation of samples, collocation points, etc. might be costly, provide a default implementation here that backs out from the maxEvalConcurrency.

Reimplemented from Analyzer.

References NonDSparseGrid::ssgDriver.

void sampling_reset (int min_samples, bool all_data_flag, bool stats_flag) [protected], [virtual]

used by DataFitSurrModel::build_global() to publish the minimum number of points needed from the sparse grid routine in order to build a particular global approximation.

Reimplemented from Iterator.

References NonDSparseGrid::ssgDriver, and NonDSparseGrid::ssgLevelRef.

The documentation for this class was generated from the following files:

- NonDSparseGrid.hpp
- NonDSparseGrid.cpp

13.123 NonDStochCollocation Class Reference

Nonintrusive stochastic collocation approaches to uncertainty quantification.

Inheritance diagram for NonDStochCollocation:

```
  NonDStochCollocation
    NonDExpansion
    NonD
    Analyzer
    Iterator

```
CHAPTER 13. CLASS DOCUMENTATION

**Public Member Functions**

- **NonDStochCollocation (ProblemDescDB &problem_db, Model &model)**
  
  *standard constructor*

- **NonDStochCollocation (Model &model, short exp_coeffs_approach, const UShortArray &num_int_seq, const RealVector &dim_pref, short u_space_type, bool piecewise_basis, bool use_derivs)**
  
  *alternate constructor*

- **∼ NonDStochCollocation ()**
  
  *destructor*

- **bool resize ()**
  
  *reinitializes iterator based on new variable size*

**Protected Member Functions**

- **void resolve_inputs (short &u_space_type, short &data_order)**
  
  *perform error checks and mode overrides*

- **void initialize_u_space_model ()**
  
  *initialize uSpaceModel polynomial approximations with PCE/SC data*

- **void update_expansion ()**
  
  *update an expansion; avoids overhead in compute_expansion()*

- **Real compute_covariance_metric ()**
  
  *compute 2-norm of change in response covariance*

- **Real compute_final_statistics_metric ()**
  
  *compute 2-norm of change in final statistics*

**Additional Inherited Members**

**13.123.1 Detailed Description**

Nonintrusive stochastic collocation approaches to uncertainty quantification.

The **NonDStochCollocation** class uses a stochastic collocation (SC) approach to approximate the effect of parameter uncertainties on response functions of interest. It utilizes the InterpPolyApproximation class to manage multidimensional Lagrange polynomial interpolants.

**13.123.2 Constructor & Destructor Documentation**

**NonDStochCollocation ( ProblemDescDB & problem_db, Model & model )**

*standard constructor*

This constructor is called for a standard letter-envelope iterator instantiation using the **ProblemDescDB**.

References **Response::active_set(), Model::assign_rep(), NonDExpansion::check_dimension_preference(), Parallel-Library::command_line_check(), NonDExpansion::construct_expansion_sampler(), NonDExpansion::construct_quadrature(), NonDExpansion::construct_sparse_grid(), Model::current_response(), NonDExpansion::expansion_BasisType, NonDExpansion::expansionCoeffsApproach, ProblemDescDB::get_bool(), ProblemDescDB::get_rv(), ProblemDescDB::get_short(), ProblemDescDB::get_string(), ProblemDescDB::get_usa(), ProblemDescDB::get_ushort(), NonDExpansion::initialize(), NonDStochCollocation::initialize_u_space_model(), Iterator::iteratedModel, NonDExpansion::nestedRules, NonDExpansion::numSamplesOnModel, Iterator::outputLevel, Iterator::parallel_Lib, NonDExpansion::piecewiseBasis, Iterator::probDescDB, NonDExpansion::refineControl, ActiveSet::request_values(), NonDStochCollocation::resolve_inputs(), NonD::transform_model(), and NonDExpansion::uSpaceModel.
NonDStochCollocation ( Model & model, short exp_coeffs_approach, const UShortArray & num_int_seq, const RealVector & dim_pref, short u_space_type, bool piecewise_basis, bool use_derivs )

alternate constructor
This constructor is used for helper iterator instantiation on the fly.
References Response::active_set(), Model::assign_rep(), NonDExpansion::check_dimension_preference(), NonDExpansion::construct_quadrature(), NonDExpansion::construct_sparse_grid(), Model::current_response(), NonDStochCollocation::expansionBasisType, NonDExpansion::expansionCoeffsApproach, NonDExpansion::initialize(), NonDStochCollocation::initialize_u_space_model(), Iterator::iteratedModel, Iterator::outputLevel, NonDExpansion::piecewiseBasis, ActiveSet::request_values(), NonDStochCollocation::resolve_inputs(), NonD::transform_model(), and NonDExpansion::uSpaceModel.

13.123.3 Member Function Documentation

Real compute_covariance_metric ( ) [protected], [virtual]
compute 2-norm of change in response covariance
computes the default refinement metric based on change in respCovariance
Reimplemented from NonDExpansion.
References Model::approximations(), NonDExpansion::compute_covariance_metric(), PecosApproximation::delta_covariance(), PecosApproximation::expansion_coefficient_flag(), NonDExpansion::expansionBasisType, NonDExpansion::initialPtU, NonD::numContDesVars, NonD::numContEpistUncVars, NonD::numContStateVars, Response::num_functions(), NonD::numFunctions, NonD::respCovariance, and NonDExpansion::uSpaceModel.

Real compute_final_statistics_metric ( ) [protected], [virtual]
compute 2-norm of change in final statistics
computes a "goal-oriented" refinement metric employing finalStatistics
Reimplemented from NonDExpansion.
References Model::approximations(), NonD::cdfFlag, NonDExpansion::compute_final_statistics_metric(), NonDExpansion::compute_statistics(), PecosApproximation::delta_z(), PecosApproximation::expansion_coefficient_flag(), NonDExpansion::expansionBasisType, NonD::finalStatistics, Response::function_values(), NonDExpansion::initialPtU, Response::num_functions(), NonD::numContEpistUncVars, NonD::numContEpistUncVars, NonD::numContStateVars, Analyzer::numFunctions, NonD::requestedGenRelLevels, NonD::requestedProbLevels, NonD::requestedRelLevels, NonD::requestedRespLevels, NonD::respLevelTarget, and NonDExpansion::uSpaceModel.

The documentation for this class was generated from the following files:

- NonDStochCollocation.hpp
- NonDStochCollocation.cpp

13.124 NonDWASABIBayesCalibration Class Reference

WASABI - Weighted Adaptive Surrogate Approximations for Bayesian Inference.
Inheritance diagram for NonDWASABIBayesCalibration:
Public Member Functions

- **NonDWASABIBayesCalibration (ProblemDescDB &problem_db, Model &model)**
  
  *standard constructor*

- **~NonDWASABIBayesCalibration ()**
  
  *destructor*

- **void compute_responses (RealMatrix &samples, RealMatrix &responses)**

Static Public Member Functions

- **static void problem_size (int &chain_num, int &cr_num, int &gen_num, int &pair_num, int &par_num)**
  
  *initializer for problem size characteristics in WASABI*

- **static void problem_value (std::string *chain_filename, std::string *gr_filename, double &gr_threshold, int &jumpstep, double limits[], int par_num, int &printstep, std::string *restart_read_filename, std::string *restart_write_filename)**

  *Filename and data initializer for WASABI.*

Protected Member Functions

- **void core_run ()**

- **void print_results (std::ostream &s)**

  *print the final iterator results*

- **void extract_selected_posterior_samples (const std::vector<int> &points_to_keep, const RealMatrix &samples_for_posterior_eval, const RealVector &posterior_density, RealMatrix &posterior_data)**

  *Extract a subset of samples for posterior eval according to the indices in points_to_keep.*

- **void export_posterior_samples_to_file (const std::string filename, const RealMatrix &posterior_data)**

  *Export posterior data to file.*
Protected Attributes

- RealVector **dataDistMeans**
  
  *The mean of the multivariate Gaussian distribution of the obs. data.*

- RealVector **dataDistCovariance**
  
  *The covariance of the multivariate Gaussian distribution of the obs. data.*

- std::string **dataDistFilename**
  
  *The filename of the file containing the data that with density estimator defines the distribution of the obs. data.*

- std::string **dataDistCovType**
  
  *The type of covariance data provided ("diagonal","matrix")*

- std::string **posteriorSamplesImportFile**
  
  *The filename of the import file containing samples at which the posterior will be evaluated.*

- unsigned short **posteriorSamplesImportFormat**
  
  *Format of imported posterior samples file.*

- std::string **exportPosteriorDensityFile**
  
  *The filename of the export file containing an arbitrary set of samples and their corresponding density values.*

- std::string **exportPosteriorSamplesFile**
  
  *The filename of the export file containing samples from the posterior and their corresponding density values.*

- unsigned short **exportFileFormat**
  
  *Format of imported posterior samples and values file.*

- bool **generateRandomPosteriorSamples**
  
  *Flag specifying whether to generate random samples from the posterior.*

- bool **evaluatePosteriorDensity**
  
  *Flag specifying whether to evaluate the posterior density at a set of samples.*

- RealVector **paramMins**
  
  *lower bounds on calibrated parameters*

- RealVector **paramMaxs**
  
  *upper bounds on calibrated parameters*

- boost::mt19937 **rnumGenerator**
  
  *random number engine for sampling the prior*

Additional Inherited Members

13.124.1 Detailed Description

**WASABI - Weighted Adaptive Surrogate Approximations for Bayesian Inference.**

This class performs Bayesian calibration using the WASABI approach.

13.124.2 Constructor & Destructor Documentation

**NonDWASABIBayesCalibration** ( ProblemDescDB & probDescDB, Model & model )

standard constructor

This constructor is called for a standard letter-envelope iterator instantiation. In this case, set_db_list_nodes has been called and probDescDB can be queried for settings from the method specification.
13.124.3 Member Function Documentation

```cpp
void core_run ( ) [protected], [virtual]
```

Perform the uncertainty quantification
Reimplemented from `Iterator`.
References Dakota::abort_handler(), Dakota::copy_data(), NonDBayesCalibration::emulatorType, NonDWASABIBayesCalibration::evaluatePosteriorDensity, NonDWASABIBayesCalibration::export_posterior_samples_to_file(), NonDWASABIBayesCalibration::exportPosteriorDensityFile, NonDWASABIBayesCalibration::exportPosteriorSamplesFile, NonDWASABIBayesCalibration::extract_selected_posterior_samples(), NonD::generate_system_seed(), NonDWASABIBayesCalibration::generateRandomPosteriorSamples, NonDBayesCalibration::initialize_model(), NonD::natafTransform, NonDBayesCalibration::nonBayesInstance, Analyzer::numContinuousVars, Iterator::outputLevel, NonDWASABIBayesCalibration::paramMaxs, NonDWASABIBayesCalibration::paramMins, NonDWASABIBayesCalibration::posteriorSamplesImportFile, NonDBayesCalibration::prior_density(), NonDBayesCalibration::prior_sample(), NonDBayesCalibration::randomSeed, NonDWASABIBayesCalibration::rnumGenerator, and NonDBayesCalibration::standardizedSpace.

```cpp
void print_results ( std::ostream & s ) [protected], [virtual]
```

print the final iterator results
This virtual function provides additional iterator-specific final results outputs beyond the function evaluation summary printed in `finalize_run()`.
Reimplemented from `NonDBayesCalibration`.
References `NonDBayesCalibration::print_results()`.
The documentation for this class was generated from the following files:

- NonDWASABIBayesCalibration.hpp
- NonDWASABIBayesCalibration.cpp

13.125 NonlinearCGOptimizer Class Reference

Inheritance diagram for NonlinearCGOptimizer:

```
NonlinearCGOptimizer
    |    |
    | Minimizer
    |    |
    | Optimizer
    |    |
    | Iterator
```

Public Member Functions

- `NonlinearCGOptimizer (ProblemDescDB &problem_db, Model &model)`
  * standard constructor
- `~NonlinearCGOptimizer ()`
13.125. **NONLINEARCGOPTIMIZER CLASS REFERENCE**

** Destructor **
- Real linesearch_eval (const Real &trial_step, short req_val=1)
  
  evaluate the objective function given a particular step size (public for use in boost ls_eval functor; could use friend)

** Protected Member Functions **
- void core_run ()
  
  core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

** Private Member Functions **
- void parse_options ()
  
  constructor helper function to parse misc_options from ProblemDescDB
- void compute_direction ()
  
  compute next direction via choice of method
- bool compute_step ()
  
  compute step: fixed, simple decrease, sufficient decrease
- void bracket_min (Real &xa, Real &xb, Real &xc, Real &fa, Real &fb, Real &fc)
  
  bracket the 1-D minimum in the linesearch
- Real brent_minimize (Real a, Real b, Real tol)
  
  Perform 1-D minimization for the stepLength using Brent's method.

** Private Attributes **
- Real initialStep
  
  initial step length
- Real linesearchTolerance
  
  approximate accuracy of absissca in LS
- unsigned linesearchType
  
  type of line search (if any)
- unsigned maxLinesearchIters
  
  maximum evaluations in line search
- Real relFunctionTol
  
  stopping criterion for rel change in fn
- Real relGradientTol
  
  stopping criterion for rel reduction in g
- bool resetStep
  
  whether to reset step with each linesearch
- unsigned restartIter
  
  iter at which to reset to steepest descent
- unsigned updateType
  
  type of CG direction update
- unsigned iterCurr
  
  current iteration number
- RealVector designVars
current decision variables in the major iteration

- RealVector trialVars
decision variables in the linesearch

- Real functionCurr
current function value

- Real functionPrev
previous function value

- RealVector gradCurr
current gradient

- RealVector gradPrev
previous gradient

- RealVector gradDiff
temporary for gradient difference (gradCurr - gradPrev)

- RealVector searchDirection
current aggregate search direction

- Real stepLength
current step length parameter alpha

- Real gradDotGrad_init
initial gradient norm squared

- Real gradDotGrad_curr
gradCurr dot gradCurr

- Real gradDotGrad_prev
gradPrev dot gradPrev

Additional Inherited Members

13.125.1 Detailed Description
Experimental implementation of nonlinear CG optimization

13.125.2 Member Function Documentation

```cpp
void core_run() [protected], [virtual]
```
core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post
Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.
Reimplemented from `Iterator`.

References: `Iterator::activeSet`, `Iterator::bestResponseArray`, `Iterator::bestVariablesArray`, `NonlinearCGOptimizer::compute_direction()`, `NonlinearCGOptimizer::compute_step()`, `Model::continuous_variables()`, `Iterator::convergenceTol`, `Dakota::copy_data()`, `Model::current_response()`, `NonlinearCGOptimizer::designVars`, `Model::evaluate()`, `Response::function_gradient_copy()`, `Response::function_gradient_view()`, `Response::function_values()`, `NonlinearCGOptimizer::functionCurr`, `NonlinearCGOptimizer::functionPrev`, `NonlinearCGOptimizer::gradCurr`, `NonlinearCGOptimizer::gradDotGrad_curr`, `NonlinearCGOptimizer::gradDotGrad_init`, `NonlinearCGOptimizer::gradDotGrad_prev`, `NonlinearCGOptimizer::gradPrev`, `Iterator::iteratedModel`, `NonlinearCGOptimizer::iterCurr`, `NonlinearCGOptimizer::linesearchType`, `Optimizer::localObjectiveRecast`, `Iterator::maxIterations`, `Minimizer::numContinuousVars`, `Iterator::outputLevel`, `NonlinearCGOptimizer::relFunctionTol`, `NonlinearCGOptimizer::relGradientTol`, `ActiveSet::request_values()`, `NonlinearCGOptimizer::searchDirection`, `NonlinearCGOptimizer::stepLength`, and `NonlinearCGOptimizer::trialVars`. 
Real brent_minimize ( Real a, Real b, Real tol ) [private]

Perform 1-D minimization for the stepLength using Brent’s method.

References NonlinearCGOptimizer::linesearch_eval(), NonlinearCGOptimizer::maxLinesearchIters, and Iterator-::outputLevel.

The documentation for this class was generated from the following files:

- NonlinearCGOptimizer.hpp
- NonlinearCGOptimizer.cpp

13.126 NPSOLOptimizer Class Reference

Wrapper class for the NPSOL optimization library.

Inheritance diagram for NPSOLOptimizer:

```
Iterator
Minimizer
Optimizer  SOLBase
NPSOLOptimizer
```

Public Member Functions

- NPSOLOptimizer (ProblemDescDB &problem_db, Model &model)
  
  standard constructor

- NPSOLOptimizer (Model &model)
  
  alternate constructor for Iterator instantiations by name

- NPSOLOptimizer (Model &model, const int &derivative_level, const Real &conv_tol)
  
  alternate constructor for instantiations "on the fly"

- NPSOLOptimizer (const RealVector &initial_point, const RealVector &var_lower_bnds, const RealVector &var_upper_bnds, const RealMatrix &lin_ineq_coeffs, const RealVector &lin_ineq_lower_bnds, const RealVector &lin_ineq_upper_bnds, const RealMatrix &lin_eq_coeffs, const RealVector &lin_eq_targets, const RealVector &nonlin_ineq_lower_bnds, const RealVector &nonlin_ineq_upper_bnds, const RealVector &nonlin_eq_targets, void(*user_obj_eval)(int &, int &, double *, double &, double *, int &), void(*user_con_eval)(int &), int &), const int &derivative_level, const Real &conv_tol)
  
  alternate constructor for instantiations "on the fly"

- ~NPSOLOptimizer ()
  
  destructor

- void core_run ()
core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

Private Member Functions

- void find_optimum_on_model ()
  called by core_run for setUpType == "model"
- void find_optimum_on_user_functions ()
  called by core_run for setUpType == "user_functions"

Static Private Member Functions

- static void objective_eval (int &mode, int &n, double *x, double &f, double *gradf, int &nstate)
  OBJFUN in NPSOL manual: computes the value and first derivatives of the objective function (passed by function pointer to NPSOL).

Private Attributes

- String setUpType
  controls iteration mode: "model" (normal usage) or "user_functions" (user-supplied functions mode for "on the fly" instantiations). NonDReliability currently uses the user_functions mode.
- RealVector initialPoint
  holds initial point passed in for "user_functions" mode.
- RealVector lowerBounds
  holds variable lower bounds passed in for "user_functions" mode.
- RealVector upperBounds
  holds variable upper bounds passed in for "user_functions" mode.
- void(* userObjectiveEval )(int &, int &, double *, double &, double *, int &)
  holds function pointer for objective function evaluator passed in for "user_functions" mode.
- void(* userConstraintEval )(int &, int &, int &, int &, int *, double *, double *, double *, int &)
  holds function pointer for constraint function evaluator passed in for "user_functions" mode.

Static Private Attributes

- static NPSOLOptimizer * npsolInstance
  pointer to the active object instance used within the static evaluator functions in order to avoid the need for static data

Additional Inherited Members

13.126.1 Detailed Description

Wrapper class for the NPSOL optimization library.

The NPSOLOptimizer class provides a wrapper for NPSOL, a Fortran 77 sequential quadratic programming library from Stanford University marketed by Stanford Business Associates. It uses a function pointer approach for which passed functions must be either global functions or static member functions. Any attribute used within static member functions must be either local to that function or accessed through a static pointer.

The user input mappings are as follows: max_function_evaluations is implemented directly in NPSOLOptimizer’s evaluator functions since there is no NPSOL parameter equivalent, and max_iterations,
13.126. NPSOLOPTIMIZER CLASS REFERENCE

convergence_tolerance, output verbosity, verify_level, function_precision, and linesearch_tolerance are mapped into NPSOL’s "Major Iteration Limit", "Optimality Tolerance", "Major Print Level" (verbose: Major Print Level = 20; quiet: Major Print Level = 10), "Verify Level", "Function Precision", and "Linesearch Tolerance" parameters, respectively, using NPSOL’s npoptn subroutine (as wrapped by npoptn2() from the npoptn_wrapper.f file). Refer to [Gill, P.E., Murray, W., Saunders, M.A., and Wright, M.H., 1986] for information on NPSOL’s optional input parameters and the npoptn() subroutine.

13.126.2 Constructor & Destructor Documentation

NPSOLOptimizer ( ProblemDescDB & problem_db, Model & model )

standard constructor
This is the primary constructor. It accepts a Model reference.
References Minimizer::constraintTol, Iterator::convergenceTol, Model::fd_gradient_step_size(), ProblemDescDB::get_int(), ProblemDescDB::get_real(), Model::gradient_type(), Iterator::iteratedModel, Iterator::maxIterations, Iterator::outputLevel, Iterator::probDescDB, SOLBase::set_options(), Minimizer::speculativeFlag, and Minimizer::vendorNumericalGradFlag.

NPSOLOptimizer ( Model & model )

alternate constructor for Iterator instantiations by name
This is an alternate constructor which accepts a Model but does not have a supporting method specification from the ProblemDescDB.
References Minimizer::constraintTol, Iterator::convergenceTol, Model::fd_gradient_step_size(), Model::gradient_type(), Iterator::iteratedModel, Iterator::maxIterations, Iterator::outputLevel, SOLBase::set_options(), Minimizer::speculativeFlag, and Minimizer::vendorNumericalGradFlag.

NPSOLOptimizer ( Model & model, const int & derivative_level, const Real & conv_tol )

alternate constructor for instantiations "on the fly"
This is an alternate constructor for instantiations on the fly using a Model but no ProblemDescDB.

NPSOLOptimizer ( const RealVector & initial_point, const RealVector & var_lower_bnds, const RealVector & var_upper_bnds, const RealMatrix & lin_ineq_coeffs, const RealVector & lin_ineq_lower_bnds, const RealVector & lin_ineq_upper_bnds, const RealMatrix & lin_eq_coeffs, const RealVector & lin_eq_targets, const RealVector & nonlin_ineq_lower_bnds, const RealVector & nonlin_ineq_upper_bnds, const RealVector & nonlin_eq_targets, void(*)(int &, int &, double *, double &, double *, int &) user_obj_eval, void(*)(int &, int &, int &, int &, int *, double *, double *, double *, int &) user_con_eval, const int & derivative_level, const Real & conv_tol )

alternate constructor for instantiations "on the fly"
This is an alternate constructor for performing an optimization using the passed in objective function and constraint function pointers.
References SOLBase::allocate_arrays(), SOLBase::allocate_workspace(), SOLBase::augment_bounds(), NPSOLOptimizer::lowerBounds, Minimizer::numContinuousVars, Minimizer::numLinearConstraints, Minimizer::numNonlinearConstraints, and NPSOLOptimizer::upperBounds.
13.126.3 Member Function Documentation

```c++
void core_run() [virtual]
```
core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post
Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.
Reimplemented from Iterator.
References Dakota::abort_handler(), NPSOLOptimizer::find_optimum_on_model(), NPSOLOptimizer::find_-optimum_on_user_functions(), and NPSOLOptimizer::setUpType.
The documentation for this class was generated from the following files:

- NPSOLOptimizer.hpp
- NPSOLOptimizer.cpp

13.127 OptDartsOptimizer Class Reference

Wrapper class for OptDarts Optimizer.
Inheritance diagram for OptDartsOptimizer:

```
+-----------------+                 +-------+         +--------+
| Iterator        |                 | Minimizer |         | Optimizer |
|                 |                  |           |         |          |
|                 +-----------------+         +--------+
|                     | Optimizer        |          |
|                     |                 |          |
+-----------------+---+-------+         +--------+
            |     | Minimizer |
+---------+---+-------+         +--------+
  | OptDartsOptimizer |
```

Public Member Functions

- OptDartsOptimizer (ProblemDescDB &problem_db, Model &model)
  Constructor.
- OptDartsOptimizer (Model &model)
  alternate constructor for Iterator instantiations by name
- ~OptDartsOptimizer ()
  Destructor.
- void core_run ()
  Calls the OptDarts algorithm.

Private Member Functions

- void load_parameters (Model &model)
  Convenience function for Parameter loading.
- double opt_darts_f ()
  Function evaluation.
void opt_darts_execute (size_t num_dim, size_t budget, double *xmin, double *xmax, double TOL, size_t problem_index, double fw_MC, double fb_MC)

Run the OPT-DARTS method.

void opt_darts_initiate (double *xmin, double *xmax)

Initialize OPT-DARTS.

void opt_darts_reset_convex_hull ()

Choose the next trial iterate.

void retrieve_extended_neighbors (size_t icandidate)

void opt_darts_sample_from_candidate_neighborhood (size_t icandidate, size_t ifunc)

void DIRECT_sample_from_candidate_neighborhood (size_t icandidate)

void opt_darts_add_dart ()

void opt_darts_update_K_h_approximate_Voronoi (size_t isample)

void opt_dartsTerminate ()

Release memory and exit cleanly.

void opt_darts_plot_discs_2d (size_t icandidate)

Convenience function for plotting iterates.

void opt_darts_plot_hull_2d (size_t icandidate, size_t ifunc)

Convenience function for plotting convex hull.

void initiate_random_generator (unsigned long x)

double generate_a_random_number ()

void sample_uniformly_from_unit_sphere_surface (double *dart, size_t num_dim)

bool trim_line_using_Hyperplane (size_t num_dim, double *st, double *end, double *qH, double *nH)

Private Attributes

double * _xmin

double * _xmax

double * _dart

double * _st

double * _end

double * _tmp_point

double * _qH

double * _nH

double ** _x

double ** _xc

double ** _f

double ** _K

double * _h

double * _r

size_t ** _neighbors

size_t * _tmp_neighbors

size_t * _ext_neighbors

size_t _num_ext_neighbors

bool _use_opt_darts

bool _estimate_K
Additional Inherited Members

13.127.1 Detailed Description

Wrapper class for OptDarts Optimizer.

The documentation for this class was generated from the following files:

- OptDartsOptimizer.hpp
- OptDartsOptimizer.cpp
13.128 Optimizer Class Reference

Base class for the optimizer branch of the iterator hierarchy.

Inheritance diagram for Optimizer:

```
Iterator
    Minimizer
        Optimizer
            APPSOptimizer
            COLINOptimizer
            CONMINOptimizer
            DOTOptimizer
            JEGAOptimizer
            NCSUOptimizer
            NLPQLPOptimizer
            NomadOptimizer
            NonlinearCGOptimizer
            NPSOLOptimizer
            OptDartsOptimizer
            SNLLOptimizer
```

Static Public Member Functions

- static void not_available (const std::string &package_name)
  
  Static helper function: third-party opt packages which are not available.

Protected Member Functions

- Optimizer ()
  
  default constructor

- Optimizer (ProblemDescDB &problem_db, Model &model)
  
  alternate constructor; accepts a model

- Optimizer (unsigned short method_name, Model &model)
  
  alternate constructor for "on the fly" instantiations
• **Optimizer** (unsigned short *method_name*, size_t *num_cv*, size_t *num_div*, size_t *num_dsv*, size_t *num_drv*, size_t *num_lin_ineq*, size_t *num_lin_eq*, size_t *num_nln_ineq*, size_t *num_nln_eq*)

  alternate constructor for "on the fly" instantiations

• ~Optimizer ()

  destructor

• void initialize_run ()

• void post_run (std::ostream &s)

• void finalize_run ()

  utility function to perform common operations following *post_run*(); deallocation and resetting of instance pointers

• void print_results (std::ostream &s)

**Protected Attributes**

• size_t *numObjectiveFns*

  number of objective functions (iterator view)

• bool *localObjectiveRecast*

  flag indicating whether local recasting to a single objective is used

• Optimizer * prevOptInstance

  pointer containing previous value of optimizerInstance

**Static Protected Attributes**

• static Optimizer * optimizerInstance

  pointer to Optimizer instance used in static member functions

**Private Member Functions**

• void reduce_model (bool *local_nls_recast*, bool *require_hessians*)

  Wrap *iteratedModel* in a *RecastModel* that performs (weighted) multi-objective or sum-of-squared residuals transformation.

• void objective_reduction (const Response & *full_response*, const BoolDeque & *sense*, const RealVector & *full_wts*, Response & *reduced_response*) const

  forward mapping: maps multiple primary response functions to a single weighted objective for single-objective optimizers

**Static Private Member Functions**

• static void primary_resp_reducer (const Variables & *full_vars*, const Variables & *reduced_vars*, const Response & *full_response*, Response & *reduced_response*)

  Recast callback to reduce multiple objectives or residuals to a single objective, with gradients and Hessians as needed.

**Additional Inherited Members**

13.128.1 Detailed Description

Base class for the optimizer branch of the iterator hierarchy.

The Optimizer class provides common data and functionality for DOTOptimizer, CONMINOptimizer, NPSOLOptimizer, SNLLOptimizer, NLPQLPOptimizer, COLINOptimizer, and JEGAOptimizer.
13.128.2 Member Function Documentation

void initialize_run ( ) [protected], [virtual]

Implements portions of initialize_run specific to Optimizers. This function should be invoked (or reimplemented) by any derived implementations of initialize_run() (which would otherwise hide it).

Reimplemented from Minimizer.
Reimplemented in SNLLOptimizer, NLPQLPOptimizer, and DOTOptimizer.
References Minimizer::initialize_run(), Iterator::iteratedModel, Iterator::myModelLayers, Optimizer::optimizerInstance, Optimizer::prevOptInstance, and Model::update_from_subordinate_model().
Referenced by DOTOptimizer::initialize_run(), CONMINOptimizer::initialize_run(), NLPQLPOptimizer::initialize_run(), and SNLLOptimizer::initialize_run().

void post_run ( std::ostream & s ) [protected], [virtual]

Implements portions of post_run specific to Optimizers. This function should be invoked (or reimplemented) by any derived implementations of post_run() (which would otherwise hide it).

Reimplemented from Minimizer.
Reimplemented in SNLLOptimizer.
References Dakota::abort_handler(), Iterator::bestResponseArray, Iterator::bestVariablesArray, Variables::continuous_variables(), ScalingModel::cv_scaled2native(), Minimizer::local_recast_retrieve(), Optimizer::localObjectiveRecast, Model::model_rep(), Minimizer::post_run(), ScalingModel::resp_scaled2native(), Minimizer::scaleFlag, and Minimizer::scalingModel.
Referenced by COLINOptimizer::post_run(), and SNLLOptimizer::post_run().

void finalize_run ( ) [inline], [protected], [virtual]

utility function to perform common operations following post_run(); deallocation and resetting of instance pointers
Optional: perform finalization phases of run sequence, like deallocating memory and resetting instance pointers. Commonly used in sub-iterator executions. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s finalize_run(), typically after performing its own implementation steps.

Reimplemented from Minimizer.
Reimplemented in SNLLOptimizer.
References Minimizer::finalize_run(), Optimizer::optimizerInstance, and Optimizer::prevOptInstance.
Referenced by SNLLOptimizer::finalize_run().

void print_results ( std::ostream & s ) [protected], [virtual]

Redefines default iterator results printing to include optimization results (objective functions and constraints).

Reimplemented from Iterator.
References Dakota::abort_handler(), Minimizer::archive_allocate_best(), Minimizer::archive_best(), Iterator::bestResponseArray, Iterator::bestVariablesArray, Minimizer::calibrationDataFlag, Model::current_response(), Dakota::data_pairs, DataTransformModel::data_transform_response(), Minimizer::dataTransformModel, Response::function_values(), Model::interface_id(), Dakota::lookup_by_val(), Model::model_rep(), Model::num_functions(), Minimizer::numContinuousVars, Minimizer::numNonlinearConstraints, Minimizer::numTotalCalibTerms, Minimizer::numUserPrimaryFns, Minimizer::optimizationFlag, Minimizer::original_model(), Model::primary_response_fn_weights(), Minimizer::print_model_resp(), and Minimizer::print_residuals().
void reduce_model ( bool local_nls_recast, bool require_hessians ) [private]

Wrap iteratedModel in a RecastModel that performs (weighted) multi-objective or sum-of-squared residuals transformation.

Reduce model for least-squares or multi-objective transformation. Doesn’t map variables, or secondary responses. Maps active set for Gauss-Newton. Maps primary responses to single objective so user vs. iterated matters.

References Iterator::activeSet, Model::assign_rep(), Minimizer::calibrationDataFlag, Model::current_response(), Response::function_gradients(), Iterator::gnewton_set_recast(), Model::hessian_type(), Iterator::iteratedModel, Iterator::myModelLayers, Minimizer::numContinuousVars, Minimizer::numFunctions, Minimizer::numIterPrimaryFns, Minimizer::numNonlinearConstraints, Minimizer::numNonlinearIneqConstraints, Optimizer::numObjectiveFns, Minimizer::numTotalCalibTerms, Minimizer::numUserPrimaryFns, Iterator::outputLevel, Model::primary_fn_type(), Optimizer::primary_resp_reducer(), Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), ActiveSet::request_vector(), and Response::reshape().

Referenced by Optimizer::Optimizer().

void primary_resp_reducer ( const Variables & full_vars, const Variables & reduced_vars, const Response & full_response, Response & reduced_response ) [static], [private]

Recast callback to reduce multiple objectives or residuals to a single objective, with gradients and Hessians as needed.

Objective function map from multiple primary responses (objective or residuals) to a single objective. Currently supports weighted sum; may later want more general transformations, e.g., goal-oriented

References Iterator::iteratedModel, Optimizer::objective_reduction(), Optimizer::optimizerInstance, Iterator::outputLevel, Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), and Model::subordinate_model().

Referenced by Optimizer::reduce_model().

void objective_reduction ( const Response & full_response, const BoolDeque & sense, const RealVector & full_wts, Response & reduced_response ) const [private]

forward mapping: maps multiple primary response functions to a single weighted objective for single-objective optimizers

This function is responsible for the mapping of multiple objective functions into a single objective for publishing to single-objective optimizers. Used in DOTOptimizer, NPSOLOptimizer, SNLLOptimizer, and SGOPTApplication on every function evaluation. The simple weighting approach (using primaryRespFnWts) is the only technique supported currently. The weightings are used to scale function values, gradients, and Hessians as needed.

References Response::active_set_request_vector(), Response::function_gradient_view(), Response::function_gradients(), Response::function_hessian_view(), Response::function_hessians(), Response::function_value(), Response::function_values(), Response::num_functions(), Minimizer::numConstraints, Minimizer::objective(), Minimizer::objective_gradient(), Minimizer::objective_hessian(), Iterator::outputLevel, and Dakota::write_precision.

Referenced by Optimizer::primary_resp_reducer().

The documentation for this class was generated from the following files:

- DakotaOptimizer.hpp
- DakotaOptimizer.cpp
13.129 OutputManager Class Reference

Class to manage redirection of stdout/stderr, keep track of current redir state, and manage rank 0 output. Also manage tabular data output for post-processing with Matlab, Tecplot, etc. and delegate to Graphics for X Windows Graphics.

Public Member Functions

- **OutputManager ()**
  Default constructor (needed for default environment ctors)

- **OutputManager (const ProgramOptions &prog_opts, int dakota_world_rank=0, bool dakota_mpirun_flag=false)**
  Standard constructor, taking user-specified program options and optionally taking the rank of this process in Dakota's MPI_Comm.

- **~OutputManager ()**
  Destructor that closes streams and other outputs.

- **void close_streams ()**
  helper to close streams during destructor or abnormal abort

- **Graphics & graphics ()**
  retrieve the graphics handler object

- **void parse (const ProblemDescDB &problem_db)**
  Extract environment options from ProblemDescDB.

- **void startup_message (const String &start_msg)**
  Set the Dakota startup message ("Running on...")

- **void push_output_tag (const String &iterator_tag, const ProgramOptions &prog_opts, bool force_cout_redirect, bool force_rst_redirect)**
  Update the tag to use on files and rebind any streams as needed.

- **String build_output_tag () const**
  return the full output tag

- **void pop_output_tag ()**
  (Potentially) remove an output context and rebind streams

- **void output_version (std::ostream &os=Cout) const**
  Output the current Dakota version.

- **void output_startup_message (std::ostream &os=Cout) const**
  Output the startup header and time.

- **void output_helper (const String &message, std::ostream &os) const**
  Output only on Dakota world rank 0 (for version, help, etc.)

- **void append_restart (const ParamResponsePair &prp)**
  append a parameter/response set to the restart file

- **void add_datapoint (const Variables &vars, const String &_iface, const Response &response)**
  adds data to each window in the 2d graphics and adds a row to the tabular data file based on the results of a model evaluation

- **void create_tabular_datastream (const Variables &vars, const Response &resp)**
  initialize the tabular datastream on iterator leaders

- **void close_tabular ()**
  close tabular datastream
void graphics_counter (int cntr)  
set graphicsCntr equal to cntr

int graphics_counter () const  
return graphicsCntr

void tabular_counter_label (const std::string &label)  
set tabularCntrLabel equal to label

Public Attributes

- bool graph2DFlag  
  whether user requested 2D graphics plots
- bool tabularDataFlag  
  whether user requested tabular data file
- bool resultsOutputFlag  
  whether user requested results data output
- String tabularDataFile  
  filename for tabulation of graphics data
- String resultsOutputFile  
  filename for results data

Private Member Functions

- void read_write_restart (bool restart_requested, bool read_restart_flag, const String &read_restart_filename, size_t stop_restart_eval, const String &write_restart_filename)  
  conditionally import evaluations from restart file, then always create or overwrite restart file

Private Attributes

- int worldRank  
  output manager handles rank 0 only output when needed
- bool mpirunFlag  
  some output is only for MPI runs
- StringArray fileTags  
  set of tags for various input/output files (default none)
- bool redirCalled  
  temporary variable to prevent recursive tagging initially
- ConsoleRedirector coutRedirector  
  set of redirections for Dakota::Cout; stores any tagged filename when there are concurrent Iterators
- ConsoleRedirector cerrRedirector  
  set of redirections for Dakota::Cerr; stores any tagged filename when there are concurrent Iterators and error redirection is requested
- std::vector< boost::shared_ptr< RestartWriter > > restartDestinations  
  Stack of active restart destinations; end is the last (active) redirection. All remain open until popped or destroyed.
- String startupMessage
message to print at startup when proceeding to instantiate objects

- **Graphics dakotaGraphics**
  - graphics and tabular data output handler used by meta-iterators, models, and approximations; encapsulated here so destroyed with the OutputManager

- unsigned short **tabularFormat**
  - tabular format options; see enum

- int **graphicsCntr**
  - used for x axis values in 2D graphics and for 1st column in tabular data

- std::ofstream **tabularDataFStream**
  - file stream for tabulation of graphics data within compute_response

- std::string **tabularCntrLabel**
  - label for counter used in first line comment w/ the tabular data file

- short **outputLevel**
  - output level (for debugging only; not passed in)

### 13.129.1 Detailed Description

Class to manage redirection of stdout/stderr, keep track of current redir state, and manage rank 0 output. Also manage tabular data output for post-processing with Matlab, Tecplot, etc. and delegate to Graphics for X Windows Graphics.

### 13.129.2 Constructor & Destructor Documentation

**OutputManager ( const ProgramOptions & prog_opts, int dakota_world_rank = 0, bool dakota_mpirun_flag = false )**

Standard constructor, taking user-specified program options and optionally taking the rank of this process in Dakota’s MPI_Comm.

- Only get minimal information off ProgramOptions as may be updated later by broadcast.

  References OutputManager::cerrRedirector, OutputManager::coutRedirector, ProgramOptions::error_file(), OutputManager::mpirunFlag, ProgramOptions::output_file(), OutputManager::outputLevel, ConsoleRedirector::push_back(), Dakota::start_dakota_heartbeat(), ProgramOptions::user_stderr_redirect(), ProgramOptions::user_stdout_redirect(), and OutputManager::worldRank.

### 13.129.3 Member Function Documentation

**void pop_output_tag ( )**

(Potentially) remove an output context and rebind streams

- For now this assumes the tag is .<int>

  References OutputManager::build_output_tag(), OutputManager::cerrRedirector, OutputManager::coutRedirector, OutputManager::fileTags, OutputManager::outputLevel, ConsoleRedirector::pop_back(), OutputManager::restartDestinations, and OutputManager::worldRank.

  Referenced by ParallelLibrary::pop_output_tag().
void add_datapoint ( const Variables & vars, const String & iface, const Response & response )

adds data to each window in the 2d graphics and adds a row to the tabular data file based on the results of a model evaluation.

Adds data to each 2d plot and each tabular data column (one for each active variable and for each response function). graphicsCntr is used for the x axis in the graphics and the first column in the tabular data.

References Response::active_set_request_vector(), Graphics::add_datapoint(), OutputManager::dakotaGraphics, OutputManager::graphicsCntr, OutputManager::tabularDataFStream, and OutputManager::tabularFormat.

Referenced by SurrBasedLocalMinimizer::core_run(), Model::evaluate(), Model::synchronize(), and Model::synchronize_nowait().

void create_tabular_datastream ( const Variables & vars, const Response & response )

initialize the tabular datastream on iterator leaders.

Opens the tabular data file stream and prints headings, one for each active continuous and discrete variable and one for each response function, using the variable and response function labels. This tabular data is used for post-processing of DAKOTA results in Matlab, Tecplot, etc.

References OutputManager::build_output_tag(), OutputManager::tabularDataFile, OutputManager::tabularDataFStream, and OutputManager::tabularFormat.

Referenced by SurrBasedMinimizer::initialize_graphics(), and Iterator::initialize_graphics().

The documentation for this class was generated from the following files:

- OutputManager.hpp
- OutputManager.cpp

13.130 OutputWriter Class Reference

Public Member Functions

- OutputWriter (std::ostream *output_stream)
  
  ostream constructor; used to construct a writer to existing stream, e.g., std::cout

- OutputWriter (const String &output_filename)

  file redirect constructor; opens an overwriting file stream to given name

- const String & filename () const

  the (possibly empty) file name for this stream

- std::ostream * output_stream ()

  a pointer to the stream, either cout/cerr or a file

Protected Attributes

- String outputFilename

  the name of the output file (empty when constructed from pointer)

- std::ofstream outputFS

  file output stream for console text; only open if string non-empty

- std::ostream * outputStream

  pointer to the stream for this writer
13.131. **ParallelConfiguration Class Reference**

Component to manage a redirected output or error stream

The documentation for this class was generated from the following files:

- OutputManager.hpp
- OutputManager.cpp

### Public Member Functions

- **ParallelConfiguration ()**
  *default constructor*
- **ParallelConfiguration (const ParallelConfiguration &pl)**
  *copy constructor*
- **~ParallelConfiguration ()**
  *destructor*
- **ParallelConfiguration & operator= (const ParallelConfiguration &pl)**
  *assignment operator*
- **const ParallelLevel & w_parallel_level () const**
  *return the ParallelLevel corresponding to miPLIters.front()*
- **const ParallelLevel & mi_parallel_level (size_t index= NPOS) const**
  *return the ParallelLevel corresponding to miPLIters[index]*
- **const ParallelLevel & ie_parallel_level () const**
  *return the ParallelLevel corresponding to iePLIter*
- **const ParallelLevel & ea_parallel_level () const**
  *return the ParallelLevel corresponding to eaPLIter*
- **bool w_parallel_level_defined () const**
  *test for definition of world parallel level*
- **bool mi_parallel_level_defined (size_t index= NPOS) const**
  *test for definition of meta-iterator-iterator parallel level*
- **bool ie_parallel_level_defined () const**
  *test for definition of iterator-evaluation parallel level*
- **bool ea_parallel_level_defined () const**
  *test for definition of evaluation-analysis parallel level*
- **ParLevLIter w_parallel_level_iterator () const**
  *return miPLIters.front()*
- **ParLevLIter mi_parallel_level_iterator (size_t index= NPOS) const**
  *return miPLIters[index]*
- **ParLevLIter ie_parallel_level_iterator () const**
  *return iePLIter*
• ParLevLIter ea_parallel_level_iterator () const
  
return eaPLIter

• size_t mi_parallel_level_index (ParLevLIter pl_iter) const
  
return the index within miPLIters corresponding to pl_iter

• size_t mi_parallel_level_last_index () const
  
return the index of the last entry in miPLIters

Private Member Functions

• void assign (const ParallelConfiguration &pl)
  
assign the attributes of the incoming pl to this object

Private Attributes

• short numParallelLevels
  
number of parallel levels

• std::vector< ParLevLIter > miPLIters
  
list iterator for world level followed by any concurrent iterator partitions (there may be multiple per parallel configuration instance)

• ParLevLIter iePLIter
  
list iterator identifying the iterator-evaluation parallelLevel (there can only be one)

• ParLevLIter eaPLIter
  
list iterator identifying the evaluation-analysis parallelLevel (there can only be one)

• ParLevLIter endPLIter
  
list iterator identifying the end of ParallelLibrary::parallelLevels; used for detecting when a component of the parallel configuration has been initialized

Friends

• class ParallelLibrary
  
the ParallelLibrary class has special access privileges in order to streamline implementation

13.131.1 Detailed Description

Container class for a set of ParallelLevel list iterators that collectively identify a particular multilevel parallel configuration.

Rather than containing the multilevel parallel configuration directly, ParallelConfiguration instead provides a set of list iterators which point into a combined list of ParallelLevels. This approach allows different configurations to reuse ParallelLevels without copying them. A list of ParallelConfigurations is contained in ParallelLibrary (ParallelLibrary::parallelConfigurations).
13.132 ParallelDirectApplicInterface Class Reference

Sample derived interface class for testing parallel simulator plug-ins using assign_rep().

Inheritance diagram for ParallelDirectApplicInterface:

```
Interface
  ApplicationInterface
    DirectApplicInterface
      ParallelDirectApplicInterface
```

**Public Member Functions**

- **ParallelDirectApplicInterface** (const Dakota::ProblemDescDB &problem_db, const MPI_Comm &analysis_comm)
  
  *constructor*

- **~ParallelDirectApplicInterface** ()
  
  *destructor*

**Protected Member Functions**

- int **derived_map_ac** (const Dakota::String &ac_name)
  
  *execute an analysis code portion of a direct evaluation invocation*

- void **derived_map_asynch** (const Dakota::ParamResponsePair &pair)
no-op hides base error; job batching occurs within \texttt{wait\_local\_evaluations()}

- **\texttt{void wait\_local\_evaluations (Dakota::PRPQueue &prp\_queue)}**
  
  \textit{evaluate the batch of jobs contained in \texttt{prp\_queue}}

- **\texttt{void test\_local\_evaluations (Dakota::PRPQueue &prp\_queue)}**
  
  \textit{invokes \texttt{wait\_local\_evaluations()} (no special nowait support)}

- **\texttt{void set\_communicators\_checks (int max\_eval\_concurrency)}**
  
  \textit{no-op hides default run-time error checks at DirectApplicInterface level}

### Private Member Functions

- **\texttt{int textbook (const Dakota::RealVector &c\_vars, const Dakota::ShortArray &asv, Dakota::RealVector &fn\_vals, Dakota::RealMatrix &fn\_grads, Dakota::RealSymMatrixArray &fn\_hessians)}**
  
  \textit{demo evaluator function for parallel plug-ins}

### Additional Inherited Members

#### 13.132.1 Detailed Description

Sample derived interface class for testing parallel simulator plug-ins using \texttt{assign\_rep()}.

The plug-in \texttt{ParallelDirectApplicInterface} resides in namespace \texttt{SIM} and uses a copy of textbook() to perform parallel parameter to response mappings. It is used to demonstrate plugging in a parallel direct analysis driver into \texttt{Dakota} in library mode. Test input files can then use an analysis driver of "plugin\_textbook".

#### 13.132.2 Member Function Documentation

**\texttt{void test\_local\_evaluations ( Dakota::PRPQueue & prp\_queue ) [inline], [protected]}**

\textit{invokes \texttt{wait\_local\_evaluations()} (no special nowait support)}

For use by \texttt{ApplicationInterface::serve\_evaluations\_asynch()}, which can provide a batch processing capability within message passing schedulers (called using chain \texttt{ApplicationInterface::serve\_evaluations()} from \texttt{Model-\_\_\_serve()} from \texttt{IteratorScheduler::run\_\_\_iterator()}).

References \texttt{ParallelDirectApplicInterface::wait\_local\_evaluations()}. The documentation for this class was generated from the following files:

- \texttt{PluginParallelDirectApplicInterface.hpp}
- \texttt{PluginParallelDirectApplicInterface.cpp}

#### 13.133 ParallelLevel Class Reference

Container class for the data associated with a single level of communicator partitioning.

### Public Member Functions

- **\texttt{ParallelLevel ( )}**
  
  \textit{default constructor}

- **\texttt{ParallelLevel (const ParallelLevel &pl)}**
  
  \textit{copy constructor}

- **\texttt{\sim ParallelLevel ( )}**
• Destructor
  ParallelLevel & operator=(const ParallelLevel &pl)
  assignment operator

• bool dedicated_master() const
  return dedicatedMasterFlag

• bool communicator_split() const
  return commSplitFlag

• bool server_master() const
  return serverMasterFlag

• bool message_pass() const
  return messagePass

• bool idle_partition() const
  return idlePartition

• int num_servers() const
  return numServers

• int processors_per_server() const
  return procsPerServer

• int processor_remainder() const
  return procRemainder

• const MPI_Comm & server_intra_communicator() const
  return serverIntraComm

• int server_communicator_rank() const
  return serverCommRank

• int server_communicator_size() const
  return serverCommSize

• const MPI_Comm & hub_server_intra_communicator() const
  return hubServerIntraComm

• int hub_server_communicator_rank() const
  return hubServerCommRank

• int hub_server_communicator_size() const
  return hubServerCommSize

• const MPI_Comm & hub_server_inter_communicator() const
  return hubServerInterComm

• MPI_Comm * hub_server_inter_communicators() const
  return hubServerInterComms

• int server_id() const
  return serverId

• void read(MPIUnpackBuffer &s)
  read a ParallelLevel object from a packed MPI buffer

• void write(MPIPackBuffer &s) const
  write a ParallelLevel object to a packed MPI buffer

• void clear()
  deallocate the communicators in this ParallelLevel
• void assign (const ParallelLevel &pl)
  assign the attributes of the incoming pl to this object. For communicators, this is a lightweight copy which assigns
  the same pointer values as the incoming pl, resulting in the same context.
• void copy (const ParallelLevel &pl)
  deep copy the attributes of the incoming pl to this object using MPI_Comm_dup to create equivalent communicators
  with a unique context.
• void copy_config (const ParallelLevel &pl)
  copy the scalar attributes of the incoming pl to this object, omitting communicators

Private Attributes

• bool dedicatedMasterFlag
  signals dedicated master partitioning
• bool commSplitFlag
  signals a communicator split was used
• bool serverMasterFlag
  identifies master server processors
• bool messagePass
  flag for message passing at this level
• bool idlePartition
  identifies presence of an idle processor
  < partition at this level
• int numServers
  number of servers
• int procsPerServer
  processors per server
• int procRemainder
  proc remainder after equal distribution
• int serverId
  server identifier
• MPI_Comm serverIntraComm
  intracomm. for each server partition
• int serverCommRank
  rank in serverIntraComm
• int serverCommSize
  size of serverIntraComm
• MPI_Comm hubServerIntraComm
  intracomm for all serverCommRank==0
  < w/i next higher level serverIntraComm
• int hubServerCommRank
  rank in hubServerIntraComm
• int hubServerCommSize
  size of hubServerIntraComm
• MPI_Comm hubServerInterComm
intercomm. between a server & the hub
< (on server partitions only)
• MPI_Comm * hubServerInterComms
  intercomm. array on hub processor

Friends
• class ParallelLibrary
  the ParallelLibrary class has special access privileges in order to streamline implementation

13.133.1 Detailed Description
Container class for the data associated with a single level of communicator partitioning.
A list of these levels is contained in ParallelLibrary (ParallelLibrary::parallelLevels), which defines all of the
parallelism levels across one or more multilevel parallelism configurations.

13.133.2 Member Function Documentation
void clear ( ) [inline]
deallocate the communicators in this ParallelLevel
  This appears to be more robust outside of the destructor due to interactions among managed deallocation and
default deallocation (e.g., explicitly freeing a communicator and then default deallocating its handle).
  References ParallelLevel::commSplitFlag, ParallelLevel::dedicatedMasterFlag, ParallelLevel::hubServerInter-
  Comm, ParallelLevel::hubServerInterComms, ParallelLevel::hubServerIntraComm, ParallelLevel::idlePartition,
  ParallelLevel::numServers, ParallelLevel::serverld, and ParallelLevel::serverIntraComm.
  The documentation for this class was generated from the following file:
  • ParallelLibrary.hpp

13.134 ParallelLibrary Class Reference
Class for partitioning multiple levels of parallelism and managing message passing within these levels.

Public Member Functions
• ParallelLibrary ()
  default constructor (used for dummy_lib)
• ParallelLibrary (const MPIManager &mpi_mngr, ProgramOptions &prog_opts, OutputManager &output_-
mgr)
  stand-alone and default library mode constructor; don’t require options
• ~ParallelLibrary ()
  destructor
• const ParallelLevel & init_iterator_communicators (int iterator_servers, int procs_per_iterator, int min_procs-
  _per_iterator, int max_procs_per_iterator, int max_iterator_concurrency, short default_config, short iterator-
  _scheduling, bool peer_dynamic_avail)
  split MPI_COMM_WORLD into iterator communicators
- const ParallelLevel & init_evaluation_communicators (int evaluation_servers, int procs_per_evaluation, int min_procs_per_eval, int max_procs_per_eval, int max_evaluation_concurrency, int async_local_evaluation_concurrency, short default_config, short evaluation_scheduling, bool peer_dynamic_avail)
  split an iterator communicator into evaluation communicators
- const ParallelLevel & init_analysis_communicators (int analysis_servers, int procs_per_analysis, int min_procs_per_analysis, int max_procs_per_analysis, int max_analysis_concurrency, int async_local_analysis_concurrency, short default_config, short analysis_scheduling, bool peer_dynamic_avail)
  split an evaluation communicator into analysis communicators
- void print_configuration ()
  print the parallel level settings for a particular parallel configuration
- void push_output_tag (const ParallelLevel &pl)
  conditionally append an iterator server id tag to the hierarchical output tag, manage restart, and rebind cout/cerr
- void pop_output_tag (const ParallelLevel &pl)
  pop the last output tag and rebind streams as needed; pl isn’t yet used, but may be in the future when we generalize to arbitrary output context switching
- void write_restart (const ParamResponsePair &prp)
  write a parameter/response set to the restart file
- ProgramOptions & program_options ()
  return programOptions reference
- OutputManager & output_manager ()
  return outputManager reference
- void terminate_modelcenter ()
  terminate ModelCenter if running
- void abort_helper (int code)
  finalize MPI with correct communicator for abort
- bool command_line_check () const
  return checkFlag
- bool command_line_pre_run () const
  return preRunFlag
- bool command_line_run () const
  return runFlag
- bool command_line_post_run () const
  return postRunFlag
- bool command_line_user_modes () const
  return userModesFlag
- const String & command_line_pre_run_input () const
  preRunInput filename
- const String & command_line_pre_run_output () const
  preRunOutput filename
- const String & command_line_run_input () const
  runInput filename
- const String & command_line_run_output () const
  runOutput filename
- const String & command_line_post_run_input () const
postRunInput filename

- `const String & command_line_post_run_output () const`

postRunOutput fname

- `void send (MPIPackBuffer &send_buff, int dest, int tag, const ParallelLevel &parent_pl, const ParallelLevel &child_pl)`
  
  blocking buffer send at the current communication level

- `void send (int &send_int, int dest, int tag, const ParallelLevel &parent_pl, const ParallelLevel &child_pl)`
  
  blocking integer send at the current communication level

- `void isend (MPIPackBuffer &send_buff, int dest, int tag, MPI_Request &send_req, const ParallelLevel &parent_pl, const ParallelLevel &child_pl)`

  nonblocking buffer send at the current communication level

- `void isend (int &send_int, int dest, int tag, MPI_Request &send_req, const ParallelLevel &parent_pl, const ParallelLevel &child_pl)`

  nonblocking integer send at the current communication level

- `void recv (MPIUnpackBuffer &recv_buff, int source, int tag, MPI_Status &status, const ParallelLevel &parent_pl, const ParallelLevel &child_pl)`

  blocking buffer receive at the current communication level

- `void recv (int &recv_int, int source, int tag, MPI_Status &status, const ParallelLevel &parent_pl, const ParallelLevel &child_pl)`

  blocking integer receive at the current communication level

- `void irecv (MPIUnpackBuffer &recv_buff, int source, int tag, MPI_Request &recv_req, const ParallelLevel &parent_pl, const ParallelLevel &child_pl)`

  nonblocking buffer receive at the current communication level

- `void irecv (int &recv_int, int source, int tag, MPI_Request &recv_req, const ParallelLevel &parent_pl, const ParallelLevel &child_pl)`

  nonblocking integer receive at the current communication level

- `void check_mi_index (size_t &index) const`
  
  process _NPOS default and perform error checks

- `void send_mi (int &send_int, int dest, int tag, size_t index=_NPOS)`

  blocking send at the metaiterator-iterator communication level

- `void isend_mi (int &send_int, int dest, int tag, MPI_Request &send_req, size_t index=_NPOS)`

  nonblocking send at the metaiterator-iterator communication level

- `void recv_mi (int &recv_int, int source, int tag, MPI_Status &status, size_t index=_NPOS)`

  blocking receive at the metaiterator-iterator communication level

- `void irecv_mi (int &recv_int, int source, int tag, MPI_Request &recv_req, size_t index=_NPOS)`

  nonblocking receive at the metaiterator-iterator communication level

- `void send_mi (MPIPackBuffer &send_buff, int dest, int tag, size_t index=_NPOS)`

  blocking send at the metaiterator-iterator communication level

- `void isend_mi (MPIPackBuffer &send_buff, int dest, int tag, MPI_Request &send_req, size_t index=_NPOS)`

  nonblocking send at the metaiterator-iterator communication level

- `void recv_mi (MPIUnpackBuffer &recv_buff, int source, int tag, MPI_Status &status, size_t index=_NPOS)`

  blocking receive at the metaiterator-iterator communication level

- `void irecv_mi (MPIUnpackBuffer &recv_buff, int source, int tag, MPI_Request &recv_req, size_t index=_NPOS)`
nonblocking receive at the metaiterator-iterator communication level

- void send_ie (int &send_int, int dest, int tag)

blocking send at the iterator-evaluation communication level

- void isend_ie (int &send_int, int dest, int tag, MPI_Request &send_req)

nonblocking send at the iterator-evaluation communication level

- void recv_ie (int &recv_int, int source, int tag, MPI_Status &status)

blocking receive at the iterator-evaluation communication level

- void irecv_ie (int &recv_int, int source, int tag, MPI_Request &recv_req)

nonblocking receive at the iterator-evaluation communication level

- void send ie (MPIPackBuffer &send_buff, int dest, int tag)

blocking send at the iterator-evaluation communication level

- void isend ie (MPIPackBuffer &send_buff, int dest, int tag, MPI_Request &send_req)

nonblocking send at the iterator-evaluation communication level

- void recv ie (MPIUnpackBuffer &recv_buff, int source, int tag, MPI_Status &status)

blocking receive at the iterator-evaluation communication level

- void irecv ie (MPIUnpackBuffer &recv_buff, int source, int tag, MPI_Request &recv_req)

nonblocking receive at the iterator-evaluation communication level

- void send ea (int &send_int, int dest, int tag)

blocking send at the evaluation-analysis communication level

- void isend ea (int &send_int, int dest, int tag, MPI_Request &send_req)

nonblocking send at the evaluation-analysis communication level

- void recv ea (int &recv_int, int source, int tag, MPI_Status &status)

blocking receive at the evaluation-analysis communication level

- void irecv ea (int &recv_int, int source, int tag, MPI_Request &recv_req)

nonblocking receive at the evaluation-analysis communication level

- void bcast (int &data, const ParallelLevel &pl)

broadcast an integer across the serverIntraComm of a ParallelLevel

- void bcast (short &data, const ParallelLevel &pl)

broadcast an integer across the serverIntraComm of a ParallelLevel

- void bcast (MPIPackBuffer &send_buff, const ParallelLevel &pl)

broadcast a MPIPackBuffer across the serverIntraComm of a ParallelLevel

- void bcast (MPIUnpackBuffer &recv_buff, const ParallelLevel &pl)

broadcast a MPIUnpackBuffer across the serverIntraComm of a ParallelLevel

- void bcast hs (int &data, const ParallelLevel &pl)

broadcast an integer across the hubServerIntraComm of a ParallelLevel

- void bcast hs (MPIPackBuffer &send_buff, const ParallelLevel &pl)

broadcast a MPIPackBuffer across the hubServerIntraComm of a ParallelLevel

- void bcast hs (MPIUnpackBuffer &recv_buff, const ParallelLevel &pl)

broadcast a MPIUnpackBuffer across the hubServerIntraComm of a ParallelLevel

- void bcast w (int &data)

broadcast an integer across MPI_COMM_WORLD

- void bcast i (int &data, size_t index=NPOS)

broadcast an integer across an iterator communicator
• void bcast\_i (short &data, size\_t index=_NPOS)
  broadcast a short integer across an iterator communicator
• void bcast\_e (int &data)
  broadcast an integer across an evaluation communicator
• void bcast\_a (int &data)
  broadcast an integer across an analysis communicator
• void bcast\_mi (int &data, size\_t index=_NPOS)
  broadcast an integer across a metaiterator-iterator intra communicator
• void bcast\_w (MPIPackBuffer &send\_buff)
  broadcast a packed buffer across MPI\_COMM\_WORLD
• void bcast\_i (MPIPackBuffer &send\_buff, size\_t index=_NPOS)
  broadcast a packed buffer across an iterator communicator
• void bcast\_e (MPIPackBuffer &send\_buff)
  broadcast a packed buffer across an evaluation communicator
• void bcast\_a (MPIPackBuffer &send\_buff)
  broadcast a packed buffer across an analysis communicator
• void bcast\_mi (MPIPackBuffer &send\_buff, size\_t index=_NPOS)
  broadcast a packed buffer across a metaiterator-iterator intra communicator
• void bcast\_w (MPIUnpackBuffer &recv\_buff)
  matching receive for packed buffer broadcast across MPI\_COMM\_WORLD
• void bcast\_i (MPIUnpackBuffer &recv\_buff, size\_t index=_NPOS)
  matching receive for packed buffer bcast across an iterator communicator
• void bcast\_e (MPIUnpackBuffer &recv\_buff)
  matching receive for packed buffer bcast across an evaluation communicator
• void bcast\_a (MPIUnpackBuffer &recv\_buff)
  matching receive for packed buffer bcast across an analysis communicator
• void bcast\_mi (MPIUnpackBuffer &recv\_buff, size\_t index=_NPOS)
  matching recv for packed buffer bcast across a metaiterator-iterator intra comm
• void barrier\_w ()
  enforce MPI\_Barrier on MPI\_COMM\_WORLD
• void barrier\_i (size\_t index=_NPOS)
  enforce MPI\_Barrier on an iterator communicator
• void barrier\_e ()
  enforce MPI\_Barrier on an evaluation communicator
• void barrier\_a ()
  enforce MPI\_Barrier on an analysis communicator
• void reduce\_sum\_ea (double *local\_vals, double *sum\_vals, int num\_vals)
  compute a sum over an eval-analysis intra-communicator using MPI\_Reduce
• void reduce\_sum\_aa (double *local\_vals, double *sum\_vals, int num\_vals)
  compute a sum over an analysis communicator using MPI\_Reduce
• void test (MPI\_Request &request, int &test\_flag, MPI\_Status &status)
  test a nonblocking send/receive request for completion
• void wait (MPI\_Request &request, MPI\_Status &status)
wait for a nonblocking send/receive request to complete

- **void** `waitall` (int num_recs, MPI_Request *recv_reqs)
  
  wait for all messages from a series of nonblocking receives

- **void** `waitsome` (int num_sends, MPI_Request *recv_requests, int &num_recs, int *index_array, MPI_Status *status_array)
  
  wait for at least one message from a series of nonblocking receives but complete all that are available

- **void** `free` (MPI_Request &request)
  
  free an MPI_Request

- **int** `world_size` () const
  
  return MPIManager::worldSize

- **int** `world_rank` () const
  
  return MPIManager::worldRank

- **bool** `mpirun_flag` () const
  
  return MPIManager::mpirunFlag

- **bool** `is_null` () const
  
  return dummyFlag

- **Real** `parallel_time` () const
  
  returns current MPI wall clock time

- **void** `parallel_configuration_iterator` (ParConfigLIter pc_iter)
  
  set the current ParallelConfiguration node

- **ParConfigLIter** `parallel_configuration_iterator` () const
  
  return the current ParallelConfiguration node

- **const ParallelConfiguration & parallel_configuration** () const
  
  return the current ParallelConfiguration instance

- **size_t** `num_parallel_configurations` () const
  
  returns the number of entries in parallelConfigurations

- **bool** `parallel_configuration_is_complete` ()
  
  identifies if the current ParallelConfiguration has been fully populated

- **void** `increment_parallel_configuration` (ParLevLIter mi_pl_iter)
  
  add a new node to parallelConfigurations and increment currPCIter; limit miPLIter within new configuration to mi_pl_iter level

- **void** `increment_parallel_configuration` ()
  
  add a new node to parallelConfigurations and increment currPCIter; copy all of miPLIter within new configuration

- **bool** `w_parallel_level_defined` () const
  
  test current parallel configuration for definition of world parallel level

- **bool** `mi_parallel_level_defined` (size_t index=NPOS) const
  
  test current parallel configuration for definition of meta-iterator-iterator parallel level

- **bool** `ie_parallel_level_defined` () const
  
  test current parallel configuration for definition of iterator-evaluation parallel level

- **bool** `ea_parallel_level_defined` () const
  
  test current parallel configuration for definition of evaluation-analysis parallel level

- **ParLevLIter** `w_parallel_level_iterator` ()
  
  for this level, access through ParallelConfiguration is not necessary
size_t parallel_level_index (ParLevLIter pl_iter)
    return the index within parallelLevels corresponding to pl_iter

std::vector< MPI_Comm > analysis_intra_communicators ()
    return the set of analysis intra communicators for all parallel configurations (used for setting up direct simulation interfaces prior to execution time).

Private Member Functions

void init_mpi_comm ()
    convenience function for initializing DAKOTA’s top-level MPI communicators, based on dakotaMPIComm

void initialize_timers ()
    initialize DAKOTA and UTILIB timers

void output_timers ()
    conditionally output timers in destructor

void init_communicators (const ParallelLevel &parent_pl, int num_servers, int procs_per_server, int min_procs_per_server, int max_procs_per_server, int max_concurrency, int asynch_local_concurrency, short default_config, short scheduling_override, bool peer_dynamic_avail)
    split a parent communicator into child server communicators

void split_communicator_dedicated_master (const ParallelLevel &parent_pl, ParallelLevel &child_pl)
    split a parent communicator into a dedicated master processor and num_servers child communicators

void split_communicator_peer_partition (const ParallelLevel &parent_pl, ParallelLevel &child_pl)
    split a parent communicator into num_servers peer child communicators (no dedicated master processor)

void resolve_inputs (ParallelLevel &child_pl, int avail_procs, int min_procs_per_server, int max_procs_per_server, int max_concurrency, int capacity_multiplier, short default_config, short scheduling_override, bool peer_dynamic_avail, bool print_rank)
    resolve user inputs into a sensible partitioning scheme

void bcast (int &data, const MPI_Comm &comm)
    broadcast an integer across a communicator

void bcast (short &data, const MPI_Comm &comm)
    broadcast a short integer across a communicator

void bcast (MPIPackBuffer &send_buff, const MPI_Comm &comm)
    send a packed buffer across a communicator using a broadcast

void bcast (MPIUnpackBuffer &recv_buff, const MPI_Comm &comm)
    matching receive for a packed buffer broadcast

void barrier (const MPI_Comm &comm)
    enforce MPI_Barrier on comm

void reduce_sum (double *local_vals, double *sum_vals, int num_vals, const MPI_Comm &comm)
    compute a sum over comm using MPI_Reduce

void check_error (const String &err_source, int err_code)
    check the MPI return code and abort if error

void inherit_as_server_comm (const ParallelLevel &parent_pl, ParallelLevel &child_pl)
    convenience function for updating child serverIntraComm from parent serverIntraComm

void inherit_as_hub_server_comm (const ParallelLevel &parent_pl, ParallelLevel &child_pl)
    convenience function for updating child hubServerIntraComm from parent serverIntraComm
CHAPTER 13. CLASS DOCUMENTATION

Private Attributes

- `const MPIManager & mpiManager`  
  reference to the MPI manager with Dakota’s MPI options
- `ProgramOptions & programOptions`  
  `programOptions` is non-const due to updates from broadcast
- `OutputManager & outputManager`  
  Non-const output handler to help with file redirection.
- `bool dummyFlag`  
  prevents multiple MPI_Finalize calls due to dummy_lib
- `bool outputTimings`  
  timing info only beyond help/version/check
- `Real startCPUtime`  
  start reference for UTILIB CPU timer
- `Real startWCTime`  
  start reference for UTILIB wall clock timer
- `Real startMPItime`  
  start reference for MPI wall clock timer
- `long startClock`  
  start reference for local clock() timer measuring <parent+child CPU
- `std::list< ParallelLevel > parallelLevels`  
  the complete set of parallelism levels for managing multilevel parallelism among one or more configurations
- `std::list< ParallelConfiguration > parallelConfigurations`  
  the set of parallel configurations which manage list iterators for indexing into parallelLevels
- `ParConfigLIter currPCIter`  
  list iterator identifying the current node in parallelConfigurations

13.134.1 Detailed Description

Class for partitioning multiple levels of parallelism and managing message passing within these levels.

The `ParallelLibrary` class encapsulates all of the details of performing message passing within multiple levels of parallelism. It provides functions for partitioning of levels according to user configuration input and functions for passing messages within and across MPI communicators for each of the parallelism levels. If support for other message-passing libraries beyond MPI becomes needed (PVM, ...), then `ParallelLibrary` would be promoted to a base class with virtual functions to encapsulate the library-specific syntax.

13.134.2 Constructor & Destructor Documentation

`ParallelLibrary()`  

default constructor (used for dummy_lib)

This constructor is used for creation of the global dummy_lib object, which is used to satisfy initialization requirements when the real `ParallelLibrary` object is not available.
ParallelLibrary (const MPIManager & mpi_mgr, ProgramOptions & prog_opts, OutputManager & output_mgr)

stand-alone and default library mode constructor; don't require options
library mode constructor accepting communicator
TODO: Update comment.
Same constructor is used for executable and library environments and sequencing of object construction is ordered, so no need to separately get updates off command line (programOptions)
References ParallelLibrary::init_mpi_comm(), and ParallelLibrary::initialize_timers().

13.134.3 Member Function Documentation

void push_output_tag (const ParallelLevel & pl)

conditionally append an iterator server id tag to the hierarchical output tag, manage restart, and rebind cout/cerr
If the user has specified the use of files for DAKOTA standard output and/or standard error, then bind these filenames to the Cout/Cerr macros. In addition, if concurrent iterators are to be used, create and tag multiple output streams in order to prevent jumbled output. Manage restart file(s) by processing any incoming evaluations from an old restart file and by setting up the binary output stream for new evaluations. Only master iterator processor(s) read & write restart information. This function must follow init_iterator_communicators so that restart can be managed properly for concurrent iterator strategies. In the case of concurrent iterators, each iterator has its own restart file tagged with iterator number.
References ParallelLibrary::bcast(), ParallelLevel::dedicatedMasterFlag, OutputManager::graph2DFlag, ParallelLevel::hubServerCommRank, ParallelLevel::hubServerCommSize, ParallelLevel::hubServerIntraComm, ParallelLevel::numServers, ParallelLibrary::outputManager, ParallelLibrary::programOptions, OutputManager::push_output_tag(), OutputManager::resultsOutputFile, OutputManager::resultsOutputFlag, ParallelLevel::serverCommRank, ParallelLevel::serverId, MPIPackBuffer::size(), OutputManager::tabularDataFile, and OutputManager::tabular-DataFlag.
Referenced by Environment::construct(), and IteratorScheduler::partition().

void terminate_modelcenter()

terminate ModelCenter if running
Close streams associated with manage_outputs and manage_restart and terminate any additional services that may be active.
References Dakota::abort_handler(), Dakota::dc_ptr_int, and Dakota::mc_ptr_int.
Referenced by ParallelLibrary::~ParallelLibrary().

void increment_parallel_configuration (ParLevLIter mi_pl_iter) [inline]

add a new node to parallelConfigurations and increment currPCIter; limit miPLIters within new configuration to mi_pl_iter level
Called from the ParallelLibrary ctor and from Model::init_communicators(). An increment is performed for each Model initialization except the first (which inherits the world level from the first partial configuration).
References ParallelLibrary::currPCIter, ParallelConfiguration::eaPLIter, ParallelConfiguration::endPLIter, Parallel-Configuration::iePLIter, ParallelConfiguration::miPLIter, ParallelConfiguration::numParallelLevels, ParallelLibrary-::parallelConfigurations, and ParallelLibrary::parallelLevels.
Referenced by Iterator::init_communicators(), and Model::init_communicators().
void init_mpi_comm ( ) [private]

convenience function for initializing DAKOTA’s top-level MPI communicators, based on dakotaMPIComm

shared function for initializing based on passed MPI_Comm

References Dakota::abort_handler(), MPIManager::dakota_mpi_comm(), ParallelLibrary::increment_parallel_configuration(), ParallelLibrary::mpiManager, MPIManager::mpirun_flag(), ParallelLevel::numServers, ParallelLibrary::outputManager, ParallelLibrary::parallelLevels, ParallelLevel::procsPerServer, ParallelLevel::serverCommRank, ParallelLevel::serverCommSize, ParallelLevel::serverId, ParallelLevel::serverIntraComm, ParallelLevel::serverMasterFlag, ParallelLibrary::startMPITime, OutputManager::startup_message(), MPIManager::world_rank(), and MPIManager::world_size().

Referenced by ParallelLibrary::ParallelLibrary().

void init_communicators ( const ParallelLevel & parent_pl, int num_servers, int procs_per_server, int min_procs_per_server, int max_procs_per_server, int max_concurrency, int async_local_concurrency, short default_config, short scheduling_override, bool peer_dynamic_avail ) [private]

split a parent communicator into child server communicators

Split parent communicator into concurrent child server partitions as specified by the passed parameters. This constructs new child intra-communicators and parent-child inter-communicators. This fn is called from Meta-Iterators and NestedModel for the concurrent iterator level and from ApplicationInterface::init_communicators() for the concurrent evaluation and concurrent analysis levels.

References ParallelLibrary::currPCIter, ParallelLevel::dedicatedMasterFlag, ParallelLevel::messagePass, ParallelLevel::numServers, ParallelLibrary::parallelLevels, ParallelLevel::procsPerServer, ParallelLibrary::resolve inputs(), ParallelLevel::serverCommRank, ParallelLevel::serverCommSize, ParallelLibrary::split_communicator_dedicated_master(), and ParallelLibrary::split_communicator_peer_partition().

Referenced by ParallelLibrary::init_analysis_communicators(), ParallelLibrary::init_evaluation_communicators(), and ParallelLibrary::init_iterator_communicators().

void resolve_inputs ( ParallelLevel & child_pl, int avail_procs, int min_procs_per_server, int max_procs_per_server, int max_concurrency, int capacity_multiplier, short default_config, short scheduling_override, bool peer_dynamic_avail, bool print_rank ) [private]

resolve user inputs into a sensible partitioning scheme

This function is responsible for the “auto-configure” intelligence of DAKOTA. It resolves a variety of inputs and overrides into a sensible partitioning configuration for a particular parallelism level. It also handles the general case in which a user’s specification request does not divide out evenly with the number of available processors for the level. If num_servers & procs_per_server are both nondefault, then the former takes precedence.

References Dakota::abort_handler(), ParallelLevel::dedicatedMasterFlag, ParallelLevel::numServers, ParallelLevel::procRemainder, and ParallelLevel::procsPerServer.

Referenced by ParallelLibrary::init_communicators().

The documentation for this class was generated from the following files:

- ParallelLibrary.hpp
- ParallelLibrary.cpp

13.135  ParamResponsePair Class Reference

Container class for a variables object, a response object, and an evaluation id.
Public Member Functions

- **ParamResponsePair ()**
  default constructor
- **ParamResponsePair (const Variables &vars, const String &interface_id, const Response &response, bool deep_copy=false)**
  alternate constructor for temporaries
- **ParamResponsePair (const Variables &vars, const String &interface_id, const Response &response, const int eval_id, bool deep_copy=true)**
  standard constructor for history uses
- **ParamResponsePair (const ParamResponsePair &pair)**
  copy constructor
- **~ParamResponsePair ()**
  destructor
- **ParamResponsePair & operator= (const ParamResponsePair &pair)**
  assignment operator
- void **read (std::istream &s)**
  read a ParamResponsePair object from an std::istream
- void **write (std::ostream &s) const**
  write a ParamResponsePair object to an std::ostream
- void **read.annotated (std::istream &s)**
  read a ParamResponsePair object in annotated format from an std::istream
- void **write.annotated (std::ostream &s) const**
  write a ParamResponsePair object in annotated format to an std::ostream
- void **write.tabular (std::ostream &s, unsigned short tabular_format) const**
  write a ParamResponsePair object in tabular format (all variables active/inactive) to an std::ostream
- void **write.tabular.labels (std::ostream &s, unsigned short tabular_format) const**
  write PRP labels in tabular format to an std::ostream
- void **read (MPIUnpackBuffer &s)**
  read a ParamResponsePair object from a packed MPI buffer
- void **write (MPIPackBuffer &s) const**
  write a ParamResponsePair object to a packed MPI buffer
- int **eval_id () const**
  return the evaluation identifier
- void **eval_id (int id)**
  set the evaluation identifier
- const String & **interface_id () const**
  return the interface identifier from the response object
- const IntStringPair & **eval_interface_ids () const**
  return the aggregate eval/interface identifier from the response object
- const Variables & **variables () const**
  return the parameters object
- void **variables (const Variables &vars)**
  set the parameters object
• const Response & response () const
  return the response object
• void response (const Response &resp)
  set the response object
• const ActiveSet & active_set () const
  return the active set object from the response object
• void active_set (const ActiveSet &set)
  set the active set object within the response object

Private Member Functions
• template<class Archive >
  void serialize (Archive &ar, const unsigned int version)
  serialize the PRP: write and read are symmetric for this class

Private Attributes
• Variables prpVariables
  the set of parameters for the function evaluation
• Response prpResponse
  the response set for the function evaluation
• IntStringPair evalInterfaceIds
  the evalInterfaceIds aggregate

Friends
• class boost::serialization::access
  allow boost access to serialize this class
• bool operator== (const ParamResponsePair &pair1, const ParamResponsePair &pair2)
  equality operator
• bool operator!= (const ParamResponsePair &pair1, const ParamResponsePair &pair2)
  inequality operator

13.135.1 Detailed Description

Container class for a variables object, a response object, and an evaluation id.

ParamResponsePair provides a container class for association of the input for a particular function evaluation (a variables object) with the output from this function evaluation (a response object), along with an evaluation identifier. This container defines the basic unit used in the data_pairs cache, in restart file operations, and in a variety of scheduling algorithm queues. With the advent of STL, replacement of arrays of this class with map<> and pair<> template constructs may be possible (using map<pair<int,String>, pair<Variables,Response>>, for example), assuming that deep copies, I/O, alternate constructors, etc., can be adequately addressed. Boost tuple<> may also be a candidate.
13.135.2 Constructor & Destructor Documentation

ParamResponsePair ( const Variables & vars, const String & interface_id, const Response & response, bool deep_copy = false ) [inline]

alternate constructor for temporaries

Uses of this constructor often employ the standard Variables and Response copy constructors to share representations since this constructor is commonly used for search_pairs (which are local instantiations that go out of scope prior to any changes to values; i.e., they are not used for history).

ParamResponsePair ( const Variables & vars, const String & interface_id, const Response & response, const int eval_id, bool deep_copy = true ) [inline]

standard constructor for history uses

Uses of this constructor often do not share representations since deep copies are used when history mechanisms (e.g., data_pairs and beforeSynchCorePRPQueue) are involved.

13.135.3 Member Function Documentation

void read ( MPIUnpackBuffer & s ) [inline]

read a ParamResponsePair object from a packed MPI buffer

interfaceId is omitted since master processor retains interface ids and communicates asv and response data only with slaves.

References ParamResponsePair::evalInterfaceIds, ParamResponsePair::prpResponse, and ParamResponsePair::prpVariables.

void write ( MPIPackBuffer & s ) const [inline]

write a ParamResponsePair object to a packed MPI buffer

interfaceId is omitted since master processor retains interface ids and communicates asv and response data only with slaves.

References ParamResponsePair::evalInterfaceIds, ParamResponsePair::prpResponse, and ParamResponsePair::prpVariables.

13.135.4 Member Data Documentation

IntStringPair evalInterfaceIds [private]

the evalInterfaceIds aggregate

the function evaluation identifier (assigned from Interface::evalIdCntr) is paired with the interface used to generate the response object. Used in PRPCache id_vars_set_compare to prevent duplicate detection on results from different interfaces. evalInterfaceIds belongs here rather than in Response since some Response objects involve consolidation of several fn evals (e.g., Model::synchronize_derivatives()) that are not, in total, generated by a single interface. The prPair, on the other hand, is used for storage of all low level fn evals that get evaluated in ApplicationInterface::map().

Referenced by ParamResponsePair::eval_id(), ParamResponsePair::eval_interface_ids(), ParamResponsePair::interface_id(), ParamResponsePair::operator=(), Dakota::operator==(), ParamResponsePair::read(), and ParamResponsePair::write().

The documentation for this class was generated from the following file:

• ParamResponsePair.hpp
13.136 ParamStudy Class Reference

Class for vector, list, centered, and multidimensional parameter studies.

Inheritance diagram for ParamStudy:

```
ParamStudy
  PStudyDACE
    Analyzer
      Iterator
```

### Public Member Functions

- **ParamStudy** (ProblemDescDB &problem_db, Model &model)
  
  *constructor*

- **~ParamStudy** ()
  
  *destructor*

- **bool resize ()**
  
  reinitializes iterator based on new variable size

- **void pre_run ()**
  
  pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori

- **void core_run ()**
  
  core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

- **void post_input ()**
  
  read tabular data for post-run mode

- **void post_run (std::ostream &s)**
  
  post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way

### Private Member Functions

- **void sample ()**
  
  performs the parameter study by sampling from a list of points

- **void vector_loop ()**
  
  performs the parameter study by sampling along a vector, starting from an initial point followed by numSteps increments along continuous/discrete step vectors

- **void centered_loop ()**
  
  performs a number of plus and minus offsets for each parameter centered about an initial point

- **void multidim_loop ()**
  
  performs a full factorial combination for all intersections defined by a set of multidimensional partitions
• bool load_distribute_points (const String &points_filename, unsigned short tabular_format, bool active_only)

    load list of points from data file and distribute among listCVPoints, listDIVPoints, listDSVPoints, and listDRVPoints

• template<typename OrdinalType, typename ScalarTypeA, typename ScalarTypeC, typename ScalarTypeDI, typename ScalarTypeDS, typename ScalarTypeDR>

    bool distribute (const Teuchos::SerialDenseVector< OrdinalType, ScalarTypeA > &all_data, Teuchos::SerialDenseVector< OrdinalType, ScalarTypeC > &c_data, Teuchos::SerialDenseVector< OrdinalType, ScalarTypeDI > &di_data, Teuchos::SerialDenseVector< OrdinalType, ScalarTypeDS > &ds_data, Teuchos::SerialDenseVector< OrdinalType, ScalarTypeDR > &dr_data)

    distributes incoming all vector in standard variable ordering among continuous, discrete int, discrete string, and discrete real vectors

• template<typename ScalarType>

    bool distribute (const std::vector<ScalarType> &all_data, std::vector<ScalarType> &c_data, std::vector<ScalarType> &di_data, std::vector<ScalarType> &ds_data, std::vector<ScalarType> &dr_data)

    distributes incoming all array in standard variable ordering among continuous, discrete int, discrete string, and discrete real arrays

• bool load_list_of_points (const RealVector &list_of_pts)

    distributes list of pts coming from user spec among listCVPoints, listDIVPoints, listDSVPoints, and listDRVPoints

• void final_point_to_step_vector ()

    compute step vectors from finalPoint, initial points, and numSteps

• void distribute_partitions ()

    compute step vectors from {cont,discInt,discString,discReal}VarPartitions and global bounds

• bool check_num_steps (int num_steps)

    perform error checks on numSteps

• bool check_step_vector (const RealVector &step_vector)

    perform error checks on stepVector

• bool check_final_point (const RealVector &final_pt)

    perform error checks on finalPoint

• bool check_steps_per_variable (const IntVector &steps_per_var)

    perform error checks on stepsPerVariable

• bool check_variable_partitions (const UShortArray &partitions)

    perform error checks on variable partitions

• bool check_finite_bounds ()

    check for finite variable bounds within iteratedModel, as required for computing partitions of finite ranges

• bool check_ranges_sets (int num_steps)

    sanity check for vector parameter study

• bool check_ranges_sets (const IntVector &c_steps, const IntVector &di_steps, const IntVector &ds_steps, const IntVector &dr_steps)

    sanity check for centered parameter study

• bool check_sets (const IntVector &c_steps, const IntVector &di_steps, const IntVector &ds_steps, const IntVector &dr_steps)

    sanity check for increments along int/real set dimensions

• int integer_step (int range, int num_steps) const

    check for integer remainder and return step

• int index_step (size_t start, size_t end, int num_steps) const
check for out of bounds and index remainder and return step

- void c_step (size_t c_index, int increment, Variables &vars)
  helper function for performing a continuous step in one variable
- void dri_step (size_t di_index, int increment, Variables &vars)
  helper function for performing a discrete step in an integer range variable
- void dsi_step (size_t di_index, int increment, const IntSet &values, Variables &vars)
  helper function for performing a discrete step in an integer set variable
- void dss_step (size_t ds_index, int increment, const StringSet &values, Variables &vars)
  helper function for performing a discrete step in a string set variable
- void dsr_step (size_t dr_index, int increment, const RealSet &values, Variables &vars)
  helper function for performing a discrete step in a real set variable
- void reset (Variables &vars)
  reset vars to initial point (center)
- void centered_header (const String &type, size_t var_index, int step, size_t hdr_index)
  store a centered parameter study header within allHeaders

Private Attributes

- size_t numEvals
  total number of parameter study evaluations computed from specification
- RealVectorArray listCVPoints
  array of continuous evaluation points for the list_parameter_study
- IntVectorArray listDIVPoints
  array of discrete int evaluation points for the list_parameter_study
- StringMulti2DArray listDSVPoints
  array of discrete string evaluation points for the list_parameter_study
- RealVectorArray listDRVPoints
  array of discrete real evaluation points for the list_parameter_study
- RealVector initialCVPoint
  the continuous start point for vector and centered parameter studies
- IntVector initialDIVPoint
  the discrete int start point for vector and centered parameter studies
- StringMultiArray initialDSVPoint
  the discrete string start point for vector and centered parameter studies
- RealVector initialDRVPoint
  the discrete real start point for vector and centered parameter studies
- RealVector finalCVPoint
  the continuous ending point for vector_parameter_study
- IntVector finalDIVPoint
  the discrete int range value or set index ending point for vector_parameter_study
- IntVector finalDSVPoint
  the discrete string set index ending point for vector_parameter_study
- IntVector finalDRVPoint
the discrete real set index ending point for vector\_parameter\_study

- RealVector contStepVector
  
  the n-dimensional continuous increment

- IntVector discIntStepVector
  
  the n-dimensional discrete integer range value or set index increment

- IntVector discStringStepVector
  
  the n-dimensional discrete string set index increment

- IntVector discRealStepVector
  
  the n-dimensional discrete real set index increment

- int numSteps
  
  the number of times continuous/discrete step vectors are applied for vector\_parameter\_study (a specification option)

- IntVector contStepsPerVariable
  
  number of offsets in the plus and the minus direction for each continuous variable in a centered\_parameter\_study

- IntVector discIntStepsPerVariable
  
  number of offsets in the plus and the minus direction for each discrete integer variable in a centered\_parameter\_study

- IntVector discStringStepsPerVariable
  
  number of offsets in the plus and the minus direction for each discrete string variable in a centered\_parameter\_study

- IntVector discRealStepsPerVariable
  
  number of offsets in the plus and the minus direction for each discrete real variable in a centered\_parameter\_study

- UShortArray contVarPartitions
  
  number of partitions for each continuous variable in a multidim\_parameter\_study

- UShortArray discIntVarPartitions
  
  number of partitions for each discrete integer variable in a multidim\_parameter\_study

- UShortArray discStringVarPartitions
  
  number of partitions for each discrete string variable in a multidim\_parameter\_study

- UShortArray discRealVarPartitions
  
  number of partitions for each discrete real variable in a multidim\_parameter\_study

### Additional Inherited Members

#### 13.136.1 Detailed Description

Class for vector, list, centered, and multidimensional parameter studies.

The ParamStudy class contains several algorithms for performing parameter studies of different types. The vector parameter study steps along an n-dimensional vector from an arbitrary initial point to an arbitrary final point in a specified number of steps. The centered parameter study performs a number of plus and minus offsets in each coordinate direction around a center point. A multidimensional parameter study fills an n-dimensional hypercube based on bounds and a specified number of partitions for each dimension. And the list parameter study provides for a user specification of a list of points to evaluate, which allows general parameter investigations not fitting the structure of vector, centered, or multidim parameter studies.
13.136.2 Member Function Documentation

```cpp
void pre_run() [virtual]
```

pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori

pre-run phase, which a derived iterator may optionally reimplement; when not present, pre-run is likely integrated into the derived run function. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s `pre_run()`, if implemented, typically before performing its own implementation steps.

Reimplemented from `Analyzer`.

References Dakota::abort_handler(), SharedVariablesData::active_components_totals(), Analyzer::allHeaders, Analyzer::allVariables, ParamStudy::centered_loop(), Variables::continuous_variables(), ParamStudy::contStepsPerVariable, ParamStudy::contStepVector, ParamStudy::contVarPartitions, Dakota::copy_data(), Model::current_variables(), ParamStudy::discIntStepsPerVariable, ParamStudy::discIntStepVector, ParamStudy::discIntVarPartitions, ParamStudy::discRealStepsPerVariable, ParamStudy::discRealStepVector, ParamStudy::discRealVarPartitions, Variables::discrete_int_variables(), Variables::discrete_real_variables(), Variables::discrete_string_variables(), ParamStudy::discStringStepsPerVariable, ParamStudy::discStringStepVector, ParamStudy::discStringVarPartitions, ParamStudy::distribute_partitions(), ParamStudy::final_point_to_step_vector(), ParamStudy::finalCVPoint, ParamStudy::finalDIVPoint, ParamStudy::finalDSVPoint, ParamStudy::initialCVPoint, ParamStudy::initialDIVPoint, ParamStudy::initialDSVPoint, Iterator::iteratedModel, Iterator::method_enum_to_string(), Iterator::methodName, ParamStudy::multidim_loop(), Analyzer::numDiscreteStringsVars, ParamStudy::numEvals, ParamStudy::numSteps, Iterator::outputLevel, Analyzer::pre_run(), ParamStudy::sample(), Variables::shared_data(), Dakota::svd(), ParamStudy::vector_loop(), and Dakota::write_ordered().

```cpp
void core_run() [virtual]
```

core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post

Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.

Reimplemented from `Iterator`.

References Analyzer::evaluate_parameter_sets(), Iterator::iteratedModel, Iterator::methodName, Analyzer::numLSqTerms, Analyzer::numObjFns, and Iterator::subIteratorFlag.

```cpp
void post_run(std::ostream & s) [virtual]
```

post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way

Post-run phase, which a derived iterator may optionally reimplement; when not present, post-run is likely integrated into run. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s `post_run()`, typically after performing its own implementation steps.

Reimplemented from `Analyzer`.

References Analyzer::allResponses, Analyzer::allVariables, SensAnalysisGlobal::compute_correlations(), Model::discrete_set_string_values(), Iterator::iteratedModel, Iterator::methodName, Analyzer::post_run(), PStudyDACE::pStudyDACESensGlobal, and Iterator::subIteratorFlag.

```cpp
bool load_distribute_points(const String & points_filename, unsigned short tabular_format, bool active_only) [private]
```

load list of points from data file and distribute among listCVPoints, listDIVPoints, listDSVPoints, and listDRVPoints
Load from file and distribute points; using this function to manage construction of the temporary arrays. Historically all data was read as a real (mixture of values and indices), but now points file is valued-based (reals, integers, strings) so file input matches tabular data output. Return false on success.

References Dakota::NPOS, Model::continuous::lower::bounds(), Model::continuous::upper::bounds(), Variables::copy(), Model::current::variables(), Model::discrete::int::lower::bounds(), Model::discrete::int::upper::bounds(), Model::discrete::set::int::values(), Model::discrete::set::real::values(), Model::discrete::set::string::values(), Iterator::iteratedModel, ParamStudy::list::CV::Points, ParamStudy::list::DIV::Points, ParamStudy::list::DRV::Points, ParamStudy::list::DSV::Points, Analyzer::num::Continuous::Vars, Analyzer::num::Discrete::Int::Vars, Analyzer::num::Discrete::Real::Vars, Analyzer::num::Discrete::String::Vars, ParamStudy::num::Evals, and Dakota::set::value::to::index().

Referenced by ParamStudy::ParamStudy().

```cpp
bool distribute_list_of_points ( const RealVector & list_of_pts ) [private]
```
distributes list_of_pts coming from user spec among listCVPoints, listDIVPoints, listDSVPoints, and listDRVPoints

Parse list of points into typed data containers; list_of_pts will contain values for continuous and discrete integer range, but indices for all discrete set types (int, string, real)

References Model::discrete::int::sets(), Model::discrete::set::int::values(), Model::discrete::set::real::values(), Model::discrete::set::string::values(), ParamStudy::distribute(), Iterator::iteratedModel, ParamStudy::list::CV::Points, ParamStudy::list::DIV::Points, ParamStudy::list::DSV::Points, ParamStudy::list::DRV::Points, Analyzer::num::Continuous::Vars, Analyzer::num::Discrete::Int::Vars, Analyzer::num::Discrete::Real::Vars, Analyzer::num::Discrete::String::Vars, ParamStudy::num::Evals, and Dakota::set::index::to::value().

Referenced by ParamStudy::ParamStudy().

The documentation for this class was generated from the following files:

- ParamStudy.hpp
- ParamStudy.cpp

### 13.137 partial_prp_equality Struct Reference

Predicate for comparing ONLY the interfaceId and Vars attributes of PRPair

#### Public Member Functions

- bool operator() ( const ParamResponsePair &database_pr, const ParamResponsePair &search_pr ) const

### 13.137.1 Detailed Description

Predicate for comparing ONLY the interfaceId and Vars attributes of PRPair

The documentation for this struct was generated from the following file:

- PRPMultiIndex.hpp

### 13.138 partial_prp_hash Struct Reference

Wrapper to delegate to the `ParamResponsePair::hash::value::function`
Public Member Functions

- std::size_t operator() (const ParamResponsePair &prp) const
  access operator

13.138.1 Detailed Description

wrapper to delegate to the ParamResponsePair hash_value function
The documentation for this struct was generated from the following file:

- PRPMultiIndex.hpp

13.139 PebblBranching Class Reference

Main Branching class for the PEBBL-based Minimizer.
Inherits branching.

Public Member Functions

- PebblBranching ()
  Default Constructor.
- ~PebblBranching ()
  Destructor.
- pebbl::branchSub * blankSub ()
  Method that returns an empty Sub-Branch.
- void setModel (Model &model)
- void setIterator (Iterator &iterator)

Protected Attributes

- Model parentModel
  Original model, before branching.
- Iterator nlpSolver
  Solver to be used at root node.
- RealVector cont_vars
  Initial variable values for root node.
- RealVector lower_bounds
  Lower bounds for root node.
- RealVector upper_bounds
  Upper bounds for root node.

Friends

- class PebblBranchSub
13.139.1 Detailed Description

Main Branching class for the PEBBL-based Minimizer.
The documentation for this class was generated from the following files:

- PEBBLBranching.hpp
- PEBBLBranching.cpp

13.140 PebbldBranchSub Class Reference

Sub Branch class for the PEBBL-based Minimizer.
Inherits branchSub.

Public Member Functions

- PebbldBranchSub ()
  Constructor.
- ~PebbldBranchSub ()
  Destructor.
- PebbldBranching * global () const
  Returns a reference to the corresponding main Branching object.
- pebbl::branching * bGlobal () const
  Returns a reference to the corresponding main Branching object.
- void setGlobalInfo (PebbldBranching *global)
  Method that sets up the main Branching object.
- void setRootComputation ()
  Method that is called when declaring the current node as a root node.
- void boundComputation (double *controlParam)
  Method that does the Bounding Operation. In other words, it calls the optimization algorithm on the relaxed domain.
- bool candidateSolution ()
  Method called after the bounding operation, returns true if the bounding resulted in a possible solution to the original non-relaxed problem.
- pebbl::solution * extractSolution ()
  Method that returns a PEBBL-based solution.
- int splitComputation ()
  Method that determines how many branches are created and how. Returns the number of branches created from this object.
- pebbl::branchSub * makeChild (int whichChild)
  Method that returns a new PebbldBranchSub object based on Objective Function improvements and the number of branches.
- void pebblSubAsChildOf (PebbldBranchSub *parent, int splitVar, int whichChild, std::vector< double > _candidate_x, RealVector _lower_bounds, RealVector _upper_bounds)
  Method that creates a new PebbldBranching object.
Protected Attributes

- **PebbldBranching** * globalPtr
  
  Pointer referring to all info passed to subproblem.

- **Model** subModel
  
  Model used for sub-problem.

- **Iterator** subNLP Solver
  
  Solver used for sub-problems.

- **std::vector< double >** candidate_x
  
  Candidate solution after solving sub-problem (also the bound)

- **double** candidate_objFn
  
  Objective value at the candidate solution.

- **int** splitVar
  
  Variable to branch on.

- **RealVector cont_vars**
  
  Initial variable values for sub-problem.

- **RealVector lower_bounds**
  
  Lower bounds for sub-problem.

- **RealVector upper_bounds**
  
  Upper bounds for sub-problem.

Friends

- class **PebbldBranching**

13.140.1 Detailed Description

Sub Branch class for the PEBBL-based Minimizer.

The documentation for this class was generated from the following files:

- PEBBLBranching.hpp
- PEBBLBranching.cpp

13.141 PebbldMinimizer Class Reference

Wrapper class for experimental PebbldMinimizer.

Inheritance diagram for PebbldMinimizer:
Public Member Functions

- PebbldMinimizer (ProblemDescDB &problem_db, Model &model)
  
  *standard constructor*

- PebbldMinimizer (Model &model)
  
  *Constructor.*

- PebbldMinimizer (Model &model, int random_seed, int max_iter, int max_eval)
  
  *Constructor.*

- ~PebbldMinimizer ()
  
  *Destructor.*

Protected Member Functions

- void core_run ()
  
  *Calls the Pebbl Branch and Bound solver.*

- void print_results (std::ostream &s)
  
  *Redefinition of default results printing.*

Private Attributes

- PebblBranching * branchAndBound
  
  *Object that implements the branching and bounding logic.*

- Iterator subProbMinimizer
  
  *Minimizer used to solve the subproblem on each branch.*

Additional Inherited Members

13.141.1 Detailed Description

Wrapper class for experimental PebbldMinimizer.

13.141.2 Constructor & Destructor Documentation

PebbldMinimizer ( Model & model )

Constructor.

<table>
<thead>
<tr>
<th>model</th>
<th>DAKOTA Model object</th>
</tr>
</thead>
</table>

PebbldMinimizer ( Model & model, int random_seed, int max_iter, int max_eval )

Constructor.

  PebbldMinimizer Constructor
Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>model</td>
<td>DAKOTA Model object</td>
</tr>
<tr>
<td>random_seed</td>
<td>Random Seed</td>
</tr>
<tr>
<td>max_iter</td>
<td>Maximum number of iterations</td>
</tr>
<tr>
<td>max_eval</td>
<td>Maximum number of Black Box Evaluations</td>
</tr>
</tbody>
</table>

13.141.3 Member Function Documentation

```cpp
void core_run() [protected, virtual]
```

Calls the PEBBL Branch and Bound solver.
redefines default iterator logic to execute branch and bound and extract optimization results.
Reimplemented from `Iterator`.
References `Iterator::bestResponseArray`, `Iterator::bestVariablesArray`, `PebblMinimizer::branchAndBound`, and `Minimizer::numContinuousVars`.

```cpp
void print_results(std::ostream &s) [protected, virtual]
```

Redefinition of default results printing.
Redefines default iterator results printing to include optimization results (objective functions and constraints).
Reimplemented from `Iterator`.
References `Dakota::abort_handler()`, `Iterator::activeSet`, `Minimizer::archive_allocate_best()`, `Minimizer::archive_best()`, `Iterator::bestResponseArray`, `Iterator::bestVariablesArray`, `Dakota::data_pairs`, `Model::interface_id()`, `Iterator::iteratedModel`, `Dakota::lookup_by_val()`, `Minimizer::numFunctions`, `Minimizer::numUserPrimaryFns`, `Minimizer::optimizationFlag`, and `ActiveSet::request_values()`.
The documentation for this class was generated from the following files:
- PEBBLMinimizer.hpp
- PEBBLMinimizer.cpp

13.142 PecosApproximation Class Reference

Derived approximation class for global basis polynomials.
Inheritance diagram for PecosApproximation:

```
Approximation

PecosApproximation
```

Public Member Functions

- `PecosApproximation()`
  default constructor
- `PecosApproximation(ProblemDescDB &problem_db, const SharedApproxData &shared_data, const String &approx_label)`
PECOSAPPROXIMATION CLASS REFERENCE

13.142.

standard ProblemDescDB-driven constructor

- **PecosApproximation** (const SharedApproxData &shared_data)

alternate constructor

- ~PecosApproximation ()

destructor

- void expansion_coefficient_flag (bool coeff_flag)
  
  set pecosBasisApprox.configOptions.expansionCoeffFlag

- bool expansion_coefficient_flag () const
  
  get pecosBasisApprox.configOptions.expansionCoeffFlag

- void expansion_gradient_flag (bool grad_flag)
  
  set pecosBasisApprox.configOptions.expansionGradFlag

- bool expansion_gradient_flag () const
  
  get pecosBasisApprox.configOptions.expansionGradFlag

- void compute_component_effects ()
  
  Performs global sensitivity analysis using Sobol’ Indices by computing component (main and interaction) effects.

- void compute_total_effects ()
  
  Performs global sensitivity analysis using Sobol’ Indices by computing total effects.

- const Pecos::RealVector & sobol_indices () const
  
  return polyApproxRep->sobolIndices

- const Pecos::RealVector & total_sobol_indices () const
  
  return polyApproxRep->totalSobolIndices

- Pecos::ULongULongMap sparse_sobol_index_map () const
  
  return RegressOrthogPolyApproximation::sparseSobolIndexMap

- const Pecos::RealVector & dimension_decay_rates () const
  
  return OrthogPolyApproximation::decayRates

- void allocate_arrays ()
  
  invoke Pecos::PolynomialApproximation::allocate_arrays()

- Real mean ()
  
  return the mean of the expansion, treating all variables as random

- Real mean (const Pecos::RealVector &x)
  
  return the mean of the expansion for a given parameter vector, treating a subset of the variables as random

- const Pecos::RealVector & mean_gradient ()
  
  return the gradient of the expansion mean for a given parameter vector, treating all variables as random

- const Pecos::RealVector & mean_gradient (const Pecos::RealVector &x, const Pecos::SizetArray &dvv)
  
  return the gradient of the expansion mean for a given parameter vector and given DVV, treating a subset of the variables as random

- Real variance ()
  
  return the variance of the expansion, treating all variables as random

- Real variance (const Pecos::RealVector &x)
  
  return the variance of the expansion for a given parameter vector, treating a subset of the variables as random

- const Pecos::RealVector & variance_gradient ()
  
  return the gradient of the expansion variance for a given parameter vector, treating all variables as random

- const Pecos::RealVector & variance_gradient (const Pecos::RealVector &x, const Pecos::SizetArray &dvv)
return the gradient of the expansion variance for a given parameter vector and given DVV, treating a subset of the variables as random

- Real covariance (PecosApproximation *pecos_approx_2)
  return the covariance between two response expansions, treating all variables as random

- Real covariance (const Pecos::RealVector &x, PecosApproximation *pecos_approx_2)
  return the covariance between two response expansions, treating a subset of the variables as random

- Real delta covariance (PecosApproximation *pecos_approx_2)
  return the change in covariance between two response expansions, treating all variables as random

- Real delta covariance (const Pecos::RealVector &x, PecosApproximation *pecos_approx_2)
  return the change in covariance between two response expansions, treating a subset of the variables as random

- Real delta mean ()
  return the change in mean between two response expansions, treating all variables as random

- Real delta mean (const RealVector &x)
  return the change in mean between two response expansions, treating a subset of variables as random

- Real delta std deviation ()
  return the change in standard deviation between two response expansions, treating all variables as random

- Real delta std deviation (const RealVector &x)
  return the change in standard deviation between two response expansions, treating a subset of variables as random

- Real delta beta (bool cdf_flag, Real z_bar)
  return the change in reliability index (mapped from z_bar) between two response expansions, treating all variables as random

- Real delta beta (const RealVector &x, bool cdf_flag, Real z_bar)
  return the change in reliability index (mapped from z_bar) between two response expansions, treating a subset of variables as random

- Real delta z (bool cdf_flag, Real beta_bar)
  return the change in response level (mapped from beta_bar) between two response expansions, treating all variables as random

- Real delta z (const RealVector &x, bool cdf_flag, Real beta_bar)
  return the change in response level (mapped from beta_bar) between two response expansions, treating a subset of the variables as random

- void compute_moments ()
  compute moments up to the order supported by the Pecos polynomial approximation

- void compute_moments (const Pecos::RealVector &x)
  compute moments in all-variables mode up to the order supported by the Pecos polynomial approximation

- const RealVector & moments () const
  return virtual Pecos::PolynomialApproximation::moments()

- const RealVector & expansion_moments () const
  return Pecos::PolynomialApproximation::expansionMoments

- const RealVector & numerical_integration_moments () const
  return Pecos::PolynomialApproximation::numericalMoments

- void standardize_moments (const Pecos::RealVector &central_moments, Pecos::RealVector &std_moments)
  standardize the central moments returned from Pecos

- void build_linear_system (RealMatrix &A, const UShort2DArray &multi_index)
  construct the Vandermonde matrix "A" for PCE regression for Ax = b
13.142. PECOSAPPROXIMATION CLASS REFERENCE

- void **augment_linear_system** (const RealVectorArray &samples, RealMatrix &A, const UShort2DArray &multi_index)
- const Pecos::SurrogateData & **surrogate_data** () const
- Pecos::BasisApproximation & **pecos_basis_approximation** ()
  
  return pecosBasisApprox

**Protected Member Functions**

- Real **value** (const Variables &vars)
  
  retrieve the approximate function value for a given parameter vector
- const Pecos::RealVector & **gradient** (const Variables &vars)
  
  retrieve the approximate function gradient for a given parameter vector
- const Pecos::RealSymMatrix & **hessian** (const Variables &vars)
  
  retrieve the approximate function Hessian for a given parameter vector
- int **min_coefficients** () const
  
  return the minimum number of samples (unknowns) required to build the derived class approximation type in num- Vars dimensions
- void **build** ()
  
  builds the approximation from scratch
- void **rebuild** ()
  
  rebuilds the approximation incrementally
- void **pop** (bool save_data)
  
  removes entries from end of SurrogateData::{vars,resp}Data (last points appended, or as specified in args)
- void **push** ()
  
  restores state prior to previous pop()
- void **finalize** ()
  
  finalize approximation by applying all remaining trial sets
- void **store** (size_t index=NPOS)
  
  store current approximation state for later combination
- void **restore** (size_t index=NPOS)
  
  restore previous approximation state
- void **remove_stored** (size_t index=NPOS)
  
  remove a stored approximation prior to combination
- void **combine** (short corr_type, size_t swap_index)
  
  combine current approximation with previously stored approximation
- void **print_coefficients** (std::ostream &s, bool normalized)
  
  print the coefficient array computed in build/rebuild()
- RealVector **approximation_coefficients** (bool normalized) const
  
  return expansion coefficients in a form consistent with the shared multi-index
- void **approximation_coefficients** (const RealVector &approx_coeffs, bool normalized)
  
  set expansion coefficients in a form consistent with the shared multi-index
- void **coefficient_labels** (std::vector<std::string> &coeff_labels) const
  
  print the coefficient array computed in build/rebuild()
Private Member Functions

- void approx\_type\_to\_basis\_type (const String &approx\_type, short &basis\_type)
  utility to convert Dakota type string to Pecos type enumeration

Private Attributes

- Pecos::BasisApproximation pecosBasisApprox
  the Pecos basis approximation, encompassing OrthogPolyApproximation and InterpPolyApproximation
- Pecos::PolynomialApproximation * polyApproxRep
  convenience pointer to representation of Pecos polynomial approximation

Additional Inherited Members

13.142.1 Detailed Description

Derived approximation class for global basis polynomials.

The PecosApproximation class provides a global approximation based on basis polynomials. This includes
orthogonal polynomials used for polynomial chaos expansions and interpolation polynomials used for stochastic
collocation.

13.142.2 Member Function Documentation

void build ( ) [inline], [protected], [virtual]
builds the approximation from scratch

This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations
should explicitly invoke (or reimplement) this base class contribution.
Reimplemented from Approximation.
References Approximation::build(), and PecosApproximation::pecosBasisApprox.

void rebuild ( ) [inline], [protected], [virtual]
rebuilds the approximation incrementally

This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations
should explicitly invoke (or reimplement) this base class contribution.
Reimplemented from Approximation.
References PecosApproximation::pecosBasisApprox.

void pop ( bool save\_data ) [inline], [protected], [virtual]
removes entries from end of SurrogateData::\{vars,resp\}Data (last points appended, or as specified in args)

This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations
should explicitly invoke (or reimplement) this base class contribution.
Reimplemented from Approximation.
References PecosApproximation::pecosBasisApprox, and Approximation::pop().
void push( ) [inline], [protected], [virtual]
restores state prior to previous pop()
This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations should explicitly invoke (or reimplement) this base class contribution.
Reimplemented from Approximation.
References PecosApproximation::pecosBasisApprox, and Approximation::push().

void finalize( ) [inline], [protected], [virtual]
finalize approximation by applying all remaining trial sets
This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations should explicitly invoke (or reimplement) this base class contribution.
Reimplemented from Approximation.
References Approximation::finalize(), and PecosApproximation::pecosBasisApprox.
The documentation for this class was generated from the following files:

- PecosApproximation.hpp
- PecosApproximation.cpp

13.143 ProbabilityTransformModel Class Reference
Probability transformation specialization of RecastModel.

Inheritance diagram for ProbabilityTransformModel:

```
+--------------------------------------------------+
| Model                                           |
+--------------------------------------------------+
| RecastModel                                      |
+--------------------------------------------------+
| ProbabilityTransformModel                        |
```

Public Member Functions

- **ProbabilityTransformModel** (const Model &sub_model, bool truncated_bounds=false, Real bound=10.)
  *standard constructor*
- **~ProbabilityTransformModel** ()
  *destructor*
- void **transform_correlations** ()
  *perform correlation warping for variable types supported by Nataf*
- bool **initialize_mapping** (ParLevLIter pl_iter)
  *initialize model mapping, returns true if the variables size has changed*
Protected Member Functions

- void `distribution_parameter_derivatives` (bool dist_param_derivs)
  set distParamDerivs
- void `initialize_random_variables` (const Pecos::ProbabilityTransformation &transform, bool deep_copy=false)
  alternate form: initialize natafTransform based on incoming data
- void `initialize_random_variable_transformation`()
  instantiate natafTransform
- void `initialize_random_variable_types`()
  initializes ranVarTypesX within natafTransform (u-space not needed)
- void `initialize_random_variable_types` (short u_space_type)
  initializes ranVarTypesX and ranVarTypesU within natafTransform
- void `initialize_random_variable_parameters`()
  initializes ranVarMeansX, ranVarStdDevsX, ranVarLowerBndsX, ranVarUpperBndsX, and ranVarAddtlParamsX within natafTransform
- void `initialize_random_variable_correlations`()
  propagate iteratedModel correlations to natafTransform
- void `verify_correlation_support` (short u_space_type)
  verify that correlation warping is supported by Nataf for given variable types
- void `transform_model` (bool truncated_binds, Real bound)
  recast x_model from x-space to u-space to create u_model
- unsigned short `pecos_to_dakota_variable_type` (unsigned short pecos_var_type)
  convert from Pecos To Dakota variable enumeration type for continuous aleatory uncertain variables used in variable transformations
- void `initialize_sizes` ()

Static Protected Member Functions

- static void `vars_u_to_x_mapping` (const Variables &u_vars, Variables &x_vars)
  static function for RecastModels used for forward mapping of u-space variables from NonD Iterators to x-space variables for Model evaluations
- static void `vars_x_to_u_mapping` (const Variables &x_vars, Variables &u_vars)
  static function for RecastModels used for inverse mapping of x-space variables from data import to u-space variables for NonD Iterators
- static void `set_u_to_x_mapping` (const Variables &u_vars, const ActiveSet &u_set, ActiveSet &x_set)
  static function for RecastModels used to map u-space ActiveSets from NonD Iterators to x-space ActiveSets for Model evaluations
- static void `resp_x_to_u_mapping` (const Variables &x_vars, const Variables &u_vars, const Response &x_response, Response &u_response)
  static function for RecastModels used to map x-space responses from Model evaluations to u-space responses for return to NonD Iterator.
Private Attributes

- **Pecos::ProbabilityTransformation natafTransform**
  Nonlinear variable transformation that encapsulates the required data for performing transformations from X -> Z -> U and back.
- **size_t numFunctions**
  number of response functions
- **size_t numContinuousVars**
  number of active continuous vars
- **size_t numDiscreteIntVars**
  number of active discrete integer vars
- **size_t numDiscreteStringVars**
  number of active discrete string vars
- **size_t numDiscreteRealVars**
  number of active discrete real vars
- **size_t numContDesVars**
  number of continuous design variables (modeled using uniform distribution for All view modes)
- **size_t numDiscIntDesVars**
  number of discrete integer design variables (modeled using discrete histogram distributions for All view modes)
- **size_t numDiscStringDesVars**
  number of discrete string design variables (modeled using discrete histogram distributions for All view modes)
- **size_t numDiscRealDesVars**
  number of discrete real design variables (modeled using discrete histogram distributions for All view modes)
- **size_t numDesignVars**
  total number of design variables
- **size_t numContStateVars**
  number of continuous state variables (modeled using uniform distribution for All view modes)
- **size_t numDiscIntStateVars**
  number of discrete integer state variables (modeled using discrete histogram distributions for All view modes)
- **size_t numDiscStringStateVars**
  number of discrete string state variables (modeled using discrete histogram distributions for All view modes)
- **size_t numDiscRealStateVars**
  number of discrete real state variables (modeled using discrete histogram distributions for All view modes)
- **size_t numStateVars**
  total number of state variables
- **size_t numNormalVars**
  number of normal uncertain variables (native space)
- **size_t numLognormalVars**
  number of lognormal uncertain variables (native space)
- **size_t numUniformVars**
  number of uniform uncertain variables (native space)
- **size_t numLoguniformVars**
  number of loguniform uncertain variables (native space)
- **size_t numTriangularVars**
number of triangular uncertain variables (native space)

- `size_t numExponentialVars`
  number of exponential uncertain variables (native space)

- `size_t numBetaVars`
  number of beta uncertain variables (native space)

- `size_t numGammaVars`
  number of gamma uncertain variables (native space)

- `size_t numGumbelVars`
  number of gumbel uncertain variables (native space)

- `size_t numFrechetVars`
  number of frechet uncertain variables (native space)

- `size_t numWeibullVars`
  number of weibull uncertain variables (native space)

- `size_t numHistogramBinVars`
  number of histogram bin uncertain variables (native space)

- `size_t numPoissonVars`
  number of Poisson uncertain variables (native space)

- `size_t numBinomialVars`
  number of binomial uncertain variables (native space)

- `size_t numNegBinomialVars`
  number of negative binomial uncertain variables (native space)

- `size_t numGeometricVars`
  number of geometric uncertain variables (native space)

- `size_t numHyperGeomVars`
  number of hypergeometric uncertain variables (native space)

- `size_t numHistogramPtIntVars`
  number of histogram point integer uncertain variables (native space)

- `size_t numHistogramPtStringVars`
  number of histogram point string uncertain variables (native space)

- `size_t numHistogramPtRealVars`
  number of histogram point real uncertain variables (native space)

- `size_t numContIntervalVars`
  number of continuous interval uncertain variables (native space)

- `size_t numDiscIntervalVars`
  number of discrete interval uncertain variables (native space)

- `size_t numDiscSetIntUncVars`
  number of discrete integer set uncertain variables (native space)

- `size_t numDiscSetStringUncVars`
  number of discrete integer set uncertain variables (native space)

- `size_t numDiscSetRealUncVars`
  number of discrete real set uncertain variables (native space)

- `size_t numContAleatUncVars`
  total number of continuous aleatory uncertain variables (native space)
13.143. PROBABILITYTRANSFORMMODEL CLASS REFERENCE

- `size_t numDiscIntAleatUncVars`
  total number of discrete integer aleatory uncertain variables (native space)
- `size_t numDiscStringAleatUncVars`
  total number of discrete string aleatory uncertain variables (native space)
- `size_t numDiscRealAleatUncVars`
  total number of discrete real aleatory uncertain variables (native space)
- `size_t numAleatoryUncVars`
  total number of aleatory uncertain variables (native space)
- `size_t numDiscIntEpistUncVars`
  total number of discrete integer epistemic uncertain variables (native space)
- `size_t numDiscStringEpistUncVars`
  total number of discrete string epistemic uncertain variables (native space)
- `size_t numDiscRealEpistUncVars`
  total number of discrete real epistemic uncertain variables (native space)
- `size_t numEpistemicUncVars`
  total number of epistemic uncertain variables (native space)
- `size_t numUncertainVars`
  total number of uncertain variables (native space)
- `bool distParamDerivs`
  flags calculation of derivatives with respect to distribution parameters s within resp_x_to_u_mapping() using the chain rule df/dx dx/ds. The default is to calculate derivatives with respect to standard random variables u using the chain rule df/dx dx/du.
- `bool truncatedBounds`
  boolean flag to indicate truncated bounds
- `Real boundVal`
  bound value
- `bool epistemicStats`
  flag for computing interval-type metrics instead of integrated metrics If any epistemic variables are active in a metric evaluation, then this flag is set.
- `SizetArray primaryACVarMapIndices`
  “primary” all continuous variable mapping indices flowed down from higher level iteration
- `ShortArray secondaryACVarMapTargets`
  “secondary” all continuous variable mapping targets flowed down from higher level iteration

Static Private Attributes

- `static ProbabilityTransformModel * ptmInstance`
  static pointer to this class for use in static callbacks

Additional Inherited Members

13.143.1 Detailed Description

Probability transformation specialization of RecastModel.
Specialization of RecastModel to transform a sub-model to u-space.
13.143.2 Member Function Documentation

void initialize_random_variables ( const Pecos::ProbabilityTransformation & transform, bool deep_copy = false ) [protected]

alternate form: initialize natafTransform based on incoming data

This function is commonly used to publish transformation data when the Model variables are in a transformed space (e.g., u-space) and ProbabilityTransformation::ranVarTypes et al. may not be generated directly. This allows for the use of inverse transformations to return the transformed space variables to their original states.

References ProbabilityTransformModel::initialize_random_variable_transformation(), ProbabilityTransformModel::natafTransform, ProbabilityTransformModel::numContDesVars, ProbabilityTransformModel::numContEpistUncVars, ProbabilityTransformModel::numContIntervalVars, and ProbabilityTransformModel::numContStateVars.

void initialize_random_variable_types ( ) [protected]

initializes ranVarTypesX within natafTransform (u-space not needed)

Build ProbabilityTransformation::ranVar arrays containing the uncertain variable distribution types and their corresponding means/standard deviations. This function is used when the Model variables are in x-space.


Referenced by ProbabilityTransformModel::ProbabilityTransformModel().

void initialize_random_variable_types ( short u_space_type ) [protected]

initializes ranVarTypesX and ranVarTypesU within natafTransform

Build ProbabilityTransformation::ranVar arrays containing the uncertain variable distribution types and their corresponding means/standard deviations. This function is used when the Model variables are in x-space.

void initialize_random_variable_parameters() [protected]
initializes ranVarMeansX, ranVarStdDevsX, ranVarLowerBndsX, ranVarUpperBndsX, and ranVarAddtlParamsX within natafTransform

Build ProbabilityTransformation::ranVar arrays containing the uncertain variable distribution types and their corresponding means/standard deviations. This function is used when the Model variables are in x-space.

References Model::aleatory_distribution_parameters(), Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::epistemic_distribution_parameters(), ProbabilityTransformModel::natafTransform, ProbabilityTransformModel::numAleatoryUncVars, ProbabilityTransformModel::numContDesVars, ProbabilityTransformModel::numContinuousVars, ProbabilityTransformModel::numContStateVars, ProbabilityTransformModel::numEpistemicUncVars, and RecastModel::subModel.

Referenced by ProbabilityTransformModel::initialize_mapping().

void vars_u_to_x_mapping ( const Variables & u_vars, Variables & x_vars ) [inline], [static], [protected]
static function for RecastModels used for forward mapping of u-space variables from NonD Iterators to x-space variables for Model evaluations
Map the variables from iterator space (u) to simulation space (x).

References Variables::continuous_variables(), Variables::continuous_variables_view(), ProbabilityTransformModel::natafTransform, and ProbabilityTransformModel::ptmInstance.

Referenced by ProbabilityTransformModel::ProbabilityTransformModel().

void vars_x_to_u_mapping ( const Variables & x_vars, Variables & u_vars ) [inline], [static], [protected]
static function for RecastModels used for inverse mapping of x-space variables from data import to u-space variables for NonD Iterators
Map the variables from simulation space (x) to iterator space (u).

References Variables::continuous_variables(), Variables::continuous_variables_view(), ProbabilityTransformModel::natafTransform, and ProbabilityTransformModel::ptmInstance.

Referenced by ProbabilityTransformModel::ProbabilityTransformModel().

void set_u_to_x_mapping ( const Variables & u_vars, const ActiveSet & u_set, ActiveSet & x_set ) [static], [protected]
static function for RecastModels used to map u-space ActiveSets from NonD Iterators to x-space ActiveSets for Model evaluations
Define the DVV for x-space derivative evaluations by augmenting the iterator requests to account for correlations.

References Dakota::NPOS, Variables::all_continuous_variable_ids(), Dakota::contains(), Variables::continuous_variable_ids(), ActiveSet::derivative_vector(), Dakota::find_index(), Variables::inactive_continuous_variable_ids(), ProbabilityTransformModel::natafTransform, and ProbabilityTransformModel::ptmInstance.

Referenced by ProbabilityTransformModel::ProbabilityTransformModel().

13.143.3 Member Data Documentation

ProbabilityTransformModel * ptmInstance [static], [private]
static pointer to this class for use in static callbacks
initialization of static needed by RecastModel
Referenced by ProbabilityTransformModel::ProbabilityTransformModel(), ProbabilityTransformModel::resp_x_to_u_mapping(), ProbabilityTransformModel::set_u_to_x_mapping(), ProbabilityTransformModel::vars_u_to_x_mapping(), and ProbabilityTransformModel::vars_x_to_u_mapping.

The documentation for this class was generated from the following files:

- ProbabilityTransformModel.hpp
- ProbabilityTransformModel.cpp

### 13.144 ProblemDescDB Class Reference

The database containing information parsed from the DAKOTA input file.

Inheritance diagram for ProblemDescDB:

```
ProblemDescDB
   |   ↓
NIDRProblemDescDB
```

#### Public Member Functions

- **ProblemDescDB ()**
  - default constructor
- **ProblemDescDB (ParallelLibrary &parallel_lib)**
  - standard constructor
- **ProblemDescDB (const ProblemDescDB &db)**
  - copy constructor
- **~ProblemDescDB ()**
  - destructor
- **ProblemDescDB operator= (const ProblemDescDB &db)**
  - assignment operator
- **void parse_inputs (const ProgramOptions &prog_opts, DbCallbackFunctionPtr callback=NULL, void *callback_data=NULL)**
  - Parses the input file or input string if present and executes callbacks. Does not perform any validation.
- **void check_and_broadcast (const ProgramOptions &prog_opts)**
  - performs check_input, broadcast, and post_process, but for now, allowing separate invocation through the public API as well
- **void check_input ()**
  - verifies that there is at least one of each of the required keywords in the dakota input file
- **void broadcast ()**
  - invokes send_dh_buffer() and receive_dh_buffer() to broadcast DB data across the processor allocation. Used by manage_inputs().
- **void post_process ()**
  - post-processes the (minimal) input specification to assign default variables/responses specification arrays. Used by manage_inputs().
• **void lock ()**

  Locks the database in order to prevent data access when the list nodes may not be set properly. Unlocked by a set
  nodes operation.

• **void unlock ()**

  Explicitly unlocks the database. Use with care.

• **void set_db_list_nodes (const String &method_tag)**

  Set dataMethodIter based on a method identifier string to activate a particular method specification in dataMethod-
  List and use pointers from this method specification to set all other list iterators.

• **void set_db_list_nodes (size_t method_index)**

  Set dataMethodIter based on an index within dataMethodList to activate a particular method specification and use
  pointers from this method specification to set all other list iterators.

• **void resolve_top_method (bool set_model_nodes=true)**

  For a (default) environment lacking a top method pointer, this function is used to determine which of several poten-
  tial method specifications corresponds to the top method and then sets the list nodes accordingly.

• **void set_db_method_node (const String &method_tag)**

  Set dataMethodIter based on a method identifier string to activate a particular method specification (only).

• **void set_db_method_node (size_t method_index)**

  Set dataMethodIter based on an index within dataMethodList to activate a particular method specification (only).

• **size_t get_db_method_node ()**

  Return the index of the active node in dataMethodList

• **void set_db_model_nodes (const String &model_tag)**

  Set the model list iterators (dataModelIter, dataVariablesIter, dataInterfaceIter, and dataResponsesIter) based on
  the model identifier string

• **void set_db_model_nodes (size_t model_index)**

  Set the model list iterators (dataModelIter, dataVariablesIter, dataInterfaceIter, and dataResponsesIter) based on
  an index within dataModelList

• **size_t get_db_model_node ()**

  Return the index of the active node in dataModelList

• **void set_db_variables_node (const String &variables_tag)**

  Set dataVariablesIter based on the variables identifier string

• **void set_db_interface_node (const String &interface_tag)**

  Set dataInterfaceIter based on the interface identifier string

• **void set_db_responses_node (const String &responses_tag)**

  Set dataResponsesIter based on the responses identifier string

• **ParallelLibrary & parallel_library () const**

  Return the parallelLib reference

• **IteratorList & iterator_list ()**

  Return a list of all Iterator objects that have been instantiated

• **ModelList & model_list ()**

  Return a list of all Model objects that have been instantiated

• **VariablesList & variables_list ()**

  Return a list of all Variables objects that have been instantiated

• **InterfaceList & interface_list ()**

  Return a list of all Interface objects that have been instantiated
• ResponseList & response_list ()
  return a list of all Response objects that have been instantiated
• const RealMatrixArray & get_rma (const String &entry_name) const
  get a RealMatrixArray out of the database based on an identifier string
• const RealVector & get_rv (const String &entry_name) const
  get a RealVector out of the database based on an identifier string
• const IntVector & get_iv (const String &entry_name) const
  get an IntVector out of the database based on an identifier string
• const BitArray & get_ba (const String &entry_name) const
  get a BitArray out of the database based on an identifier string
• const SizetArray & get_sza (const String &entry_name) const
  get a SizetArray out of the database based on an identifier string
• const UShortArray & get_usa (const String &entry_name) const
  get a UShortArray out of the database based on an identifier string
• const RealSymMatrix & get_rsm (const String &entry_name) const
  get a RealSymMatrix out of the database based on an identifier string
• const RealVectorArray & get_rva (const String &entry_name) const
  get a RealVectorArray out of the database based on an identifier string
• const IntVectorArray & get_iva (const String &entry_name) const
  get an IntVectorArray out of the database based on an identifier string
• const IntSet & get_is (const String &entry_name) const
  get an IntSet out of the database based on an identifier string
• const IntSetArray & get_isa (const String &entry_name) const
  get an IntSetArray out of the database based on an identifier string
• const StringSetArray & get_ssa (const String &entry_name) const
  get a StringSetArray out of the database based on an identifier string
• const RealSetArray & get_rsa (const String &entry_name) const
  get a RealSetArray out of the database based on an identifier string
• const IntRealMapArray & get_irma (const String &entry_name) const
  get an IntRealMapArray out of the database based on an identifier string
• const StringRealMapArray & get_srma (const String &entry_name) const
  get a StringRealMapArray out of the database based on an identifier string
• const RealRealMapArray & get_rrma (const String &entry_name) const
  get a RealRealMapArray out of the database based on an identifier string
• const RealRealPairRealMapArray & get_rrrma (const String &entry_name) const
  get a RealRealPairRealMapArray out of the database based on an identifier string
• const IntIntPairRealMapArray & get_iirma (const String &entry_name) const
  get an IntIntPairRealMapArray out of the database based on an identifier string
• const StringArray & get_sa (const String &entry_name) const
  get a StringArray out of the database based on an identifier string
• const String2DArray & get_s2a (const String &entry_name) const
  get a String2DArray out of the database based on an identifier string
• const String & get_string (const String &entry_name) const
get a String out of the database based on an identifier string

- const Real & get_real (const String &entry_name) const
  get a Real out of the database based on an identifier string

- int get_int (const String &entry_name) const
  get an int out of the database based on an identifier string

- short get_short (const String &entry_name) const
  get a short out of the database based on an identifier string

- unsigned short get_ushort (const String &entry_name) const
  get an unsigned short out of the database based on an identifier string

- size_t get_sizet (const String &entry_name) const
  get a size_t out of the database based on an identifier string

- bool get_bool (const String &entry_name) const
  get a bool out of the database based on an identifier string

- void ** getVoidss (const String &entry_name) const
  for getting a void**, e.g., &dlLib

- void insert_node (const DataEnvironment &data_env)
  set the DataEnvironment object

- void insert_node (const DataMethod &data_method)
  add a DataMethod object to the dataMethodList

- void insert_node (const DataModel &data_model)
  add a DataModel object to the dataModelList

- void insert_node (DataVariables &data_variables)
  add a DataVariables object to the dataVariablesList

- void insert_node (const DataInterface &data_interface)
  add a DataInterface object to the dataInterfaceList

- void insert_node (const DataResponses &data_responses)
  add a DataResponses object to the dataResponsesList

- void set (const String &entry_name, const RealVector &rv)
  set a RealVector within the database based on an identifier string

- void set (const String &entry_name, const IntVector &iv)
  set an IntVector within the database based on an identifier string

- void set (const String &entry_name, const BitArray &ba)
  set a BitArray within the database based on an identifier string

- void set (const String &entry_name, const RealSymMatrix &rsm)
  set a RealSymMatrix within the database based on an identifier string

- void set (const String &entry_name, const RealVectorArray &rva)
  set a RealVectorArray within the database based on an identifier string

- void set (const String &entry_name, const IntVectorArray &iva)
  set an IntVectorArray within the database based on an identifier string

- void set (const String &entry_name, const IntSetArray &isa)
  set an IntSetArray within the database based on an identifier string

- void set (const String &entry_name, const RealSetArray &rsa)
  set a RealSetArray within the database based on an identifier string
• void set (const String &entry_name, const IntRealMapArray &irma)
  set an IntRealMapArray within the database based on an identifier string
• void set (const String &entry_name, const StringRealMapArray &srma)
  set a StringRealMapArray within the database based on an identifier string
• void set (const String &entry_name, const RealRealMapArray &rrma)
  set a RealRealMapArray within the database based on an identifier string
• void set (const String &entry_name, const RealRealPairRealMapArray &iirma)
  set a RealRealPairRealMapArray in the db based on an identifier string
• void set (const String &entry_name, const IntIntPairRealMapArray &iirma)
  set an IntIntPairRealMapArray in the db based on an identifier string
• void set (const String &entry_name, const StringArray &sa)
  set a StringArray within the database based on an identifier string
• int min_procs_per_ea ()
  compute minimum evaluation partition size based on lower level overrides
• int max_procs_per_ea ()
  compute maximum evaluation partition size based on lower level overrides and concurrency levels
• int min_procs_per_ie ()
  compute minimum iterator partition size based on lower level overrides
• int max_procs_per_ie (int max_eval_concurrency)
  compute maximum iterator partition size based on lower level overrides and concurrency levels
• bool is_null () const
  function to check dbRep (does this envelope contain a letter)

Static Public Member Functions

• static int min_procs_per_level (int min_procs_per_server, int pps_spec, int num_serv_spec)
  compute minimum partition size for a parallel level based on lower level overrides
• static int max_procs_per_level (int max_procs_per_server, int pps_spec, int num_serv_spec, short sched_spec,
  int asynch_local_conc, bool peer_dynamic_avail, int max_concurrency)
  compute maximum partition size for a parallel level based on lower level overrides

Protected Member Functions

• ProblemDescDB (BaseConstructor, ParallelLibrary &parallel_lib)
  constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)
• virtual void derived_parse_inputs (const ProgramOptions &prog_opts)
  derived class specifics within parse_inputs()
• virtual void derived_broadcast ()
  derived class specifics within broadcast()
• virtual void derived_post_process ()
  derived class specifics within post_process()
Protected Attributes

- DataEnvironment environmentSpec
  the environment specification (only one allowed) resulting from a call to environment_kwhandler() or insert_node()
- std::list< DataMethod > dataMethodList
  list of method specifications, one for each call to method_kwhandler() or insert_node()
- std::list< DataModel > dataModelList
  list of model specifications, one for each call to model_kwhandler() or insert_node()
- std::list< DataVariables > dataVariablesList
  list of variables specifications, one for each call to variables_kwhandler() or insert_node()
- std::list< DataInterface > dataInterfaceList
  list of interface specifications, one for each call to interface_kwhandler() or insert_node()
- std::list< DataResponses > dataResponsesList
  list of responses specifications, one for each call to responses_kwhandler() or insert_node()
- size_t environmentCntr
  counter for environment specifications used in check_input

Private Member Functions

- const Iterator & get_iterator ()
  retrieve an existing Iterator, if it exists, or instantiate a new one
- const Iterator & get_iterator (Model &model)
  retrieve an existing Iterator, if it exists in iteratorList, or instantiate a new one
- const Iterator & get_iterator (const String &method_name, Model &model)
  retrieve an existing Iterator, if it exists in iteratorByNameList, or instantiate a new one
- const Model & get_model ()
  retrieve an existing Model, if it exists, or instantiate a new one
- const Variables & get_variables ()
  retrieve an existing Variables, if it exists, or instantiate a new one
- const Interface & get_interface ()
  retrieve an existing Interface, if it exists, or instantiate a new one
- const Response & get_response (short type, const Variables &vars)
  retrieve an existing Response, if it exists, or instantiate a new one
- ProblemDescDB * get_db (ParallelLibrary &parallel_lib)
  Used by the envelope constructor to instantiate the correct letter class.
- void send_db_buffer ()
  MPI send of a large buffer containing environmentSpec and all objects in dataMethodList, dataModelList, dataVariablesList, dataInterfaceList, and dataResponsesList. Used by manage_inputs().
- void receive_db_buffer ()
  MPI receive of a large buffer containing environmentSpec and all objects in dataMethodList, dataModelList, dataVariablesList, dataInterfaceList, and dataResponsesList. Used by manage_inputs().
- bool model_has_interface (DataModelRep *model_rep) const
  helper function for determining whether an interface specification should be active, based on model type
- void echo_input_file (const ProgramOptions &prog_opts)
  echo the (potentially) specified input file or string to stdout
Private Attributes

- **ParallelLibrary & parallelLib**
  reference to the parallelLib object passed from main
- **std::list< DataMethod >::iterator dataMethodIter**
  iterator identifying the active list node in dataMethodList
- **std::list< DataModel >::iterator dataModelIter**
  iterator identifying the active list node in dataModelList
- **std::list< DataVariables >::iterator dataVariablesIter**
  iterator identifying the active list node in dataVariablesList
- **std::list< DataInterface >::iterator dataInterfaceIter**
  iterator identifying the active list node in dataInterfaceList
- **std::list< DataResponses >::iterator dataResponsesIter**
  iterator identifying the active list node in dataResponsesList
- **IteratorList iteratorList**
  list of iterator objects, one for each method specification
- **IteratorList iteratorByNameList**
  list of iterator objects, one for each lightweight instantiation by name
- **ModelList modelList**
  list of model objects, one for each model specification
- **VariablesList variablesList**
  list of variables objects, one for each variables specification
- **InterfaceList interfaceList**
  list of interface objects, one for each interface specification
- **ResponseList responseList**
  list of response objects, one for each responses specification
- **bool methodDBLocked**
  prevents use of get_<type> retrieval and set_<type> update functions prior to setting the list node for the active method specification
- **bool modelDBLocked**
  prevents use of get_<type> retrieval and set_<type> update functions prior to setting the list node for the active model specification
- **bool variablesDBLocked**
  prevents use of get_<type> retrieval and set_<type> update functions prior to setting the list node for the active variables specification
- **bool interfaceDBLocked**
  prevents use of get_<type> retrieval and set_<type> update functions prior to setting the list node for the active interface specification
- **bool responsesDBLocked**
  prevents use of get_<type> retrieval and set_<type> update functions prior to setting the list node for the active responses specification
- **ProblemDescDB * dbRep**
pointer to the letter (initialized only for the envelope)
• int referenceCount
    number of objects sharing dbRep

Friends
• class Model
    Model requires access to get_variables() and get_response()
• class SimulationModel
    SimulationModel requires access to get_interface()
• class HierarchSurrModel
    HierarchSurrModel requires access to get_model()
• class DataFitSurrModel
    DataFitSurrModel requires access to get_iterator() and get_model()
• class NestedModel
    NestedModel requires access to get_interface(), get_response(), get_iterator(), and get_model()
• class ActiveSubspaceModel
• class RandomFieldModel
• class Environment
    Environment requires access to get_iterator()
• class IteratorScheduler
    Environment requires access to get_iterator()
• class Iterator
    Iterator requires access to get_model()
• class MetaIterator
    Iterator requires access to get_model()
• class SeqHybridMetaIterator
    SeqHybridMetaIterator requires access to get_model()
• class CollabHybridMetaIterator
    CollabHybridMetaIterator requires access to get_model()
• class ConcurrentMetaIterator
    ConcurrentMetaIterator requires access to get_model()
• class SurrBasedLocalMinimizer
    SurrBasedLocalMinimizer requires access to get_iterator()
• class SurrBasedGlobalMinimizer
    SurrBasedGlobalMinimizer requires access to get_iterator()
• class PebblMinimizer
    PEBBLMinimizer requires access to get_iterator()

13.144.1 Detailed Description

The database containing information parsed from the DAKOTA input file.

The ProblemDescDB class is a database for DAKOTA input file data that is populated by a parser defined in a derived class. When the parser reads a complete keyword, it populates a data class object (DataEnvironment, DataMethod, DataVariables, DataInterface, or DataResponses) and, for all cases except environment, appends the object to a linked list (dataMethodList, dataVariablesList, dataInterfaceList, or dataResponsesList). No environment linked list is used since only one environment specification is allowed.
13.144.2 Constructor & Destructor Documentation

ProblemDescDB ( )
default constructor
  The default constructor: dbRep is NULL in this case. This makes it necessary to check for NULL in the copy
  constructor, assignment operator, and destructor.

ProblemDescDB ( ParallelLibrary & parallel_lib )
standard constructor
  This is the envelope constructor which uses problem_db to build a fully populated db object. It only needs
to extract enough data to properly execute get_db(problem_db), since the constructor overloaded with Base-
Constructor builds the actual base class data inherited by the derived classes.
  References Dakota::abort_handler(), ProblemDescDB::dbRep, and ProblemDescDB::get_db().

ProblemDescDB ( const ProblemDescDB & db )
copy constructor
  Copy constructor manages sharing of dbRep and incrementing of referenceCount.
  References ProblemDescDB::dbRep, and ProblemDescDB::referenceCount.

~ProblemDescDB ( )
destructor
  Destructor decrements referenceCount and only deletes dbRep when referenceCount reaches zero.
  References Dakota::Dak_pddb, ProblemDescDB::dbRep, and ProblemDescDB::referenceCount.

ProblemDescDB ( BaseConstructor, ParallelLibrary & parallel_lib ) [protected]
constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion
in the derived class constructors - Coplien, p. 139)
  This constructor is the one which must build the base class data for all derived classes. get_db() instantiates
a derived class letter and the derived constructor selects this base class constructor in its initialization list (to
avoid the recursion of the base class constructor calling get_db() again). Since the letter IS the representation, its
representation pointer is set to NULL (an uninitialized pointer causes problems in ~ProblemDescDB).

13.144.3 Member Function Documentation

ProblemDescDB operator= ( const ProblemDescDB & db )
assignment operator
  Assignment operator decrements referenceCount for old dbRep, assigns new dbRep, and increments reference-
Count for new dbRep.
  References ProblemDescDB::dbRep, and ProblemDescDB::referenceCount.

void parse_inputs ( const ProgramOptions & prog_opts, DbCallbackFunctionPtr callback = NULL, void * callback_data = NULL )
Parses the input file or input string if present and executes callbacks. Does not perform any validation.
  DB setup phase 1: parse the input file and execute callback functions if present. Rank 0 only.
  DB setup phase 2: optionally insert additional data via late sets. Rank 0 only.
References Dakota::abort_handler(), ProblemDescDB::dbRep, ProblemDescDB::derived_parse_inputs(), ProgramOptions::echo_input(), ProgramDescDB::echo_input_file(), ProgramOptions::input_file(), ProgramOptions::input_string(), ProblemDescDB::parallelLib, ProblemDescDB::parse_inputs(), and ParallelLibrary::world_rank().

Referenced by Environment::parse(), and ProblemDescDB::parse_inputs().

```cpp
void check_and_broadcast ( const ProgramOptions & prog_opts )
```

performs check_input, broadcast, and post_process, but for now, allowing separate invocation through the public API as well.

DB setup phase 3: perform basic checks on keywords counts in current DB state, then sync to all processors.

References ProblemDescDB::broadcast(), ProblemDescDB::check_and_broadcast(), ProblemDescDB::check_input(), ProblemDescDB::dbRep, ProblemDescDB::parallelLib, ProblemDescDB::post_process(), and ParallelLibrary::world_rank().

Referenced by ProblemDescDB::check_and_broadcast(), LibraryEnvironment::done_modifying_db(), and Environment::parse().

```cpp
void check_input ( )
```

verifies that there is at least one of each of the required keywords in the dakota input file.

NOTE: when using library mode in a parallel application, check_input() should either be called only on world-Rank 0, or it should follow a matched send_db_buffer()/receive_db_buffer() pair.

References Dakota::abort_handler(), ProblemDescDB::check_input(), ParallelLibrary::command_line_post_run_input(), ParallelLibrary::command_line_post_run_output(), ParallelLibrary::command_line_pre_run_input(), ParallelLibrary::command_line_pre_run_output(), ParallelLibrary::command_line_run_input(), ParallelLibrary::command_line_run_output(), ParallelLibrary::command_line_user_modes(), ProblemDescDB::dataInterfaceList, ProblemDescDB::dataMethodList, ProblemDescDB::dataModelList, ProblemDescDB::dataResponsesList, ProblemDescDB::dataVariablesList, ProblemDescDB::dbRep, ProblemDescDB::environmentCntr, ProblemDescDB::parallelLib, and Dakota::strbegins().

Referenced by ProblemDescDB::check_and_broadcast(), and ProblemDescDB::check_input().

```cpp
void post_process ( )
```

post-processes the (minimal) input specification to assign default variables/responses specification arrays. Used by manage_inputs().

When using library mode in a parallel application, post_process() should be called on all processors following broadcast() of a minimal problem specification.

References ProblemDescDB::dbRep, and ProblemDescDB::derived_post_process().

Referenced by ProblemDescDB::check_and_broadcast().

```cpp
ProblemDescDB * get_db ( ParallelLibrary & parallel_lib ) [private]
```

Used by the envelope constructor to instantiate the correct letter class.

Initializes dbRep to the appropriate derived type. The standard derived class constructors are invoked.

References Dakota::Dak_pddb.

Referenced by ProblemDescDB::ProblemDescDB().

The documentation for this class was generated from the following files:

- ProblemDescDB.hpp
- ProblemDescDB.cpp
13.145 ProcessApplicInterface Class Reference

Derived application interface class that spawns a simulation code using a separate process and communicates with it through files.

Inheritance diagram for ProcessApplicInterface:

```
            Interface
               |
          ApplicationInterface
               |
       ProcessApplicInterface
               |
ProcessHandleApplicInterface
               |
ForkApplicInterface
               |
SpawnApplicInterface
               |
GridApplicInterface
```

Public Member Functions

- **ProcessApplicInterface** (const ProblemDescDB &problem_db)
  
  * constructor

- **~ProcessApplicInterface** ()
  
  * destructor

Protected Member Functions

- void **derived_map** (const Variables &vars, const ActiveSet &set, Response &response, int fn_eval_id)

  * Called by map() and other functions to execute the simulation in synchronous mode. The portion of performing an evaluation that is specific to a derived class.

- void **derived_map_asynch** (const ParamResponsePair &pair)

  * Called by map() and other functions to execute the simulation in asynchronous mode. The portion of performing an asynchronous evaluation that is specific to a derived class.

- const StringArray & **analysis_drivers** () const

  * retrieve the analysis drivers specification for application interfaces

- void **file_cleanup** () const

- void **remove_params_results_files** (const bfs::path &params_path, const bfs::path &results_path) const

  * Remove (potentially autotagged for multiple programs) parameters and results files with passed root names.

- void **autotag_files** (const bfs::path &params_path, const bfs::path &results_path, const String &eval_id_tag) const

  * Utility to automatically tag parameters and results files with passed root names (the files may already need per-program tagging)

- virtual void **map_bookkeeping** (pid_t pid, int fn_eval_id)=0

  * bookkeeping of process and evaluation ids for asynchronous maps

- virtual pid_t **create_evaluation_process** (bool block_flag)=0
Spawn the evaluation by managing the input filter, analysis drivers, and output filter. Called from derived_map() & derived_map_asynch().

- **void synchronous_local_analyses** (int start, int end, int step)
  execute analyses synchronously on the local processor

- **void define_filenames** (const String &eval_id_tag)
  define modified filenames from user input by handling Unix temp file and optionally tagging with given eval_id_tag

- **void write_parameters_files** (const Variables &vars, const ActiveSet &set, const Response &response, const int id)
  write the parameters data and response request data to one or more parameters files (using one or more invocations of write_parameters_file()) in either standard or aprepro format

- **void read_results_files** (Response &response, const int id, const String &eval_id_tag)
  read the response object from one or more results files using full eval_id_tag passed

- **bfs::path get_workdir_name** ()
  construct a work directory name (tmp or named), with optional tag

- **void prepare_process_environment** ()
  set PATH, environment variables, and change directory prior to fork/system/spawn

- **void reset_process_environment** ()
  reset PATH and current directory after system/spawn (workdir case)

Protected Attributes

- **bool fileTagFlag**
  flags tagging of parameter/results files

- **bool fileSaveFlag**
  flags retention of parameter/results files

- **bool commandLineArgs**
  flag indicating use of passing of filenames as command line arguments to the analysis drivers and input/output filters

- **bool apreproFlag**
  flag indicating use of the APREPRO (the Sandia "A PRE PROcessor" utility) format for parameter files

- **unsigned short resultsFileFormat**
  results file format

- **bool multipleParamsFiles**
  flag indicating the need for separate parameters files for multiple analysis drivers

- **std::string iFilterName**
  the name of the input filter (input filter user specification)

- **std::string oFilterName**
  the name of the output filter (output filter user specification)

- **std::vector<String> programNames**
  the names of the analysis code programs (analysis drivers user specification)

- **std::string specifiedParamsFileName**
  the name of the parameters file from user specification

- **std::string paramsFileName**
  the parameters file name actually used (modified with tagging or temp files); only valid from define_filenames to write_parameters_files
- `std::string paramsFileWritten`  
  actual, qualified name of the params file written, possibly with workdir

- `std::string specifiedResultsFileName`  
  the name of the results file from user specification

- `std::string resultsFileName`  
  the results file name actually used (modified with tagging or temp files); only valid from define filenames to write parameters files

- `std::string resultsFileWritten`  
  actual, qualified name of the results file written, possibly with workdir

- `std::string fullEvalId`  
  complete evalIdTag, possibly including hierarchical tagging and final eval id, but not program numbers, for passing to write parameters files

- `bool allowExistingResults`  
  by default analysis code interfaces delete results files if they exist; user may override with this flag and we’ll try to gather and only fork if needed

- `std::map<int, PathTriple> fileNameMap`  
  Maps function evaluation ID to triples (parameters, results, and workdir) paths used in spawning function evaluations. Workdir will be empty if not created specifically for this eval.

- `bool useWorkdir`  
  whether to use a work directory

- `std::string workDirName`  
  work directory name, if specified...

- `bool dirTag`  
  whether to tag the working directory

- `bool dirSave`  
  whether dir save was specified

- `bfs::path curWorkdir`  
  active working directory for this evaluation; valid only from define filenames to create evaluation process

- `bfs::path createdDir`  
  non-empty if created for this eval; valid only from define filenames to write parameters files

- `StringArray linkFiles`  
  template directory (if specified)

- `StringArray copyFiles`  
  template files (if specified)

- `bool templateReplace`  
  whether to replace existing files

### Private Member Functions

- `void write_parameters_file` (const Variables &vars, const ActiveSet &set, const Response &response, const std::string &prog, const std::vector<String> &an_comps, const std::string &params_fname)  
  write the variables, active set vector, derivative variables vector, and analysis components to the specified parameters file in either standard or aprerepro format

- `void read_results_file` (Response &response, const bfs::path &path, const int id)  
  Open and read the results file at path, properly handling errors.
Private Attributes

- String2DArray analysisComponents
  
  the set of optional analysis components used by the analysis drivers (from the analysis_components interface specification)

13.145.1 Detailed Description

Derived application interface class that spawns a simulation code using a separate process and communicates with it through files.

ProcessApplicInterface is subclassed for process handles or file completion testing.

13.145.2 Member Function Documentation

void file_cleanup ( ) const [protected], [virtual]

Remove any files and directories still referenced in the fileNameMap

Reimplemented from Interface.

References WorkdirHelper::concat_path(), ProcessApplicInterface::dirSave, ProcessApplicInterface::fileNameMap, ProcessApplicInterface::fileNameFlag, ProcessApplicInterface::iFilterName, ProcessApplicInterface::multipleParamsFiles, ProcessApplicInterface::programNames, and WorkdirHelper::recursive_remove().

void autotag_files ( const bfs::path & params_path, const bfs::path & results_path, const String & eval_id_tag ) const [protected]

Utility to automatically tag parameters and results files with passed root names (the files may already need per-program tagging)

Move specified params and results files to unique tagged versions when needed

References WorkdirHelper::concat_path(), ProcessApplicInterface::iFilterName, ProcessApplicInterface::multipleParamsFiles, ProcessApplicInterface::oFilterName, Interface::outputLevel, ProcessApplicInterface::programNames, WorkdirHelper::rename(), ProcessApplicInterface::specifiedParamsFileName, ProcessApplicInterface::specifiedResultsFileName, and ApplicationInterface::suppressOutput.

Referenced by ProcessApplicInterface::read_results_files().

void synchronous_local_analyses ( int start, int end, int step ) [inline], [protected]

execute analyses synchronously on the local processor

Execute analyses synchronously in succession on the local processor (start to end in step increments). Modeled after ApplicationInterface::synchronous_local_evaluations().

References ApplicationInterface::synchronous_local_analysis().

Referenced by ProcessHandleApplicInterface::create_evaluation_process().

void prepare_process_environment ( ) [protected]

set PATH, environment variables, and change directory prior to fork/system/spawn

Guidance: environment (PATH, current directory) should be set immediately before Dakota spawns a process and reset immediately afterwards (except fork which never returns)

References WorkdirHelper::change_directory(), ProcessApplicInterface::curWorkdir, Interface::outputLevel, ProcessApplicInterface::paramsFileName, ProcessApplicInterface::resultsFileName, WorkdirHelper::set_environment(), WorkdirHelper::set_preferred_path(), and ProcessApplicInterface::useWorkdir.
void reset_process_environment ( ) [protected]
reset PATH and current directory after system/spawn (workdir case)
  Undo anything done prior to spawn
  References Interface::outputLevel, WorkdirHelper::reset(), WorkdirHelper::startup_pwd(), and ProcessApplic-Interface::useWorkdir.
  Referenced by SpawnApplicInterface::create_analysis_process(), ForkApplicInterface::create_analysis_process(),
  SysCallApplicInterface::spawn_analysis_to_shell(), SysCallApplicInterface::spawn_evaluation_to_shell(), SysCall-
  ApplicInterface::spawn_input_filter_to_shell(), and SysCallApplicInterface::spawn_output_filter_to_shell().

void read_results_file ( Response & response, const bfs::path & path, const int id ) [private]
Open and read the results file at path, properly handling errors.
  Helper for read_results_files that opens the results file at results_path and reads it, handling various errors/exceptions.
  References Dakota::abort_handler(), Response::read(), and ProcessApplicInterface::resultsFileFormat.
  Referenced by ProcessApplicInterface::read_results_files().
  The documentation for this class was generated from the following files:
  • ProcessApplicInterface.hpp
  • ProcessApplicInterface.cpp

13.146 ProcessHandleApplicInterface Class Reference
Derived application interface class that spawns a simulation code using a separate process, receives a process identifier, and communicates with the spawned process through files.
  Inheritance diagram for ProcessHandleApplicInterface:

```
Interface
   ApplicationInterface
      ProcessApplicInterface
         ProcessHandleApplicInterface
```

Public Member Functions
  • ProcessHandleApplicInterface (const ProblemDescDB &problem_db)
    constructor
• ~ProcessHandleApplicInterface ()
  destructor

Protected Member Functions

• int synchronous_local_analysis (int analysis_id)
• void init_communicators_checks (int max_eval_concurrency)
• void set_communicators_checks (int max_eval_concurrency)
• void map_bookkeeping (pid_t pid, int fn_eval_id)
  bookkeeping of process and evaluation ids for asynchronous maps
• pid_t create_evaluation_process (bool block_flag)
• virtual pid_t create_analysis_process (bool block_flag, bool new_group)=0
  spawn a child process for an analysis component within an evaluation
• virtual size_t wait_local_analyses ()=0
  wait for asynchronous analyses on the local processor, completing at least one job
• virtual size_t test_local_analyses_send (int analysis_id)=0
  test for asynchronous analysis completions on the local processor and return results for any completions by sending
  messages
• virtual void join_evaluation_process_group (bool new_group)
  create (if new_group) and join the process group for asynch evaluations
• virtual void join_analysis_process_group (bool new_group)
  create (if new_group) and join the process group for asynch analyses
• virtual void evaluation_process_group_id (pid_t pgid)
  set evalProcGroupId
• virtual pid_t evaluation_process_group_id () const
  return evalProcGroupId
• virtual void analysis_process_group_id (pid_t pgid)
  set analysisProcGroupId
• virtual pid_t analysis_process_group_id () const
  return analysisProcGroupId
• void process_local_evaluation (PRPQueue &prp_queue, const pid_t pid)
  Common processing code used by {wait,test} _local_evaluations.
• void check_wait (pid_t pid, int status)
  check the exit status of a forked process and abort if an error code was returned
• void asynchronous_local_analyses (int start, int end, int step)
  execute analyses asynchronously on the local processor
• void serve_analyses_asynch ()
  serve the analysis scheduler and execute analysis jobs asynchronously
• void ifilter_argument_list ()
  set argList for execution of the input filter
• void ofilter_argument_list ()
  set argList for execution of the output filter
• void driver_argument_list (int analysis_id)
  set argList for execution of the specified analysis driver
CHAPTER 13. CLASS DOCUMENTATION

- void create_command_arguments (boost::shared_array< const char * > &av, StringArray &driver_and_args)
  parse argList into argument array av suitable for passing to execvp, appending parameters and results filenames if requested by commandLineArgs

Protected Attributes

- std::map< pid_t, int > evalProcessIdMap
  map of fork process id’s to function evaluation id’s for asynchronous evaluations
- std::map< pid_t, int > analysisProcessIdMap
  map of fork process id’s to analysis job id’s for asynchronous analyses
- std::vector< std::string > argList
  an array of strings for use with execvp(const char *, char *const *). These are converted to an array of const char*’s in fork_program().

13.146.1 Detailed Description

Derived application interface class that spawns a simulation code using a separate process, receives a process identifier, and communicates with the spawned process through files.

ProcessHandleApplicInterface is subclassed for fork/execvp/waitpid (Unix) and spawnvp (Windows).

13.146.2 Constructor & Destructor Documentation

ProcessHandleApplicInterface ( const ProblemDescDB & problem_db ) [inline]
constructor
argList sized 3 for [driver name, input file, output file]

13.146.3 Member Function Documentation

int synchronous_local_analysis ( int analysis_id ) [inline], [protected], [virtual]
This code provides the derived function used by ApplicationInterface:: serve_analyses_synch() as well as a convenience function for ProcessHandleApplicInterface::synchronous_local_analyses() below.
Reimplemented from ApplicationInterface.
References ProcessHandleApplicInterface::create_analysis_process(), and ProcessHandleApplicInterface::driver_argument_list().

void init_communicators_checks ( int max_eval_concurrency ) [inline], [protected], [virtual]
No derived interface plug-ins, so perform construct-time checks. However, process init issues as warnings since some contexts (e.g., HierarchSurfModel) initialize more configurations than will be used.
Reimplemented from ApplicationInterface.
References ApplicationInterface::check_multiprocessor_analysis(), and ApplicationInterface::check_multiprocessor_asyncynchronous().

void set_communicators_checks ( int max_eval_concurrency ) [inline], [protected], [virtual]
Process run-time issues as hard errors.
Reimplemented from ApplicationInterface.
References Dakota::abort_handler(), ApplicationInterface::check_multiprocessor_analysis(), and ApplicationInterface::check_multiprocessor_asyncynchronous().
**13.146. PROCESSHANDLEAPPLICINTERFACE CLASS REFERENCE**

**pid_t create_evaluation_process ( bool block_flag ) [protected], [virtual]**

Manage the input filter, 1 or more analysis programs, and the output filter in blocking or nonblocking mode as governed by block_flag. In the case of a single analysis and no filters, a single fork is performed, while in other cases, an initial fork is reforked multiple times. Called from derived_map() with block_flag == BLOCK and from derived_map_asynch() with block_flag == FALL_THROUGH. Uses create_analysis_process() to spawn individual program components within the function evaluation.

Implements ProcessApplicInterface.

References Dakota::abort_handler(), ProcessHandleApplicInterface::analysis_process_group_id(), ApplicationInterface::analysisServerId, ApplicationInterface::asynchLocalAnalysisConcurrency, ApplicationInterface::asynchLocalAnalysisFlag, ProcessHandleApplicInterface::asynchronous_local_analyses(), ParallelLibrary::barrier_e(), ProcessApplicInterface::commandLineArgs, ProcessHandleApplicInterface::create_analysis_process(), ProcessHandleApplicInterface::driver_argument_list(), ApplicationInterface::eaDedMasterFlag, ApplicationInterface::evalCommRank, ApplicationInterface::evalCommSize, ProcessHandleApplicInterface::evalProcessIdMap, ProcessHandleApplicInterface::evaluation_process_group_id(), ProcessHandleApplicInterface::ifilter_argument_list(), ProcessApplicInterface::iFilterName, ProcessHandleApplicInterface::join_evaluation_process_group(), ApplicationInterface::master_dynamic_schedule_analyses(), ProcessApplicInterface::multipleParamsFiles, ApplicationInterface::numAnalysisDrivers, ApplicationInterface::numAnalysisServers, ProcessHandleApplicInterface::ofilter_argument_list(), ProcessApplicInterface::oFilterName, ApplicationInterface::parallelLib, ProcessApplicInterface::paramsFileName, ProcessApplicInterface::programNames, ProcessApplicInterface::resultsFileName, ProcessHandleApplicInterface::serve_analyses_asynch(), ApplicationInterface::serve_analyses_synch(), ApplicationInterface::suppressOutput, and ProcessApplicInterface::synchronous_local_analyses().

**void check_wait ( pid_t pid, int status ) [protected]**

check the exit status of a forked process and abort if an error code was returned

Check to see if the process terminated abnormally (WIFEXITED(status)==0) or if either execvp or the application returned a status code of -1 (WIFEXITED(status)!=0 && (signed char)WEXITSTATUS(status)==-1). If one of these conditions is detected, output a failure message and abort. Note: the application code should not return a status code of -1 unless an immediate abort of dakota is wanted. If for instance, failure capturing is to be used, the application code should write the word "FAIL" to the appropriate results file and return a status code of 0 through exit().

References Dakota::abort_handler().

Referenced by ForkApplicInterface::create_analysis_process(), SpawnApplicInterface::test_local_analyses_send(), SpawnApplicInterface::test_local_evaluations(), ForkApplicInterface::wait(), SpawnApplicInterface::wait_local_analyses(), and SpawnApplicInterface::wait_local_evaluations().

**void asynchronous_local_analyses ( int start, int end, int step ) [protected]**

execute analyses asynchronously on the local processor

Schedule analyses asynchronously on the local processor using a dynamic scheduling approach (start to end in step increments). Concurrency is limited by asynchLocalAnalysisConcurrency. Modeled after ApplicationInterface::asynchronous_local_evaluations(). NOTE: This function should be elevated to ApplicationInterface if and when another derived interface class supports asynchronous local analyses.

References Dakota::abort_handler(), ProcessHandleApplicInterface::analysisProcessIdMap, ApplicationInterface::asynchLocalAnalysisConcurrency, ProcessHandleApplicInterface::create_analysis_process(), ProcessHandleApplicInterface::driver_argument_list(), ApplicationInterface::numAnalysisDrivers, and ProcessHandleApplicInterface::wait_local_analyses().

Referenced by ProcessHandleApplicInterface::create_evaluation_process().
void serve_analyses_asynch( ) [protected]

serve the analysis scheduler and execute analysis jobs asynchronously

This code runs multiple async analyses on each server. It is modeled after ApplicationInterface::serve_evaluations_asynch(). NOTE: This fn should be elevated to ApplicationInterface if and when another derived interface class supports hybrid analysis parallelism.

References Dakota::abort_handler(), ProcessHandleApplicInterface::analysisProcessIdMap, ApplicationInterface::asynchLocalAnalysisConcurrency, ProcessHandleApplicInterface::create_analysis_process(), ProcessHandleApplicInterface::driver_argument_list(), ParallelLibrary::irecv_ea(), ApplicationInterface::numAnalysisDrivers, ApplicationInterface::parallelLib, ParallelLibrary::recv_ea(), ParallelLibrary::test(), and ProcessHandleApplicInterface::test_local_analyses_send().

Referenced by ProcessHandleApplicInterface::create_evaluation_process().

void create_command_arguments ( boost::shared_array< const char * > & av, StringArray & driver_and_args ) [protected]

parse argList into argument array av suitable for passing to execvp, appending parameters and results filenames if requested by commandLineArgs

This function will split the analysis command in argList[0] based on whitespace, but preserve spaces within quoted strings, such that quoted strings can be passed as single command arguments. NOTE: This function allocates memory in av that might be implicitly freed when the child exits (control never returns to caller). driver_and_args needs to be a return argument because av will contain pointers into its c_str()’s when done.

References ProcessHandleApplicInterface::argList, ProcessApplicInterface::commandLineArgs, and WorkdirHelper::tokenize_driver()

Referenced by SpawnApplicInterface::create_analysis_process(), and ForkApplicInterface::create_analysis_process().

The documentation for this class was generated from the following files:

- ProcessHandleApplicInterface.hpp
- ProcessHandleApplicInterface.cpp

13.147 ProgramOptions Class Reference

ProgramOptions stores options whether from the CLH or from library user; initially valid only on worldRank = 0, but then broadcast in ParallelLibrary::push_output_tag()

Public Member Functions

- ProgramOptions ()
  default constructor (needed for default environment ctors and could be used by library clients to late update data)
- ProgramOptions (int world_rank)
  constructor that accepts world rank to help with I/O control; allows default constructed ProgramOptions to get rank in library mode
- ProgramOptions (int argc, char *argv[], int world_rank)
  standard constructor that uses a CommandLineHandler to parse user options
- const String & input_file () const
  Dakota input file base name (no tag)
- const String & input_string () const
13.147. PROGRAMOPTIONS CLASS REFERENCE

alternate Dakota input string literal

- bool echo_input () const
  is input echo specified?
- const String & parser_options () const
  (deprecated) NIDR parser options
- String output_file () const
  output (user-provided or default) file base name (no tag)
- const String & error_file () const
  error file base name (no tag)
- const String & exit_mode () const
  behavior of abort_handler (throw or exit)
- const String & read_restart_file () const
  restart file base name (no tag)
- size_t stop_restart_evals () const
  eval ID at which to stop reading restart
- String write_restart_file () const
  write restart (user-provided or default) file base name (no tag)
- bool help () const
  is help mode active?
- bool version () const
  is version mode active?
- bool check () const
  is check mode active?
- bool pre_run () const
  is pre-run mode active?
- bool run () const
  is run mode active?
- bool post_run () const
  is post-run mode active?
- bool user_modes () const
  are any non-default, user-specified run modes active?
- const String & pre_run_input () const
  filename for pre-run input
- const String & pre_run_output () const
  filename for pre-run output
- const String & run_input () const
  filename for run input
- const String & run_output () const
  filename for run output
- const String & post_run_input () const
  filename for post-run input
- const String & post_run_output () const
  filename for post-run output
• unsigned int pre_run_output_format () const  
  tabular format for pre-run output
• unsigned int post_run_input_format () const  
  tabular format for post-run input
• bool proceed_to_instantiate () const  
  whether steps beyond help/version are requested (instantiation required)
• bool proceed_to_run () const  
  Whether steps beyond check are requested.
• bool user_stdout_redirect () const  
  whether the user/client code requested a redirect of stdout
• bool user_stderr_redirect () const  
  whether the user/client code requested a redirect of stderr
• void world_rank (int world_rank)  
  set the world rank to govern early conditional output
• void input_file (const String &in_file)  
  set Dakota input file base name (no tag)
• void input_string (const String &in_string)  
  set alternate Dakota input string literal
• void echo_input (bool echo_flag)  
  set whether to echo input to output
• void exit_mode (const String &mode)  
  set behavior for abort_handler
• void output_file (const String &out_file)  
  set base file name for Dakota output
• void error_file (const String &err_file)  
  set base file name for Dakota errors
• void read_restart_file (const String &read_rst)  
  set base file name for restart file from which to read
• void stop_restart_evals (size_t stop_rst)  
  set eval ID at which to stop reading restart
• void write_restart_file (const String &write_rst)  
  set base file name for restart file to write
• void help (bool help_flag)  
  set true to print help information and exit
• void version (bool version_flag)  
  set true to print version information and exit
• void check (bool check_flag)  
  set true to check input and instantiate objects, then exit
• void pre_run (bool pre_run_flag)  
  set to enable/disable pre-run phase
• void run (bool run_flag)  
  set to enable/disable run phase
• void post_run (bool post_run_flag)
set to enable/disable post-run phase

- **void pre_run_input** (const String &pre_run_in)
  Specify the pre-run phase input filename.

- **void pre_run_output** (const String &pre_run_out)
  Specify the pre-run phase output filename.

- **void run_input** (const String &run_in)
  Specify the run phase input filename.

- **void run_output** (const String &run_out)
  Specify the run phase output filename.

- **void post_run_input** (const String &post_run_in)
  Specify the post-run phase input filename.

- **void post_run_output** (const String &post_run_out)
  Specify the post-run phase output filename.

- **void parse** (const ProblemDescDB &problem_db)
  Extract environment options from ProblemDescDB.

- **void read** (MPIUnpackBuffer &s)
  helper function for reading some class data from MPI buffer

- **void write** (MPIPackBuffer &s) const
  helper function for writing some class data to MPI buffer

**Private Member Functions**

- **void parse_environment_options** ()
  any environment variables affecting global behavior get read here

- **void manage_run_modes** (const CommandLineHandler &clh)
  retrieve run mode options from the CLH

- **void split_filenames** (const char *filenames, std::string &input_filename, std::string &output_filename)
  manage pre/run/post filenames

- **void validate** ()
  verify consistency of user settings (helpful for library mode especially)

- **void validate_run_modes** ()
  validate user run modes and set userModesFlag

- **void set_option** (const ProblemDescDB &problem_db, const String &db_name, String &data_member)
  retrieve environment.<db_name> from the problem db and update data_member, warning if needed

**Private Attributes**

- **int worldRank**
  cache the world rank to help with conditional output

- **String inputFile**
  *Dakota* input file name, e.g., "dakota.in".

- **String inputString**
  alternate input means for library clients: input string (mutually exclusive with input file)

- **bool echoInput**
whether to echo client’s input file at parse

- **String** `parserOptions`
  
  Deprecated option for NIDR parser options.

- **String** `exitMode`
  
  Abort or throw on error.

- **String** `outputFile`
  
  Dakota output base file name, e.g., "dakota.out".

- **String** `errorFile`
  
  Dakota error base file name, e.g., "dakota.err".

- **String** `readRestartFile`
  
  e.g., "dakota.old.rst"

- **size_t** `stopRestartEvals`
  
  eval number at which to stop restart read

- **String** `writeRestartFile`
  
  e.g., "dakota.new.rst"

- **bool** `helpFlag`
  
  whether to print help message and exit

- **bool** `versionFlag`
  
  whether to print version message and exit

- **bool** `checkFlag`
  
  flags invocation with command line option -check

- **bool** `preRunFlag`
  
  flags invocation with command line option -pre

- **bool** `runFlag`
  
  flags invocation with command line option -run

- **bool** `postRunFlag`
  
  flags invocation with command line option -post

- **bool** `userModesFlag`
  
  whether any user run modes are active

- **String** `preRunInput`
  
  filename for pre_run input

- **String** `preRunOutput`
  
  filename for pre_run output

- **String** `runInput`
  
  filename for run input

- **String** `runOutput`
  
  filename for run output

- **String** `postRunInput`
  
  filename for post_run input

- **String** `postRunOutput`
  
  filename for post_run output

- **unsigned short** `preRunOutputFormat`
  
  tabular format for pre_run output

- **unsigned short** `postRunInputFormat`
  
  tabular format for post_run input
13.147.1 Detailed Description

ProgramOptions stores options whether from the CLH or from library user; initially valid only on worldRank = 0, but then broadcast in ParallelLibrary::push_output_tag()

13.147.2 Member Function Documentation

void split_filenames ( const char ∗ filenames, std::string & input_filename, std::string & output_filename )
[private]

manage pre/run/post filenames
Tokenize colon-delimited input and output filenames, returns unchanged strings if tokens not found.
Referenced by ProgramOptions::manage_run_modes().
The documentation for this class was generated from the following files:

- ProgramOptions.hpp
- ProgramOptions.cpp

13.148 PStudyDACE Class Reference

Base class for managing common aspects of parameter studies and design of experiments methods.
Inheritance diagram for PStudyDACE:

```
  PStudyDACE
   |         
   |  Analyzer
   |         
  PStudyDACE
   
  DDACEDesignCompExp  FSUDesignCompExp  ParamStudy  PSUADEDesignCompExp
```

Public Member Functions

- bool resize ()
  reinitializes iterator based on new variable size

Protected Member Functions

- PStudyDACE (ProblemDescDB &problem_db, Model &model)
  constructor
- PStudyDACE (unsigned short method_name, Model &model)
  alternate constructor for instantiations "on the fly"
- ~PStudyDACE ()
  destructor
- void print_results (std::ostream &s)
  print the final iterator results
• void volumetric_quality (int ndim, int num_samples, double *sample_points)

  Calculation of volumetric quality measures.

Protected Attributes

• SensAnalysisGlobal pStudyDACESensGlobal

    initialize statistical post processing

• bool volQualityFlag

    flag which specifies evaluation of volumetric quality measures

• bool varBasedDecompFlag

    flag which specifies calculating variance based decomposition sensitivity analysis metrics

Private Attributes

• double chiMeas

    quality measure

• double dMeas

    quality measure

• double hMeas

    quality measure

• double tauMeas

    quality measure

Additional Inherited Members

13.148.1 Detailed Description

Base class for managing common aspects of parameter studies and design of experiments methods.

The PStudyDACE base class manages common data and functions, such as those involving the best solutions located during the parameter set evaluations or the printing of final results.

13.148.2 Member Function Documentation

void print_results ( std::ostream & s ) [protected], [virtual]

print the final iterator results

    This virtual function provides additional iterator-specific final results outputs beyond the function evaluation summary printed in finalize_run().

    Reimplemented from Analyzer.

    References PStudyDACE::chiMeas, Analyzer::compactMode, Model::continuous_variable_labels(), SensAnalysisGlobal::correlations_computed(), Model::discrete_int_variable_labels(), Model::discrete_real_variable_labels(), Model::discrete_string_variable_labels(), PStudyDACE::dMeas, PStudyDACE::hMeas, Iterator::iteratedModel, Analyzer::numLsqTerms, Analyzer::numObjFs, SensAnalysisGlobal::print_correlations(), Analyzer::print_results(), Analyzer::print_sobol_indices(), PStudyDACE::pStudyDACESensGlobal, Model::response_labels(), PStudyDACE::tauMeas, PStudyDACE::varBasedDecompFlag, and PStudyDACE::volQualityFlag.
void volumetric_quality ( int ndim, int num_samples, double * sample_points ) [protected]

Calculation of volumetric quality measures.
Calculation of volumetric quality measures developed by FSU.
References PStudyDACE::chiMeas, PStudyDACE::dMeas, PStudyDACE::hMeas, and PStudyDACE::tauMeas.
Referenced by FSUDesignCompExp::get_parameter_sets(), and DDACEDesignCompExp::get_parameter_sets().
The documentation for this class was generated from the following files:

- DakotaPStudyDACE.hpp
- DakotaPStudyDACE.cpp

13.149 PSUADEDesignCompExp Class Reference

Wrapper class for the PSUADE library.
Inheritance diagram for PSUADEDesignCompExp:

```
PSUADEDesignCompExp
 |                 +--- PSUADE
 |                     |       +--- DACE
 |                     +--- Analyzer
 +-------------------------+-------------------
               Iterator
```

Public Member Functions
- PSUADEDesignCompExp (ProblemDescDB &problem_db, Model &model)
  primary constructor for building a standard DACE iterator
- ~PSUADEDesignCompExp ()
  destructor
- bool resize ()
  reinitializes iterator based on new variable size

Protected Member Functions
- void pre_run ()
  pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a priori
- void post_input ()
  read tabular data for post-run mode
- void core_run ()
  core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post
- void post_run (std::ostream &s)
CHAPTER 13. CLASS DOCUMENTATION

post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/Responses and perform final analysis phase in a standalone way

- int num_samples () const
  - void sampling_reset (int min_samples, bool all_data_flag, bool stats_flag)
    reset sampling iterator to use at least min_samples
- unsigned short sampling_scheme () const
  return sampling name
- void vary_pattern (bool pattern_flag)
  sets varyPattern in derived classes that support it
- void get_parameter_sets (Model &model)
  Returns one block of samples (ndim * num_samples)

Private Member Functions

- void enforce_input_rules ()
  enforce sanity checks/modifications for the user input specification

Private Attributes

- int samplesSpec
  initial specification of number of samples
- int numSamples
  current number of samples to be evaluated
- const UShortArray & varPartitionsSpec
  number of partitions in each variable direction
- int numPartitions
  number of partitions to pass to PSUADE (levels = partitions + 1)
- bool allDataFlag
  flag which triggers the update of allVars/allResponses for use by \texttt{Iterator::all variables()} and \texttt{Iterator::all responses()}
- size_t numDACERuns
  counter for number of executions for this object
- bool varyPattern
  flag for generating a sequence of seed values within multiple \texttt{get parameter sets()} calls so that the sample sets are not repeated, but are still repeatable
- const int seedSpec
  the user seed specification for the random number generator (allows repeatable results)
- int randomSeed
  current seed for the random number generator

Additional Inherited Members

13.149.1 Detailed Description

Wrapper class for the PSUADE library.

The \texttt{PSUADEDesignCompExp} class provides a wrapper for PSUADE, a C++ design of experiments library from Lawrence Livermore National Laboratory. Currently this class only includes the PSUADE Morris One-at-a-time (MOAT) method to uniformly sample the parameter space spanned by the active bounds of the current \texttt{Model}. It returns all generated samples and their corresponding responses as well as the best sample found.
13.149.2 Constructor & Destructor Documentation

PSUADEDesignCompExp ( ProblemDescDB & problem_db, Model & model )

primary constructor for building a standard DACE iterator
This constructor is called for a standard iterator built with data from probDescDB.
References Dakota::abort_handler(), Iterator::maxEvalConcurrency, Iterator::methodName, and PSUADE-
DesignCompExp::numSamples.

13.149.3 Member Function Documentation

void pre_run ( ) [protected], [virtual]
pre-run portion of run (optional); re-implemented by Iterators which can generate all Variables (parameter sets) a
priori
pre-run phase, which a derived iterator may optionally reimplement; when not present, pre-run is likely inte-
grated into the derived run function. This is a virtual function; when re-implementing, a derived class must call
its nearest parent’s pre_run(), if implemented, typically before performing its own implementation steps.
Reimplemented from Analyzer.
References PSUADEDesignCompExp::get_parameter_sets(), Iterator::iteratedModel, and Analyzer::pre_run().

void core_run ( ) [protected], [virtual]
core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post
Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.
Reimplemented from Iterator.
References Analyzer::evaluate_parameter_sets(), Iterator::iteratedModel, Analyzer::numLSqTerms, and Analyzer-
::numObjFns.

void post_run ( std::ostream & s ) [protected], [virtual]
post-run portion of run (optional); verbose to print results; re-implemented by Iterators that can read all Variables/-
Responses and perform final analysis phase in a standalone way
Post-run phase, which a derived iterator may optionally reimplement; when not present, post-run is likely inte-
grated into run. This is a virtual function; when re-implementing, a derived class must call its nearest parent’s
post_run(), typically after performing its own implementation steps.
Reimplemented from Analyzer.
References Dakota::abort_handler(), Analyzer::allResponses, Analyzer::allSamples, Model::continuous_lower-
_bounds(), Model::continuous_upper_bounds(), Iterator::iteratedModel, Analyzer::numContinuousVars, Analyzer-
::numFunctions, PSUADEDesignCompExp::numSamples, and Analyzer::post_run().

int num_samples ( ) const [inline], [protected], [virtual]
Return current number of evaluation points. Since the calculation of samples, collocation points, etc. might be
costly, provide a default implementation here that backs out from the maxEvalConcurrency.
Reimplemented from Analyzer.
References PSUADEDesignCompExp::numSamples.
void enforce_input_rules() [private]

enforce sanity checks/modifications for the user input specification

Users may input a variety of quantities, but this function must enforce any restrictions imposed by the sampling algorithms.

References Dakota::abort_handler(), Iterator::methodName, Analyzer::numContinuousVars, PSUADEDesign-CompExp::numPartitions, PSUADEDesignCompExp::numSamples, and PSUADEDesignCompExp::varPartitions-Spec.

Referenced by PSUADEDesignCompExp::get_parameter_sets().

The documentation for this class was generated from the following files:
- PSUADEDesignCompExp.hpp
- PSUADEDesignCompExp.cpp

13.150 PythonInterface Class Reference

Inheritance diagram for PythonInterface:

```
  Interface
  |      |
  v      v
ApplicationInterface
  |      |
  v      v
DirectApplicInterface
  |      |
  v      v
PythonInterface
```

Public Member Functions

- **PythonInterface** (const ProblemDescDB &problem_db)
  *constructor*
- **~PythonInterface** ()
  *destructor*

Protected Member Functions

- virtual int derived_map_ac (const String &ac_name)
  *execute an analysis code portion of a direct evaluation invocation*
- int python_run (const String &ac_name)
  *direct interface to Python via API, BMA 07/02/07*
- template<class ArrayT, class Size>
  bool python_convert_int (const ArrayT &src, Size size, PyObject **dst)
  *convert arrays of integer types to Python list or numpy array*
- bool python_convert (const RealVector &src, PyObject **dst)
  *convert RealVector to Python list or numpy array*
• bool python_convert (const RealVector &c_src, const IntVector &di_src, const RealVector &dr_src, PyObject **dst)

    convert RealVector + IntVector + RealVector to Python mixed list or numpy double array

• template<class StringArrayT>
  bool python_convert_strlist (const StringArrayT &src, PyObject **dst)

  convert labels

• bool python_convert (const StringMultiArray &c_src, const StringMultiArray &di_src, const StringMultiArray &dr_src, PyObject **dst)

  convert all labels to single list

• bool python_convert (PyObject *pyv, RealVector &rv, const int &dim)

  convert python [list of int or float] or [numpy array of double] to RealVector (for fns)

• bool python_convert (PyObject *pyv, double *rv, const int &dim)

  convert python [list of int or float] or [numpy array of double] to double[], for use as helper in converting gradients

• bool python_convert (PyObject *pym, RealMatrix &rm)

  convert python [list of lists of int or float] or [numpy array of dbl] to RealMatrix (for gradients)

• bool python_convert (PyObject *pym, RealSymMatrix &rm)

  convert python [list of lists of int or float] or [numpy array of dbl] to RealMatrix (used as helper in Hessian conversion)

• bool python_convert (PyObject *pyma, RealSymMatrixArray &rma)

  convert python [list of lists of lists of int or float] or [numpy array of double] to RealSymMatrixArray (for Hessians)

Protected Attributes

• bool userNumpyFlag

  whether the user requested numpy data structures in the input file

• bool ownPython

  true if this class created the interpreter instance

13.150.1 Detailed Description

Specialization of DirectApplicInterface to link to Python analysis drivers. Includes convenience functions to map data to/from Python

13.150.2 Member Function Documentation

int derived_map_ac ( const String &ac_name ) [protected], [virtual]

execute an analysis code portion of a direct evaluation invocation

Python specialization of derived analysis components.

Reimplemented from DirectApplicInterface.

References ApplicationInterface::analysisServerId, and PythonInterface::python_run().
bool python_convert_int ( const ArrayT & src, Size sz, PyObject ** dst ) [protected]

convert arrays of integer types to Python list or numpy array
convert all integer array types including IntVector, ShortArray, and SizetArray to Python list of ints or numpy array of ints
References PythonInterface::userNumpyFlag.
Referenced by PythonInterface::python_run().
The documentation for this class was generated from the following files:

• PythonInterface.hpp
• PythonInterface.cpp

13.151 QuesoJointPdf< V, M > Class Template Reference

Dakota specialization of QUESO generic joint PDF.
Inherits BaseJointPdf< V, M >.

Public Member Functions

• QuesoJointPdf (const char *prefix, const QUESO::VectorSet< V, M > &domainSet, NonDQUESOBayesCalibration *nond_queso_ptr)
  Default constructor.
• virtual ~QuesoJointPdf ()
  Destructor.
• double actualValue (const V &domainVector, const V *domainDirection, V *gradVector, M *hessianMatrix, V *hessianEffect) const
  Actual value of the PDF (scalar function).
• double lnValue (const V &domainVector, const V *domainDirection, V *gradVector, M *hessianMatrix, V *hessianEffect) const
  Logarithm of the value of the function.
• double computeLogOfNormalizationFactor (unsigned int numSamples, bool m_logOfNormalizationFactor) const
  Computes the logarithm of the normalization factor.

Private Attributes

• NonDQUESOBayesCalibration * nondQUESOInstance

13.151.1 Detailed Description

template<class V, class M> class Dakota::QuesoJointPdf< V, M >

Dakota specialization of QUESO generic joint PDF.
13.151.2 Constructor & Destructor Documentation

QuesoJointPdf (const char* prefix, const QUESO::VectorSet< V, M >& domainSet, NonDQUESOBayesCalibration* nond_queso_ptr)

Default constructor.
Instantiates an object of the class, i.e. a scalar function, given a prefix and its domain.
The documentation for this class was generated from the following file:

- NonDQUESOBayesCalibration.cpp

13.152 QuesoVectorRV< V, M > Class Template Reference

Dakota specialization of QUESO vector-valued random variable.
Inherits BaseVectorRV< V, M >.

Public Member Functions

- QuesoVectorRV (const char* prefix, const QUESO::VectorSet< V, M >& imageSet, NonDQUESOBayesCalibration* nond_queso_ptr)
  Default constructor.
- virtual ~QuesoVectorRV ()
  Virtual destructor.
- void print (std::ostream &os) const
  TODO: Prints the vector RV (required pure virtual).

13.152.1 Detailed Description

template< class V, class M > class Dakota::QuesoVectorRV< V, M >

Dakota specialization of QUESO vector-valued random variable.

13.152.2 Constructor & Destructor Documentation

QuesoVectorRV (const char* prefix, const QUESO::VectorSet< V, M >& imageSet, NonDQUESOBayesCalibration* nond_queso_ptr)

Default constructor.
Constructs a generic queso vector RV, given a prefix and the image set of the vector RV.
The documentation for this class was generated from the following file:

- NonDQUESOBayesCalibration.cpp

13.153 RandomFieldModel Class Reference

Random field model, capable of generating and then forward propagating.

Inheritance diagram for RandomFieldModel:
CHAPTER 13. CLASS DOCUMENTATION

Public Member Functions

- **RandomFieldModel (ProblemDescDB &problem_db)**
  Problem database constructor.
- ~**RandomFieldModel ()**
  Destructor
- **bool initialize_mapping (ParLevLIter pl_iter)**
  for KL models, the model is augmented with the random coeffs of the KL
- **bool finalize_mapping ()**
  currently no-op

Protected Member Functions

- **Model get_sub_model (ProblemDescDB &problem_db)**
  retrieve the sub-Model from the DB to pass up the constructor chain
- **void init_dace_iterator (ProblemDescDB &problem_db)**
  initialize the RF-generating sampler
- **void validate_inputs ()**
  validate the build controls and set defaults
- **void get_field_data ()**
  Source data generation: get the field data either from file or simulation by running the DACE Iterator. Populates rfBuildData.
- **void identify_field_model ()**
  Generate field representation: generate a KL or PCA/GP.
- **void rf_suite_identify_field_model ()**
  Generate field representation: utilize RF Suite.
- **void initialize_recast ()**
  Initialize the base class RecastModel with reduced space variable sizes.
- **SizetArray variables_resize ()**
  Create a variables components totals array with the reduced space size for continuous variables.
- **void initialize_rf_coeffs ()**
  For KL models, augment the subModel's uncertain variables with additional N(0,1) variables; set up AleatoryDist-Params for the N(0,1)'s.
- **void derived_evaluate (const ActiveSet &set)**
  generate a random field realization, then evaluate the submodel
- **void derived_evaluate_nowait (const ActiveSet &set)**
generate a random field realization, then evaluate the submodel (asynch)

- void `generate_kl_realization()`
  generate a KL realization and write to file

- void `generate_pca_gp_realization()`
  generate a PCA/GP realization and write to file

- void `write_field` (const RealVector &field_prediction)
  write a field realization to console and file

**Static Protected Member Functions**

- static void `vars_mapping` (const Variables &recast_xi_vars, Variables &sub_model_x_vars)
  map the active continuous recast variables to the active submodel variables (linear transformation)

- static void `set_mapping` (const Variables &recast_vars, const ActiveSet &recast_set, ActiveSet &sub_model_set)
  map the inbound `ActiveSet` to the sub-model (map derivative variables)

**Protected Attributes**

- size_t `numFunctions`
- String `rfDataFilename`
  name of the data file with RF build data
- size_t `numObservations`
  rows of data matrix
- IntVector `fieldLengths`
  column partitions of data matrix
- RealMatrix `rfBuildData`
  data matrix with realizations of the random field to approximate
- RealMatrix `rfBuildVars`
  matrix of samples used to build the RF data
- Iterator `daceIterator`
  String `dataDirectoryBasename`
- unsigned short `expansionForm`
  unsigned short analyticCovForm;
- unsigned short `covarianceForm`
  form of the analytic covariance function
- int `requestedReducedRank`
  current approximation of system rank
- Real `percentVariance`
  fraction of energy to capture
- int `actualReducedRank`
  command to run RF Suite
- ReducedBasis `rfBasis`
  reduced basis representation (for KL or PCA case)
- int `fieldRealizationId`
CHAPTER 13. CLASS DOCUMENTATION

counter for RF Suite

- std::vector< Approximation > gpApproximations
  approximate models used to map the uncertain vars through the PCA approx

Static Protected Attributes

- static RandomFieldModel * rfmInstance
  static pointer to this class for use in static callbacks

13.153.1 Detailed Description

Random field model, capable of generating and then forward propagating.

Specialization of a RecastModel that optionally identifies an approximate random field model during build phase and creates a RecastModel capable of performing forward UQ including the field and auxiliiary uncertain variables reduced space. This RandomFieldModel wraps the random field propagation model (not the RF-generating model)

13.153.2 Member Function Documentation

bool initialize_mapping ( ParLevLIter pl_iter ) [virtual]

for KL models, the model is augmented with the random coeffs of the KL

May eventually take on init_comms and related operations. Also may want ide of build/update like DataFit-SurrModel, eventually.

Reimplemented from Model.

References RandomFieldModel::covarianceForm, Model::estimate_message_lengths(), RandomFieldModel::expansionForm, RandomFieldModel::fieldRealizationId, RandomFieldModel::get_field_data(), RandomFieldModel::identify_field_model(), RandomFieldModel::initialize_recast(), RandomFieldModel::initialize_rf_coeffs(), and RandomFieldModel::rf_suite_identify_field_model().

void get_field_data( ) [protected]

Source data generation: get the field data either from file or simulation by running the DACE Iterator. Populates rfBuildData.

Populate rfBuildData

References Iterator::all_responses(), Iterator::all_samples(), Dakota::copy_data(), Model::cv(), RandomFieldModel::daceIterator, RandomFieldModel::expansionForm, Iterator::is_null(), Iterator::num_samples(), RandomFieldModel::rfBuildData, RandomFieldModel::rfBuildVars, Iterator::run(), and RecastModel::subModel.

Referenced by RandomFieldModel::initialize_mapping().

void rf_suite_identify_field_model( ) [protected]

Generate field representation: utilize RF Suite.

Alternative to below function when using RFSuite.

References RandomFieldModel::actualReducedRank, and RandomFieldModel::requestedReducedRank.

Referenced by RandomFieldModel::initialize_mapping().
void initialize_recast ( ) [protected]
Initialize the base class RecastModel with reduced space variable sizes.
Initialize the recast model to augment the uncertain variables with actualReducedRank additional N(0,1) variables, with no response function mapping (for now).
References RandomFieldModel::actualReducedRank, Model::aleatory_distribution_parameters(), Model::current_response(), Model::cv(), Model::div(), Model::drv(), Model::dsv(), Response::function_gradients(), Response::function_hessians(), RecastModel::init_maps(), RecastModel::init_sizes(), Model::num_functions(), Model::num_nonlinear_ineq_constraints(), Model::num_primary_fns(), RandomFieldModel::rfmInstance, RandomFieldModel::set_mapping(), RecastModel::subModel, RandomFieldModel::variables_resize(), and RandomFieldModel::vars_mapping().
Referenced by RandomFieldModel::initialize_mapping().

SizetArray variables_resize ( ) [protected]
Create a variables components totals array with the reduced space size for continuous variables.
Create a variables components totals array with the reduced space size for continuous variables TODO: augment normal uncVars for KL case.
References RandomFieldModel::actualReducedRank, SharedVariablesData::components_totals(), Model::current_variables(), RandomFieldModel::expansionForm, Variables::shared_data(), RecastModel::subModel, and Dakota::svd().
Referenced by RandomFieldModel::initialize_recast().

void initialize_rf_coefs ( ) [protected]
For KL models, augment the subModel’s uncertain variables with additional N(0,1) variables; set up Aleatory-DistParams for the N(0,1)’s.
Initialize the aleatory dist params for the KL coeffs
References RandomFieldModel::actualReducedRank, Model::aleatory_distribution_parameters(), Variables::continuous_variable_label(), Model::continuous_variable_labels(), Model::currentVariables, RandomFieldModel::expansionForm, and RecastModel::subModel.
Referenced by RandomFieldModel::initialize_mapping().

void vars_mapping ( const Variables & recast_xi_vars, Variables & sub_model_x_vars ) [static], [protected]
map the active continuous recast variables to the active submodel variables (linear transformation)
map the active continuous recast variables to the active submodel variables
References Variables::active_variables(), RandomFieldModel::actualReducedRank, Model::aleatory_distribution_parameters(), Variables::continuous_variables(), Model::cv(), Variables::discrete_int_variables(), Model::discrete_int_variables(), Variables::discrete_real_variables(), Model::discrete_real_variables(), Variables::discrete_string_variables(), Model::discrete_string_variables(), RandomFieldModel::expansionForm, RandomFieldModel::rfm-Instance, and RecastModel::subModel.
Referenced by RandomFieldModel::initialize_recast().

13.153.3 Member Data Documentation

Iterator daceIterator [protected]
String dataDirectoryBasename;
DACE Iterator to evaluate the RF generating model
Referenced by RandomFieldModel::get_field_data(), RandomFieldModel::init_dace_iterator(), and RandomFieldModel::validate_inputs().

**unsigned short expansionForm**  [protected]

unsigned short analyticCovForm;
  form of the RF representation (KL, PCA, ICA)
  Referenced by RandomFieldModel::derived_evaluate(), RandomFieldModel::derived_evaluate_nowait(), RandomFieldModel::get_field_data(), RandomFieldModel::identify_field_model(), RandomFieldModel::initialize_mapping(), RandomFieldModel::initialize_rf_coeffs(), RandomFieldModel::variables_resize(), and RandomFieldModel::vars_mapping().

**int actualReducedRank**  [protected]

command to run RF Suite
  number of bases retained in decomposition
  Referenced by RandomFieldModel::generate_kl_realization(), RandomFieldModel::generate_pca_gp_realization(), RandomFieldModel::identify_field_model(), RandomFieldModel::initialize_recast(), RandomFieldModel::initialize_rf_coeffs(), RandomFieldModel::rf_suite_identify_field_model(), RandomFieldModel::variables_resize(), and RandomFieldModel::vars_mapping().

**RandomFieldModel ∗ rfmInstance**  [static], [protected]

static pointer to this class for use in static callbacks
  initialization of static needed by RecastModel
  Referenced by RandomFieldModel::initialize_recast(), RandomFieldModel::RandomFieldModel(), and RandomFieldModel::vars_mapping().
  The documentation for this class was generated from the following files:
  - RandomFieldModel.hpp
  - RandomFieldModel.cpp

### 13.154 RecastModel Class Reference

Derived model class which provides a thin wrapper around a sub-model in order to recast the form of its inputs and/or outputs.

Inheritance diagram for RecastModel:

```
  Model
  \-----------
  |           |
  | RecastModel |
  \-----------
  | ActiveSubspaceModel |
  | DataTransformModel   |
  | ProbabilityTransformModel |
  | RandomFieldModel     |
  \-----------
  | ScalingModel        |
```

**Public Member Functions**

- **RecastModel** (const Model &sub_model, const Sizet2DArray &vars_map_indices, const SizetArray &vars_comps_total, const BitArray &all_relax_di, const BitArray &all_relax_dr, bool nonlinear_vars_mapping,

standard (full) constructor; assumes provided sizes and map functions are final and constructs all member data

• RecastModel (const Model &sub_model, const SizetArray &vars_comps_totals, const BitArray &all_relax_di, const BitArray &all_relax_dr, size_t num_recast_primary_fns, size_t num_recast_secondary_fns, size_t recast_secondary_offset, short recast_resp_order)

alternate constructor; uses provided sizes to construct Variables, Response and Constraints so Model can be passed to an Iterator; requires subsequent init_sizes() call.

• RecastModel (ProblemDescDB &problem_db, const Model &sub_model)

Problem DB-based ctor, e.g., for use in subspace model; assumes mappings to be initialized later; only initializes based on sub-model.

• RecastModel (const Model &sub_model)

lightest constructor used when transform sizes aren’t known at construct time; doesn’t initialize variables and responses, so this Model can’t be used to construct an Iterator; requires subsequent init_sizes() and init_maps() calls.

• ~RecastModel ()

destructor

• void init_sizes (const SizetArray &vars_comps_totals, const BitArray &all_relax_di, const BitArray &all_relax_dr, size_t num_recast_primary_fns, size_t num_recast_secondary_fns, size_t recast_secondary_offset, short recast_resp_order)

update recast sizes and size Variables and Response members after alternate construction


initialize inverse indices and map callbacks after alternate construction

• void inverse_mappings (void(*inv_vars_map)(const Variables &sub_model_vars, Variables &recast_vars), void(*inv_set_map)(const Variables &sub_model_vars, const ActiveSet &sub_model_set, ActiveSet &recast_set), void(*inv_pri_resps_map)(const Variables &recast_vars, const Variables &sub_model_vars, const Response &recast Resp, Response &sub_model_resps), void(*inv_sec_resps_map)(const Variables &recast_vars, const Variables &sub_model_vars, const Response &sub_model_resps, Response &recast_response))

provide optional inverse mappings

• void transform_variables (const Variables &recast_vars, Variables &sub_model_vars)

perform transformation of Variables (recast \rightarrow sub-model)

• void transform_set (const Variables &recast_vars, const ActiveSet &recast_set, ActiveSet &sub_model_set)

into sub_model_set for use with subModel.

• void transform_response (const Variables &recast_vars, const Variables &sub_model_vars, const Response &sub_model_resps, Response &recast_response)

perform transformation of Response (sub-model \rightarrow recast)
CHAPTER 13. CLASS DOCUMENTATION

- void inverse_transform_variables (const Variables &sub_model_vars, Variables &recast_vars)
  perform inverse transformation of Variables (sub-model -> recast)
- void inverse_transform_set (const Variables &sub_model_vars, const ActiveSet &sub_model_set, ActiveSet &recast_set)
  into sub_model_set for use with subModel.
- void inverse_transform_response (const Variables &sub_model_vars, const Variables &recast_vars, const Response &recastResp, Response &sub_model_resp)
  perform inverse transformation of Response (recast -> sub-model)
- void submodel_supports_derivative_estimation (bool sed_flag)
  override the submodel’s derivative estimation behavior

Protected Member Functions

- void derived_evaluate (const ActiveSet &set)
  portion of evaluate() specific to RecastModel (forward to subModel.evaluate())
- void derived_evaluate_nowait (const ActiveSet &set)
  portion of evaluate_nowait() specific to RecastModel (forward to subModel.evaluate_nowait())
- const IntResponseMap & derived_synchronize ()
  portion of synchronize() specific to RecastModel (forward to subModel.synchronize())
- const IntResponseMap & derived_synchronize_nowait ()
  portion of synchronize_nowait() specific to RecastModel (forward to subModel.synchronize_nowait())
- Iterator & subordinate_iterator ()
  return sub-iterator, if present, within subModel
- Model & subordinate_model ()
  return subModel
- Model & surrogate_model ()
  return surrogate model, if present, within subModel
- Model & truth_model ()
  return truth model, if present, within subModel
- void derived_subordinate_models (ModelList &ml, bool recurse_flag)
  add subModel to list and recurse into subModel
- void update_from_subordinate_model (size_t depth=std::numeric_limits<size_t>::max())
  pass request to subModel if recursing and then update from it
- Interface & derived_interface ()
  return subModel interface
- void primary_response_fn_weights (const RealVector &wts, bool recurse_flag=true)
  set the relative weightings for multiple objective functions or least squares terms and optionally recurses into subModel
- void surrogate_function_indices (const IntSet &surr_fn_indices)
  update the subModel’s surrogate response function indices (DataFitSurrModel::surrogateFnIndices)
- void surrogate_response_mode (short mode)
  update the subModel’s surrogate response mode (SurrogateModel::responseMode)
- void build_approximation ()
  builds the subModel approximation
13.154. RECASTMODEL CLASS REFERENCE

- **bool build_approximation (const Variables &vars, const IntResponsePair &response_pr)**
  builds the subModel approximation

- **void update_approximation (bool rebuild_flag)**
  replaces data in the subModel approximation

- **void update_approximation (const Variables &vars, const IntResponsePair &response_pr, bool rebuild_flag)**
  replaces data in the subModel approximation

- **void update_approximation (const VariablesArray &vars_array, const IntResponseMap &resp_map, bool rebuild_flag)**
  replaces data in the subModel approximation

- **void append_approximation (bool rebuild_flag)**
  appends data to the subModel approximation

- **void append_approximation (const Variables &vars, const IntResponsePair &response_pr, bool rebuild_flag)**
  appends data to the subModel approximation

- **void append_approximation (const VariablesArray &vars_array, const IntResponseMap &resp_map, bool rebuild_flag)**
  appends data to the subModel approximation

- **void pop_approximation (bool save_surr_data, bool rebuild_flag=false)**
  remove the previous data set addition to a surrogate (e.g., due to a previous append_approximation() call); flag manages storing of surrogate data for use in a subsequent push_approximation()

- **void push_approximation ()**
  push a previous approximation data state; reverse of pop_approximation

- **bool push_available ()**
  query for whether a trial increment is restorable within a surrogate

- **void finalize_approximation ()**
  finalize an approximation by applying all previous trial increments

- **void store_approximation (size_t index=NPOS)**
  move the current approximation into storage for later combination; the index of the stored set can be passed to allow replacement instead of augmentation (default is push.back)

- **void restore_approximation (size_t index=NPOS)**
  return an approximation from storage; the index identifies a particular stored data set (default is pop.back from stored)

- **void remove_stored_approximation (size_t index=NPOS)**
  remove a stored approximation, due to redundancy with the current approximation, prior to combination (default for no index is pop.back)

- **void combine_approximation (short corr_type)**
  combine the current approximation with previously stored data sets

- **std::vector< Approximation > & approximations ()**
  retrieve the set of Approximations from the subModel

- **const RealVectorArray & approximation_coefficients (bool normalized=false)**
  retrieve the approximation coefficients from the subModel

- **void approximation_coefficients (const RealVectorArray &approx_coeffs, bool normalized=false)**
  set the approximation coefficients within the subModel

- **const RealVector & approximation_variances (const Variables &vars)**
  retrieve the approximation variances from the subModel
• const Pecos::SurrogateData & approximation_data (size_t index) 
  
  retrieve the approximation data from the subModel

• void component_parallel_mode (short mode)
  
  RecastModel only supports parallelism in subModel, so this virtual function redefinition is simply a sanity check.

• size_t mi_parallel_level_index () const
  
  return subModel’s MI parallel level index

• short local_eval_synchronization ()
  
  return subModel local synchronization setting

• int local_eval_concurrency ()
  
  return subModel local evaluation concurrency

• bool derived_master_overload () const
  
  flag which prevents overloading the master with a multiprocessor evaluation (request forwarded to subModel)

• IntIntPair estimate_partition_bounds (int max_eval_concurrency)
  
  estimate the minimum and maximum partition sizes that can be utilized by this Model

• void derived_init_communicators (ParLevLitIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  
  set up RecastModel for parallel operations (request forwarded to subModel)

• void derived_init_serial ()
  
  set up RecastModel for serial operations (request forwarded to subModel).

• void derived_set_communicators (ParLevLitIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  
  set active parallel configuration within subModel

• void derived_free_communicators (ParLevLitIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  
  deallocate communicator partitions for the RecastModel (request forwarded to subModel)

• void serve_run (ParLevLitIter pl_iter, int max_eval_concurrency)
  
  Service subModel job requests received from the master. Completes when a termination message is received from stop_servers().

• void stop_servers ()
  
  executed by the master to terminate subModel server operations when RecastModel iteration is complete.

• void inactive_view (short view, bool recurse_flag=true)
  
  update the Model’s inactive view based on higher level (nested) context and optionally recurse into subModel

• const String & interface_id () const
  
  return the subModel interface identifier

• int evaluation_id () const
  
  return the current evaluation id for the RecastModel (request forwarded to subModel)

• void set_evaluation_reference ()
  
  set the evaluation counter reference points for the RecastModel (request forwarded to subModel)

• void fine_grained_evaluation_counters ()
  
  request fine-grained evaluation reporting within subModel

• void print_evaluation_summary (std::ostream &s, bool minimal_header=false, bool relative_count=true) const
  
  print the evaluation summary for the RecastModel (request forwarded to subModel)

• void eval_tag_prefix (const String &eval_id_str)
  
  set the hierarchical eval ID tag prefix

• bool db_lookup (const Variables &search_vars, const ActiveSet &search_set, Response &found_res)
RecastModel may need to map variables, asv before DB lookup, or responses after lookup.

- **bool init_variables** (const SizetArray &vars_comps_totals, const BitArray &all_relax_di, const BitArray &all_relax_dr)
  
  initialize currentVariables and related info from the passed size/type info

- **void init_response** (size_t num_recast_primary_fns, size_t num_recast_secondary_fns, short recastResp_order, bool reshape_vars)
  
  initialize currentResponse from the passed size info

- **void init_constraints** (size_t num_recast_secondary_fns, size_t recast_secondary_offset, bool reshape_vars)
  
  initialize userDefinedConstraints from the passed size info

**Protected Attributes**

- **Model subModel**
  
  the sub-model underlying the function pointers

**Private Member Functions**

- **void initialize_data_from_submodel** ()
  
  code shared among constructors to initialize base class data from submodel

- **void update_from_sub_model** ()
  
  update current variables/labels/bounds/targets from subModel

**Private Attributes**

- **Sizet2DArray varsMapIndices**
  
  For each subModel variable, identifies the indices of the recast variables used to define it (maps RecastModel variables to subModel variables; data is packed with only the variable indices employed rather than a sparsely filled N_sm x N_f matrix).

- **bool nonlinearVarsMapping**
  
  boolean set to true if the variables mapping involves a nonlinear transformation. Used in transform_set() to manage the requirement for gradients within the Hessian transformations. This does not require a BoolDeque for each individual variable, since response gradients and Hessians are managed per function, not per variable.

- **bool respMapping**
  
  set to true if non-NULL primaryRespMapping or secondaryRespMapping are supplied

- **Sizet2DArray primaryRespMapIndices**
  
  For each recast primary function, identifies the indices of the subModel functions used to define it (maps subModel response to RecastModel Response).

- **Sizet2DArray secondaryRespMapIndices**
  
  For each recast secondary function, identifies the indices of the subModel functions used to define it (maps subModel response to RecastModel response).

- **BoolDequeArray nonlinearRespMapping**
  
  array of BoolDeques, one for each recast response function. Each BoolDeque defines which subModel response functions contribute to the recast function using a nonlinear mapping. Used in transform_set() to augment the subModel function value/gradient requirements.

- **IntActiveSetMap recastSetMap**
  
  map of recast active set passed to derived_evaluate_nowait(). Needed for currentResponse update in synchronization routines.
• IntVariablesMap recastVarsMap
  map of recast variables used by derived_evaluate_nowait(). Needed for primaryRespMapping() and secondaryRespMapping() in synchronization routines.

• IntVariablesMap subModelVarsMap
  map of subModel variables used by derived_evaluate_nowait(). Needed for primaryRespMapping() and secondaryRespMapping() in synchronization routines.

• IntResponseMap recastResponseMap
  map of recast responses used by RecastModel::derived_synchronize() and RecastModel::derived_synchronize_nowait()

• void(* variablesMapping )(const Variables &recast_vars, Variables &sub_model_vers)
  holds pointer for variables mapping function passed in ctor/initialize

• void(* setMapping )(const Variables &recast_vars, const ActiveSet &recast_set, ActiveSet &sub_model_set)
  holds pointer for set mapping function passed in ctor/initialize

• void(* primaryRespMapping )(const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)
  holds pointer for primary response mapping function passed in ctor/initialize

• void(* secondaryRespMapping )(const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response)
  holds pointer for secondary response mapping function passed in ctor/initialize

• void(* invVarsMapping )(const Variables &sub_model_vars, Variables &recast_vars)
  holds pointer for optional inverse variables mapping function passed in inverse_mappings()

• void(* invSetMapping )(const Variables &sub_model_vars, const ActiveSet &sub_model_set, ActiveSet &recast_set)
  holds pointer for optional inverse set mapping function passed in inverse_mappings()

• void(* invPriRespMapping )(const Variables &recast_vars, const Variables &sub_model_vars, const Response &recast_resp, Response &sub_model_resp)
  holds pointer for optional inverse primary response mapping function passed in inverse_mappings()

• void(* invSecRespMapping )(const Variables &recast_vars, const Variables &sub_model_vars, const Response &recast_resp, Response &sub_model_resp)
  holds pointer for optional inverse secondary response mapping function passed in inverse_mappings()

13.154.1 Detailed Description

Derived model class which provides a thin wrapper around a sub-model in order to recast the form of its inputs and/or outputs.

The RecastModel class uses function pointers to allow recasting of the subModel input/output into new problem forms. For example, this is used to recast SBO approximate subproblems, multiobjective and least-squares reductions, and variable/response.

For now, making the assumption that variables mappings are ordered by submodel active continuous, discrete int, discrete string, discrete real variables, even though all current use cases are continuous only.

When not using the standard (full) constructor, client code must make sure to complete initialization before using the RecastModel’s mapping functions. Initialization steps:

1. sub model (all ctors do this)
2. init_sizes: once known, size Variables, Response, Constraints (full and intermediate ctor do this)
3. init_maps: set indices and callback pointers (only full ctor does this)
13.154. RECASTMODEL CLASS REFERENCE

13.154.2 Constructor & Destructor Documentation

RecastModel ( const Model & sub_model, const Sizet2DArray & vars_map_indices, const SizetArray & vars_comps_totals, const BitArray & all_relax_di, const BitArray & all_relax_dr, bool nonlinear_vars_mapping, void(*)(const Variables & recast_vars, Variables & sub_model_vars) variables_map, void(*)(const Variables & recast_vars, const ActiveSet & recast_set, ActiveSet & sub_model_set) set_map, const Sizet2DArray & primary_resp_map_indices, const Sizet2DArray & secondary_resp_map_indices, size_t recast_secondary_offset, short recast_resp_order, const BoolDequeArray & nonlinear_resp_mapping, void(*)(const Variables & sub_model_vars, const Variables & recast_vars, const Response & sub_model_response, Response & recast_response) primary_map, void(*)(const Variables & sub_model_vars, const Variables & recast_vars, const Response & sub_model_response, Response & recast_response) secondary_map )

standard (full) constructor; assumes provided sizes and map functions are final and constructs all member data

Default recast model constructor. Requires full definition of the transformation; if any mappings are NULL, they are assumed to remain so in later initialization or updates. Parameter vars_comps_totals indicates the number of each type of variable \{4 types\} \times \{3 domains\} in the recast variable space. Note: recast_secondary_offset is the start index for equality constraints, typically num nonlinear ineq constraints.

References Dakota::abort_handler(), Response::copy(), Variables::copy(), Model::current_response(), Model::current_variables(), Model::currentResponse, Model::currentVariables, Variables::cv(), RecastModel::init_constraints(), RecastModel::init_response(), RecastModel::init_variables(), RecastModel::initialize_data_from_submodel(), Model::modelType, RecastModel::nonlinearRespMapping, Response::num_functions(), Model::numDerivVars, Model::numFns, RecastModel::primaryRespMapIndices, RecastModel::primaryRespMapping, RecastModel::respMapping, RecastModel::secondaryRespMapIndices, RecastModel::secondaryRespMapping, RecastModel::subModel, Model::supportsEstimDerivs, and RecastModel::variablesMapping.

RecastModel ( const Model & sub_model, const SizetArray & vars_comps_totals, const BitArray & all_relax_di, const BitArray & all_relax_dr, size_t num_recast_primary_fns, size_t num_recast_secondary_fns, size_t recast_secondary_offset, short recast_resp_order )

alternate constructor; uses provided sizes to construct Variables, Response and Constraints so Model can be passed to an Iterator; requires subsequent init_maps() call.

This alternate constructor defers initialization of the function pointers until a separate call to initialize(), and accepts the minimum information needed to construct currentVariables, currentResponse, and userDefined-Constraints. The resulting model is sufficiently complete for passing to an Iterator. Parameter vars_comps_totals indicates the number of each type of variable \{4 types\} \times \{3 domains\} in the recast variable space. Note: recast_secondary_offset is the start index for equality constraints, typically num nonlinear ineq constraints.

References RecastModel::init_sizes(), RecastModel::initialize_data_from_submodel(), Model::modelType, and Model::supportsEstimDerivs.
13.154.3 Member Function Documentation

```cpp
void init_maps ( const Sizet2DArray & vars_map_indices, bool nonlinear_vars_mapping, void(*)(const Variables &recast_vars, Variables &sub_model_vars) variables_map, void(*)(const Variables &recast_vars, const ActiveSet &recast_set, ActiveSet &sub_model_set) set_map, const Sizet2DArray & primary_resp_map_indices, const Sizet2DArray & secondary_resp_map_indices, const BoolDequeArray & nonlinear_resp_mapping, void(*)(const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response) primary_resp_map, void(*)(const Variables &sub_model_vars, const Variables &recast_vars, const Response &sub_model_response, Response &recast_response) secondary_resp_map )
```

initialize recast indices and map callbacks after alternate construction

This function is used for late initialization of the recasting functions. It is used in concert with the alternate constructor.


Referenced by NonDGlobalInterval::core_run(), NonDLocalInterval::core_run(), DataTransformModel::DataTransformModel(), RandomFieldModel::initialize_recast(), ActiveSubspaceModel::initialize_recast(), EffGlobalMinimizer::minimize_surrogates_on_model(), NonDLocalReliability::mpp_search(), NonDGlobalReliability::optimize_gaussian_process(), ProbabilityTransformModel::ProbabilityTransformModel(), and ScalingModel::ScalingModel().

```cpp
void derived_evaluate ( const ActiveSet & set ) [protected], [virtual]
```

portion of evaluate() specific to RecastModel (forward to subModel.evaluate())

The RecastModel is evaluated by an Iterator for a recast problem formulation. Therefore, the currentVariables, incoming active set, and output currentResponse all correspond to the recast inputs/outputs.

Reimplemented from Model.

References Response::active_set(), Model::current_response(), Model::current_variables(), Model::currentResponse, Model::currentVariables, Model::evaluate(), RecastModel::respMapping, RecastModel::subModel, RecastModel::transform_response(), RecastModel::transform_set(), RecastModel::transform_variables(), and Response::update().

Referenced by ActiveSubspaceModel::derived_evaluate(), and RandomFieldModel::derived_evaluate().

```cpp
void eval_tag_prefix ( const String & eval_id_str ) [inline], [protected], [virtual]
```

set the hierarchical eval ID tag prefix

RecastModel just forwards any tags to its subModel

Reimplemented from Model.

References Model::eval_tag_prefix(), and RecastModel::subModel.

```cpp
void update_from_sub_model ( ) [private]
```

update current variables/labels/bounds/targets from subModel

Update inactive values and labels in currentVariables and inactive bound constraints in userDefinedConstraints from variables and constraints data within subModel.

References Model::aleatDistParams, Model::aleatory_distribution_parameters(), Constraints::continuous_lower_bounds(), Model::continuous_lower_bounds(), Constraints::continuous_upper_bounds(), Model::continuous_upper_bounds(), Variables::continuous_variable_labels(), Model::continuous_variable_labels(), Variables::continuous_variables(), Model::continuous_variables(), Model::currentResponse, Model::currentVariables, Model::discrete_design_set_int_values(), Model::discrete_design_set_real_values(), Constraints::discrete-
Public Member Functions

- **ReducedBasis()**
  
  *default constructor*

- **void set_matrix(const RealMatrix &)*

- **const RealMatrix & get_matrix()**

- **void center_matrix()**

  *center the matrix by scaling each column by its means*

- **void update_svd(bool center_matrix_by_col_means=true)**

  *ensure that the factorization is current, centering if requested*
- bool is_valid () const
- const Real & get_singular_values_sum () const
- const Real & get_eigen_values_sum () const
- const RealVector & get_column_means ()
- const RealVector & get_singular_values () const
- RealVector get_singular_values (const TruncationCondition &) const
- const RealMatrix & get_left_singular_vector () const

  the num_observations n x num_observations n orthogonal matrix U; the left singular vectors are the first min(n,p) columns

- const RealMatrix & get_right_singular_vector_transpose () const

  the num_responses p x num_responses p orthogonal matrix V'; the right singular vectors are the first min(n,p) rows of V' (columns of V)

### Private Attributes

- RealMatrix matrix
- RealMatrix workingMatrix
- RealMatrix U_matrix
- RealVector S_values
- RealMatrix VT_matrix
- RealVector column_means
- bool col_means_computed
- bool is_centered
- bool is_valid_svd
- Real singular_values_sum
- Real eigen_values_sum
- TruncationCondition * truncation

### 13.155.1 Detailed Description

The ReducedBasis class is used to ... (TODO - RWH)

Class to manage data-driven dimension reduction. The passed matrix with num_observations n rows and num_responses p columns contains realizations of a set of responses. The class optionally centers the matrix by the column means. Stores a singular value decomposition of the passed data matrix X = U*S*V', which can also be used for PCA, where we seek an eigendecomposition of the covariance: X' * X = V*D*V' \^ {-1} = V*S^2 * V'

The documentation for this class was generated from the following files:

- ReducedBasis.hpp
- ReducedBasis.cpp

### 13.156 RelaxedVarConstraints Class Reference

Derived class within the Constraints hierarchy which employs relaxation of discrete variables. 

Inheritance diagram for RelaxedVarConstraints:
Public Member Functions

- **RelaxedVarConstraints** (const SharedVariablesData &svd)
  lightweight constructor
- **RelaxedVarConstraints** (const ProblemDescDB &problem_db, const SharedVariablesData &svd)
  standard constructor
- **~RelaxedVarConstraints** ()
  destructor
- void **write** (std::ostream &s) const
  write a variable constraints object to an std::ostream
- void **read** (std::istream &s)
  read a variable constraints object from an std::istream

Additional Inherited Members

### 13.156.1 Detailed Description

Derived class within the Constraints hierarchy which employs relaxation of discrete variables.

Derived variable constraints classes take different views of the design, uncertain, and state variable types and the continuous and discrete domain types. The RelaxedVarConstraints derived class combines continuous and discrete domain types through integer relaxation. The branch and bound method uses this approach (see Variables-::get_variables(problem_db) for variables type selection; variables type is passed to the Constraints constructor in Model).

### 13.156.2 Constructor & Destructor Documentation

**RelaxedVarConstraints** ( const ProblemDescDB & problem_db, const SharedVariablesData & svd )

standard constructor

In this class, a relaxed data approach is used in which continuous and discrete arrays are combined into a single continuous array (integrality is relaxed; the converse of truncating reals is not currently supported but could be in the future if needed). Iterators which use this class include: BranchBndOptimizer.

References SharedVariablesData::all_released_discrete_int(), SharedVariablesData::all_released_discrete_real(), Constraints::allContinuousLowerBnds, Constraints::allContinuousUpperBnds, Constraints::allDiscreteIntLowerBnds, Constraints::allDiscreteIntUpperBnds, Constraints::allDiscreteRealLowerBnds, Constraints::allDiscreteRealUpperBnds, Dakota::copy_data_partial(), ProblemDescDB::get_iv(), ProblemDescDB::get_rv(), Constraints::sharedVarsData, and SharedVariablesData::view().

The documentation for this class was generated from the following files:

- RelaxedVarConstraints.hpp
- RelaxedVarConstraints.cpp
13.157 RelaxedVariables Class Reference

Derived class within the Variables hierarchy which employs the relaxation of discrete variables.

Inheritance diagram for RelaxedVariables:

```
Variables
   
RelaxedVariables
```

Public Member Functions

- RelaxedVariables (const ProblemDescDB &problem_db, const std::pair< short, short > &view)
  
  standard constructor

- RelaxedVariables (const SharedVariablesData &svd)
  
  lightweight constructor

- ~RelaxedVariables ()
  
  destructor

Protected Member Functions

- void read (std::istream &s)
  
  read a variables object from an std::istream

- void write (std::ostream &s) const
  
  write a variables object to an std::ostream, e.g., the console

- void write_aprepro (std::ostream &s) const
  
  write a variables object to an std::ostream in aprepro format, e.g., a parameters file

- void read_tabular (std::istream &s, bool active_only=false)
- void write_tabular (std::ostream &s, bool active_only=false) const
  
  write a variables object in tabular format to an std::ostream

- void write_tabular_labels (std::ostream &s, bool active_only=false) const
  
  write the labels in input spec order to a std::ostream

- template<typename Reader >
  void read_core (std::istream &s, Reader read_handler, const SizetArray &vc_totals)
  
  Implementation of reading various formats using the specified read handler, accounting for reordering due to relaxation.

- template<typename Writer >
  void write_core (std::ostream &s, Writer write_handler, const SizetArray &vc_totals) const
  
  Implementation of writing various formats using the specified write handler, accounting for reordering due to relaxation.
13.157. RELAXEDVARIABLES CLASS REFERENCE

Additional Inherited Members

13.157.1 Detailed Description

Derived class within the Variables hierarchy which employs the relaxation of discrete variables.

Derived variables classes take different views of the design, uncertain, and state variable types and the continuous and discrete domain types. The RelaxedVariables derived class combines continuous and discrete domain types but separates design, uncertain, and state variable types. The branch and bound method uses this approach (see Variables::get_variables(problem_db)).

13.157.2 Constructor & Destructor Documentation

RelaxedVariables ( const ProblemDescDB & problem_db, const std::pair< short, short > & view )

standard constructor

In this class, a relaxed data approach is used in which continuous and discrete arrays are combined into a single continuous array (integrality is relaxed; the converse of truncating reals is not currently supported but could be in the future if needed). Iterators/strategies which use this class include: BranchBndOptimizer. Extract fundamental variable types and labels and merge continuous and discrete domains to create aggregate arrays and views.

References SharedVariablesData::all_relaxed_discrete_int(), SharedVariablesData::all_relaxed_discrete_real(), Variables::allContinuousVars, Variables::allDiscreteIntVars, Variables::allDiscreteRealVars, Variables::allDiscreteStringVars, Dakota::copy_data_partial(), ProblemDescDB::get_iv(), ProblemDescDB::get_rv(), ProblemDescDB::get_sa(), Variables::sharedVarsData, and SharedVariablesData::view().

13.157.3 Member Function Documentation

void read_tabular ( std::istream & s, bool active_only = false ) [protected], [virtual]

Presumes variables object is appropriately sized to receive data

Reimplemented from Variables.

References SharedVariablesData::active_components_totals(), SharedVariablesData::components_totals(), RelaxedVariables::read_core(), and Variables::sharedVarsData.

void read_core ( std::istream & s, Reader read_handler, const SizetArray & vc_totals ) [protected]

Implementation of reading various formats using the specified read handler, accounting for reordering due to relaxation.

Reordering is required in all read/write cases that will be visible to the user since all derived vars classes should use the same ordering for clarity. Neutral file I/O, binary streams, and packed buffers do not need to reorder (so long as read/write are consistent) since this data is not intended for public consumption.

References Variables::all_continuous_variable_labels(), Variables::all_discrete_int_variable_labels(), Variables::all_discrete_real_variable_labels(), Variables::all_discrete_string_variable_labels(), SharedVariablesData::all_relaxed_discrete_int(), SharedVariablesData::all_relaxed_discrete_real(), Variables::allContinuousVars, Variables::allDiscreteIntVars, Variables::allDiscreteRealVars, Variables::allDiscreteStringVars, and Variables::sharedVarsData.

Referenced by RelaxedVariables::read(), and RelaxedVariables::read_tabular().

The documentation for this class was generated from the following files:

- RelaxedVariables.hpp
- RelaxedVariables.cpp
13.158 Response Class Reference

Container class for response functions and their derivatives. Response provides the enveloper base class.

Inheritance diagram for Response:

```
Response
  |  |
  v  v
ExperimentResponse  SimulationResponse
```

Public Member Functions

- **Response ()**
  - default constructor

- **Response (short type, const Variables &vars, const ProblemDescDB &problem_db)**
  - standard constructor built from problem description database

- **Response (const SharedResponseData &srd, const ActiveSet &set)**
  - alternate constructor that shares response data

- **Response (short type, const ActiveSet &set)**
  - alternate constructor using limited data without sharing

- **Response (const SharedResponseData &srd)**
  - alternate constructor using limited data (explicit disallows implicit type conversion)

- **Response (const Response &response)**
  - copy constructor

- virtual **~Response ()**
  - destructor

- **Response operator= (const Response &response)**
  - assignment operator

- **const SharedResponseData & shared_data () const**
  - return sharedRespData

- **SharedResponseData & shared_data ()**
  - return sharedRespData

- **size_t num_functions () const**
  - return the number of response functions

- **const ActiveSet & active_set () const**
  - return the active set

- **void active_set (const ActiveSet &set)**
  - set the active set

- **const ShortArray & active_set_request_vector () const**
  - return the active set request vector

- **void active_set_request_vector (const ShortArray &asrv)**
  - set the active set request vector and verify consistent number of response functions

- **const SizetArray & active_set_derivative_vector () const**
13.158. RESPONSE CLASS REFERENCE

return the active set derivative vector

- void active_set_derivative_vector (const SizetArray &asdv)
  *set the active set derivative vector and reshape functionGradients/functionHessians if needed*

- const Real & function_value (size_t i) const
  *return a function value*

- Real & function_value_view (size_t i)
  *return a “view” of a function value for updating in place*

- const RealVector & function_values () const
  *return all function values*

- RealVector function_values_view ()
  *return all function values as a view for updating in place*

- RealVector function_values_view () const
  *return all function values as a view for accessing the function values vector from a const response*

- void function_value (const Real &function_val, size_t i)
  *set a function value*

- void function_values (const RealVector &function_vals)
  *set all function values*

- const Real * function_gradient (int i) const
  *return the i-th function gradient as a const Real*

- RealVector function_gradient_view (int i)
  *return the i-th function gradient as a SerialDenseVector view (shallow copy) for updating in place*

- RealVector function_gradient_view (int i) const
  *return the i-th function gradient as a SerialDenseVector Teuchos::View (shallow copy) for accessing a column vector from a const matrix*

- RealVector function_gradient_copy (int i) const
  *return the i-th function gradient as a SerialDenseVector Teuchos::Copy (deep copy)*

- const RealMatrix & function_gradients () const
  *return all function gradients*

- RealMatrix function_gradients_view ()
  *return all function gradients as a view for updating in place*

- RealMatrix function_gradients_view () const
  *return all function gradients as a view for updating in place*

- void function_gradient (const RealVector &function_grad, int i)
  *set a function gradient*

- void function_gradients (const RealMatrix &function_grads)
  *set all function gradients*

- const RealSymMatrix & function_hessian (size_t i) const
  *return the i-th function Hessian*

- RealSymMatrix function_hessian_view (size_t i)
  *return the i-th function Hessian as a Teuchos::View (shallow copy) for updating in place*

- RealSymMatrix function_hessian_view (size_t i) const
  *return the i-th function Hessian as a Teuchos::View (shallow copy) for accessing the i-th matrix within a const matrix array*
• const RealSymMatrixArray & function_hessians () const
  return all function Hessians
• RealSymMatrixArray function_hessians_view ()
  return all function Hessians as Teuchos::Views (shallow copies) for updating in place
• RealSymMatrixArray function_hessians_view () const
  return all function Hessians as Teuchos::Views (shallow copies) for updating in place
• void function_hessian (const RealSymMatrix &function_hessian, size_t i)
  set a function Hessian
• void function_hessians (const RealSymMatrixArray &function_hessians)
  set all function Hessians
• RealVector field_values_view (size_t i) const
  return const field values
• RealVector field_values_view (size_t i)
  return a "view" of a field value for updating in place
• void field_values (const RealVector &field_val, size_t i)
  set a field value
• RealMatrix field_coords_view (size_t i)
  return a "view" of a field value’s coordinates
• const RealMatrix field_coords_view (size_t i) const
  return a const "view" of a field value’s coordinates
• void field_coords (const RealMatrix &field_coords, size_t i)
  set a field value’s coordinates
• RealMatrix field_gradients_view (size_t i) const
  return a view of the gradients of each field element
• RealSymMatrixArray field_hessians_view (size_t i) const
  return a view of the hessians of each field element
• const IntVector & field_lengths () const
  return the field lengths from sharedRespData
• void field_lengths (const IntVector &field_lens)
  set the field lengths within sharedRespData
• const IntVector & num_coords_per_field () const
  return the num_coords_per_field from sharedRespData
• void set_coord_values (const RealMatrix &coord_values, const size_t i) const
  return the coordinate values per field
• const RealMatrix & get_coord_values (const size_t i)
  set the coordinate values per field
• const StringArray & function_labels () const
  return the fine-grained (unrolled) response function identifier strings from sharedRespData
• void function_labels (const StringArray &labels)
  set the fine-grained (unrolled) response function identifier strings within sharedRespData
• const StringArray & field_group_labels ()
  return the user-provided field group labels instead of the unrolled labels available through function_labels()
• void read (std::istream &s, const unsigned short format=FLEXIBLE_RESULTS)
13.158. RESPONSE CLASS REFERENCE

- read a response object of specified format from an std::istream
  - void write (std::ostream &s) const
    - write a response object to an std::ostream
  - void read_annotated (std::istream &s)
    - read a response object in annotated format from an std::istream
  - void write_annotated (std::ostream &s) const
    - write a response object in annotated format to an std::ostream
  - void read_tabular (std::istream &s)
    - read responseRep::functionValues in tabular format from an std::istream
  - void write_tabular (std::ostream &s) const
    - write responseRep::functionValues in tabular format to an std::ostream
  - void write_tabular_labels (std::ostream &s) const
    - write the labels to a tabular data stream
  - void read (MPIUnpackBuffer &s)
    - read a response object from a packed MPI buffer
  - void write (MPIPackBuffer &s) const
    - write a response object to a packed MPI buffer
  - Response copy (bool deep_srd=false) const
    - return a deep response copy of the contained responseRep for use in history mechanisms (SharedResponseData uses a shallow copy by default)
  - int data_size ()
    - return the number of doubles active in response. Used for sizing double* response_data arrays passed into read_data and write_data.
  - void read_data (double *response_data)
    - read from an incoming double* array
  - void write_data (double *response_data)
    - write to an incoming double* array
  - void overlay (const Response &response)
    - add incoming response to functionValues/Gradients/Hessians
  - void update (const Response &response)
    - Used in place of operator= when only results data updates are desired (functionValues/functionGradients/functionHessians are updated, ASV/labels/id’s/etc. are not). Care is taken to allow different derivative array sizing between the two response objects.
  - void update (const RealVector &source_fn_vals, const RealMatrix &source_fn_grads, const RealSymMatrixArray &source_fn_hessians, const ActiveSet &source_set)
    - Overloaded form which allows update from components of a response object. Care is taken to allow different derivative array sizing.
  - void update_partial (size_t start_index_target, size_t num_items, const Response &response, size_t start_index_source)
    - partial update of this response object from another response object. The response objects may have different numbers of response functions.
  - void update_partial (size_t start_index_target, size_t num_items, const RealVector &source_fn_vals, const RealMatrix &source_fn_grads, const RealSymMatrixArray &source_fn_hessians, const ActiveSet &source_set, size_t start_index_source)
Overloaded form which allows partial update from components of a response object. The response objects may have different numbers of response functions.

- void reshape (size_t num_fns, size_t num_params, bool grad_flag, bool hess_flag)
  reshapes response data arrays
- void reset ()
  resets all response data to zero
- void reset_inactive ()
  resets all inactive response data to zero
- bool is_null () const
  function to check responseRep (does this handle contain a body)
- virtual void set_scalar_covariance (RealVector &scalars)
  method to set the covariance matrix defined for ExperimentResponse
- virtual const ExperimentCovariance & experiment_covariance () const
  retrieve the ExperimentCovariance structure
- virtual void set_full_covariance (std::vector< RealMatrix > &matrices, std::vector< RealVector > &diagonals, RealVector &scalars, IntVector matrix_map_indices, IntVector diagonal_map_indices, IntVector scalar_map_indices)
  method to set the full covariance matrices for ExperimentResponse
- virtual Real apply_covariance (const RealVector &residuals) const
  method to compute the triple product $v' \text{inv}(C) \cdot v$.
- virtual void apply_covariance_inv_sqrt (const RealVector &residuals, RealVector &weighted_residuals) const
  method to compute $(v' \text{inv}(C)^{1/2})$, to compute weighted residual
- virtual void apply_covariance_inv_sqrt (const RealMatrix &gradients, RealMatrix &weighted_gradients) const
- virtual void apply_covariance_inv_sqrt (const RealSymMatrixArray &hessians, RealSymMatrixArray &weighted_hessians) const
- virtual void get_covariance_diagonal (RealVector &diagonal) const
  covariance determinant for one experiment (default 1.0)
- virtual Real log_covariance_determinant () const
  log of covariance determinant for one experiment (default 0.0)

Protected Member Functions

- Response (BaseConstructor, const Variables &vars, const ProblemDescDB &problem_db)
  constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)
- Response (BaseConstructor, const SharedResponseData &srd, const ActiveSet &set)
  constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)
- Response (BaseConstructor, const ActiveSet &set)
  constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)
• **Response** (BaseConstructor, const SharedResponseData &srd)
  constructor initializes the base class part of letter classes *(BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)*

• virtual void **copy_rep** (Response *source_rep)
  Implementation of data copy for Response letters (specialized by some derived letter types): pulls base class data from source_rep into this object.

### Protected Attributes

- **SharedResponseData sharedRespData**
  reference-counted instance of shared response data: id’s, labels

- **RealVector functionValues**
  abstract set of response functions

- **RealMatrix functionGradients**
  first derivatives of the response functions

- **RealSymMatrixArray functionHessians**
  second derivatives of the response functions

- **IntRealMatrixMap fieldCoords**
  coordinates for the field values

- **ActiveSet responseActiveSet**
  copy of the ActiveSet used by the Model to generate a Response instance

### Private Member Functions

- template<class Archive, typename OrdinalType, typename ScalarType>
  void **write_sdm_col** (Archive &ar, int col, const Teuchos::SerialDenseMatrix<OrdinalType, ScalarType> &sdm) const
  write a column of a SerialDenseMatrix

- template<class Archive, typename OrdinalType, typename ScalarType>
  void **read_sdm_col** (Archive &ar, int col, Teuchos::SerialDenseMatrix<OrdinalType, ScalarType> &sdm)
  read a column of a SerialDenseMatrix

- template<class Archive>
  void **load** (Archive &ar, const unsigned int version)
  read a Response from an archive<,class Archive>

- template<class Archive>
  void **load_rep** (Archive &ar, const unsigned int version)
  read a Response letter object from an archive

- template<class Archive>
  void **save** (Archive &ar, const unsigned int version) const
  write a Response to an archive

- template<class Archive>
  void **save_rep** (Archive &ar, const unsigned int version) const
  write a Response letter object to an archive

- **BOOST_SERIALIZATION_SPLIT_MEMBER (**Response **get_response**(short type)
  Used by standard envelope constructor to instantiate a new letter class.
CHAPTER 13. CLASS DOCUMENTATION

- **Response * get_response** (const SharedResponseData &srd, const ActiveSet &set) const
  
  Used by alternate envelope constructor to instantiate a new letter class.

- **Response * get_response** (short type, const ActiveSet &set) const
  
  Used by alternate envelope constructor to instantiate a new letter class.

- **Response * get_response** (const SharedResponseData &srd) const
  
  Used by copy() to instantiate a new letter class.

- **Response * get_response** (short type) const
  
  Used by read functions to instantiate a new letter class.

- **void read_annotated_rep** (std::istream &s)
  
  read a letter object in annotated format from an std::istream

- **void write_annotated_rep** (std::ostream &s) const
  
  write a letter object in annotated format to an std::ostream

- **void read_rep** (MPIUnpackBuffer &s)
  
  read a letter object from a packed MPI buffer

- **void write_rep** (MPIPackBuffer &s) const
  
  write a letter object to a packed MPI buffer

- **void shape_rep** (const ActiveSet &set, bool initialize=true)
  
  resizes the representation's containers

- **void reshape_rep** (size_t num_fns, size_t num_params, bool grad_flag, bool hess_flag)
  
  resizes the representation's containers

- **void read_gradients** (std::istream &s, const ShortArray &asv, std::ostringstream &error)
  
  Read gradients from a freeform stream. Insert error messages.

- **void read_hessians** (std::istream &s, const ShortArray &asv, std::ostringstream &error)
  
  Read Hessians from a freeform stream. Insert error messages.

- **void read_labeled_fn_vals** (std::istream &s, const ShortArray &asv, std::ostringstream &errors)
  
  Read function values from an annotated stream. Insert error messages.

- **void read_flexible_fn_vals** (std::istream &s, const ShortArray &asv, std::ostringstream &errors)
  
  Read function values from a stream in a "flexible" way – ignoring any labels. Insert error messages into errors stream.

- **bool failure_reported** (std::istream &s)
  
  Check for FAIL in stream.

**Private Attributes**

- const Variables & vars
- const Variables const
  
  ProblemDescDB &problem_db const

- **Response * responseRep**
  
  pointer to the body (handle-body idiom)

- int referenceCount
  
  number of handle objects sharing responseRep
13.159.  **RESTARTWRITER CLASS REFERENCE**

**Friends**

- class `boost::serialization::access`
- bool `operator==` (const `Response` &resp1, const `Response` &resp2)
  
  *equality operator*
- bool `operator!=` (const `Response` &resp1, const `Response` &resp2)
  
  *inequality operator*

### 13.158.1 Detailed Description

Container class for response functions and their derivatives. `Response` provides the enveloper base class.

The `Response` class is a container class for an abstract set of functions (functionValues) and their first (function-Gradients) and second (functionHessians) derivatives. The functions may involve objective and constraint functions (optimization data set), least squares terms (parameter estimation data set), or generic response functions (uncertainty quantification data set). For memory efficiency, it employs the "letter-envelope idiom" approach to reference counting and representation sharing (see Coplien ’’Advanced C++’’), for which the base `Response` class serves as the envelope and one of its derived classes serves as the letter.

### 13.158.2 Member Data Documentation

**RealMatrix functionGradients**  [protected]

First derivatives of the response functions

- the gradient vectors (plural) are column vectors in the matrix (singular) with (row, col) = (variable index, response fn index).

Referenced by `Response::field_gradients_view()`, `Response::function_gradient()`, `Response::function_gradient_copy()`, `Response::function_gradient_view()`, `Response::function_gradients()`, and `Response::function_gradients_view()`.

The documentation for this class was generated from the following file:

- DakotaResponse.hpp

### 13.159 RestartWriter Class Reference

**Public Member Functions**

- **RestartWriter ()**

  *optional default ctor allowing a non-outputting RestartWriter*

- **RestartWriter (const String &write_restart_filename)**

  *typical ctor taking a filename*

- const String & `filename ()`

  *output filename for this writer*

- void **append_prp (const ParamResponsePair &prp_in)**

  *add the passed pair to the restart file*

- void **flush ()**

  *flush the restart stream so we have a complete restart record should Dakota abort*
**Private Member Functions**

- **RestartWriter** (const RestartWriter &)
  
  *copy constructor is disallowed due to file stream*

- **const RestartWriter & operator=** (const RestartWriter &)
  
  *assignment is disallowed due to file stream*

**Private Attributes**

- **String restartOutputFilename**
  
  *the name of the restart output file*

- **std::ofstream restartOutputFS**
  
  *Binary stream to which restart data is written.*

- **boost::scoped_ptr< boost::archive::binary_oarchive > restartOutputArchive**
  
  *Binary output archive to which data is written (pointer since no default ctor for oarchive and may not be initialized).*

---

**13.159.1 Detailed Description**

Component for writing restart files. Creation and destruction of archive and associated stream are managed here. The documentation for this class was generated from the following files:

- OutputManager.hpp
- OutputManager.cpp

---

**13.160 ResultsDBAny Class Reference**

**Public Member Functions**

- **template<typename StoredType>**
  
  void **array_allocate** (const StrStrSizet &iterator_id, const std::string &data_name, size_t array_size, const MetaDataType &metadata)
  
  *allocate an entry with sized array of the StoredType, e.g., array across response functions or optimization results sets*

- **template<typename StoredType>**
  
  void **array_insert** (const StrSizet &iterator_id, const std::string &data_name, size_t index, const StoredType &sent_data)
  
  *insert sent_data in specified position in previously allocated array*

- **template<typename StoredType>**
  
  StoredType **get_data** (const StrStrSizet &iterator_id, const std::string &data_name) const
  
  *return requested data by value in StoredType*

- **template<typename StoredType>**
  
  StoredType **get_array_data** (const StrSizet &iterator_id, const std::string &data_name, size_t index) const
  
  *return requested data from array by value in StoredType*

- **template<typename StoredType>**
  
  const StoredType **get_data_ptr** (const StrSizet &iterator_id, const std::string &result_key) const
13.1.60. RESULTSDBANY CLASS REFERENCE

return pointer to stored data entry

• template<typename StoredType>
  const StoredType * get_array_data_ptr (const StrStrSizet &iterator_id, const std::string &data_name, size_t index) const

  return pointer to stored data at given array location

• void insert (const StrStrSizet &iterator_id, const std::string &data_name, const boost::any &result, const MetaDataType &metadata)

  record addition with metadata map

• void dump_data (std::ostream &output_stream)

  coarsely dump the data to the passed output stream

• void print_data (std::ostream &output_stream)

  pretty print the data to the passed output stream

Private Member Functions

• const ResultsValueType & lookup_data (const StrStrSizet &iterator_id, const std::string &data_name) const

  attempt to find the requested data, erroring if not found

• template<typename StoredType>
  StoredType cast_data (const boost::any &dataholder) const

  cast the reference to the any data to the requested type

• template<typename StoredType>
  const StoredType * cast_data_ptr (const boost::any &dataholder) const

  cast the pointer to the any data to the requested type

• void print_metadata (std::ostream &os, const MetaDataType &md)

  print metadata to ostream

• void extract_data (const boost::any &dataholder, std::ostream &os)

  determine the type of contained data and output it to ostream

• void output_data (const std::vector<double> &data, std::ostream &os)

  output data to ostream

• void output_data (const std::vector<RealVector> &data, std::ostream &os)

  output data to ostream

• void output_data (const std::vector<std::string> &data, std::ostream &os)

  output data to ostream

• void output_data (const std::vector<std::vector<std::string>> &data, std::ostream &os)

  output data to ostream

• void output_data (const RealMatrix &data, std::ostream &os)

  output data to ostream

Private Attributes

• std::map<ResultsKeyType, ResultsValueType> iteratorData

  core data storage (map from key to value type)
13.160.1 Detailed Description

Class: ResultsDBAny Description: A map-based container to store DAKOTA Iterator results in underlying boost::any, with optional metadata

13.160.2 Member Function Documentation

void array_insert ( const StrStrSizet & iterator_id, const std::string & data_name, size_t index, const StoredType & sent_data )

insert sent_data in specified position in previously allocated array
   insert requires previous allocation, and does not allow metadata update
   References Dakota::abort_handler(), ResultsDBAny::iteratorData, and Dakota::make_key().

void insert ( const StrStrSizet & iterator_id, const std::string & data_name, const boost::any & result, const MetaDataType & metadata )

record addition with metadata map
   Add or update existing entry
   References ResultsDBAny::iteratorData, and Dakota::make_key().
   Referenced by ResultsDBAny::array_allocate().

void extract_data ( const boost::any & dataholder, std::ostream & os ) [private]

determine the type of contained data and output it to ostream
   Extract the data from the held any and map to supported concrete types int double RealVector (Teuchos::SerialDenseVector<int,double>) RealMatrix (Teuchos::SerialDenseMatrix<int,double>)
   References ResultsDBAny::output_data().
   Referenced by ResultsDBAny::dump_data(), and ResultsDBAny::print_data().
   The documentation for this class was generated from the following files:

   • ResultsDBAny.hpp
   • ResultsDBAny.cpp

13.161 ResultsEntry<StoredType> Class Template Reference

Class to manage in-core vs. file database lookups.

Public Member Functions

• ResultsEntry (const ResultsManager &results_mgr, const StrStrSizet &iterator_id, const std::string &data_name)

   Construct ResultsEntry containing retrieved item of StoredType.

• ResultsEntry (const ResultsManager &results_mgr, const StrStrSizet &iterator_id, const std::string &data_name, size_t array_index)

   Construct ResultsEntry to retrieve item array_index from array of StoredType.
Private Member Functions

- **ResultsEntry ()**
  
  `return a reference to the stored data, whether from core or file`

Private Attributes

- **bool coreActive**
  
  `whether the ResultsManager has an active in-core database`

- **StoredType dbData**
  
  `data retrieved from file database`

- **const StoredType *dbDataPtr**
  
  `non-const pointer to const data we don’t own in the core case`

### 13.161.1 Detailed Description

**template<typename StoredType> class Dakota::ResultsEntry< StoredType >**

Class to manage in-core vs. file database lookups.

**ResultsEntry** manages database lookups. If a core database is available, will return a reference directly to the stored data; if disk, will return reference to a local copy contained in this class. Allows disk-stored data to persist for minimum time during lookup to support true out-of-core use cases.

### 13.161.2 Constructor & Destructor Documentation

**ResultsEntry ( ) [private]**

`return a reference to the stored data, whether from core or file`

`default construction disallowed: data must be initialized from DB lookup if needed`

The documentation for this class was generated from the following file:

- **ResultsManager.hpp**

### 13.162 ResultsFileError Class Reference

Exception throw for other results file read error

Inheritance diagram for ResultsFileError:

```
FileReadException

ResultsFileError
```

Public Member Functions

- **ResultsFileError (const std::string &msg)**
13.162.1 Detailed Description

exception throw for other results file read error

The documentation for this class was generated from the following file:

- dakota_global_defs.hpp

13.163 ResultsID Class Reference

Get a globally unique 1-based execution number for a given iterator name (combination of methodName and methodID) for use in results DB. Each Iterator::run() call creates or increments this count for its string identifier.

Public Member Functions

- size_t increment_id (const std::string &methodName, const std::string &methodID)
  explicitly increment the iterator results ID, init to 1 if needed
- size_t get_id (const std::string &methodName, const std::string &methodID)
  get (possibly creating) a unique iterator results ID for the passed name
- size_t get_id (const std::string &methodName, const std::string &methodID) const
  get a unique iterator results ID for the passed name (const version errors if not found)

Static Public Member Functions

- static ResultsID & instance ()
  get the single unique instance of ResultsID

Private Member Functions

- ResultsID ()
  Private constructor for ResultsID.
- ~ResultsID ()
  Private destructor for ResultsID.
- ResultsID (ResultsID const &)
  Private copy constructor for ResultsID.
- ResultsID & operator= (ResultsID const &)
  Private assignment operator for ResultsID.

Private Attributes

- std::map<std::pair<std::string, std::string>, size_t> idMap
  storage for the results IDs
13.164. RESULTSMANAGER CLASS REFERENCE

13.163.1 Detailed Description

Get a globally unique 1-based execution number for a given iterator name (combination of methodName and methodID) for use in results DB. Each Iterator::run() call creates or increments this count for its string identifier.

The documentation for this class was generated from the following files:

- ResultsManager.hpp
- ResultsManager.cpp

13.164 ResultsManager Class Reference

Results manager for iterator final data.

Public Member Functions

- **ResultsManager** ()
  
  *default constructor: no databases active until initialize called*

- **void initialize** (const std::string &base_filename)
  
  *initialize the results manager to manage an in-core database, writing to the specified file name*

- **bool active** () const
  
  *whether any databases are active*

- **void write_databases** ()
  
  *Write in-core databases to file.*

- **template<typename StoredType> void insert** (const StrStrSizet &iterator_id, const std::string &data_name, const StoredType &sent_data, const MetaDataType metadata=MetaDataType())
  
  *insert data*

- **void insert** (const StrStrSizet &iterator_id, const std::string &data_name, StringMultiArrayConstView sma_labels, const MetaDataType metadata=MetaDataType())

- **template<typename StoredType> void array_allocate** (const StrStrSizet &iterator_id, const std::string &data_name, size_t array_size, const MetaDataType metadata=MetaDataType())
  
  *allocate an entry with an array of StoredType of array_size for future insertion; likely move to non-templated accessors for these*

- **template<typename StoredType> void array_insert** (const StrStrSizet &iterator_id, const std::string &data_name, size_t index, const StoredType &sent_data)
  
  *insert into a previously allocated array of StoredType at index specified; metadata must be specified at allocation*

- **template<typename StoredType> void array_insert** (const StrStrSizet &iterator_id, const std::string &data_name, size_t index, StringMultiArrayConstView sent_data)
  
  *specialization: insert a SMACV into a previously allocated array of StringArrayStoredType at index specified; metadata must be specified at allocation*

Public Attributes

- **ResultsNames results_names**
  
  *Copy of valid results names for when manager is passed around.*
Private Member Functions

- template<typename StoredType >
  StoredType core_lookup (const StrStrSizet &iterator_id, const std::string &data_name) const
  retrieve in-core entry given by id and name

- template<typename StoredType >
  StoredType * core_lookup_ptr (const StrStrSizet &iterator_id, const std::string &data_name) const
  retrieve data via pointer to avoid copy; work-around for Boost any use of pointer (could use utilib::Any)

- template<typename StoredType >
  StoredType core_lookup (const StrStrSizet &iterator_id, const std::string &data_name, size_t index) const
  retrieve data from in-core array of StoredType at given index

- template<typename StoredType >
  const StoredType * core_lookup_ptr (const StrStrSizet &iterator_id, const std::string &data_name, size_t index) const
  retrieve data via pointer to entry in in-core array

- template<typename StoredType >
  void file_lookup (StoredType &db_data, const StrStrSizet &iterator_id, const std::string &data_name) const
  retrieve requested data into provided db_data StoredType

Private Attributes

- bool coreDBActive
  whether the in-core database is active

- std::string coreDBFilename
  filename for the in-core database

- bool hdf5DBActive
  whether the file database is active

- boost::scoped_ptr<ResultsDBAny> coreDB
  In-core database, with option to flush to file at end.

- boost::shared_ptr<ResultsDBHDF5> hdf5DB
  File-based database; using shared_ptr due to potentially incomplete type and requirements for checked_delete in debug builds.

Friends

- template<typename StoredType >
  class ResultsEntry
  
  ResultsEntry is a friend of ResultsManager.

13.164.1 Detailed Description

Results manager for iterator final data.

The results manager provides the API for posting and retrieving iterator results data (and eventually run config/statistics). It can manage a set of underlying results databases, in or out of core, depending on configuration.

The key for a results entry is documented in results_types.hpp, e.g., tuple<std::string, std::string, size_t, std::string>
For now, using concrete types for most insertion, since underlying databases like HDF5 might need concrete
types; though template parameter for array allocation and retrieval.
All insertions overwrite any previous data.
The documentation for this class was generated from the following files:

- ResultsManager.hpp
- ResultsManager.cpp

13.165 ResultsNames Class Reference

List of valid names for iterator results.

Public Member Functions

- ResultsNames ()

  Default constructor initializes all valid names.

Public Attributes

- size_t namesVersion
- std::string best_cv
- std::string best_div
- std::string best_dsv
- std::string best_drv
- std::string best_fns
- std::string moments_std
- std::string moments_central
- std::string moments_std_num
- std::string moments_central_num
- std::string moments_std_exp
- std::string moments_central_exp
- std::string moment_cis
- std::string extreme_values
- std::string mapRespProb
- std::string mapRespRel
- std::string map_prob_resp
- std::string mapRelResp
- std::string mapGenrelResp
- std::string pdfHistgrams
- std::string correl_simple_all
- std::string correl_simple_io
- std::string correlPartialIo
- std::string correlSimpleRankAll
- std::string correlSimpleRankIo
- std::string correlPartialRankIo
- std::string pce_coeffs
13.165.1 Detailed Description

List of valid names for iterator results.

All data in the ResultsNames class is public, basically just a struct
The documentation for this class was generated from the following file:

- ResultsManager.hpp

13.166 RichExtrapVerification Class Reference

Class for Richardson extrapolation for code and solution verification.

Inheritance diagram for RichExtrapVerification:

```
            Iterator
            /   \
         Analyzer   \\
                /    \
           Verification
                /     \\
            RichExtrapVerification
```

Public Member Functions

- **RichExtrapVerification** (ProblemDescDB &problem_db, Model &model)
  
  *constructor*

- **~RichExtrapVerification** ()
  
  *destructor*

- void **core_run** ()
  
  *core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post*

- void **print_results** (std::ostream &s)
  
  *print the final iterator results*

Private Member Functions

- void **estimate_order** ()
  
  *perform a single estimation of convOrder using extrapolation()*

- void **converge_order** ()

- std::string **pce_coeff_labels**

- std::string **cv_labels**

- std::string **div_labels**

- std::string **dsv_labels**

- std::string **drv_labels**

- std::string **fn_labels**
iterate using extrapolation() until convOrder stabilizes

• void converge_qoi()
  iterate using extrapolation() until QOIs stabilize

• void extrapolation(const RealVector &refine_triple, RealMatrix &qoi_triples)
  estimate convOrder from refinement and quantity of interest (QOI) triples

• void extrapolate_result(const RealVector &refine_triple, const RealMatrix &qoi_triples)
  predict the converged value based on the convergence rate and the value of Phi

Private Attributes

• unsigned short studyType
  internal code for extrapolation study type: SUBMETHOD_{CONVERGE_ORDER,CONVERGE_QOI,ESTIMATE_ORDER}

• size_t numFactors
  number of refinement factors defined from active state variables

• RealVector initialCVars
  initial reference values for refinement factors

• size_t factorIndex
  the index of the active factor

• Real refinementRate
  rate of mesh refinement (default = 2.)

• RealMatrix convOrder
  the orders of convergence of the QOIs (numFunctions by numFactors)

• RealMatrix extrapQOI
  the extrapolated value of the QOI (numFunctions by numFactors)

• RealMatrix numErrorQOI
  the numerical uncertainty associated with level of refinement (numFunctions by numFactors)

• RealVector refinementRefPt
  This is a reference point reported for the converged extrapQOI and numErrorQOI. It currently corresponds to the coarsest mesh in the final refinement triple.

Additional Inherited Members

13.166.1 Detailed Description

Class for Richardson extrapolation for code and solution verification.

The RichExtrapVerification class contains several algorithms for performing Richardson extrapolation.

13.166.2 Member Function Documentation

void core_run() [virtual]

core portion of run; implemented by all derived classes and may include pre/post steps in lieu of separate pre/post
Virtual run function for the iterator class hierarchy. All derived classes need to redefine it.
Reimplemented from Iterator.
References Dakota::abort_handler(), Model::continuous_variables(), RichExtrapVerification::converge_order(),
RichExtrapVerification::converge_qoi(), RichExtrapVerification::convOrder, RichExtrapVerification::estimate_order(),
RichExtrapVerification::extrapQOI, RichExtrapVerification::initialCVars, Iterator::iteratedModel, RichExtrapVerification::numErrorQOI, RichExtrapVerification::numFactors, Analyzer::numFunctions, Iterator::outputLevel, RichExtrapVerification::refinementRefPt, and RichExtrapVerification::studyType.

void print_results ( std::ostream & s ) [virtual]
print the final iterator results
This virtual function provides additional iterator-specific final results outputs beyond the function evaluation summary printed in finalize_run().
Reimplemented from Verification.
References Model::continuous_variable_labels(), RichExtrapVerification::convOrder, Dakota::copy_data(), RichExtrapVerification::extrapQOI, Iterator::iteratedModel, RichExtrapVerification::numErrorQOI, Verification::print_results(), RichExtrapVerification::refinementRate, RichExtrapVerification::refinementRefPt, and Model::response_labels().

void estimate_order( ) [private]
perform a single estimation of convOrder using extrapolation()
This algorithm executes a single refinement triple and returns convergence order estimates.
Referenced by RichExtrapVerification::core_run().

void converge_order( ) [private]
iterate using extrapolation() until convOrder stabilizes
This algorithm continues to refine until the convergence order estimate converges.
Referenced by RichExtrapVerification::core_run().

void converge_qoi( ) [private]
iterate using extrapolation() until QOIs stabilize
This algorithm continues to refine until the discretization error lies within a prescribed tolerance.
Referenced by RichExtrapVerification::core_run().
The documentation for this class was generated from the following files:

- RichExtrapVerification.hpp
- RichExtrapVerification.cpp
13.167 ScalingModel Class Reference

Scaling specialization of RecastModel.

Inheritance diagram for ScalingModel:

- Model
  - RecastModel
    - ScalingModel

### Public Member Functions

- **ScalingModel (Model &sub_model)**
  - Standard constructor
- **~ScalingModel ()**
  - Destructor
- **RealVector cv_scaled2native (const RealVector &scaled_cv) const**

### Public members for help in final results recovery

- void **resp_scaled2native (const Variables &native_vars, Response &updatedResp) const**
  - Map responses from scaled to native space, updating provided Response in-place (on entry it’s scaled response, on exit it’s native)
- void **secondary_resp_scaled2native (const RealVector &scaled_nln_cons, const ShortArray &asv, RealVector &native_fns) const**
  - Use scaled nonlinear constraints (sized total functions) to update the nonlinear constraints portion of the passed native_fns array.

### Protected Member Functions

- void **initialize_scaling (Model &sub_model)**
  - Initialize scaling types, multipliers, and offsets; perform error checking
- void **compute_scaling (int object_type, int auto_type, int num_vars, RealVector &lbs, RealVector &ubs, RealVector &targets, const StringArray &scale_strings, const RealVector &scales, IntArray &scale_types, RealVector &scale_mults, RealVector &scale_offsets)**
  - General helper function for initializing scaling types and factors on a vector of variables, functions, constraints, etc.
- RealMatrix **lin_coeffs_modify_n2s (const RealMatrix &native_coeffs, const RealVector &cv_multipliers, const RealVector &lin_multipliers) const**
  - General linear coefficients mapping from native to scaled space
- bool **compute_scale_factor (const Real lower_bound, const Real upper_bound, Real *multiplier, Real *offset)**
  - Automatically compute a single scaling factor – bounds case
- bool **compute_scale_factor (const Real target, Real *multiplier)**
  - Automatically compute a single scaling factor – target case
• void print_scaling (const String &info, const IntArray &scale_types, const RealVector &scale_mults, const RealVector &scale_offsets, const StringArray &labels)

  print scaling information for a particular response type in tabular form

• bool need_resp_trans_byvars (const ShortArray &asv, int start_index, int numResp) const

  determine if response transformation is needed due to variable transformations

• RealVector modify_n2s (const RealVector &native_vars, const IntArray &scale_types, const RealVector &multipliers, const RealVector &offsets) const

  general RealVector mapping from native to scaled variables vectors:

• RealVector modify_s2n (const RealVector &scaled_vars, const IntArray &scale_types, const RealVector &multipliers, const RealVector &offsets) const

  general RealVector mapping from scaled to native variables (and values)

• void response_modify_n2s (const Variables &scaled_vars, const Response &native_response, Response &scaled_response, int start_offset, int numResponses) const

  map responses from native to scaled variable space

• void response_modify_s2n (const Variables &native_vars, const Response &scaled_response, Response &native_response, int start_offset, int numResponses) const

  map responses from scaled to native space

Static Protected Member Functions

• static short response_order (const Model &sub_model)

  helper to compute the recast response order during member initialization

• static bool scaling_active (const StringArray &scale_types)

  check whether the passed scale strings include any active (≠ none) scale types

• static void variables_scaler (const Variables &scaled_vars, Variables &native_vars)

  RecastModel callback for variables scaling: transform variables from scaled to native (user) space.

• static void variables_unscaler (const Variables &native_vars, Variables &scaled_vars)

  RecastModel callback for inverse variables scaling: transform variables from native (user) to scaled space.

• static void primary_respscaler (const Variables &native_vars, const Variables &scaled_vars, const Response &native_response, Response &iterator_response)

  RecastModel callback for primary response scaling: transform responses (grads, Hessians) from native (user) to scaled space.

• static void secondary_respscaler (const Variables &native_vars, const Variables &scaled_vars, const Response &native_response, Response &scaled_response)

  RecastModel callback for secondary response scaling: transform constraints (grads, Hessians) from native (user) to scaled space.

Protected Attributes

• bool varsScaleFlag

  flag for variables scaling

• bool primaryRespScaleFlag

  flag for primary response scaling

• bool secondaryRespScaleFlag

  flag for secondary response scaling
• IntArray cvScaleTypes
  scale flags for continuous vars.
• RealVector cvScaleMultipliers
  scales for continuous variables
• RealVector cvScaleOffsets
  offsets for continuous variables
• IntArray responseScaleTypes
  scale flags for all responses
• RealVector responseScaleMultipliers
  scales for all responses
• RealVector responseScaleOffsets
  offsets for all responses (zero < for functions, not for nonlin con)
• IntArray linearIneqScaleTypes
  scale flags for linear ineq
• RealVector linearIneqScaleMultipliers
  scales for linear ineq constrs.
• RealVector linearIneqScaleOffsets
  offsets for linear ineq constrs.
• IntArray linearEqScaleTypes
  scale flags for linear eq.
• RealVector linearEqScaleMultipliers
  scales for linear constraints
• RealVector linearEqScaleOffsets
  offsets for linear constraints

Static Protected Attributes
• static ScalingModel * scaleModelInstance
  static pointer to this class for use in static callbacks

13.167.1 Detailed Description
Scaling specialization of RecastModel.

Specialization of RecastModel to scale Variables and/or Responses This class provides a simple constructor
that forwards to the more complicated RecastModel API

13.167.2 Constructor & Destructor Documentation
ScalingModel ( Model & sub_model )

standard constructor
This constructor computes various indices and mappings, then updates the properties of the RecastModel
References Model::cv(), ScalingModel::cvScaleTypes, Model::div(), Model::drv(), Model::dsv(), RecastModel::
::init_maps(), ScalingModel::initialize_scaling(), RecastModel::inverse_mappings(), Model::num_functions(), Model::
::num_primary_fns(), Model::outputLevel, ScalingModel::primary_resp_scaler(), Model::primary_response_fn_sense(),
CHAPTER 13. CLASS DOCUMENTATION

Model::primary_response_fn_weights(), ScalingModel::primaryRespScaleFlag, ScalingModel::responseScaleTypes, ScalingModel::scaleModelInstance, ScalingModel::secondary_resp_scaler(), ScalingModel::secondaryRespScaleFlag, ScalingModel::variables_scaler(), ScalingModel::variables_unscaler(), and ScalingModel::varsScaleFlag.

13.167.3 Member Function Documentation

RealVector cv_scaled2native ( const RealVector & scaled_cv ) const

Public members for help in final results recovery

recover native variable values from the scaled space

Since this convenience function is public, it must have a fall-through to return a copy for when this scaling type isn’t active.

References ScalingModel::cvScaleMultipliers, ScalingModel::cvScaleOffsets, ScalingModel::cvScaleTypes, ScalingModel::modify_s2n(), and ScalingModel::varsScaleFlag.

Referenced by LeastSq::post_run(), and Optimizer::post_run().

void resp_scaled2native ( const Variables & native_vars, Response & updated_resp ) const

map responses from scaled to native space, updating provided Response in-place (on entry it’s scaled response, on exit it’s native)

Since this convenience function is public, it must behave correctly when this scale type isn’t active. It does, because it modifies in-place

References Response::active_set_request_vector(), Response::copy(), ScalingModel::needResp_trans_byvars(), Model::num_nonlinear_eq_constraints(), Model::num_nonlinear_ineq_constraints(), Model::num_primary_fns(), ScalingModel::primaryRespScaleFlag, ScalingModel::response_modify_s2n(), ScalingModel::secondaryRespScaleFlag, and Response::update_partial().

Referenced by LeastSq::post_run(), and Optimizer::post_run().

void secondary_resp_scaled2native ( const RealVector & scaled_nln_cons, const ShortArray & asv, RealVector & native_fns ) const

Use scaled nonlinear constraints (sized total functions) to update the nonlinear constraints portion of the passed native_fns array.

Since this convenience function is public, it must have a fall-through to return a copy for when this scaling type isn’t active.

References Dakota::copy_data_partial(), ScalingModel::modify_s2n(), ScalingModel::needResp_trans_byvars(), Model::num_functions(), Model::num_nonlinear_eq_constraints(), Model::num_nonlinear_ineq_constraints(), Model::num_primary_fns(), ScalingModel::responseScaleMultipliers, ScalingModel::responseScaleOffsets, ScalingModel::responseScaleTypes, and ScalingModel::secondaryRespScaleFlag.

void initialize_scaling ( Model & sub_model ) [protected]

initialize scaling types, multipliers, and offsets; perform error checking

Initialize scaling types, multipliers, and offsets. Update the iteratedModel appropriately

References Dakota::abort_handler(), ScalingModel::compute_scaling(), Model::continuous_lower_bounds(), Model::continuous_upper_bounds(), Model::continuous_variable_labels(), Model::continuous_variables(), Dakota::copy_data(), Model::cv(), ScalingModel::cvScaleMultipliers, ScalingModel::cvScaleOffsets, ScalingModel::cvScaleTypes, ScalingModel::lin_coeffs_modify_n2s(), Model::linear_eq_constraint_coeffs(), Model::linear_eq_constraint_targets(), Model::linear_ineq_constraint_coeffs(), Model::linear_ineq_constraint_lower_bounds(), Model::linear_ineq_constraint_upper_bounds(), ScalingModel::linearEqScaleMultipliers, ScalingModel::linearEqScaleOffsets,
ScalingModel::linearEqScaleTypes, ScalingModel::linearIneqScaleMultipliers, ScalingModel::linearIneqScaleOffsets, ScalingModel::linearIneqScaleTypes, ScalingModel::modify_n2s(), Model::nonlinear_eq_constraint_targets(), Model::nonlinear_ineq_constraint_lower_bounds(), Model::nonlinear_ineq_constraint_upper_bounds(), Model::num_functions(), Model::num_linear_eq_constraints(), Model::num_linear_ineq_constraints(), Model::num_nonlinear_eq_constraints(), Model::num_nonlinear_ineq_constraints(), Model::num_primary_fns(), Model::primaryRespScaleFlag, ScalingModel::primaryRespScaleFlag, Model::print_scaling(), Model::primaryRespScaleFlag, ScalingModel::respScaleOffsets, ScalingModel::respScaleTypes, ScalingModel::scaling_active(), Model::scalingOpts, ScalingModel::secondaryRespScaleFlag, Model::supports_derivative_estimation(), and ScalingModel::varsScaleFlag.
   Referenced by ScalingModel::ScalingModel().

RealMatrix lin_coeffs_modify_n2s ( const RealMatrix & src_coeffs, const RealVector & cv_multipliers, const RealVector & lin_multipliers ) const [protected]
   general linear coefficients mapping from native to scaled space
   compute scaled linear constraint matrix given design variable multipliers and linear scaling multipliers. Only scales components corresponding to continuous variables so for src_coeffs of size MxN, lin_multipliers.size() <= M, cv_multipliers.size() <= N
   Referenced by ScalingModel::initialize_scaling().

void variables_scaler ( const Variables & scaled_vars, Variables & native_vars ) [static], [protected]
   RecastModel callback for variables scaling: transform variables from scaled to native (user) space.
   Variables map from iterator/scaled space to user/native space using a RecastModel.
   References Variables::continuous_variable_labels(), Variables::continuous_variables(), ScalingModel::cvScaleMultipliers, ScalingModel::cvScaleOffsets, ScalingModel::cvScaleTypes, ScalingModel::modify_s2n(), Model::outputLevel, and ScalingModel::scaleModelInstance.
   Referenced by ScalingModel::ScalingModel().

void secondaryRespScaler ( const Variables & native_vars, const Variables & scaled_vars, const Response & native_response, Response & iterator_response ) [static], [protected]
   RecastModel callback for secondary response scaling: transform constraints (grads, Hessians) from native (user) to scaled space.
   Constraint function map from user/native space to iterator/scaled/combined space using a RecastModel.
   References Response::active_set_request_vector(), ScalingModel::needRespTransByVar(), Model::num_nonlinear_eq_constraints(), Model::num_nonlinear_ineq_constraints(), Model::num_primary_fns(), Model::outputLevel, ScalingModel::responseModify_n2s(), ScalingModel::scaleModelInstance, ScalingModel::secondaryRespScaleFlag, and Response::update_partial().
   Referenced by ScalingModel::ScalingModel().

bool needRespTransByvars ( const ShortArray & asv, int start_index, int num_resp ) const [protected]
   determine if response transformation is needed due to variable transformations
   Determine if variable transformations present and derivatives requested, which implies a response transformation is necessary
   References ScalingModel::varsScaleFlag.
   Referenced by ScalingModel::primaryRespScaler(), ScalingModel::resp_scaled2native(), ScalingModel::secondaryResp_scaled2native(), and ScalingModel::secondaryRespScaler().
RealVector modify_n2s ( const RealVector & native_vars, const IntArray & scale_types, const RealVector & multipliers, const RealVector & offsets ) const [protected]

general RealVector mapping from native to scaled variables vectors:
    general RealVector mapping from native to scaled variables; loosely, in greatest generality: scaled_var = log((native_var - offset) / multiplier)

Referenced by ScalingModel::initialize_scaling(), and ScalingModel::variables_unscaler().

RealVector modify_s2n ( const RealVector & scaled_vars, const IntArray & scale_types, const RealVector & multipliers, const RealVector & offsets ) const [protected]

general RealVector mapping from scaled to native variables (and values)
    general RealVector mapping from scaled to native variables and/or vals; loosely, in greatest generality: scaled_var = (LOG_BASE^scaled_var) * multiplier + offset

Referenced by ScalingModel::cv_scaled2native(), ScalingModel::secondary_resp_scaled2native(), and ScalingModel::variables_scaler().

void response_modify_n2s ( const Variables & native_vars, const Response & native_response, Response & recast_response, int start_offset, int num_responses ) const [protected]

map responses from native to scaled variable space
    Scaling response mapping: modifies response from a model (user/native) for use in iterators (scaled). Maps num_responses starting at response_offset

References Response::active_set(), Variables::acv(), Variables::all_continuous_variable_ids(), Variables::all_continuous_variables(), Variables::continuous_variable_ids(), Variables::continuous_variables(), Dakota::copy_data(), Variables::cv(), ScalingModel::cvScaleMultipliers, ScalingModel::cvScaleOffsets, ScalingModel::cvScaleTypes, ActiveSet::derivative_vector(), Dakota::find_index(), Response::function_gradient_view(), Response::function_gradients(), Response::function_hessian_view(), Response::function_hessians(), Response::function_labels(), Response::function_value(), Response::function_values(), Variables::icv(), Variables::inactive_continuous_variable_ids(), Variables::inactive_continuous_variables(), Model::num_primary_fns(), Model::outputLevel, ActiveSet::request_vector(), ScalingModel::responseScaleMultipliers, ScalingModel::responseScaleOffsets, ScalingModel::responseScaleTypes, and Dakota::write_precision.

Referenced by ScalingModel::primary_resp_scaler(), and ScalingModel::secondary_resp_scaler().

void response_modify_s2n ( const Variables & native_vars, const Response & scaled_response, Response & native_response, int start_offset, int num_responses ) const [protected]

map responses from scaled to native space
    Unscaling response mapping: modifies response from scaled (iterator) to native (user) space. Maps num_responses starting at response_offset

References Response::active_set(), Variables::acv(), Variables::all_continuous_variable_ids(), Variables::all_continuous_variables(), Variables::continuous_variable_ids(), Variables::continuous_variables(), Dakota::copy_data(), Variables::cv(), ScalingModel::cvScaleMultipliers, ScalingModel::cvScaleOffsets, ScalingModel::cvScaleTypes, ActiveSet::derivative_vector(), Dakota::find_index(), Response::function_gradient_view(), Response::function_gradients(), Response::function_hessian_view(), Response::function_hessians(), Response::function_labels(), Response::function_value(), Response::function_values(), Variables::icv(), Variables::inactive_continuous_variable_ids(), Variables::inactive_continuous_variables(), Model::num_primary_fns(), Model::outputLevel, ActiveSet::request_vector(), ScalingModel::responseScaleMultipliers, ScalingModel::responseScaleOffsets, ScalingModel::responseScaleTypes, and Dakota::write_precision.

Referenced by ScalingModel::resp_scaled2native().
13.168 SCALINGOPTIONS CLASS REFERENCE

13.167.4 Member Data Documentation

ScalingModel * scaleModelInstance  [static],[protected]

static pointer to this class for use in static callbacks
initialization of static needed by RecastModel
Referred by ScalingModel::primary_resp_scaler(), ScalingModel::ScalingModel(), ScalingModel::secondary_resp_scaler(), ScalingModel::variables_scaler(), and ScalingModel::variables_unscaler().

The documentation for this class was generated from the following files:

- ScalingModel.hpp
- ScalingModel.cpp

13.168 ScalingOptions Class Reference

Simple container for user-provided scaling data, possibly expanded by replicates through the models.

Public Member Functions

- ScalingOptions ()
  default ctor: no scaling specified
- ScalingOptions (const StringArray &cv_st, RealVector cv_s, const StringArray &pri_st, RealVector pri_s, const StringArray &nln_ineq_st, RealVector nln_ineq_s, const StringArray &nln_eq_st, RealVector nln_eq_s, const StringArray &lin_ineq_st, RealVector lin_ineq_s, const StringArray &lin_eq_st, RealVector lin_eq_s)
  standard ctor: scaling from problem DB

Public Attributes

- StringArray cvScaleTypes
- RealVector cvScales
- StringArray priScaleTypes
- RealVector priScales
- StringArray nlnIneqScaleTypes
- RealVector nlnIneqScales
- StringArray nlnEqScaleTypes
- RealVector nlnEqScales
- StringArray linIneqScaleTypes
- RealVector linIneqScales
- StringArray linEqScaleTypes
- RealVector linEqScales

13.168.1 Detailed Description

Simple container for user-provided scaling data, possibly expanded by replicates through the models.

The documentation for this class was generated from the following file:

- DakotaModel.hpp
## 13.169 ScilabInterface Class Reference

Inheritance diagram for ScilabInterface:

```
  Interface
   |
   V
ApplicationInterface
   |
   V
DirectApplicInterface
   |
   V
ScilabInterface
```

### Public Member Functions

- **ScilabInterface** (const ProblemDescDB &problem_db)
  
  *Constructor*: start Matlab engine.

- **~ScilabInterface** ()
  
  *Destructor*: close Matlab engine.

### Protected Member Functions

- virtual int **derived_map_ac** (const String &ac_name)
  
  *execute an analysis code portion of a direct evaluation invocation*

- int **scilab_engine_run** (const String &ac_name)
  
  *principal Scilab execute function*

### Protected Attributes

- int **scilabEngine**
  
  *identifier for the running Scilab engine*

### 13.169.1 Detailed Description

Specialization of **DirectApplicInterface** to link to Scilab analysis drivers. Includes convenience functions to map data to/from Scilab.

The documentation for this class was generated from the following files:

- ScilabInterface.hpp
- ScilabInterface.cpp

## 13.170 SensAnalysisGlobal Class Reference

Class for a utility class containing correlation calculations and variance-based decomposition.
Public Member Functions

- **SensAnalysisGlobal ()**  
  constructor
- **∼SensAnalysisGlobal ()**  
  destructor
- **void compute_correlations (const VariablesArray &vars_samples, const IntResponseMap &resp_samples, const StringSetArray &dss_vals)**  
  computes four correlation matrices for input and output data simple, partial, simple rank, and partial rank
- **void compute_correlations (const RealMatrix &vars_samples, const IntResponseMap &resp_samples)**  
  computes four correlation matrices for input and output data simple, partial, simple rank, and partial rank
- **void archive_correlations (const StrStrSizet &run_identifier, ResultsManager &iterator_results, StringMultiArrayConstView cv_labels, StringMultiArrayConstView div_labels, StringMultiArrayConstView dsv_labels, StringMultiArrayConstView drv_labels, const StringArray &resp_labels) const**  
  save correlations to database
- **bool correlations_computed () const**  
  returns corrComputed to indicate whether compute_correlations() has been invoked
- **void print_correlations (std::ostream &s, StringMultiArrayConstView cv_labels, StringMultiArrayConstView div_labels, StringMultiArrayConstView dsv_labels, StringMultiArrayConstView drv_labels, const StringArray &resp_labels) const**  
  prints the correlations computed in compute_correlations()

Private Member Functions

- **size_t find_valid_samples (const IntResponseMap &resp_samples, BoolDeque &valid_sample)**  
  find samples with finite response (any sample with any Nan or +/-Inf observation will be dropped)
- **void valid_sample_matrix (const VariablesArray &vars_samples, const IntResponseMap &resp_samples, const StringSetArray &dss_vals, const BoolDeque is_valid_sample, RealMatrix &valid_data)**  
  extract a compact valid sample (vars/resp) matrix from the passed data
- **void valid_sample_matrix (const RealMatrix &vars_samples, const IntResponseMap &resp_samples, const BoolDeque is_valid_sample, RealMatrix &valid_samples)**  
  extract a compact valid sample (vars/resp) matrix from the passed data
- **void values_to_ranks (RealMatrix &valid_data)**  
  replace sample values with their ranks, in-place
- **void center_rows (RealMatrix &data_matrix)**  
  center the passed matrix by its mean, in-place
- **void correl_adjust (Real &corr_value)**  
  if result was NaN/Inf, preserve it, otherwise truncate to [-1.0, 1.0]
- **void simple_corr (RealMatrix &total_data, const int &num_in, RealMatrix &corr_matrix)**  
  computes simple correlations, populating corr_matrix
- **void partial_corr (RealMatrix &total_data, const int num_in, const RealMatrix &simple_corr_mat, RealMatrix &corr_matrix, bool &numerical_issues)**  
  computes partial correlations, populating corr_matrix and numerical_issues
Static Private Member Functions

- static bool rank_sort (const int &x, const int &y)
  sort algorithm to compute ranks for rank correlations

Private Attributes

- RealMatrix simpleCorr
  matrix to hold simple raw correlations
- RealMatrix simpleRankCorr
  matrix to hold simple rank correlations
- RealMatrix partialCorr
  matrix to hold partial raw correlations
- RealMatrix partialRankCorr
  matrix to hold partial rank correlations
- size_t numFns
  number of responses
- size_t numVars
  number of inputs
- bool numericalIssuesRaw
  flag indicating numerical issues in partial raw correlation calculations
- bool numericalIssuesRank
  flag indicating numerical issues in partial rank correlation calculations
- bool corrComputed
  flag indicating whether correlations have been computed

Static Private Attributes

- static RealArray rawData = RealArray()
  array to hold temporary data before sort

13.170.1 Detailed Description

Class for a utility class containing correlation calculations and variance-based decomposition. This class provides code for several of the sampling methods both in the NonD branch and in the PStudyD-ACE branch. Currently, the utility functions provide global sensitivity analysis through correlation calculations (e.g. simple, partial, rank, raw) as well as variance-based decomposition.

13.170.2 Member Function Documentation

void compute_correlations (const VariablesArray &vars_samples, const IntResponseMap &resp_samples, const StringSetArray &dss_vals)

computes four correlation matrices for input and output data simple, partial, simple rank, and partial rank

This version is used when full variables objects are being processed. Calculates simple correlation, partial correlation, simple rank correlation, and partial rank correlation coefficients.
References Dakota::abort_handler(), SensAnalysisGlobal::corrComputed, SensAnalysisGlobal::find_valid_samples(), SensAnalysisGlobal::numericalIssuesRank, SensAnalysisGlobal::numericalIssuesRaw, SensAnalysisGlobal::numFns, SensAnalysisGlobal::numVars, SensAnalysisGlobal::partial_corr(), SensAnalysisGlobal::partialRankCorr, SensAnalysisGlobal::simple_corr(), SensAnalysisGlobal::simpleRankCorr, SensAnalysisGlobal::simpleCorr, SensAnalysisGlobal::valid_sample_matrix(), and SensAnalysisGlobal::values_to_ranks().

Referenced by NonDSampling::compute_statistics(), ParamStudy::post_run(), FSUDesignCompExp::post_run(), and DDACEDesignCompExp::post_run().

```cpp
void compute_correlations ( const RealMatrix & vars_samples, const IntResponseMap & resp_samples )
```

computes four correlation matrices for input and output data simple, partial, simple rank, and partial rank

This version is used when compact samples matrix is being processed. Calculates simple correlation, partial correlation, simple rank correlation, and partial rank correlation coefficients.

```cpp
void values_to_ranks ( RealMatrix & valid_data ) [private]
```

replace sample values with their ranks, in-place

When converting values to ranks, uses the average ranks of any tied values

Referenced by SensAnalysisGlobal::compute_correlations().

```cpp
void simple_corr ( RealMatrix & total_data, const int & num_in, RealMatrix & corr_matrix ) [private]
```

computes simple correlations, populating corr_matrix

Calculates simple correlation coefficients from a matrix of data (oriented factors x observations):

- num_corr is number of rows of total data
- num_in indicates whether only pairs of correlations should be calculated between pairs of columns (num_in vs. num_corr-num_in); if num_in = num_corr, correlations are calculated between all columns

References SensAnalysisGlobal::center_rows(), and SensAnalysisGlobal::correl_adjust().

Referenced by SensAnalysisGlobal::compute_correlations().

```cpp
void partial_corr ( RealMatrix & total_data, const int num_in, const RealMatrix & simple_corr_mat, RealMatrix & corr_matrix, bool & numerical_issues ) [private]
```

computes partial correlations, populating corr_matrix and numerical_issues

Calculates partial correlation coefficients between num_in inputs and numRows() - num_in outputs.

References Dakota::abort_handler(), SensAnalysisGlobal::center_rows(), SensAnalysisGlobal::correl_adjust(), Dakota::qr(), Dakota::qr_rsolve(), and Dakota::svd().

Referenced by SensAnalysisGlobal::compute_correlations().

The documentation for this class was generated from the following files:

- SensAnalysisGlobal.hpp
- SensAnalysisGlobal.cpp
13.171 **SeqHybridMetaIterator Class Reference**

Method for sequential hybrid iteration using multiple optimization and nonlinear least squares methods on multiple models of varying fidelity.

Inheritance diagram for SeqHybridMetaIterator:

```
  Iterator
   |   
  -------
  MetaIterator
      |   
  -------
 SeqHybridMetaIterator
```

**Public Member Functions**

- `SeqHybridMetaIterator (ProblemDescDB &problem_db)`
  
  *standard constructor*

- `SeqHybridMetaIterator (ProblemDescDB &problem_db, Model &model)`

  *alternate constructor*

- `~SeqHybridMetaIterator ()`

  *destructor*

**Protected Member Functions**

- `void core_run ()`

  *Performs the hybrid iteration by executing a sequence of iterators, using a similar sequence of models that may vary in fidelity.*

- `void print_results (std::ostream &s)`

  *print the final iterator results*

- `void derived_init_communicators (ParLevLIter pl_iter)`

  *derived class contributions to initializing the communicators associated with this Iterator instance*

- `void derived_set_communicators (ParLevLIter pl_iter)`

  *derived class contributions to setting the communicators associated with this Iterator instance*

- `void derived_free_communicators (ParLevLIter pl_iter)`

  *derived class contributions to freeing the communicators associated with this Iterator instance*

- `IntIntPair estimate_partition_bounds ()`

  *estimate the minimum and maximum partition sizes that can be utilized by this Iterator*

- `const Variables & variables_results () const`

  *return the final solution from selectedIterators (variables)*

- `const Response & response_results () const`

  *return the final solution from selectedIterators (response)*

- `void initialize_iterator (int job_index)`

  *used by IteratorScheduler to set the starting data for a run*

- `void pack_parameters_buffer (MPIPackBuffer &send_buffer, int job_index)`
used by IteratorScheduler to pack starting data for an iterator run

- **void unpack_parameters_initialize (MPIUnpackBuffer &recv_buffer)**
  used by IteratorScheduler to unpack starting data and initialize an iterator run

- **void pack_results_buffer (MPIPackBuffer &send_buffer, int job_index)**
  used by IteratorScheduler to pack results data from an iterator run

- **void unpack_results_buffer (MPIUnpackBuffer &recv_buffer, int job_index)**
  used by IteratorScheduler to unpack results data from an iterator run

- **void update.local_results (int job_index)**
  used by IteratorScheduler to update local results arrays

### Private Member Functions

- **void run_sequential ()**
  run a sequential hybrid

- **void run_sequential_adaptive ()**
  run a sequential adaptive hybrid

- **void partition_sets (size_t num_sets, int job_index, size_t &start_index, size_t &job_size)**
  convert num_sets and job_index into a start_index and job_size for extraction from parameterSets

- **void extract_parameter_sets (int job_index, VariablesArray &partial_param_sets)**
  extract partial_param_sets from parameterSets based on job_index

- **void update.local_results (PRPArray &prp_results, int job_id)**
  update the partial set of final results from the local iterator execution

- **void initialize_iterator (const VariablesArray &param_sets)**
  called by unpack_parameters_initialize(MPIUnpackBuffer) and initialize_iterator(int) to update the active Model and Iterator

### Private Attributes

- **String seqHybridType**
  empty (default) or "adaptive"

- **StringArray methodList**
  the list of method name identifiers

- **bool lightwtCtor**
  use of lightweight Iterator construction by name

- **IteratorArray selectedIterators**
  the set of iterators, one for each entry in methodList

- **ModelArray selectedModels**
  the set of models, one for each iterator (if not lightweight construction)

- **size_t seqCount**
  hybrid sequence counter: 0 to numIterators-1

- **Real progressThreshold**
  when the progress metric falls below this threshold, the sequential adaptive hybrid switches to the next method

- **PRP2DArray prpResults**
  2-D array of results corresponding to numIteratorJobs, one set of results per job (iterators may return multiple final solutions)
VariablesArray parameterSets

1-D array of variable starting points for the iterator jobs

Friends

- class IteratorScheduler

  protect scheduler callback functions from general access

Additional Inherited Members

13.171.1 Detailed Description

Method for sequential hybrid iteration using multiple optimization and nonlinear least squares methods on multiple models of varying fidelity.

Sequential hybrid meta-iteration supports two approaches: (1) the non-adaptive sequential hybrid runs one method to completion, passes its best results as the starting point for a subsequent method, and continues this succession until all methods have been executed (the stopping rules are controlled internally by each iterator), and (2) the adaptive sequential hybrid uses adaptive stopping rules for the iterators that are controlled externally by this method. Any iterator may be used so long as it defines the notion of a final solution which can be passed as starting data for subsequent iterators.

13.171.2 Member Function Documentation

void print_results ( std::ostream & s ) [protected], [virtual]

print the final iterator results

This virtual function provides additional iterator-specific final results outputs beyond the function evaluation summary printed in finalize_run().

Reimplemented from Iterator.

References Response::function_values(), Response::is_null(), Variables::is_null(), MetaIterator::iterSched, IteratorScheduler::messagePass, and SeqHybridMetaIterator::prpResults.

void run_sequential( ) [private]

run a sequential hybrid

In the sequential nonadaptive case, there is no interference with the iterators. Each runs until its own convergence criteria is satisfied. Status: fully operational.

References Iterator::accepts_multiple_points(), ParallelLibrary::bcast(), ParallelLibrary::bcast hs(), Iterator::initialize_graphics(), Model::interface_id(), Iterator::iteratedModel, IteratorScheduler::iterator_message_lengths(), IteratorScheduler::iteratorCommRank, IteratorScheduler::iteratorCommSize, IteratorScheduler::iteratorScheduling, IteratorScheduler::iteratorServerId, MetaIterator::iterSched, SeqHybridMetaIterator::messagePass, SeqHybridMetaIterator::methodList, Iterator::methodPCIter, IteratorScheduler::miPLIndex, Iterator::num_final_solutions(), IteratorScheduler::numIteratorJobs, IteratorScheduler::numIteratorServers, SeqHybridMetaIterator::pack_parameters_buffer(), Iterator::parallelLib, SeqHybridMetaIterator::parametersSets, SeqHybridMetaIterator::prpResults, ParallelLibrary::recv(), Iterator::response_results(), IteratorScheduler::schedule_iterators(), SeqHybridMetaIterator::selectedIterators, SeqHybridMetaIterator::selectedModels, ParallelLibrary::send(), SeqHybridMetaIterator::seqCount, MPIPackBuffer::size(), Iterator::summaryOutputFlag, and Iterator::variables_results().

Referenced by SeqHybridMetaIterator::core_run().
void run_sequential_adaptive() [private]

run a sequential adaptive hybrid

In the sequential adaptive case, there is interference with the iterators through the use of the ++ overloaded operator. iterator++ runs the iterator for one cycle, after which a progress_metric is computed. This progress metric is used to dictate method switching instead of each iterator’s internal convergence criteria. Status: incomplete.

References Iterator::finalize_run(), Iterator::initialize_graphics(), Iterator::initialize_run(), IteratorScheduler::iteratorCommRank, IteratorScheduler::iteratorServerId, MetaIterator::iterSched, SeqHybridMetaIterator::methodList, IteratorScheduler::numIteratorServers, SeqHybridMetaIterator::progressThreshold, Iterator::response_results(), SeqHybridMetaIterator::selectedIterators, SeqHybridMetaIterator::selectedModels, SeqHybridMetaIterator::seqCount, Iterator::summaryOutputFlag, and Iterator::variables_results().

Referenced by SeqHybridMetaIterator::core_run().

void extract_parameter_sets(int job_index, VariablesArray &partial_param_sets) [inline], [private]

extract partial_param_sets from parameterSets based on job_index

This convenience function is executed on an iterator master (static scheduling) or a meta-iterator master (self scheduling) at run initialization time and has access to the full parameterSets array (this is All-Reduced for all peers at the completion of each cycle in run_sequential()).

References SeqHybridMetaIterator::parameterSets, and SeqHybridMetaIterator::partition_sets().

Referenced by SeqHybridMetaIterator::initialize_iterators(), and SeqHybridMetaIterator::pack_parameters_buffer().

The documentation for this class was generated from the following files:

- SeqHybridMetaIterator.hpp
- SeqHybridMetaIterator.cpp

13.172 SerialDirectApplicInterface Class Reference

Sample derived interface class for testing serial simulator plug-ins using assign_rep().

Inheritance diagram for SerialDirectApplicInterface:

```
  Interface
   |        |
   v        v
ApplicationInterface
   |        |        |
   v        v        v
DirectApplicInterface
   |        |        |        |
   v        v        v        v
SerialDirectApplicInterface
```

Public Member Functions

- **SerialDirectApplicInterface** (const Dakota::ProblemDescDB &problem_db)
  
  *constructor*

- **~SerialDirectApplicInterface** ()
  
  *destructor*
Protected Member Functions

- int derived_map_ac (const Dakota::String &ac_name)
  
  execute an analysis code portion of a direct evaluation invocation

- void derived_map_asynch (const Dakota::ParamResponsePair &pair)
  
  no-op hides base error; job batching occurs within wait_local_evaluations()

- void wait_local_evaluations (Dakota::PRPQueue &prp_queue)
  
  evaluate the batch of jobs contained in prp_queue

- void test_local_evaluations (Dakota::PRPQueue &prp_queue)
  
  invokes wait_local_evaluations() (no special nowait support)

- void set_communicators_checks (int max_eval_concurrency)
  
  no-op hides default run-time error checks at DirectApplicInterface level

Private Member Functions

- int rosenbrock (const Dakota::RealVector &c_vars, short asv, Dakota::Real &fn_val, Dakota::RealVector &fn_grad, Dakota::RealSymMatrix &fn_hess)

  Rosenbrock plug-in test function.

Additional Inherited Members

13.172.1 Detailed Description

Sample derived interface class for testing serial simulator plug-ins using assign_rep().

The plug-in SerialDirectApplicInterface resides in namespace SIM and uses a copy of rosenbrock() to perform serial parameter to response mappings. It is used to demonstrate plugging in a serial direct analysis driver into Dakota in library mode. Test input files can then use an analysis_driver of "plugin_rosenbrock".

13.172.2 Member Function Documentation

void test_local_evaluations ( Dakota::PRPQueue & prp_queue )  [inline], [protected]

invokes wait_local_evaluations() (no special nowait support)

For use by ApplicationInterface::serve_evaluations_asynch(), which can provide a batch processing capability within message passing schedulers (called using chain IteratorScheduler::run_iterator() –> Model::serve() –> ApplicationInterface::serve_evaluations() –> ApplicationInterface::serve_evaluations_asynch()).

References SerialDirectApplicInterface::serve_evaluations().

The documentation for this class was generated from the following files:

- PluginSerialDirectApplicInterface.hpp
- PluginSerialDirectApplicInterface.cpp

13.173 SharedApproxData Class Reference

Base class for the shared approximation data class hierarchy.

Inheritance diagram for SharedApproxData:
Public Member Functions

- `SharedApproxData ()`
  default constructor

- `SharedApproxData (ProblemDescDB &problem_db, size_t num_vars)`
  standard constructor for envelope

- `SharedApproxData (const String &approx_type, const UShortArray &approx_order, size_t num_vars, short data_order, short output_level)`
  alternate constructor for envelope

- `SharedApproxData (const SharedApproxData &approx)`
  copy constructor

- virtual `~SharedApproxData ()`
  destructor

- `SharedApproxData operator= (const SharedApproxData &approx)`
  assignment operator

- virtual void `build ()`
  builds the shared approximation data from scratch

- virtual void `rebuild ()`
  rebuilds the shared approximation data incrementally

- virtual void `pop (bool save_surr_data)`
  back out the previous increment to the shared approximation data

- virtual bool `push_available ()`
  queries availability of pushing data associated with a trial set

- virtual size_t `retrieval_index ()`
  return index of trial set within popped bookkeeping sets

- virtual void `pre_push ()`
  push a previous state of the shared approximation data

- virtual void `post_push ()`
  clean up popped bookkeeping following push

- virtual size_t `finalization_index (size_t i)`
  return index of i-th trailing trial set within restorable bookkeeping sets

- virtual void `pre_finalize ()`
  finalize the shared approximation data following a set of increments

- virtual void `post_finalize ()`
  clean up popped bookkeeping following aggregation

- virtual void `store (size_t index=NPOS)`
  store the current state of the shared approximation data for later combination (defaults to push_back)
virtual void restore (size_t index= _NPOS)
    restore a previous state of the shared approximation data (defaults to pop_back from stored)

virtual void remove_stored (size_t index=_NPOS)
    remove an instance of stored approximation data prior to combination (defaults to pop_back)

virtual size_t pre_combine (short corr_type)
    aggregate the shared approximation data from current and stored states

virtual void post_combine (short corr_type)
    clean up stored data sets after aggregation

void set_bounds (const RealVector &c_l_bnds, const RealVector &c_u_bnds, const IntVector &d_l_bnds, const IntVector &d_u_bnds, const RealVector &d_r_l_bnds, const RealVector &d_r_u_bnds)

set approximation lower and upper bounds (currently only used by graphics)

SharedApproxData * data_rep () const
    returns dataRep for access to derived class member functions that are not mapped to the top SharedApproxData level

Protected Member Functions

SharedApproxData (BaseConstructor, ProblemDescDB &problem_db, size_t num_vars)
    constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

SharedApproxData (NoDBBaseConstructor, const String &approx_type, size_t num_vars, short data_order, short output_level)
    constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

Protected Attributes

size_t numVars
    number of variables in the approximation

String approxType
    approximation type identifier

short buildDataOrder
    order of the data used for surrogate construction, in ActiveSet request vector 3-bit format.

short outputLevel
    output verbosity level: {SILENT,QUIET,NORMAL,VERBOSE,DEBUG},OUTPUT

String modelExportPrefix
    Prefix for model export files.

unsigned short modelExportFormat
    Bitmapped format request for exported models.

RealVector approxCLowerBnds
    approximation continuous lower bounds (used by 3D graphics and Surfpack KrigingModel)

RealVector approxCUpperBnds
    approximation continuous upper bounds (used by 3D graphics and Surfpack KrigingModel)

IntVector approxDLowerBnds
    approximation continuous lower bounds
13.173. SHAREDAPPROXDATA CLASS REFERENCE

• IntVector approxDIUpperBnds
  approximation continuous upper bounds
• RealVector approxDRLowerBnds
  approximation continuous lower bounds
• RealVector approxDRUpperBnds
  approximation continuous upper bounds

Private Member Functions

• SharedApproxData * get_shared_data (ProblemDescDB &problem_db, size_t num_vars)
  Used only by the standard envelope constructor to initialize dataRep to the appropriate derived type.
• SharedApproxData * get_shared_data (const String &approx_type, const UShortArray &approx_order, size_t num_vars, short data_order, short output_level)
  Used only by the alternate envelope constructor to initialize dataRep to the appropriate derived type.

Private Attributes

• SharedApproxData * dataRep
  pointer to the letter (initialized only for the envelope)
• int referenceCount
  number of objects sharing dataRep

Friends

• class Approximation
• class TaylorApproximation
• class TANA3Approximation
• class GaussProcApproximation
• class VPSApproximation
• class SurfpackApproximation
• class PecosApproximation

13.173.1 Detailed Description

Base class for the shared approximation data class hierarchy.

The SharedApproxData class is the base class for the shared approximation data class hierarchy in DAKOTA.
For memory efficiency and enhanced polymorphism, the approximation hierarchy employs the “letter/envelope
idiom” (see Coplien ”Advanced C++”, p. 133), for which the base class (SharedApproxData) serves as the
envelope and one of the derived classes (selected in SharedApproxData::get_shared_data()) serves as the letter.

13.173.2 Constructor & Destructor Documentation

SharedApproxData ()
default constructor

For the default constructor, dataRep is NULL. This makes it necessary to check for NULL in the copy con-
stuctor, assignment operator, and destructor.
  Referenced by SharedApproxData::get_shared_data().
SharedApproxData ( ProblemDescDB & problem_db, size_t num_vars )

standard constructor for envelope

Envelope constructor only needs to extract enough data to properly execute get_shared_data, since SharedApproxData/BaseConstructor, problem_db builds the actual base class data for the derived approximations.
References Dakota::abort_handler(), SharedApproxData::dataRep, and SharedApproxData::get_shared_data().

SharedApproxData ( const String & approx_type, const UShortArray & approx_order, size_t num_vars, short data_order, short output_level )

alternate constructor for envelope

This is the alternate envelope constructor for instantiations on the fly. Since it does not have access to problem_db, it utilizes the NoDBBaseConstructor constructor chain.
References Dakota::abort_handler(), SharedApproxData::dataRep, and SharedApproxData::get_shared_data().

SharedApproxData ( const SharedApproxData & shared_data )

copy constructor

Copy constructor manages sharing of dataRep and incrementing of referenceCount.
References SharedApproxData::dataRep, and SharedApproxData::referenceCount.

~SharedApproxData ( ) [virtual]

destructor

Destructor decrements referenceCount and only deletes dataRep when referenceCount reaches zero.
References SharedApproxData::dataRep, and SharedApproxData::referenceCount.

SharedApproxData ( BaseConstructor, ProblemDescDB & problem_db, size_t num_vars ) [protected]

constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

This constructor is the one which must build the base class data for all derived classes. get_shared_data() instantiates a derived class letter and the derived constructor selects this base class constructor in its initialization list (to avoid recursion in the base class constructor calling get_shared_data() again). Since the letter IS the representation, its rep pointer is set to NULL (an uninitialized pointer causes problems in ~SharedApproxData).
References SharedApproxData::approxType, SharedApproxData::buildDataOrder, ProblemDescDB::get_bool(), ProblemDescDB::get_db_model_node(), ProblemDescDB::get_string(), ProblemDescDB::set_db_model_nodes(), Dakota::strbegins(), and Dakota::strends().

SharedApproxData ( NoDBBaseConstructor, const String & approx_type, size_t num_vars, short data_order, short output_level ) [protected]

constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

This constructor is the one which must build the base class data for all derived classes. get_shared_data() instantiates a derived class letter and the derived constructor selects this base class constructor in its initialization list (to avoid recursion in the base class constructor calling get_shared_data() again). Since the letter IS the representation, its rep pointer is set to NULL (an uninitialized pointer causes problems in ~SharedApproxData).
References SharedApproxData::approxType, SharedApproxData::buildDataOrder, Dakota::strbegins(), and Dakota::strends().
13.173.3 Member Function Documentation

SharedApproxData operator= ( const SharedApproxData & shared_data )

assignment operator
  References SharedApproxData::dataRep, and SharedApproxData::referenceCount.

SharedApproxData * get_shared_data ( ProblemDescDB & problem_db, size_t num_vars ) [private]

Used only by the standard envelope constructor to initialize dataRep to the appropriate derived type.
  Used only by the envelope constructor to initialize dataRep to the appropriate derived type.
  References ProblemDescDB::get_string(), SharedApproxData::SharedApproxData(), and Dakota::strends().
  Referenced by SharedApproxData::SharedApproxData().

SharedApproxData * get_shared_data ( const String & approx_type, const UShortArray & approx_order, size_t num_vars, short data_order, short output_level ) [private]

Used only by the alternate envelope constructor to initialize dataRep to the appropriate derived type.
  Used only by the envelope constructor to initialize dataRep to the appropriate derived type.
  References SharedApproxData::SharedApproxData(), and Dakota::strends().

13.173.4 Member Data Documentation

short buildDataOrder [protected]

order of the data used for surrogate construction, in ActiveSet request vector 3-bit format.
  This setting distinguishes derivative data intended for use in construction (includes derivatives w.r.t. the build variables) from derivative data that may be approximated separately (excludes derivatives w.r.t. auxiliary variables). This setting should also not be inferred directly from the responses specification, since we may need gradient support for evaluating gradients at a single point (e.g., the center of a trust region), but not require gradient evaluations at every point.
  Referenced by SharedSurfpackApproxData::add_sd_to_surfdata(), TaylorApproximation::build(), TaylorApproximation::gradient(), TaylorApproximation::hessian(), TaylorApproximation::min_coefficients(), Approximation::min_points(), Approximation::recommended_points(), SharedApproxData::SharedApproxData(), SharedPecosApproxData::SharedPecosApproxData(), SurfpackApproximation::SurfpackApproximation(), SurfpackApproximation::surrogates_to_surf_data(), TANA3Approximation::TANA3Approximation(), and TaylorApproximation::value().
  The documentation for this class was generated from the following files:

• SharedApproxData.hpp
• SharedApproxData.cpp

13.174 SharedPecosApproxData Class Reference

Derived approximation class for global basis polynomials.
  Inheritance diagram for SharedPecosApproxData:
CHAPTER 13. CLASS DOCUMENTATION

Public Member Functions

- **SharedPecosApproxData ()**
  
  *default constructor*

- **SharedPecosApproxData (const String &approx_type, const UShortArray &approx_order, size_t num_vars, short data_order, short output_level)**
  
  *alternate constructor*

- **SharedPecosApproxData (ProblemDescDB &problem_db, size_t num_vars)**
  
  *standard ProblemDescDB-driven constructor*

- **~SharedPecosApproxData ()**
  
  *destructor*

- **void random_variables_key (const Pecos::BitArray &random_vars_key)**
  
  *set pecosBasisApprox.randomVarsKey*

- **void integration_iterator (const Iterator &iterator)**
  
  *set pecosBasisApprox.driverRep*

- **void construct_basis (const Pecos::ShortArray &u_types, const Pecos::AleatoryDistParams &adp)**
  
  *invoke Pecos::SharedOrthogPolyApproxData::construct_basis()*

- **void polynomial_basis (const std::vector<Pecos::BasisPolynomial>& poly_basis)**
  
  *set Pecos::SharedOrthogPolyApproxData::polynomialBasis*

- **const std::vector<Pecos::BasisPolynomial>& polynomial_basis () const**
  
  *get Pecos::SharedOrthogPolyApproxData::polynomialBasis*

- **std::vector<Pecos::BasisPolynomial>& polynomial_basis ()**
  
  *get Pecos::SharedOrthogPolyApproxData::polynomialBasis*

- **void allocate (const UShort2DArray &mi)**
  
  *set Pecos::SharedOrthogPolyApproxData::multiIndex and allocate associated arrays*

- **const UShort2DArray & multi_index () const**

- **const Pecos::BitArrayULONGMap & sobol_index_map () const**
  
  *return Pecos::SharedPolyApproxData::sobolIndexMap*

- **void coefficients_norms_flag (bool flag)**
  
  *invoke Pecos::SharedOrthogPolyApproxData::coefficients_norms_flag()*

- **size_t expansion_terms () const**
  
  *return Pecos::SharedOrthogPolyApproxData::expansion_terms()*

- **const UShortArray & expansion_order () const**
  
  *return Pecos::SharedOrthogPolyApproxData::expansion_order()*

- **void expansion_order (const UShortArray &order)**
invokes Pecos::SharedOrthogPolyApproxData::expansion_order(UShortArray&)

- void **increment_order**()
  invokes Pecos::SharedOrthogPolyApproxData::increment_order()

- void **configuration_options** (const Pecos::ExpansionConfigOptions &ec_options)
  set the expansion configuration options within Pecos::SharedPolyApproxData

- void **configuration_options** (const Pecos::BasisConfigOptions &bc_options)
  set the basis configuration options within Pecos::SharedPolyApproxData

- void **configuration_options** (const Pecos::RegressionConfigOptions &rc_options)
  set the regression configuration options within Pecos::SharedRegressOrthogPolyApproxData

**Protected Member Functions**

- void **build**()
  builds the shared approximation data from scratch

- void **rebuild**()
  rebuilds the shared approximation data incrementally

- void **pop** (bool save_surr_data)
  back out the previous increment to the shared approximation data

- bool **push_available**()
  queries availability of pushing data associated with a trial set

- size_t **retrieval_index**()
  return index of trial set within popped bookkeeping sets

- void **pre_push**()
  push a previous state of the shared approximation data

- void **post_push**()
  clean up popped bookkeeping following push

- size_t **finalization_index** (size_t i)
  return index of i-th trailing trial set within restorable bookkeeping sets

- void **pre_finalize**()
  finalize the shared approximation data following a set of increments

- void **post_finalize**()
  clean up popped bookkeeping following aggregation

- void **store** (size_t index=_NPOS)
  store the current state of the shared approximation data for later combination (defaults to push_back)

- void **restore** (size_t index=_NPOS)
  restore a previous state of the shared approximation data (defaults to pop_back from stored)

- void **remove_stored** (size_t index=_NPOS)
  remove an instance of stored approximation data prior to combination (defaults to pop_back)

- size_t **pre_combine** (short corr_type)
  aggregate the shared approximation data from current and stored states

- void **post_combine** (short corr_type)
  clean up stored data sets after aggregation
Private Member Functions

- Pecos::SharedBasisApproxData & pecos_shared_data ()
  
  return pecosSharedData

- void approx_type_to_basis_type (const String &approx_type, short &basis_type)
  
  utility to convert Dakota type string to Pecos type enumeration

Private Attributes

- Pecos::SharedBasisApproxData pecosSharedData
  the Pecos shared approximation data

- Pecos::SharedPolyApproxData * pecosSharedDataRep
  convenience pointer to derived letter within pecosSharedData

Friends

- class PecosApproximation

Additional Inherited Members

13.174.1 Detailed Description

Derived approximation class for global basis polynomials.

The SharedPecosApproxData class provides a global approximation based on basis polynomials. This includes orthogonal polynomials used for polynomial chaos expansions and interpolation polynomials used for stochastic collocation.

The documentation for this class was generated from the following files:

- SharedPecosApproxData.hpp
- SharedPecosApproxData.cpp

13.175 SharedResponseData Class Reference

Container class encapsulating variables data that can be shared among a set of Response instances.

Public Member Functions

- SharedResponseData ()
  
  default constructor

- SharedResponseData (const ProblemDescDB &problem_db)
  
  standard constructor

- SharedResponseData (const ActiveSet &set)
  
  alternate on-the-fly constructor (explicit disallows its use for implicit type conversion so that instantiations of Response(set) are invalid)

- SharedResponseData (const SharedResponseData &srdf)
  
  copy constructor

- ~SharedResponseData ()
  
  destructor
• `SharedResponseData & operator= (const SharedResponseData &srd)`
  
  assignment operator

• `bool operator== (const SharedResponseData &other)`

  experimental operator== for use in unit testing

• `size_t num_scalar_responses () const`
  
  number of scalar responses

• `size_t num_field_response_groups () const`
  
  number of field response groups

• `size_t num_response_groups () const`
  
  total number of response groups (scalars + field groups)

• `size_t num_field_functions () const`
  
  total number of field functions (1-norm of fieldRespGroupLengths)

• `size_t num_functions () const`
  
  total number of response functions (scalars + 1-norm of fieldRespGroupLengths)

• `const IntVector & field_lengths () const`
  
  index of field lengths for field data

• `void field_lengths (const IntVector &field_lengths)`
  
  set field lengths (if experiment different from simulation)

• `const IntVector & num_coords_per_field () const`
  
  dimensions of each function

• `const String & function_label (size_t i) const`
  
  return a response function identifier string

• `const StringArray & function_labels () const`
  
  return the response function identifier strings

• `StringArray & function_labels ()`
  
  return the response function identifier strings

• `void function_label (const String &label, size_t i)`
  
  set a response function identifier string

• `void function_labels (const StringArray &labels)`
  
  set the response function identifier strings

• `const StringArray & field_group_labels ()`
  
  return the coarse (per-group) field response labels

• `void field_group_labels (const StringArray &field_labels)`
  
  set the coarse field group labels (must agree with number fields)

• `const String & responses_id () const`
  
  return the response identifier

• `short response_type () const`
  
  return the response type: {BASE,SIMULATION,EXPERIMENT}_RESPONSE

• `void response_type (short type)`
  
  set the response type: {BASE,SIMULATION,EXPERIMENT}_RESPONSE

• `short primary_fn_type () const`
  
  get the primary function type (generic, objective, calibration)

• `void primary_fn_type (short type)`
set the primary function type (generic, objective, calibration)

- **SharedResponseData copy()** const
  
  create a deep copy of the current object and return by value

- **void reshape(size_t num_fns)**
  
  reshape the data, disconnecting a shared rep if necessary

- **bool is_null()** const
  
  return true if empty handle with null representation

- **long reference_count()** const
  
  how many handles (including this) are sharing this representation (body); for debugging/testing only

- **template<class Archive> void serialize(Archive &ar, const unsigned int version)**

Private Member Functions

- **template<class Archive> void serialize(Archive &ar, const unsigned int version)**
  
  serialize through the pointer, which requires object tracking; write and read are symmetric for this class

Private Attributes

- **boost::shared_ptr<SharedResponseDataRep> srdRep**
  
  pointer to the body (handle-body idiom)

Friends

- **class boost::serialization::access**
  
  allow boost access to serialize this class

13.175.1 Detailed Description

Container class encapsulating variables data that can be shared among a set of Response instances.

An array of Response objects (e.g., Analyzer::allResponse) contains repeated configuration data (id’s, labels, counts). SharedResponseData employs a handle-body idiom to allow this shared data to be managed in a single object with many references to it, one per Response object in the array. This allows scaling to larger sample sets.

13.175.2 Member Function Documentation

**SharedResponseData copy()** const

create a deep copy of the current object and return by value

Deep copies are used when recasting changes the nature of a Response set.

References SharedResponseData::srdRep.

Referenced by ExperimentData::initialize(), and ExperimentData::load_data().

The documentation for this class was generated from the following files:

- **SharedResponseData.hpp**
- **SharedResponseData.cpp**
13.176  SharedResponseDataRep Class Reference

The representation of a SharedResponseData instance. This representation, or body, may be shared by multiple
SharedResponseData handle instances.

Public Member Functions

- 
  ~SharedResponseDataRep ()
  destructor must be public for shared_ptr

- template<class Archive >
  void serialize (Archive &ar, const unsigned int version)

Private Member Functions

- SharedResponseDataRep ()
  default constructor

- SharedResponseDataRep (const ProblemDescDB &problem_db)
  standard constructor

- SharedResponseDataRep (const ActiveSet &set)
  alternate on-the-fly constructor

- void copy_rep (SharedResponseDataRep *srd_rep)
  copy the data from srd_rep to the current representation

- template<class Archive >
  void serialize (Archive &ar, const unsigned int version)

- bool operator== (const SharedResponseDataRep &other)
  experimental operator== for use in unit testing

- void build_field_labels ()
  build/update the unrolled field labels based on fieldLabels and group lengths

Private Attributes

- short responseType
  enumeration of BASE_RESPONSE, SIMULATION_RESPONSE, or EXPERIMENT_RESPONSE

- short primaryFnType
  data set type for primary response: generic, objective, calibration

- String responsesId
  response identifier string from the input file

- StringArray functionLabels
  fine-grained (unrolled) set of response function identifiers used to improve output readability; length Response-
  ::functionValues

- StringArray fieldLabels
  labels for each field group

- size_t numScalarResponses
  number of scalar responses

- IntVector fieldRespGroupLengths
CHAPTER 13. CLASS DOCUMENTATION

index of field lengths for field data
• IntVector numCoordsPerField
dimensions of each function

Friends
• class SharedResponseData
• class boost::serialization::access

allow boost access to serialize this class

13.176.1 Detailed Description
The representation of a SharedResponseData instance. This representation, or body, may be shared by multiple
SharedResponseData handle instances.
The SharedResponseData/SharedResponseDataRep pairs utilize a handle-body idiom (Coplien, Advanced
C++).

13.176.2 Member Function Documentation
void copy_rep ( SharedResponseDataRep * srd_rep ) [private]
copy the data from srd_rep to the current representation
Deep copies are used when recasting changes the nature of a Response set.
References SharedResponseDataRep::fieldLabels, SharedResponseDataRep::fieldRespGroupLengths, Shared-
ResponseDataRep::functionLabels, SharedResponseDataRep::numCoordsPerField, SharedResponseDataRep::num-
ScalarResponses, SharedResponseDataRep::primaryFnType, SharedResponseDataRep::responsesId, and Shared-
ResponseDataRep::responseType.
The documentation for this class was generated from the following files:
• SharedResponseData.hpp
• SharedResponseData.cpp

13.177 SharedSurfpackApproxData Class Reference
Derived approximation class for Surfpack approximation classes. Interface between Surfpack and Dakota.
Inheritance diagram for SharedSurfpackApproxData:

SharedApproxData

SharedSurfpackApproxData

Public Member Functions
• SharedSurfpackApproxData ()
default constructor
- **SharedSurfpackApproxData** (const String &approx_type, const UShortArray &approx_order, size_t num_vars, short data_order, short output_level)
  alternate constructor

- **SharedSurfpackApproxData** (ProblemDescDB &problem_db, size_t num_vars)
  standard constructor: Surfpack surface of appropriate type will be created

- ~SharedSurfpackApproxData ()
  destructor

### Private Member Functions

- **void add_sd_to_surfdata** (const Pecos::SurrogateDataVars &sdv, const Pecos::SurrogateDataResp &sdr, short fail_code, SurfData &surf_data)
  add Pecos::SurrogateData::SurrogateData{Vars,Resp} to SurfData, accounting for buildDataOrder available

- **void copy_matrix** (const RealSymMatrix &rsm, SurfpackMatrix<Real> &surfpack_matrix)
  copy RealSymMatrix to SurfpackMatrix (Real type only)

- **void merge_variable_arrays** (const RealVector &cv, const IntVector &div, const RealVector &drv, RealArray &ra)
  merge cv, div, and drv vectors into a single ra array

- **void sdv_to_realarray** (const Pecos::SurrogateDataVars &sdv, RealArray &ra)
  aggregate \{continuous,discrete int,discrete real\} variables from SurrogateDataVars into ra

- **void vars_to_realarray** (const Variables &vars, RealArray &ra)
  aggregate \{active,all\} \{continuous,discrete int,discrete real\} variables into ra

### Private Attributes

- unsigned short **approxOrder**
  order of polynomial approximation

- StringArray **diagnosticSet**
  set of diagnostic metrics

- bool **crossValidateFlag**
  whether to perform cross validation

- unsigned **numFolds**
  number of folds for CV

- Real **percentFold**
  percentage of data for CV

- bool **pressFlag**
  whether to perform PRESS

### Friends

- class **SurfpackApproximation**
- class **VPSApproximation**
Additional Inherited Members

13.177.1 Detailed Description

Derived approximation class for Surfpack approximation classes. Interface between Surfpack and Dakota.

The SharedSurfpackApproxData class is the interface between Dakota and Surfpack. Based on the information in the ProblemDescDB that is passed in through the constructor, SharedSurfpackApproxData builds a Surfpack Surface object that corresponds to one of the following data-fitting techniques: polynomial regression, kriging, artificial neural networks, radial basis function network, or multivariate adaptive regression splines (MARS).

13.177.2 Constructor & Destructor Documentation

SharedSurfpackApproxData ( const String &approx_type, const UShortArray &approx_order, size_t num_vars, short data_order, short output_level )

alternate constructor

On-the-fly constructor which uses mostly Surfpack model defaults.

References Dakota::abort_handler(), SharedSurfpackApproxData::approxOrder, and SharedApproxData::approxType.

SharedSurfpackApproxData ( ProblemDescDB &problem_db, size_t num_vars )

standard constructor: Surfpack surface of appropriate type will be created

Initialize the embedded Surfpack surface object and configure it using the specifications from the input file. Data for the surface is created later.

References SharedSurfpackApproxData::approxOrder, SharedApproxData::approxType, ProblemDescDB::get_short(), and ProblemDescDB::get_string().

The documentation for this class was generated from the following files:

- SharedSurfpackApproxData.hpp
- SharedSurfpackApproxData.cpp

13.178 SharedVariablesData Class Reference

Container class encapsulating variables data that can be shared among a set of Variables instances.

Public Member Functions

- SharedVariablesData ()
  default constructor

- SharedVariablesData ( const ProblemDescDB &problem_db, const std::pair< short, short > &view )
  standard constructor

- SharedVariablesData ( const std::pair< short, short > &view, const std::map< unsigned short, size_t > &vars_comps, const BitArray &all_relax_di=BitArray(), const BitArray &all_relax_dr=BitArray() )
  medium weight constructor providing detailed variable counts

- SharedVariablesData ( const std::pair< short, short > &view, const SizetArray &vars_comps_totals, const BitArray &all_relax_di=BitArray(), const BitArray &all_relax_dr=BitArray() )
  lightweight constructor providing variable count totals
• SharedVariablesData (const SharedVariablesData &svd)
  copy constructor

• ~SharedVariablesData ()
  destructor

• SharedVariablesData & operator= (const SharedVariablesData &svd)
  assignment operator

• SharedVariablesData copy () const
  create a deep copy of the current object and return by value

• void all_counts (size_t &num_acv, size_t &num_adiv, size_t &num_adsv, size_t &num_adrv) const
  compute all variables sums from SharedVariablesDataRep::variablesCompsTotals and SharedVariablesDataRep::allRelaxedDiscrete{Int,Real}

• void design_counts (size_t &num_cdv, size_t &num_ddiv, size_t &num_ddsv, size_t &num_ddrv) const
  compute design variables sums from SharedVariablesDataRep::variablesCompsTotals and SharedVariablesDataRep::allRelaxedDiscrete{Int,Real}

• void aleatory_uncertain_counts (size_t &num_cauv, size_t &num_dauiv, size_t &num_dausv, size_t &num_daurv) const
  compute aleatory uncertain variables sums from SharedVariablesDataRep::variablesCompsTotals and SharedVariablesDataRep::allRelaxedDiscrete{Int,Real}

• void epistemic_uncertain_counts (size_t &num_ceuv, size_t &num_deuiv, size_t &num_deusv, size_t &num_deurv) const
  compute epistemic uncertain variables sums from SharedVariablesDataRep::variablesCompsTotals and SharedVariablesDataRep::allRelaxedDiscrete{Int,Real}

• void uncertain_counts (size_t &num_cuv, size_t &num_duiv, size_t &num_dusv, size_t &num_durv) const
  compute uncertain variables sums from SharedVariablesDataRep::variablesCompsTotals and SharedVariablesDataRep::allRelaxedDiscrete{Int,Real}

• void state_counts (size_t &num_csv, size_t &num_dsiv, size_t &num_dssv, size_t &num_dsrv) const
  compute state variables sums from SharedVariablesDataRep::variablesCompsTotals and SharedVariablesDataRep::allRelaxedDiscrete{Int,Real}

• void initialize_active_start_counts ()
  initialize start index and counts for active variables

• void initialize_inactive_start_counts ()
  initialize start index and counts for inactive variables

• void initialize_active_components ()
  initialize the active components totals given active variable counts

• void initialize_inactive_components ()
  initialize the inactive components totals given inactive variable counts

• const BitArray & all_relaxed_discrete_int () const
  return allRelaxedDiscreteInt

• const BitArray & all_relaxed_discrete_real () const
  return allRelaxedDiscreteReal

• StringMultiArrayView all_continuous_labels (size_t start, size_t num_items) const
  get num_items continuous labels beginning at index start

• void all_continuous_labels (StringMultiArrayConstView cv_labels, size_t start, size_t num_items)
  set num_items continuous labels beginning at index start
• **void all_continuous_label** (const String &cv_label, size_t index)
  
  *set continuous label at index start*

• **StringMultiArrayView all_discrete_int_labels** (size_t start, size_t num_items) const

  *get num_items discrete integer labels beginning at index start*

• **void all_discrete_int_labels** (StringMultiArrayConstView div_labels, size_t start, size_t num_items)

  *set num_items discrete integer labels beginning at index start*

• **void all_discrete_int_label** (const String &div_label, size_t index)

  *set discrete integer label at index start*

• **StringMultiArrayView all_discrete_string_labels** (size_t start, size_t num_items) const

  *get num_items discrete string labels beginning at index start*

• **void all_discrete_string_labels** (StringMultiArrayConstView dsv_labels, size_t start, size_t num_items)

  *set num_items discrete string labels beginning at index start*

• **void all_discrete_string_label** (const String &dsv_label, size_t index)

  *set discrete string label at index start*

• **StringMultiArrayView all_discrete_real_labels** (size_t start, size_t num_items) const

  *get num_items discrete real labels beginning at index start*

• **void all_discrete_real_labels** (StringMultiArrayConstView drv_labels, size_t start, size_t num_items)

  *set num_items discrete real labels beginning at index start*

• **void all_discrete_real_label** (const String &drv_label, size_t index)

  *set discrete real label at index start*

• **UShortMultiArrayConstView all_continuous_types** (size_t start, size_t num_items) const

  *get num_items continuous types beginning at index start*

• **void all_continuous_types** (UShortMultiArrayConstView cv_types, size_t start, size_t num_items)

  *set num_items continuous types beginning at index start*

• **void all_continuous_type** (unsigned short cv_type, size_t index)

  *set continuous type at index*

• **UShortMultiArrayConstView all_discrete_int_types** (size_t start, size_t num_items) const

  *get num_items discrete integer types beginning at index start*

• **void all_discrete_int_types** (UShortMultiArrayConstView div_types, size_t start, size_t num_items)

  *set num_items discrete integer types beginning at index start*

• **void all_discrete_int_type** (unsigned short div_type, size_t index)

  *set discrete integer type at index*

• **UShortMultiArrayConstView all_discrete_string_types** (size_t start, size_t num_items) const

  *get num_items discrete string types beginning at index start*

• **void all_discrete_string_types** (UShortMultiArrayConstView dsv_types, size_t start, size_t num_items)

  *set num_items discrete string types beginning at index start*

• **void all_discrete_string_type** (unsigned short dsv_type, size_t index)

  *set discrete string type at index*

• **UShortMultiArrayConstView all_discrete_real_types** (size_t start, size_t num_items) const

  *get num_items discrete real types beginning at index start*

• **void all_discrete_real_types** (UShortMultiArrayConstView drv_types, size_t start, size_t num_items)

  *set num_items discrete real types beginning at index start*

• **void all_discrete_real_type** (unsigned short drv_type, size_t index)
set discrete real type at index

- `SizetMultiArrayConstView all_continuous_ids (size_t start, size_t num_items) const`
  - `get num_items continuous ids beginning at index start`

- `void all_continuous_ids (SizetMultiArrayConstView cv_ids, size_t start, size_t num_items)`
  - `set num_items continuous ids beginning at index start`

- `void all_continuous_id (size_t id, size_t index)`
  - `set num_items continuous ids beginning at index start`

- `const String & id () const`
  - `return the user-provided or default Variables identifier`

- `const SizetArray & components_totals () const`
  - `return variable type counts for {continuous,discrete integer,discrete real} {design,aleatory uncertain,epistemic uncertain,state}`

- `const SizetArray & active_components_totals () const`
  - `return active variable type counts for {continuous,discrete integer,discrete real} {design,aleatory uncertain,epistemic uncertain,state}`

- `const SizetArray & inactive_components_totals () const`
  - `return inactive variable type counts for {continuous,discrete integer,discrete real} {design,aleatory uncertain,epistemic uncertain,state}`

- `size_t vc_lookup (unsigned short key) const`
  - `retrieve the variables type count within svdRep->variablesComponents corresponding to (a fine-grain variables type) key`

- `const std::pair< short, short > & view () const`
  - `retrieve the Variables view`

- `void inactive_view (short view2)`
  - `set the inactive Variables view`

- `size_t cv () const`
  - `get number of active continuous vars`

- `size_t cv_start () const`
  - `get start index of active continuous vars`

- `size_t div () const`
  - `get number of active discrete int vars`

- `size_t div_start () const`
  - `get start index of active discrete int vars`

- `size_t dsv () const`
  - `get number of active discrete string vars`

- `size_t dsv_start () const`
  - `get start index of active discrete string vars`

- `size_t drv () const`
  - `get number of active discrete real vars`

- `size_t drv_start () const`
  - `get start index of active discrete real vars`

- `size_t icv () const`
  - `get number of inactive continuous vars`

- `size_t icv_start () const`
get start index of inactive continuous vars

- size_t idiv () const
  get number of inactive discrete int vars
- size_t idiv_start () const
  get start index of inactive discrete int vars

get number of inactive discrete string vars

- size_t idsv () const
  get start index of inactive discrete string vars
- size_t idsv_start () const
  get start index of inactive discrete string vars

get number of inactive discrete real vars

- size_t idrv () const
  get start index of inactive discrete real vars
- size_t idrv_start () const
  get start index of inactive discrete real vars

set number of active continuous vars

- void cv (size_t ncv)
  set start index of active continuous vars
- void cv_start (size_t cvs)
  set start index of active continuous vars

set number of active discrete int vars

- void div (size_t ndiv)
  set start index of active discrete int vars
- void div_start (size_t divs)
  set start index of active discrete int vars

set number of active discrete string vars

- void dsv (size_t ndsv)
  set start index of active discrete string vars
- void dsv_start (size_t dsvs)
  set start index of active discrete string vars

set number of active discrete real vars

- void drv (size_t ndrv)
  set start index of active discrete real vars
- void drv_start (size_t drvs)
  set start index of active discrete real vars

set number of inactive continuous vars

- void icv (size_t nicv)
  set start index of inactive continuous vars
- void icv_start (size_t icvs)
  set start index of inactive continuous vars

set number of inactive discrete int vars

- void idiv (size_t nidiv)
  set start index of inactive discrete int vars
- void idiv_start (size_t idivs)
  set start index of inactive discrete int vars

set number of inactive discrete string vars

- void idsv (size_t nidsv)
  set start index of inactive discrete string vars
- void idsv_start (size_t idsvs)
  set start index of inactive discrete string vars

set number of inactive discrete real vars

- void idrv (size_t nidrv)
  set number of inactive discrete real vars
• void idrv_start (size_t idrvs)
  set start index of inact discr real vars
• template<class Archive >
  void serialize (Archive &ar, const unsigned int version)

Private Member Functions

• template<class Archive >
  void serialize (Archive &ar, const unsigned int version)

  serialize through the pointer, which requires object tracking: write and read are symmetric for this class

Private Attributes

• boost::shared_ptr
  < SharedVariablesDataRep > svdRep

  pointer to the body (handle-body idiom)

Friends

• class boost::serialization::access

  allow boost access to serialize this class

13.178.1 Detailed Description

Container class encapsulating variables data that can be shared among a set of Variables instances.

An array of Variables objects (e.g., Analyzer::allVariables) contains repeated configuration data (id’s, labels, counts). SharedVariablesData employs a handle-body idiom to allow this shared data to be managed in a single object with many references to it, one per Variables object in the array. This allows scaling to larger sample sets.

13.178.2 Member Function Documentation

SharedVariablesData copy ( ) const

create a deep copy of the current object and return by value

Deep copies are used when recasting changes the nature of a Variables set.

References Dakota::svd(), and SharedVariablesData::svdRep.

The documentation for this class was generated from the following files:

• SharedVariablesData.hpp
• SharedVariablesData.cpp

13.179 SharedVariablesDataRep Class Reference

The representation of a SharedVariablesData instance. This representation, or body, may be shared by multiple SharedVariablesData handle instances.
Public Member Functions

- `~SharedVariablesDataRep()`  
  destructor must be public for shared_ptr
- Template:
  ```cpp
template <class Archive>
void save(Archive &ar, const unsigned int version) const
```
- Template:
  ```cpp
template <class Archive>
void load(Archive &ar, const unsigned int version)
```

Private Member Functions

- `SharedVariablesDataRep(const ProblemDescDB &problem_db, const std::pair<short, short> &view)`  
  standard constructor
- `SharedVariablesDataRep(const std::pair<short, short> &view, const std::map<unsigned short, size_t> &vars_comps, const BitArray &all_relax_di, const BitArray &all_relax_dr)`  
  medium weight constructor providing detailed variable counts
- `SharedVariablesDataRep(const std::pair<short, short> &view, const SizetArray &vars_comps_totals, const BitArray &all_relax_di, const BitArray &all_relax_dr)`  
  lightweight constructor providing variable count totals
- `SharedVariablesDataRep()`  
  default constructor
- `initialize_components_totals(const ProblemDescDB &problem_db)`  
  populate variables `{Components, CompsTotals}` from user variable type and count specifications
- `components_to_totals()`  
  update variables CompsTotals from variablesComponents
- `relax_noncategorical(const ProblemDescDB &problem_db)`  
  populate allRelaxedDiscrete `{Int, Real}` from user specifications (relax variables that are not declared as categorical)
- `set_relax(const BitArray &user_cat_spec, size_t ucs_index, size_t ard_cnt, BitArray &ard_container)`  
  Set the ard_cnt entry in the all-relaxed-discrete integer or real container ard_container, based on user-specification of categorical, accounting for empty.
- `all_counts(size_t &num_acv, size_t &num_adiv, size_t &num_adsv, size_t &num_adrv)` const  
  compute all variables sums from variablesCompsTotals
- `relax_counts(size_t &num_cv, size_t &num_div, size_t &num_dsv, size_t &num_drv, size_t offset_di, size_t offset_dr)` const  
  adjust counts based on allRelaxedDiscrete `{Int, Real}`
- `design_counts(size_t &num_cdv, size_t &num_ddiv, size_t &num_ddsv, size_t &num_ddrv)` const  
  compute design variables sums from variablesCompsTotals
- `aleatory_uncertain_counts(size_t &num_cauv, size_t &num_dauiv, size_t &num_dausv, size_t &num_daurv)` const  
  compute aleatory uncertain variables sums from variablesCompsTotals
- `epistemic_uncertain_counts(size_t &num_ceuv, size_t &num_deuiv, size_t &num_deusv, size_t &num_deurv)` const  
  compute epistemic uncertain variables sums from variablesCompsTotals
- `uncertain_counts(size_t &num_cuv, size_t &num_duiv, size_t &num_dusv, size_t &num_durv)` const
compute uncertain variables sums from variablesCompsTotals
• void state_counts (size_t &num_csv, size_t &num_dsv, size_t &num_dssv, size_t &numDrv) const
  compute state variables sums from variablesCompsTotals
• void view_start_counts (short view, size_t &cv_start, size_t &div_start, size_t &dsv_start, size_t &drv_start,
  size_t &num_cv, size_t &num_div, size_t &num_dsv, size_t &num_drv) const
  define start indices and counts for active variables based on view
• void size_all_labels ()
  size all{Continuous,DiscreteInt,DiscreteString,DiscreteReal}Labels, with or without discrete relaxation
• void size_all_types ()
  size all{Continuous,DiscreteInt,DiscreteString,DiscreteReal}Types, with or without discrete relaxation
• void initialize_all_labels (const ProblemDescDB &problem_db)
  aggregate all{Continuous,DiscreteInt,DiscreteString,DiscreteReal}Labels from user specification or defaults
• void initialize_all_types ()
  initialize all{Continuous,DiscreteInt,DiscreteString,DiscreteReal}Types, with or without discrete relaxation
• void initialize_all_ids ()
  initialize allContinuousIds (discrete not currently needed), with or without discrete relaxation
• void initialize_active_start_counts ()
  initialize {c,di,dr}vStart and num{D,DI,DR}V
• void initialize_inactive_start_counts ()
  initialize {c,di,dr}vStart and num{D,DI,DR}V
• void initialize_active_components ()
  initialize activeVarsCompsTotals given {c,di,dr}vStart and num{C,DI,DR}V
• void initialize_inactive_components ()
  initialize inactiveVarsCompsTotals given i{c,di,dr}vStart and numI{C,DI,DR}V
• size_t vc_lookup (unsigned short key) const
  retrieve the count within variablesComponents corresponding to key
• void copy_rep (SharedVariablesDataRep *svd_rep)
  copy the data from svd_rep to the current representation
  template<class Archive >
  void save (Archive &ar, const unsigned int version) const
  serialize the core shared variables data
  template<class Archive >
  void load (Archive &ar, const unsigned int version)
  load the core shared variables data and restore class state
• BOOST_SERIALIZATION_SPLIT_MEMBER () String variablesId
  variables identifier string from the input file

Private Attributes
• std::map< unsigned short, size_t > variablesComponents
  map linking variable types to counts
• SizetArray variablesCompsTotals
  totals for variable type counts for {continuous, discrete integer, discrete string, discrete real} {design, aleatory uncertain, epistemic uncertain, state}. 
• SizetArray activeVarsCompsTotals
  totals for active variable type counts for \{continuous,discrete integer,discrete string,discrete real\} \{design,aleatory uncertain,epistemic uncertain,state\}.

• SizetArray inactiveVarsCompsTotals
  totals for inactive variable type counts for \{continuous,discrete integer,discrete string,discrete real\} \{design,aleatory uncertain,epistemic uncertain,state\}.

• std::pair< short, short > variablesView
  the variables view pair containing active (first) and inactive (second) view enumerations

• size_t cvStart
  start index of active continuous variables within allContinuousVars

• size_t divStart
  start index of active discrete integer variables within allDiscreteIntVars

• size_t dsvStart
  start index of active discrete string vars within allDiscreteStringVars

• size_t drvStart
  start index of active discrete real variables within allDiscreteRealVars

• size_t icvStart
  start index of inactive continuous variables within allContinuousVars

• size_t idivStart
  start index of inactive discrete integer vars within allDiscreteIntVars

• size_t idsvStart
  start index of inactive discrete string vars within allDiscreteStringVars

• size_t idrvStart
  start index of inactive discrete real variables within allDiscreteRealVars

• size_t numCV
  number of active continuous variables

• size_t numDIV
  number of active discrete integer variables

• size_t numDSV
  number of active discrete string variables

• size_t numDRV
  number of active discrete real variables

• size_t numICV
  number of inactive continuous variables

• size_t numIDIV
  number of inactive discrete integer variables

• size_t numIDSV
  number of inactive discrete string variables

• size_t numIDRV
  number of inactive discrete real variables

• StringMultiArray allContinuousLabels
  array of variable labels for all of the continuous variables

• StringMultiArray allDiscreteIntLabels
array of variable labels for all of the discrete integer variables
- StringMultiArray allDiscreteIntLabels

array of variable labels for all of the discrete string variables
- StringMultiArray allDiscreteStringLabels

array of variable labels for all of the discrete real variables
- StringMultiArray allDiscreteRealLabels

array of variable types for all of the continuous variables
- UShortMultiArray allContinuousTypes

array of variable types for all of the discrete integer variables
- UShortMultiArray allDiscreteIntTypes

array of variable types for all of the discrete string variables
- UShortMultiArray allDiscreteStringTypes

array of variable types for all of the discrete real variables
- UShortMultiArray allDiscreteRealTypes

array of 1-based position identifiers for the all continuous variables array
- SizetMultiArray allContinuousIds

array of booleans to indicate relaxation (promotion from DiscreteInt to Continuous) for all specified discrete int variables
- BitArray allRelaxedDiscreteInt

array of booleans to indicate relaxation (promotion from DiscreteReal to Continuous) for all specified discrete real variables
- BitArray allRelaxedDiscreteReal

Friends
- class SharedVariablesData
- class boost::serialization::access

allow boost access to serialize this class

13.179.1 Detailed Description

The representation of a SharedVariablesData instance. This representation, or body, may be shared by multiple SharedVariablesData handle instances.

The SharedVariablesData/SharedVariablesDataRep pairs utilize a handle-body idiom (Coplien, Advanced C++).

13.179.2 Member Function Documentation

void copy_rep ( SharedVariablesDataRep * svd_rep ) [private]
copy the data from svd_rep to the current representation

Deep copies are used when recasting changes the nature of a Variables set.

References SharedVariablesDataRep::activeVarsCompsTotals, SharedVariablesDataRep::allContinuousIds, SharedVariablesDataRep::allContinuousLabels, SharedVariablesDataRep::allContinuousTypes, SharedVariablesDataRep::allDiscreteIntLabels, SharedVariablesDataRep::allDiscreteIntTypes, SharedVariablesDataRep::allDiscreteRealLabels, SharedVariablesDataRep::allDiscreteRealTypes, SharedVariablesDataRep::allDiscreteStringLabels, SharedVariablesDataRep::allDiscreteStringTypes, SharedVariablesDataRep::allRelaxedDiscreteInt, SharedVariablesDataRep::allRelaxedDiscreteReal, SharedVariablesDataRep::cvStart, SharedVariablesDataRep::divStart, SharedVariablesDataRep::
SizetArray variablesCompsTotals  [private]

totals for variable type counts for \{continuous,discrete integer,discrete string,discrete real\} \{design,aleatory uncertain,epistemic uncertain,state\}.

This data reflects the variable counts as originally specified and is not altered by relaxation.

Referenced by SharedVariablesDataRep::aleatory_uncertain_counts(), SharedVariablesDataRep::all_counts(), SharedVariablesDataRep::components_to_totals(), SharedVariablesDataRep::copy_rep(), SharedVariablesDataRep::design_counts(), SharedVariablesDataRep::epistemic_uncertain_counts(), SharedVariablesDataRep::initialize_active_components(), SharedVariablesDataRep::initialize_all_ids(), SharedVariablesDataRep::initialize_components_totals(), SharedVariablesDataRep::initialize_inactive_components(), SharedVariablesDataRep::relax_noncategorical(), SharedVariablesDataRep::state_counts(), SharedVariablesDataRep::uncertain_counts(), and SharedVariablesDataRep::view_start_counts().

SizetArray activeVarsCompsTotals  [private]

totals for active variable type counts for \{continuous,discrete integer,discrete string,discrete real\} \{design,aleatory uncertain,epistemic uncertain,state\}.

This data reflects the variable counts as originally specified and is not altered by relaxation.

Referenced by SharedVariablesDataRep::copy_rep(), and SharedVariablesDataRep::initialize_active_components().

SizetArray inactiveVarsCompsTotals  [private]

totals for inactive variable type counts for \{continuous,discrete integer,discrete string,discrete real\} \{design,aleatory uncertain,epistemic uncertain,state\}.

This data reflects the variable counts as originally specified and is not altered by relaxation.

Referenced by SharedVariablesDataRep::copy_rep(), and SharedVariablesDataRep::initialize_inactive_components().

SizetMultiArray allContinuousIds  [private]

array of 1-based position identifiers for the all continuous variables array.

These identifiers define positions of the all continuous variables array within the total variable sequence. A primary use case is for defining derivative ids (DVV) based on an active subset.

Referenced by SharedVariablesDataRep::copy_rep(), and SharedVariablesDataRep::initialize_all_ids().

The documentation for this class was generated from the following files:

- SharedVariablesData.hpp
- SharedVariablesData.cpp
13.180 SimulationModel Class Reference

Derived model class which utilizes a simulation-based application interface to map variables into responses.

Inheritance diagram for SimulationModel:

```
Model
   ^
   |
SimulationModel
```

Public Member Functions

- `SimulationModel (ProblemDescDB &problem_db)`
  constructor

- `~SimulationModel ()`
  destructor

Protected Member Functions

- `Interface & derived_interface ()`
  return userDefinedInterface

- `size_t solution_levels () const`
  return size of solnControlCostMap

- `void solution_level_index (size_t lev_index)`
  activate entry in solnControlCostMap

- `RealVector solution_level_cost () const`
  return cost estimates from solnControlCostMap

- `void derived_evaluate (const ActiveSet &set)`
  portion of evaluate() specific to SimulationModel (invokes a synchronous map() on userDefinedInterface)

- `void derived_evaluate_nowait (const ActiveSet &set)`
  portion of evaluate_nowait() specific to SimulationModel (invokes an asynchronous map() on userDefinedInterface)

- `const IntResponseMap & derived_synchronize ()`
  portion of synchronize() specific to SimulationModel (invokes synch() on userDefinedInterface)

- `const IntResponseMap & derived_synchronize_nowait ()`
  portion of synchronize_nowait() specific to SimulationModel (invokes synch_nowait() on userDefinedInterface)

- `void component_parallel_mode (short mode)`
  SimulationModel only supports parallelism in userDefinedInterface, so this virtual function redefinition is simply a
  sanity check.

- `short local_eval_synchronization ()`
  return userDefinedInterface synchronization setting

- `int local_eval_concurrency ()`
  return userDefinedInterface asynchronous evaluation concurrency

- `bool derived_master_overload () const`
CHAPTER 13. CLASS DOCUMENTATION

flag which prevents overloading the master with a multiprocessor evaluation (request forwarded to userDefinedInterface)

- **IntIntPair estimate_partition_bounds** (int max_eval_concurrency)
  estimate the minimum and maximum partition sizes that can be utilized by this Model

- **void derived_init_communicators** (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  set up SimulationModel for parallel operations (request forwarded to userDefinedInterface)

- **void derived_init_serial**
  set up SimulationModel for serial operations (request forwarded to userDefinedInterface).

- **void derived_set_communicators** (ParLevLIter pl_iter, int max_eval_concurrency, bool recurse_flag=true)
  set active parallel configuration for the SimulationModel (request forwarded to userDefinedInterface)

- **void serve_run** (ParLevLIter pl_iter, int max_eval_concurrency)
  Service userDefinedInterface job requests received from the master. Completes when a termination message is received from stop_servers().

- **void stop_servers**
  executed by the master to terminate userDefinedInterface server operations when SimulationModel iteration is complete.

- **const String & interface_id () const**
  return the userDefinedInterface identifier

- **int evaluation_id () const**
  return the current evaluation id for the SimulationModel (request forwarded to userDefinedInterface)

- **bool evaluation_cache () const**
  return flag indicated usage of an evaluation cache by the SimulationModel (request forwarded to userDefinedInterface)

- **void set_evaluation_reference ()**
  set the evaluation counter reference points for the SimulationModel (request forwarded to userDefinedInterface)

- **void fine_grained_evaluation_counters ()**
  request fine-grained evaluation reporting within the userDefinedInterface

- **void print_evaluation_summary** (std::ostream &s, bool minimal_header=false, bool relative_count=true) const
  print the evaluation summary for the SimulationModel (request forwarded to userDefinedInterface)

- **void eval_tag_prefix** (const String &eval_id_str)
  set the hierarchical eval ID tag prefix

Private Member Functions

- **void initialize_solution_control** (const String &control, const RealVector &cost)
  process the solution level inputs to define solnControlVarIndex, solnControlVarType, and solnControlCostMap

Private Attributes

- **Interface userDefinedInterface**
  the interface used for mapping variables to responses

- **short solnCntlVarType**
  type of the discrete variable that controls the set/range of solution levels

- **size_t solnCntlADVIndex**
index of the discrete variable (within all view) that controls the set/range of solution levels

- `size_t solnCntlSetIndex`

index of the discrete set variable (within its type array, managing offset when solnCntlVarType is a subset of all discrete variables) that controls the set/range of solution levels

- `std::map<Real, size_t> solnCntlCostMap`

sorted array of relative costs associated with a set of solution levels

### Additional Inherited Members

#### 13.180.1 Detailed Description

Derived model class which utilizes a simulation-based application interface to map variables into responses.

The `SimulationModel` class is the simplest of the derived model classes. It provides the capabilities of the original `Model` class, prior to the development of surrogate and nested model extensions. The derived response computation and synchronization functions utilize an application interface to perform the function evaluations.

#### 13.180.2 Member Function Documentation

```cpp
void eval_tag_prefix (const String &eval_id_str) [protected], [virtual]
```

set the hierarchical eval ID tag prefix

- `SimulationModel` doesn’t need to change the tagging, so just forward to `Interface`
- Reimplemented from `Model`.
- References `Interface::eval_tag_prefix()`, and `SimulationModel::userDefinedInterface`.

The documentation for this class was generated from the following files:

- `SimulationModel.hpp`
- `SimulationModel.cpp`

### 13.181 SimulationResponse Class Reference

Container class for response functions and their derivatives. `SimulationResponse` provides the body class.

Inheritance diagram for `SimulationResponse`:

```
     Response
     /     
SimulationResponse
```

#### Public Member Functions

- `SimulationResponse ()`
  default constructor

- `SimulationResponse (const Variables &vars, const ProblemDescDB &problem_db)`
  standard constructor built from problem description database

- `SimulationResponse (const SharedResponseData &srd, const ActiveSet &set)`
  alternate constructor that shares a `SharedResponseData` instance
• SimulationResponse (const SharedResponseData &srd)
  alternate constructor that shares a SharedResponseData instance
• SimulationResponse (const ActiveSet &set)
  alternate constructor using limited data
• ~SimulationResponse ()
  destructor

Additional Inherited Members

13.181.1 Detailed Description

Container class for response functions and their derivatives. SimulationResponse provides the body class.

The SimulationResponse class is the "representation" of the response container class. It is the "body" portion of the "handle-body idiom" (see Coplien "Advanced C++", p. 58). The handle class (Response) provides for memory efficiency in management of multiple response objects through reference counting and representation sharing. The body class (SimulationResponse) actually contains the response data (functionValues, function-Gradients, functionHessians, etc.). The representation is hidden in that an instance of SimulationResponse may only be created by Response. Therefore, programmers create instances of the Response handle class, and only need to be aware of the handle/body mechanisms when it comes to managing shallow copies (shared representation) versus deep copies (separate representation used for history mechanisms).

The documentation for this class was generated from the following files:

• SimulationResponse.hpp
• SimulationResponse.cpp

13.182 SNLLBase Class Reference

Base class for OPT++ optimization and least squares methods.

Inheritance diagram for SNLLBase:

```
  SNLLBase
   ┏┓    ┏┓
   |     | SNLLLeastSq    SNLLOptimizer
   |     |                 |
   ┗┓    ┗┓
     SNLLBase
```

Public Member Functions

• SNLLBase ()
  default constructor
• SNLLBase (ProblemDescDB &problem_db)
  standard constructor
• ~SNLLBase ()
  destructor
Protected Member Functions

- void copy_con_vals_dak_to_optpp (const RealVector &local_fn_vals, RealVector &g, size_t offset)
  - convenience function for copying local_fn_vals to g; used by constraint evaluator functions
- void copy_con_vals_optpp_to_dak (const RealVector &g, RealVector &local_fn_vals, size_t offset)
  - convenience function for copying g to local_fn_vals; used in final solution logging
- void copy_con_grad (const RealMatrix &local_fn_grads, RealMatrix &grad_g, size_t offset)
  - convenience function for copying local_fn_grads to grad_g; used by constraint evaluator functions
- void copy_con_hess (const RealSymMatrixArray &local_fn_hessians, OPTPP::OptppArray<RealSymMatrix> &hess_g, size_t offset)
  - convenience function for copying local_fn_hessians to hess_g; used by constraint evaluator functions
- void snll_pre_instantiate (bool bound_constr_flag, int num_constr)
  - convenience function for setting OPT++ options prior to the method instantiation
- void snll_post_instantiate (int num_cv, bool vendor_num_grad_flag, const String &finite_diff_type, const RealVector &fss, int max_iter, int max_fn_evals, Real conv_tol, Real grad_tol, Real max_step, bool bound_constr_flag, int num_constr, short output_lev, OPTPP::OptimizeClass *the_optimizer, OPTPP::NLP0 *nlf_objective, OPTPP::FDNLF1 *fd_nlf1, OPTPP::FDNLF1 *fd_nlf1_con)
  - convenience function for setting OPT++ options after the method instantiation
- void snll_initialize_run (OPTPP::NLP0 *nlf_objective, OPTPP::NLP *nlp_constraint, const RealVector &init_pt, bool bound_constr_flag, const RealVector &lower_bnds, const RealVector &upper_bnds, const RealMatrix &lin_eq_coeffs, const RealVector &lin_eq_l_bnds, const RealVector &lin_eq_u_bnds, const RealMatrix &lin_ineq_coeffs, const RealVector &lin_ineq_l_bnds, const RealVector &lin_ineq_u_bnds, const RealVector &nln_ineq_l_bnds, const RealVector &nln_ineq_u_bnds, const RealVector &nln_eq_targets)
  - convenience function for OPT++ configuration prior to the method invocation
- void snll_post_run (OPTPP::NLP0 *nlf_objective)
  - convenience function for setting OPT++ options after the method instantiations

Static Protected Member Functions

- static void init_fn (int n, RealVector &x)
  - An initialization mechanism provided by OPT++ (not currently used).

Protected Attributes

- String searchMethod
  - value_based_line_search, gradient_based_line_search, trust_region, or tr_pds
- OPTPP::SearchStrategy searchStrat
  - enum: LineSearch, TrustRegion, or TrustPDS
- OPTPP::MeritFcn meritFn
  - enum: NormFmu, ArgaezTapia, or VanShanno
- Real maxStep
  - value from max_step specification
- Real stepLenToBndry
  - value from steplength_to_boundary specification
- Real centeringParam
  - value from centering_parameter specification
• bool constantASVFlag
  flags a user selection of active_set_vector == constant. By mapping this into mode override, reliance on duplicate
detection can be avoided.

Static Protected Attributes

• static Minimizer * optLSqInstance
  pointer to the active base class object instance used within the static evaluator functions in order to avoid the need
for static data
• static bool modeOverrideFlag
  flags OPT++ mode override (for combining value, gradient, and Hessian requests)
• static EvalType lastFnEvalLocn
  an enum used to track whether an nlf evaluator or a constraint evaluator was the last location of a function evalu-
ation
• static int lastEvalMode
  copy of mode from constraint evaluators
• static RealVector lastEvalVars
  copy of variables from constraint evaluators

13.182.1 Detailed Description

Base class for OPT++ optimization and least squares methods.

The SNLLBase class provides a common base class for SNLLOptimizer and SNLLLeastSq, both of which
are wrappers for OPT++, a C++ optimization library from the Computational Sciences and Mathematics Research
(CSMR) department at Sandia’s Livermore CA site.

The documentation for this class was generated from the following files:

• SNLLBase.hpp
• SNLLBase.cpp

13.183 SNLLLeastSq Class Reference

Wrapper class for the OPT++ optimization library.

Inheritance diagram for SNLLLeastSq:
Public Member Functions

- `SNLLLeastSq (ProblemDescDB &problem_db, Model &model)`
  standard constructor
- `SNLLLeastSq (const String &method_name, Model &model)`
  alternate constructor for instantiations without ProblemDescDB support
- `~SNLLLeastSq ()`
  destructor
- `void core_run ()`
  compute the least squares solution

Protected Member Functions

- `void initialize_run ()`
  invokes LeastSq::initialize_run(), SNLLBase::snll_initialize_run(), and performs other set-up
- `void post_run (std::ostream &s)`
  invokes snll_post_run and re-implements post_run (does not call parent) and performs other solution processing
- `void finalize_run ()`
  restores instances

Static Private Member Functions

- `static void nlf2_evaluator_gn (int mode, int n, const RealVector &x, double &f, RealVector &grad_f, RealSymMatrix &hess_f, int &result_mode)`
  objective function evaluator function which obtains values and gradients for least square terms and computes objective function value, gradient, and Hessian using the Gauss-Newton approximation.
- `static void constraint1_evaluator_gn (int mode, int n, const RealVector &x, RealVector &g, RealMatrix &grad_g, int &result_mode)`
  constraint evaluator function which provides constraint values and gradients to OPT++ Gauss-Newton methods.
- `static void constraint2_evaluator_gn (int mode, int n, const RealVector &x, RealVector &g, RealMatrix &grad_g, OPTPP::OptppArray<RealSymMatrix> &hess_g, int &result_mode)`
  constraint evaluator function which provides constraint values, gradients, and Hessians to OPT++ Gauss-Newton methods.

Private Attributes

- `SNLLLeastSq * prevSnllSqInstance`
  pointer to the previously active object instance used for restoration in the case of iterator/model recursion
- `OPTPP::NLP0 * nlfObjective`
  objective NLF base class pointer
- `OPTPP::NLP0 * nlfConstraint`
  constraint NLF base class pointer
- `OPTPP::NLP * nlpConstraint`
  constraint NLP pointer
- `OPTPP::NLF2 * nlf2`
  pointer to objective NLF for full Newton optimizers
CHAPTER 13. CLASS DOCUMENTATION

- OPTPP::NLF2 * nlf2Con
  pointer to constraint NLF for full Newton optimizers
- OPTPP::NLF1 * nlf1Con
  pointer to constraint NLF for Quasi Newton optimizers
- OPTPP::OptimizeClass * theOptimizer
  optimizer base class pointer
- OPTPP::OptNewton * optnewton
  Newton optimizer pointer.
- OPTPP::OptBCNewton * optbcnewton
  Bound constrained Newton optimizer ptr.
- OPTPP::OptDHNIPS * optdhnips
  Disaggregated Hessian NIPS optimizer ptr.

Static Private Attributes
- static SNLLLeastSq * snllLSqInstance
  pointer to the active object instance used within the static evaluator functions in order to avoid the need for static data

Additional Inherited Members

13.183.1 Detailed Description

Wrapper class for the OPT++ optimization library.

The SNLLLeastSq class provides a wrapper for OPT++, a C++ optimization library of nonlinear programming and pattern search techniques from the Computational Sciences and Mathematics Research (CSMR) department at Sandia’s Livermore CA site. It uses a function pointer approach for which passed functions must be either global functions or static member functions. Any attribute used within static member functions must be either local to that function, a static member, or accessed by static pointer.

The user input mappings are as follows: max_iterations, max_function_evaluations, convergence_tolerance, max_step, gradient_tolerance, search_method, and search_scheme_size are set using OPT++’s setMaxIter(), setMaxEval(), setFcnTol(), setMaxStep(), setGradTol(), setSearchStrategy(), and setSSS() member functions, respectively; output verbosity is used to toggle OPT++’s debug mode using the setDebug() member function. Internal to OPT++, there are 3 search strategies, while the DAKOTA search_method specification supports 4 (value_based_line_search, gradient_based_line_search, trust_region, or tr_pds). The difference stems from the “is_expensive” flag in OPT++. If the search strategy is LineSearch and “is_expensive” is turned on, then the value_based_line_search is used. Otherwise (the “is_expensive” default is off), the algorithm will use the gradient_based_line_search. Refer to [Meza, J.C., 1994] and to the OPT++ source in the Dakota/packages/OPTPP directory for information on OPT++ class member functions.

13.183.2 Member Function Documentation

void post_run ( std::ostream & s ) [protected], [virtual]

invokes snll_post_run and re-implements post_run (does not call parent) and performs other solution processing

SNLLLeastSq requires fn DB lookup, so overrides LeastSq::post_run and directly invokes Iterator::post_run when complete.
Reimplemented from LeastSq.

References Iterator::activeSet, Iterator::bestResponseArray, Iterator::bestVariablesArray, SNLLBase::copy_con_vals_optpp_to_dak(), Dakota::copy_data_partial(), Dakota::data_pairs, LeastSq::get_confidence_intervals(), Model::interface_id(), Iterator::iteratedModel, Dakota::lookup_by_val(), Model::model_rep(), SNLLLeastSq::nlfObjective, Minimizer::numNonlinearConstraints, Minimizer::numUserPrimaryFns, Minimizer::post_run(), ActiveSet::request_vector(), Minimizer::scaleFlag, Minimizer::scalingModel, SNLLBase::snll_post_run(), and SNLLLeastSq::theOptimizer.

```cpp
void nlf2_evaluator_gn ( int mode, int n, const RealVector & x, double & f, RealSymMatrix & Hess_f, int & result_mode ) [static], [private]
```
objective function evaluator function which obtains values and gradients for least square terms and computes objective function value, gradient, and Hessian using the Gauss-Newton approximation.

This nlf2 evaluator function is used for the Gauss-Newton method in order to exploit the special structure of the nonlinear least squares problem. Here, \( f(x) = \sum_i (T_i - Tbar_i)^2 \) and \( \text{Response} \) is made up of residual functions and their gradients along with any nonlinear constraints. The objective function and its gradient vector and Hessian matrix are computed directly from the residual functions and their derivatives (which are returned from the \( \text{Response} \) object).

References Dakota::abort_handler(), Iterator::activeSet, Model::continuous_variables(), Model::current_response(), Model::evaluate(), Response::function_gradients(), Response::function_values(), Iterator::iteratedModel, SNLLBase::lastEvalMode, SNLLBase::lastEvalVars, SNLLBase::lastFnEvalLocn, Minimizer::numFunctions, LeastSq::numLeastSqTerms, Minimizer::numNonlinearConstraints, Iterator::outputLevel, ActiveSet::request_vector(), SNLLLeastSq::snllLSqInstance, and Dakota::write_precision.

Referenced by SNLLLeastSq::SNLLLeastSq().

```cpp
void constraint1_evaluator_gn ( int mode, int n, const RealVector & x, RealVector & g, RealMatrix & grad_g, int & result_mode ) [static], [private]
```
constraint evaluator function which provides constraint values and gradients to OPT++ Gauss-Newton methods.

While it does not employ the Gauss-Newton approximation, it is distinct from constraint1_evaluator() due to its need to anticipate the required modes for the least squares terms. This constraint evaluator function is used with diaggreated Hessian NIPS and is currently active.

References Dakota::abort_handler(), Iterator::activeSet, Model::continuous_variables(), SNLLBase::copy_con_grad(), SNLLBase::copy_con_val_dak_optpp(), Model::current_response(), Model::evaluate(), Response::function_gradients(), Response::function_values(), Iterator::iteratedModel, SNLLBase::lastEvalMode, SNLLBase::lastEvalVars, SNLLBase::lastFnEvalLocn, Minimizer::numFunctions, LeastSq::numLeastSqTerms, Iterator::outputLevel, ActiveSet::request_vector(), and SNLLLeastSq::snllLSqInstance.

Referenced by SNLLLeastSq::SNLLLeastSq().

```cpp
void constraint2_evaluator_gn ( int mode, int n, const RealVector & x, RealVector & g, RealMatrix & grad_g, OPTPP::OptppArray< RealSymMatrix > & Hess_g, int & result_mode ) [static], [private]
```
constraint evaluator function which provides constraint values, gradients, and Hessians to OPT++ Gauss-Newton methods.

While it does not employ the Gauss-Newton approximation, it is distinct from constraint2_evaluator() due to its need to anticipate the required modes for the least squares terms. This constraint evaluator function is used with full Newton NIPS and is currently inactive.
References Dakota::abort_handler(), Iterator::activeSet, Model::continuous_variables(), SNLLBase::copy_con-
grad(), SNLLBase::copy_con_hess(), SNLLBase::copy_con_vals_dak_to_optpp(), Model::current_response(), Model-
evaluate(), Response::function_gradients(), Response::function_hessians(), Response::function_values(), Iterator-
::iteratedModel, SNLLBase::lastEvalMode, SNLLBase::lastEvalVars, SNLLBase::lastFnEvalLocn, SNLLBase-
::modeOverrideFlag, Minimizer::numFunctions, LeastSq::numLeastSqTerms, Iterator::outputLevel, ActiveSet-
::request_vector(), and SNLLLeastSq::snllLSqInstance.

The documentation for this class was generated from the following files:

- SNLLLeastSq.hpp
- SNLLLeastSq.cpp

### 13.184 SNLLOptimizer Class Reference

Wrapper class for the OPT++ optimization library.

Inheritance diagram for SNLLOptimizer:

```
SNLLOptimizer
|     |
|     | Optimizer
|     | SNLLBase
|     |
Minimizer
|     |
|     |
Iterator
```

#### Public Member Functions

- **SNLLOptimizer** (ProblemDescDB &problem_db, Model &model)
  
  *standard constructor*

- **SNLLOptimizer** (const String &method_string, Model &model)
  
  *alternate constructor for instantiations "on the fly"*

- **SNLLOptimizer** (const RealVector &initial_pt, const RealVector &var_l_bnds, const RealVector &var_u_bnds, const RealMatrix &lin_ineq_coeffs, const RealVector &lin_ineq_l_bnds, const RealVector &lin_ineq_u_bnds, const RealMatrix &lin_eq_coeffs, const RealVector &lin_eq_tgts, const RealVector &nln_ineq_l_bnds, const RealVector &nln_ineq_u_bnds, const RealVector &nln_eq_tgts, void(*user_obj_eval)(int mode, int n, const RealVector &x, double &f, RealVector &grad_f, int &result_mode), void(*user_con_eval)(int mode, int n, const RealVector &x, RealVector &g, RealMatrix &grad_g, int &result_mode))
  
  *alternate constructor for instantiations "on the fly"*

- **~SNLLOptimizer** ()
  
  *destructor*

- **void core_run ()**
  
  *Performs the iterations to determine the optimal solution.*
13.184. SNLLOPTIMIZER CLASS REFERENCE

Protected Member Functions

- void initialize_run()
  
  invokes Optimizer::initialize_run(), SNLLBase::snll_initialize_run(), and performs other set-up
- void post_run(std::ostream &s)
  
  performs data recovery and calls Optimizer::post_run()
- void finalize_run()
  
  performs cleanup, restores instances and calls parent finalize

Private Member Functions

- void default_instantiate_q_newton(void(*obj_eval)(int mode, int n, const RealVector &x, double &f, RealVector &grad_f, int &result_mode), void(*con_eval)(int mode, int n, const RealVector &x, RealVector &g, RealMatrix &grad_g, int &result_mode))
  
  instantiate an OPTPP_Q_NEWTON solver using standard settings
- void default_instantiate_newton(void(*obj_eval)(int mode, int n, const RealVector &x, double &f, RealVector &grad_f, RealSymMatrix &hess_f, int &result_mode), void(*con_eval)(int mode, int n, const RealVector &x, RealVector &g, RealMatrix &grad_g, OPTPP::OptppArray<RealSymMatrix> &hess_g, int &result_mode))
  
  instantiate an OPTPP_NEWTON solver using standard settings

Static Private Member Functions

- static void nlf0_evaluator(int n, const RealVector &x, double &f, int &result_mode)
  
  objective function evaluator function for OPT++ methods which require only function values.
- static void nlf1_evaluator(int mode, int n, const RealVector &x, double &f, RealVector &grad_f, int &result_mode)
  
  objective function evaluator function which provides function values and gradients to OPT++ methods.
- static void nlf2_evaluator(int mode, int n, const RealVector &x, double &f, RealVector &grad_f, RealSymMatrix &hess_f, int &result_mode)
  
  objective function evaluator function which provides function values, gradients, and Hessians to OPT++ methods.
- static void constraint0_evaluator(int n, const RealVector &x, RealVector &g, int &result_mode)
  
  constraint evaluator function for OPT++ methods which require only constraint values.
- static void constraint1_evaluator(int mode, int n, const RealVector &x, RealVector &g, RealMatrix &grad_g, int &result_mode)
  
  constraint evaluator function which provides constraint values, gradients, and Hessians to OPT++ methods.
- static void constraint2_evaluator(int mode, int n, const RealVector &x, RealVector &g, RealMatrix &grad_g, OPTPP::OptppArray<RealSymMatrix> &hess_g, int &result_mode)
  
  constraint evaluator function which provides constraint values, gradients, and Hessians to OPT++ methods.

Private Attributes

- SNLLOptimizer * prevSnllOptInstance
  
  pointer to the previously active object instance used for restoration in the case of iterator/model recursion
- OPTPP::NLP0 * nlfObjective
  
  objective NLF base class pointer
• OPTPP::NLP0 * nlfConstraint
  constraint NLF base class pointer
• OPTPP::NLP * nlpConstraint
  constraint NLP pointer
• OPTPP::NLF0 * nlf0
  pointer to objective NLF for non-gradient optimizers
• OPTPP::NLF1 * nlf1
  pointer to objective NLF for (analytic) gradient-based optimizers
• OPTPP::NLF1 * nlf1Con
  pointer to constraint NLF for (analytic) gradient-based optimizers
• OPTPP::FDNLF1 * fdnlf1
  pointer to objective NLF for (finite diff) gradient-based optimizers
• OPTPP::FDNLF1 * fdnlf1Con
  pointer to constraint NLF for (finite diff) gradient-based optimizers
• OPTPP::NLF2 * nlf2
  pointer to objective NLF for full Newton optimizers
• OPTPP::NLF2 * nlf2Con
  pointer to constraint NLF for full Newton optimizers
• OPTPP::OptimizeClass * theOptimizer
  optimizer base class pointer
• OPTPP::OptPDS * optpds
  PDS optimizer pointer.
• OPTPP::OptCG * optcg
  CG optimizer pointer.
• OPTPP::OptLBFGS * optlbfgs
  L-BFGS optimizer pointer.
• OPTPP::OptNewton * optnewton
  Newton optimizer pointer.
• OPTPP::OptQNewton * optqnewton
  Quasi-Newton optimizer pointer.
• OPTPP::OptFDNewton * optfdnewton
  Finite Difference Newton opt pointer.
• OPTPP::OptBCNewton * optbcnewton
  Bound constrained Newton opt pointer.
• OPTPP::OptBCQNewton * optbcqnewton
  Bnd constrained Quasi-Newton opt ptr.
• OPTPP::OptBCFDNewton * optbcfdnewton
  Bnd constrained FD-Newton opt ptr.
• OPTPP::OptNIPS * optnips
  NIPS optimizer pointer.
• OPTPP::OptQNIPS * optqnips
  Quasi-Newton NIPS optimizer pointer.
• OPTPP::OptFDNIPS * optfdnips
Finite Difference NIPS opt pointer.

- **String setUpType**
  
  flag for iteration mode: "model" (normal usage) or "user functions" (user-supplied functions mode for "on the fly" instantiations). NonDReliability currently uses the user functions mode.

- **RealVector initialPoint**
  
  holds initial point passed in for "user functions" mode.

- **RealVector lowerBounds**
  
  holds variable lower bounds passed in for "user functions" mode.

- **RealVector upperBounds**
  
  holds variable upper bounds passed in for "user functions" mode.

**Static Private Attributes**

- **static SNLLOptimizer * snllOptInstance**
  
  pointer to the active object instance used within the static evaluator functions in order to avoid the need for static data.

**Additional Inherited Members**

### 13.184.1 Detailed Description

Wrapper class for the OPT++ optimization library.

The SNLLOptimizer class provides a wrapper for OPT++, a C++ optimization library of nonlinear programming and pattern search techniques from the Computational Sciences and Mathematics Research (CSMR) department at Sandia's Livermore CA site. It uses a function pointer approach for which passed functions must be either global functions or static member functions. Any attribute used within static member functions must be either local to that function, a static member, or accessed by static pointer.

The user input mappings are as follows: max_iterations, max_function_evaluations, convergence_tolerance, max_step, gradient_tolerance, search_method, and search_scheme_size are set using OPT++'ssetMaxIter(), setMaxFeval(), setFcnTol(), setMaxStep(), setGradTol(), setSearchStrategy(), and setSSS() member functions, respectively; output verbosity is used to toggle OPT++'s debug mode using the setDebug() member function. Internal to OPT++, there are 3 search strategies, while the DAKOTA search_method specification supports 4 (value_based_line_search, gradient_based_line_search, trust_region, or tr_pds). The difference stems from the "is_expensive" flag in OPT++. If the search strategy is LineSearch and "is_expensive" is turned on, then the value_based_line_search is used. Otherwise (the "is_expensive" default is off), the algorithm will use the gradient_based_line_search. Refer to [Meza, J.C., 1994] and to the OPT++ source in the Dakota/packages/OPTPP directory for information on OPT++ class member functions.

### 13.184.2 Constructor & Destructor Documentation

**SNLLOptimizer ( ProblemDescDB & problem_db, Model & model )**

standard constructor

This constructor is used for normal instantiations using data from the ProblemDescDB.

References Dakota::abort_handler(), Minimizer::boundConstraintFlag, SNLLBase::centeringParam, SNLLOptimizer::constraint0_evaluator(), SNLLOptimizer::constraint1_evaluator(), SNLLOptimizer::constraint2_evaluator(),
CHAPTER 13. CLASS DOCUMENTATION

**Iterator::convergenceTol, SNLLOptimizer::default_instantiate_newton(), SNLLOptimizer::default_instantiate_q_newton(), Model::fd_gradient_step_size(), SNLLOptimizer::fdnlf1, SNLLOptimizer::fdnlf1Con, ProblemDescDB::get_int(), ProblemDescDB::get_real(), SNLLBase::init_fn(), Model::interval_type(), Iterator::iteratedModel, Dakota::LARGE_SCALE, Iterator::maxEvalConcurrency, Iterator::maxFunctionEvals, Iterator::maxIterations, SNLLBase::maxStep, SNLLBase::meritFn, Iterator::method_enum_to_string(), Iterator::methodName, SNLLOptimizer::nlf0, SNLLOptimizer::nlf1_evaluator(), SNLLOptimizer::nlf1, SNLLOptimizer::nlf1Con, SNLLOptimizer::nlf2_evaluator(), SNLLOptimizer::nlfConstraint, SNLLOptimizer::nlfObjective, SNLLOptimizer::nlpConstraint, Minimizer::numConstraints, Minimizer::numContinuousVars, Minimizer::numNonlinearConstraints, SNLLOptimizer::optbcfdnewton, SNLLOptimizer::optbcqnewton, SNLLOptimizer::optcg, SNLLOptimizer::optfdnewton, SNLLOptimizer::optfnips, SNLLOptimizer::optlbfgs, SNLLOptimizer::optpds, SNLLOptimizer::optqnewton, SNLLOptimizer::optqnpips, Iterator::outputLevel, Iterator::probDescDB, SNLLBase::searchStrat, SNLLBase::snll_post_instantiate(), SNLLBase::snll_pre_instantiate(), SNLLOptimizer::theOptimizer, Minimizer::vendorNumericalGradFlag.**

**SNLLOptimizer ( const String & method_string, Model & model )**

alternate constructor for instantiations "on the fly"

This is an alternate constructor for instantiations on the fly using a `Model` but no `ProblemDescDB`.

References Dakota::abort_handler(), Minimizer::boundConstraintFlag, SNLLOptimizer::constraint1_evaluator(), SNLLOptimizer::constraint2_evaluator(), Iterator::convergenceTol, SNLLOptimizer::default_instantiate_newton(), SNLLOptimizer::default_instantiate_q_newton(), Model::fd_gradient_step_size(), Model::interval_type(), Iterator::iteratedModel, Iterator::maxFunctionEvals, Iterator::maxIterations, Iterator::method_enum_to_string(), Iterator::methodName, Minimizer::numConstraints, Minimizer::numContinuousVars, Iterator::outputLevel, SNLLBase::snll_initialize_run(), SNLLBase::snll_post_instantiate(), SNLLBase::snll_pre_instantiate(), SNLLOptimizer::theOptimizer, and Minimizer::vendorNumericalGradFlag.

**SNLLOptimizer ( const RealVector & initial_pt, const RealVector & var_lbnds, const RealVector & var_ubnds, const RealMatrix & lin_ineq_coeffs, const RealVector & lin_ineq_lbnds, const RealMatrix & lin_ineq_ubnds, const RealVector & nln_ineq_coeffs, const RealVector & nln_ineq_lbnds, const RealVector & nln_ineq_ubnds, const RealVector & &grad_f, int &result_mode) user_obf_eval, void(*)(int mode, int n, const RealVector &x, double &f, RealVector &grad_f, int &result_mode) user_con_eval )**

alternate constructor for instantiations "on the fly"

This is an alternate constructor for performing an optimization using the passed in objective function and constraint function pointers.

References Minimizer::bigRealBoundSize, Minimizer::boundConstraintFlag, SNLLOptimizer::default_instantiate_q_newton(), SNLLOptimizer::initialPoint, SNLLOptimizer::lowerBounds, SNLLOptimizer::nlfObjective, SNLLOptimizer::nlpConstraint, Minimizer::numConstraints, Minimizer::numContinuousVars, Iterator::outputLevel, SNLLBase::snll_initialize_run(), SNLLBase::snll_post_instantiate(), SNLLBase::snll_pre_instantiate(), SNLLOptimizer::theOptimizer, and SNLLOptimizer::upperBounds.

### 13.184.3 Member Function Documentation

**void nlf0_evaluator ( int n, const RealVector & x, double &f, int &result_mode ) [static], [private]**

objective function evaluator function for OPT++ methods which require only function values.

For use when DAKOTA computes f and gradients are not directly available. This is used by non-gradient-based optimizers such as PDS and by gradient-based optimizers in vendor numerical gradient mode (opt++’s internal finite difference routine is used).
References Model::continuous_variables(), Model::current_response(), Model::evaluate(), Response::function_value(), Iterator::iteratedModel, SNLLBase::lastEvalVars, SNLLBase::lastFnEvalLocn, Minimizer::numNonlinearConstraints, Iterator::outputLevel, Model::primary_response_fn_sense(), and SNLLOptimizer::snllOptInstance.

Referenced by SNLLOptimizer::SNLLOptimizer().

```cpp
void nlf1_evaluator ( int mode, int n, const RealVector & x, double & f, RealVector & grad_f, int & result_mode ) [static], [private]
```

Objective function evaluator function which provides function values and gradients to OPT++ methods.

For use when DAKOTA computes \( f \) and \( df/dX \) (regardless of gradient type). Vendor numerical gradient case is handled by nlf0_evaluator.

References Iterator::activeSet, Model::continuous_variables(), Model::current_response(), Model::evaluate(), Response::function_gradient_copy(), Response::function_value(), Iterator::iteratedModel, SNLLBase::lastEvalMode, SNLLBase::lastEvalVars, SNLLBase::lastFnEvalLocn, Minimizer::numNonlinearConstraints, Iterator::outputLevel, Model::primary_response_fn_sense(), ActiveSet::request_values(), and SNLLOptimizer::snllOptInstance.

Referenced by SNLLOptimizer::SNLLOptimizer().

```cpp
void nlf2_evaluator ( int mode, int n, const RealVector & x, double & f, RealVector & grad_f, RealSymMatrix & hess_f, int & result_mode ) [static], [private]
```

Objective function evaluator function which provides function values, gradients, and Hessians to OPT++ methods.

For use when DAKOTA computes \( f \), \( df/dX \), and \( d^2f/dx^2 \) from the ApplicationInterface (analytic only). Finite differencing does not make sense for a full Newton approach, since lack of analytic gradients & Hessian should dictate the use of quasi-newton or fd-newton. Thus, there is no fdnlf2_evaluator for use with full Newton approaches, since it is preferable to use quasi-newton or fd-newton with nlf1. Gauss-Newton does not fit this model; it uses nlf2_evaluator.gn instead of nlf2_evaluator.

References Iterator::activeSet, Model::continuous_variables(), Model::current_response(), Model::evaluate(), Response::function_gradient_copy(), Response::function_hessian(), Response::function_value(), Iterator::iteratedModel, SNLLBase::lastEvalMode, SNLLBase::lastEvalVars, SNLLBase::lastFnEvalLocn, Minimizer::numNonlinearConstraints, Iterator::outputLevel, Model::primary_response_fn_sense(), ActiveSet::request_values(), and SNLLOptimizer::snllOptInstance.

Referenced by SNLLOptimizer::SNLLOptimizer().

```cpp
void constraint0_evaluator ( int n, const RealVector & x, RealVector & g, int & result_mode ) [static], [private]
```

Constraint evaluator function for OPT++ methods which require only constraint values.

For use when DAKOTA computes \( g \) and gradients are not directly available. This is used by nongradient-based optimizers and by gradient-based optimizers in vendor numerical gradient mode (opt++’s internal finite difference routine is used).

References Model::continuous_variables(), SNLLBase::copy_con_vals_dak_to_optpp(), Model::current_response(), Model::evaluate(), Response::function_values(), Iterator::iteratedModel, SNLLBase::lastEvalVars, SNLLBase::lastFnEvalLocn, Optimizer::numObjectiveFns, Iterator::outputLevel, and SNLLOptimizer::snllOptInstance.

Referenced by SNLLOptimizer::SNLLOptimizer().

```cpp
void constraint1_evaluator ( int mode, int n, const RealVector & x, RealVector & g, RealMatrix & grad_g, int & result_mode ) [static], [private]
```

Constraint evaluator function which provides constraint values and gradients to OPT++ methods.
For use when DAKOTA computes \( g \) and \( \frac{dg}{dX} \) (regardless of gradient type). Vendor numerical gradient case is handled by constraint0_evaluator.

References Iterator::activeSet, Model::continuous variables(), SNLLBase::copy_con_grad(), SNLLBase::copy_con_vars_dak_to_optpp(), Model::current_response(), Model::evaluate(), Response::function_gradients(), Response::function_values(), Iterator::iteratedModel, SNLLBase::lastEvalMode, SNLLBase::lastEvalVars, SNLLBase::lastFnEvalLocn, Optimizer::numObjectiveFns, Iterator::outputLevel, ActiveSet::request_values(), and SNLLOptimizer::snllOptInstance.

Referenced by SNLLOptimizer::SNLLOptimizer().

```cpp
void constraint2_evaluator ( int mode, int n, const RealVector & x, RealVector & g, RealMatrix & grad_g, OPTPP::OptppArray<RealSymMatrix> & hess_g, int & result_mode ) [static], [private]
```

cost constraint evaluator function which provides constraint values, gradients, and Hessians to OPT++ methods.

For use when DAKOTA computes \( g, \frac{dg}{dX}, \) & \( \frac{d^2g}{dx^2} \) (analytic only).

References Iterator::activeSet, Model::continuous variables(), SNLLBase::copy_con_grad(), SNLLBase::copy_con_hess(), SNLLBase::copy_con_vars_dak_to_optpp(), Model::current_response(), Model::evaluate(), Response::function_gradients(), Response::function_hessians(), Response::function_values(), Iterator::iteratedModel, SNLLBase::lastEvalMode, SNLLBase::lastEvalVars, SNLLBase::lastFnEvalLocn, Optimizer::numObjectiveFns, Iterator::outputLevel, ActiveSet::request_values(), and SNLLOptimizer::snllOptInstance.

Referenced by SNLLOptimizer::SNLLOptimizer().

The documentation for this class was generated from the following files:

- SNLLOptimizer.hpp
- SNLLOptimizer.cpp

### 13.185 SOLBase Class Reference

Base class for Stanford SOL software.

Inheritance diagram for SOLBase:

```
SOLBase
   NLSSOLLeastSq
   NPSOLOptimizer
```

**Public Member Functions**

- **SOLBase ()**
  
  *default constructor*

- **SOLBase (Model &model)**
  
  *standard constructor*

- **~SOLBase ()**
  
  *destructor*
Protected Member Functions

- void **allocate_arrays** (int **num_cv**, size_t **num_nln_con**, const RealMatrix &**lin_ineq_coeffs**, const RealMatrix &**lin_eq_coeffs**)
  
  Allocates miscellaneous arrays for the SOL algorithms.

- void **deallocate_arrays** ()
  
  Deallocates memory previously allocated by allocate_arrays().

- void **allocate_workspace** (int **num_cv**, int **num_nln_con**, int **num_lin_con**, int **num_lsq**)
  
  Allocates real and integer workspaces for the SOL algorithms.

- void **set_options** (bool **speculative_flag**, bool **vendor_num_grad_flag**, short **output_lev**, int **verify_lev**, Real **fn_prec**, Real **linesrch_tol**, int **max_iter**, Real **constr_tol**, Real **conv_tol**, const std::string &**grad_type**, const RealVector &**fdss**)
  
  Sets SOL method options using calls to npoptn2.

  
  augments variable bounds with linear and nonlinear constraint bounds.

Static Protected Member Functions

- static void **constraint_eval** (int &**mode**, int &**ncnln**, int &**n**, int &**nrowj**, int *needc, double *x, double *c, double *jac, int &**nstate**)
  
  CONFUN in NPSOL manual: computes the values and first derivatives of the nonlinear constraint functions.

Protected Attributes

- int **realWorkSpaceSize**
  
  size of realWorkSpace

- int **intWorkSpaceSize**
  
  size of intWorkSpace

- RealArray **realWorkSpace**
  
  real work space for NPSOL/NLSSOL

- IntArray **intWorkSpace**
  
  int work space for NPSOL/NLSSOL

- int **nlnConstraintArraySize**
  
  used for non-zero array sizing (nonlinear constraints)

- int **linConstraintArraySize**
  
  used for non-zero array sizing (linear constraints)

- RealArray **cLambda**
  
  CLAMBDA from NPSOL manual: Langrange multipliers.

- IntArray **constraintState**
  
  ISTATE from NPSOL manual: constraint status.

- int **informResult**
  
  INFORM from NPSOL manual: optimization status on exit.

- int **numberIterations**
ITER from NPSOL manual: number of (major) iterations performed.

- int boundsArraySize
  length of augmented bounds arrays (variable bounds plus linear and nonlinear constraint bounds)
- double * linConstraintMatrixF77
  [A] matrix from NPSOL manual: linear constraint coefficients
- double * upperFactorHessianF77
- double * constraintJacMatrixF77
  [CJAC] matrix from NPSOL manual: nonlinear constraint Jacobian
- int fnEvalCnt
  counter for testing against maxFunctionEvals
- size_t constrOffset
  used in constraint_eval() to bridge NLSSOLLeastSq::numLeastSqTerms and NPSOLOptimizer::numObjectiveFns

Static Protected Attributes

- static SOLBase * solInstance
  pointer to the active object instance used within the static evaluator functions in order to avoid the need for static data
- static Minimizer * optLSqInstance
  pointer to the active base class object instance used within the static evaluator functions in order to avoid the need for static data

13.185.1 Detailed Description

Base class for Stanford SOL software.

The SOLBase class provides a common base class for NPSOLOptimizer and NLSSOLLeastSq, both of which are Fortran 77 sequential quadratic programming algorithms from Stanford University marketed by Stanford Business Associates.

The documentation for this class was generated from the following files:

- SOLBase.hpp
- SOLBase.cpp

13.186 SpawnApplicInterface Class Reference

Derived application interface class which spawns simulation codes using spawnvp.

Inheritance diagram for SpawnApplicInterface:
### Public Member Functions

- **SpawnApplicInterface** (const ProblemDescDB &problem_db)
  
  constructor

- **~SpawnApplicInterface** ()
  
  destructor

### Protected Member Functions

- void **wait_local_evaluations** (PRPQueue &prp_queue)

  For asynchronous function evaluations, this method is used to detect completion of jobs and process their results. It provides the processing code that is specific to derived classes. This version waits for at least one completion.

- void **test_local_evaluations** (PRPQueue &prp_queue)

  For asynchronous function evaluations, this method is used to detect completion of jobs and process their results. It provides the processing code that is specific to derived classes. This version is nonblocking and will return without any completions if none are immediately available.

- pid_t **create_analysis_process** (bool block_flag, bool new_group)

  spawn a child process for an analysis component within an evaluation

- size_t **wait_local_analyses** ()

  wait for asynchronous analyses on the local processor, completing at least one job

- size_t **test_local_analyses_send** (int analysis_id)

  test for asynchronous analysis completions on the local processor and return results for any completions by sending messages

### Additional Inherited Members

#### 13.186.1 Detailed Description

Derived application interface class which spawns simulation codes using spawnvp.

**SpawnApplicInterface** is used on Windows systems and is a peer to **ForkApplicInterface** for Unix systems.

The documentation for this class was generated from the following files:

- SpawnApplicInterface.hpp
- SpawnApplicInterface.cpp
13.187 SurfpackApproximation Class Reference

Derived approximation class for Surfpack approximation classes. Interface between Surfpack and Dakota. Inheritance diagram for SurfpackApproximation:

```
Approximation
  SurfpackApproximation
```

Public Member Functions

- **SurfpackApproximation ()**
  default constructor
- **SurfpackApproximation (const ProblemDescDB &problem_db, const SharedApproxData &shared_data, const String &approx_label)**
  standard constructor: Surfpack surface of appropriate type will be created
- **SurfpackApproximation (const SharedApproxData &shared_data)**
  alternate constructor
- **~SurfpackApproximation ()**
  destructor

Protected Member Functions

- **int min_coefficients () const**
  return the minimum number of samples (unknowns) required to build the derived class approximation type in numVars dimensions
- **int recommended_coefficients () const**
  return the recommended number of samples (unknowns) required to build the derived class approximation type in numVars dimensions
- **void build ()**
  SurfData object will be created from Dakota’s SurrogateData, and the appropriate Surfpack build method will be invoked.
- **void export_model (const String &fn_label, const String &export_prefix="", const unsigned short export_format=NO_MODEL_FORMAT)**
  export the Surpack model to disk or console
- **Real value (const Variables &vars)**
  Return the value of the Surfpack surface for a given parameter vector x.
- **const RealVector & gradient (const Variables &vars)**
  retrieve the approximate function gradient for a given parameter vector x
- **const RealSymMatrix & hessian (const Variables &vars)**
  retrieve the approximate function Hessian for a given parameter vector x
- **Real prediction_variance (const Variables &vars)**
  retrieve the variance of the predicted value for a given parameter set x (KrigingModel only)
• Real value (const RealVector &c_vars)
  Return the value of the Surfpack surface for a given parameter vector x.
• const RealVector & gradient (const RealVector &c_vars)
  retrieve the approximate function gradient for a given parameter vector x
• const RealSymMatrix & hessian (const RealVector &c_vars)
  retrieve the approximate function Hessian for a given parameter vector x
• Real prediction_variance (const RealVector &c_vars)
  retrieve the variance of the predicted value for a given parameter set x (KrigingModel only)
• bool diagnostics_available ()
  check if the diagnostics are available (true for the Surfpack types)
• Real diagnostic (const String &metric_type)
  retrieve a single diagnostic metric for the diagnostic type specified on the primary model and data
• Real diagnostic (const String &metric_type, const SurfpackModel &model, const SurfData &data)
  retrieve a single diagnostic metric for the diagnostic type specified on the given model and data
• void primary_diagnostics (int fn_index)
  compute and print all requested diagnostics and cross-validation
• void challenge_diagnostics (const RealMatrix &challenge_points, const RealVector &challenge_responses)
  compute and print all requested diagnostics for user provided challenge pts
• RealArray cv_diagnostic (const StringArray &metric_types, unsigned num_folds)
  compute and return cross-validation for metric_type with num_folds
• RealArray challenge_diagnostic (const StringArray &metric_types, const RealMatrix &challenge_points, const RealVector &challenge_responses)
  compute and print all requested diagnostics for user provided challenge pts

Private Member Functions

• SurfData * surrogates_to_surf_data ()
  copy from SurrogateData to SurfPoint/SurfData
• void add_anchor_to_surfdata (SurfData &surf_data)
  set the anchor point (including gradient and hessian if present) into surf_data

Private Attributes

• SurfpackModel * model
  The native Surfpack approximation.
• SurfpackModelFactory * factory
  factory for the SurfpackModel instance
• SurfData * surfData
  The data used to build the approximation, in Surfpack format.
Additional Inherited Members

13.187.1 Detailed Description

Derived approximation class for Surfpack approximation classes. Interface between Surfpack and Dakota.

The SurfpackApproximation class is the interface between Dakota and Surfpack. Based on the information in the ProblemDescDB that is passed in through the constructor, SurfpackApproximation builds a Surfpack Surface object that corresponds to one of the following data-fitting techniques: polynomial regression, kriging, artificial neural networks, radial basis function network, or multivariate adaptive regression splines (MARS).

13.187.2 Constructor & Destructor Documentation

SurfpackApproximation ( const ProblemDescDB & problem_db, const SharedApproxData & shared_data, const String & approx_label )

standard constructor: Surfpack surface of appropriate type will be created

Initialize the embedded Surfpack surface object and configure it using the specifications from the input file.

Data for the surface is created later.

References Dakota::abort_handler(), SharedSurfpackApproxData::approxOrder, SharedApproxData::approxType, SharedApproxData::buildDataOrder, Dakota::copy_data(), SharedSurfpackApproxData::crossValidateFlag, SharedSurfpackApproxData::diagnosticSet, SurfpackApproximation::factory, ProblemDescDB::get_real(), ProblemDescDB::get_rv(), ProblemDescDB::get_short(), ProblemDescDB::get_string(), SharedSurfpackApproxData::numFolds, SharedApproxData::numVars, SharedApproxData::outputLevel, SharedSurfpackApproxData::percentFold, and Approximation::sharedDataRep.

SurfpackApproximation ( const SharedApproxData & shared_data )

alternate constructor

On-the-fly constructor which uses mostly Surfpack model defaults.

References Dakota::abort_handler(), SharedSurfpackApproxData::approxOrder, SharedApproxData::approxType, SharedApproxData::buildDataOrder, SurfpackApproximation::factory, SharedApproxData::numVars, SharedApproxData::outputLevel, and Approximation::sharedDataRep.

13.187.3 Member Function Documentation

void build() [protected], [virtual]

SurfData object will be created from Dakota's SurrogateData, and the appropriate Surfpack build method will be invoked.

surfData will be deleted in dtor

Todo Right now, we’re completely deleting the old data and then recopying the current data into a SurfData object. This was just the easiest way to arrive at a solution that would build and run. This function is frequently called from addPoint rebuild, however, and it’s not good to go through this whole process every time one more data point is added.

Reimplemented from Approximation.

References Dakota::abort_handler(), SharedApproxData::approxCLowerBnds, SharedApproxData::approxCUpperBnds, SharedApproxData::approxDILowerBnds, SharedApproxData::approxDIUpperBnds, SharedApproxData::approxDRLowerBnds, SharedApproxData::approxDRUpperBnds, Approximation::build(), SurfpackApproximation::factory, SharedSurfpackApproxData::merge_variable_arrays(), SurfpackApproximation::model, Approximation::sharedDataRep, SurfpackApproximation::surfData, and SurfpackApproximation::surrogates_to_surf_data().
const RealSymMatrix & hessian ( const Variables & vars ) [protected], [virtual]
retrieve the approximate function Hessian for a given parameter vector x

Todo  Make this acceptably efficient

Reimplemented from Approximation.
References Dakota::abort_handler(), Approximation::approxHessian, SharedApproxData::approxType, Variables::cv(), SurfpackApproximation::model, and Approximation::sharedDataRep.
Referenced by SurfpackApproximation::add_anchor_to_surfdata().

const RealSymMatrix & hessian ( const RealVector & c_vars ) [protected], [virtual]
retrieve the approximate function Hessian for a given parameter vector x

Todo  Make this acceptably efficient

Reimplemented from Approximation.
References Dakota::abort_handler(), Approximation::approxHessian, SharedApproxData::approxType, SurfpackApproximation::model, and Approximation::sharedDataRep.

SurfData * surrogates_to_surf_data ( ) [private]
copy from SurrogateData to SurfPoint/SurfData
Copy the data stored in Dakota-style SurrogateData into Surfpack-style SurfPoint and SurfData objects.
References SurfpackApproximation::add_anchor_to_surfdata(), SharedSurfpackApproxData::add_sd_to_surfdata(), Approximation::approxData, SharedApproxData::buildDataOrder, SurfpackApproximation::factory, SharedApproxData::outputLevel, and Approximation::sharedDataRep.
Referenced by SurfpackApproximation::build().

void add_anchor_to_surfdata ( SurfData & surf_data ) [private]
set the anchor point (including gradient and hessian if present) into surf_data
If there is an anchor point, add an equality constraint for its response value. Also add constraints for gradient and hessian, if applicable.
References Dakota::abort_handler(), Approximation::approxData, Dakota::copy_data(), SharedSurfpackApproxData::copy_matrix(), SurfpackApproximation::gradient(), SurfpackApproximation::hessian(), SharedApproxData::outputLevel, SharedSurfpackApproxData::sdv_to_realarray(), and Approximation::sharedDataRep.
Referenced by SurfpackApproximation::surrogates_to_surf_data().
The documentation for this class was generated from the following files:

- SurfpackApproximation.hpp
- SurfpackApproximation.cpp

13.188  SurrBasedGlobalMinimizer Class Reference

The global surrogate-based minimizer which sequentially minimizes and updates a global surrogate model without trust region controls.

Inheritance diagram for SurrBasedGlobalMinimizer:
Public Member Functions

- **SurrBasedGlobalMinimizer (ProblemDescDB &problem\_db, Model &model)**
  
  *constructor*

- **~SurrBasedGlobalMinimizer ()**

  *destructor*

Protected Member Functions

- **void core\_run ()**

  *Performs global surrogate-based optimization by repeatedly optimizing on and improving surrogates of the response functions.*

- **bool returns\_multiple\_points () const**

  *Global surrogate-based methods can return multiple points.*

Private Attributes

- **bool replacePoints**

  *flag for replacing the previous iteration’s point additions, rather than continuing to append, during construction of the next surrogate*

Additional Inherited Members

13.188.1 Detailed Description

The global surrogate-based minimizer which sequentially minimizes and updates a global surrogate model without trust region controls.

This method uses a SurrogateModel to perform minimization (optimization or nonlinear least squares) through a set of iterations. At each iteration, a surrogate is built, the surrogate is minimized, and the optimal points from the surrogate are then evaluated with the "true" function, to generate new points upon which the surrogate for the next iteration is built.

The documentation for this class was generated from the following files:

- SurrBasedGlobalMinimizer.hpp
- SurrBasedGlobalMinimizer.cpp
13.189  SurrBasedLocalMinimizer Class Reference

Class for provably-convergent local surrogate-based optimization and nonlinear least squares.

Inheritance diagram for SurrBasedLocalMinimizer:

```
Iterator
  Minimizer
    SurrBasedMinimizer
      SurrBasedLocalMinimizer
```

Public Member Functions

- **SurrBasedLocalMinimizer** *(ProblemDescDB &problem_db, Model &model)*  
  constructor

- **~SurrBasedLocalMinimizer ()**  
  destructor

Protected Member Functions

- void **core_run ()**  
  Performs local surrogate-based minimization by minimizing local, global, or hierarchical surrogates over a series of trust regions.

- void **reset ()**  
  reset convergence controls in case of multiple SBLM executions

Private Member Functions

- bool **tr_bounds** *(const RealVector &global_lower_bnds, const RealVector &global_upper_bnds, RealVector &tr_lower_bnds, RealVector &tr_upper_bnds)*  
  compute current trust region bounds

- void **find_center_truth** *(const Iterator &dace_iterator, Model &truth_model)*  
  retrieve responseCenterTruth if possible, evaluate it if not

- void **find_center_approx ()**  
  retrieve responseCenter_approx if possible, evaluate it if not

- void **hard_convergence_check** *(const Response &response_truth, const RealVector &c_vars, const RealVector &lower_bnds, const RealVector &upper_bnds)*  
  check for hard convergence (norm of projected gradient of merit function near zero)

- void **tr_ratio_check** *(const RealVector &c_vars_star, const RealVector &tr_lower_bounds, const RealVector &tr_upper_bounds)*  
  compute trust region ratio (for SBLM iterate acceptance and trust region resizing) and check for soft convergence (diminishing returns)
CHAPTER 13. CLASS DOCUMENTATION

- **void update_penalty** (const RealVector &fns_center_truth, const RealVector &fns_star_truth)
  
  initialize and update the penaltyParameter

- **void relax_constraints** (const RealVector &lower_bnds, const RealVector &upper_bnds)
  
  relax constraints by updating bounds when current iterate is infeasible

### Static Private Member Functions

- **static void approx_subprob_objective_eval** (const Variables &surrogate_vars, const Variables &recast_vars, const Response &surrogate_response, Response &recast_response)
  
  static function used to define the approximate subproblem objective.

- **static void approx_subprob_constraint_eval** (const Variables &surrogate_vars, const Variables &recast_vars, const Response &surrogate_response, Response &recast_response)
  
  static function used to define the approximate subproblem constraints.

- **static void hom_objective_eval** (int &mode, int &n, double *tau and x, double &f, double *grad_f, int &)
  
  static function used by NPSOL as the objective function in the homotopy constraint relaxation formulation.

- **static void hom_constraint_eval** (int &mode, int &ncnln, int &n, int &nrowj, int *needc, double *tau and x, double *c, double *cjac, int &nstate)
  
  static function used by NPSOL as the constraint function in the homotopy constraint relaxation formulation.

### Private Attributes

- **Real origTrustRegionFactor**
  
  original user specification for trustRegionFactor

- **Real trustRegionFactor**
  
  the trust region factor is used to compute the total size of the trust region – it is a percentage, e.g. for trustRegionFactor = 0.1, the actual size of the trust region will be 10% of the global bounds (upper bound - lower bound for each design variable).

- **Real minTrustRegionFactor**
  
  a soft convergence control: stop SBLM when the trust region factor is reduced below the value of minTrustRegionFactor

- **Real trRatioContractValue**
  
  trust region ratio min value: contract tr if ratio below this value

- **Real trRatioExpandValue**
  
  trust region ratio sufficient value: expand tr if ratio above this value

- **Real gammaContract**
  
  trust region contraction factor

- **Real gammaExpand**
  
  trust region expansion factor

- **short approxSubProbObj**
  
  type of approximate subproblem objective: ORIGINAL_OBJ, LAGRANGIAN_OBJ, or AUGMENTED_LAGRANGIAN_OBJ

- **short approxSubProbCon**
  
  type of approximate subproblem constraints: NO_CON, LINEARIZED_CON, or ORIGINAL_CON

- **Model approxSubProbModel**
the approximate sub-problem formulation solved on each approximate minimization cycle: may be a shallow copy of iteratedModel, or may involve a RecastModel recursion applied to iteratedModel

- **bool recastSubProb**
  - flag to indicate when approxSubProbModel involves a RecastModel recursion

- **short trConstraintRelax**
  - type of trust region constraint relaxation for infeasible starting points: NO_RELAX or HOMOTOPY

- **short meritFnType**
  - type of merit function used in trust region ratio logic: PENALTY_MERIT, ADAPTIVE_PENALTY_MERIT, LAGRANGIAN_MERIT, or AUGMENTED_LAGRANGIAN_MERIT

- **short acceptLogic**
  - type of iterate acceptance test logic: FILTER or TR_RATIO

- **int penaltyIterOffset**
  - iteration offset used to update the scaling of the penalty parameter for adaptive penalty merit functions

- **short convergenceFlag**
  - code indicating satisfaction of hard or soft convergence conditions

- **unsigned short softConvCount**
  - number of consecutive candidate point rejections. If the count reaches softConvLimit, stop SBLM.

- **unsigned short softConvLimit**
  - the limit on consecutive candidate point rejections. If exceeded by softConvCount, stop SBLM.

- **bool truthGradientFlag**
  - flags the use/availability of truth gradients within the SBLM process

- **bool approxGradientFlag**
  - flags the use/availability of surrogate gradients within the SBLM process

- **bool truthHessianFlag**
  - flags the use/availability of truth Hessians within the SBLM process

- **bool approxHessianFlag**
  - flags the use/availability of surrogate Hessians within the SBLM process

- **short correctionType**
  - flags the use of surrogate correction techniques at the center of each trust region

- **bool globalApproxFlag**
  - flags the use of a global data fit surrogate (rsm, ann, mars, kriging)

- **bool multiptApproxFlag**
  - flags the use of a multipoint data fit surrogate (TANA)

- **bool localApproxFlag**
  - flags the use of a local data fit surrogate (Taylor series)

- **bool hierarchApproxFlag**
  - flags the use of a model hierarchy/multifidelity surrogate

- **bool newCenterFlag**
  - flags the acceptance of a candidate point and the existence of a new trust region center

- **bool daceCenterPtFlag**
  - flags the availability of the center point in the DACE evaluations for global approximations (CCD, Box-Behnken)

- **bool multiLayerBypassFlag**
flags the simultaneous presence of two conditions: (1) additional layerings w/i actual model (e.g., surrogateModel = layered/nested/layered -> actual_model = nested/layered), and (2) a user-specification to bypass all layerings within actual_model for the evaluation of truth data (responseCenterTruth and responseStarTruth).

• bool useDerivsFlag
  flag for the "use derivatives" specification for which derivatives are to be evaluated at each DACE point in global surrogate builds.

• RealVector nonlinIneqLowerBndsSlack
  individual violations of nonlinear inequality constraint lower bounds

• RealVector nonlinIneqUpperBndsSlack
  individual violations of nonlinear inequality constraint upper bounds

• RealVector nonlinEqTargetsSlack
  individual violations of nonlinear equality constraint targets

• Real tau
  constraint relaxation parameter

• Real alpha
  constraint relaxation parameter backoff parameter (multiplier)

• Variables varsCenter
  variables at the trust region center

• Response responseCenterApprox
  approx response at trust region center

• Response responseStarApprox
  approx response at SBLM cycle minimum

• IntResponsePair responseCenterTruth
  truth response at trust region center

• IntResponsePair responseStarTruth
  truth response at SBLM cycle minimum

Static Private Attributes

• static SurrBasedLocalMinimizer * sblmInstance
  pointer to SBLM instance used in static member functions

Additional Inherited Members

13.189.1 Detailed Description

Class for provably-convergent local surrogate-based optimization and nonlinear least squares.

This minimizer uses a SurrogateModel to perform minimization based on local, global, or hierarchical surrogates. It achieves provable convergence through the use of a sequence of trust regions and the application of surrogate corrections at the trust region centers.
13.189.2 Member Function Documentation

void core_run ( ) [protected], [virtual]

Performs local surrogate-based minimization by minimizing local, global, or hierarchical surrogates over a series of trust regions.

Trust region-based strategy to perform surrogate-based optimization in subregions (trust regions) of the parameter space. The minimizer operates on approximations in lieu of the more expensive simulation-based response functions. The size of the trust region is varied according to the goodness of the agreement between the approximations and the true response functions.

Reimplemented from Iterator.

References Dakota::abort_handler(), Response::active_set(), Iterator::active_set(), Model::active_variables(), OutputManager::add_datapoint(), DiscrepancyCorrection::apply(), SurrBasedLocalMinimizer::approxGradientFlag, SurrBasedLocalMinimizer::approxSubProbModel, Iterator::bestResponseArray, Model::build_approximation(), SurrBasedLocalMinimizer::constraint_violation(), Minimizer::constraintTol, SurrBasedLocalMinimizer::convergenceFlag, Iterator::bestVariablesArray, Model::build_approximation(), SurrBasedLocalMinimizer::convergenceFlag, Variables::copy(), Dakota::copy_data(), SurrBasedLocalMinimizer::correctionType, Model::current_response(), Model::current_variables(), SurrBasedLocalMinimizer::daceCenterPtFlag, Model::discrepancy_correction(), Model::evaluate(), Model::evaluation_id(), SurrBasedLocalMinimizer::find_center_approx(), SurrBasedLocalMinimizer::find_center_truth(), SurrBasedLocalMinimizer::globalApproxFlag, SurrBasedLocalMinimizer::hard_convergence_check(), Model::interface_id(), Iterator::is_null(), Iterator::iteratedModel, SurrBasedLocalMinimizer::localApproxFlag, Iterator::maxIterations, Iterator::methodPCIter, SurrBasedLocalMinimizer::minTrustRegionFactor, SurrBasedLocalMinimizer::miPLIndex, SurrBasedLocalMinimizer::multiLayerBypassFlag, SurrBasedLocalMinimizer::multiptApproxFlag, SurrBasedLocalMinimizer::newCenterFlag, Model::nonlinear_eq_constraint_targets(), Model::nonlinear_eq_constraint_upper_bounds(), Model::nonlinear_ineq_constraint_lower_bounds(), Model::nonlinear_ineq_constraint_upper_bounds(), Minimizer::numContinuousVars, SurrBasedMinimizer::origNonlinEqTargets, SurrBasedMinimizer::origNonlinIneqLowerBounds, SurrBasedMinimizer::origNonlinIneqUpperBounds, ParallelLibrary::output_manager(), Iterator::parallelLib, SurrBasedLocalMinimizer::recastSubProb, SurrBasedLocalMinimizer::relax_constraints(), ActiveSet::request_values(), SurrBasedLocalMinimizer::reset(), Iterator::response_results(), SurrBasedLocalMinimizer::response_center_approx(), SurrBasedLocalMinimizer::responseCenterApprox, SurrBasedLocalMinimizer::responseStartApprox, SurrBasedLocalMinimizer::responseStartTruth, SurrBasedLocalMinimizer::responseStarApprox, SurrBasedLocalMinimizer::responseStarTruth, Iterator::run(), Iterator::sampling_scheme(), SurrBasedMinimizer::sblmInstance, SurrBasedLocalMinimizer::softConvCount, SurrBasedLocalMinimizer::softConvLimit, Model::subordinate_iterator(), Model::surrogate_model(), Model::surrogate_response_model(), SurrBasedLocalMinimizer::tr_bounds(), SurrBasedLocalMinimizer::tr_ratio_check(), SurrBasedLocalMinimizer::trConstraintRelax, SurrBasedLocalMinimizer::trustRegionFactor, Model::truth_model(), SurrBasedLocalMinimizer::trustGradientFlag, SurrBasedLocalMinimizer::truthHessianFlag, Response::update(), SurrBasedLocalMinimizer::useDerivsFlag, Iterator::variables_results(), and SurrBasedLocalMinimizer::varsCenter.

void hard_convergence_check ( const Response & response_truth, const RealVector & c_vars, const RealVector & lower_bnds, const RealVector & upper_bnds ) [private]

check for hard convergence (norm of projected gradient of merit function near zero)

The hard convergence check computes the gradient of the merit function at the trust region center, performs a projection for active bound constraints (removing any gradient component directed into an active bound), and signals convergence if the 2-norm of this projected gradient is less than convergenceTol.

References SurrBasedLocalMinimizer::acceptLogic, SurrBasedLocalMinimizer::approxSubProbObj, SurrBasedMinimizer::constraint_violation(), Minimizer::constraintTol, SurrBasedLocalMinimizer::convergenceFlag, Iterator::convergenceTol, Response::function_gradients(), Response::function_values(), Iterator::iteratedModel, SurrBasedMinimizer::lagrangian_gradient(), SurrBasedLocalMinimizer::meritFnType, Minimizer::numContinuousVars, Minimizer::...
CHAPTER 13. CLASS DOCUMENTATION

::numNonlinearConstraints, SurrBasedMinimizer::origNonlinEqTargets, SurrBasedMinimizer::origNonlinIneqLowerBnds, SurrBasedMinimizer::origNonlinIneqUpperBnds, Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), SurrBasedMinimizer::sbIterNum, SurrBasedLocalMinimizer::truthGradientFlag, SurrBasedMinimizer::update_augmented_lagrange_multipliers(), SurrBasedMinimizer::update_filter(), and SurrBasedMinimizer::update_lagrange_multipliers.

Referenced by SurrBasedLocalMinimizer::core_run().

```cpp
void tr_ratio_check ( const RealVector & e_vars_star, const RealVector & tr_lower_bnds, const RealVector & tr_upper_bnds ) [private]
```

compute trust region ratio (for SBLM iterate acceptance and trust region resizing) and check for soft convergence (diminishing returns)

Assess acceptance of SBLM iterate (trust region ratio or filter) and compute soft convergence metrics (number of consecutive failures, min trust region size, etc.) to assess whether the convergence rate has decreased to a point where the process should be terminated (diminishing returns).

References SurrBasedLocalMinimizer::acceptLogic, SurrBasedLocalMinimizer::approxSubProbObj, SurrBasedMinimizer::augmented_lagrangian_merit(), SurrBasedMinimizer::constraintViolation(), Minimizer::constraintTol, Iterator::convergenceTol, SurrBasedMinimizer::etaSequence, Response::function_values(), SurrBasedLocalMinimizer::gammaContract, SurrBasedLocalMinimizer::gammaExpand, SurrBasedLocalMinimizer::globalApproxFlag, Iterator::iteratedModel, SurrBasedMinimizer::lagrangian_merit(), SurrBasedLocalMinimizer::meritFnType, SurrBasedLocalMinimizer::newCenterFlag, Minimizer::numContinuousVars, SurrBasedMinimizer::origNonlinEqTargets, SurrBasedMinimizer::origNonlinIneqLowerBnds, SurrBasedMinimizer::origNonlinIneqUpperBnds, SurrBasedMinimizer::penalty_merit(), Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), SurrBasedLocalMinimizer::responseCenterApprox, SurrBasedLocalMinimizer::responseCenterTruth, SurrBasedLocalMinimizer::responseStarApprox, SurrBasedLocalMinimizer::responseStarTruth, SurrBasedLocalMinimizer::softConvCount, SurrBasedLocalMinimizer::trRatioContractValue, SurrBasedLocalMinimizer::trRatioExpandValue, SurrBasedLocalMinimizer::trustRegionFactor, SurrBasedMinimizer::update_augmented_lagrange_multipliers(), SurrBasedMinimizer::update_filter(), and SurrBasedLocalMinimizer::update_penalty().

Referenced by SurrBasedLocalMinimizer::core_run().

```cpp
void update_penalty ( const RealVector & fns_center_truth, const RealVector & fns_star_truth ) [private]
```

initialize and update the penaltyParameter

Scaling of the penalty value is important to avoid rejecting SBLM iterates which must increase the objective to achieve a reduction in constraint violation. In the basic penalty case, the penalty is ramped exponentially based on the iteration counter. In the adaptive case, the ratio of relative change between center and star points for the objective and constraint violation values is used to rescale penalty values.

References SurrBasedMinimizer::alphaEta, SurrBasedLocalMinimizer::approxSubProbObj, SurrBasedMinimizer::constraintViolation(), Minimizer::constraintTol, SurrBasedMinimizer::eta, SurrBasedMinimizer::etaSequence, Iterator::iteratedModel, SurrBasedLocalMinimizer::meritFnType, Minimizer::objective(), SurrBasedLocalMinimizer::penaltyIterOffset, SurrBasedMinimizer::penaltyParameter, Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), and SurrBasedMinimizer::sbIterNum.

Referenced by SurrBasedLocalMinimizer::tr_ratio_check().

```cpp
void approx_subprob_objective_eval ( const Variables & surrogate_vars, const Variables & recast_vars, const Response & surrogate_response, Response & recast_response ) [static], [private]
```

static function used to define the approximate subproblem objective.

Objective functions evaluator for solution of approximate subproblem using a RecastModel.
References Response::active_set_request_vector(), SurrBasedLocalMinimizer::approxSubProbCon, SurrBasedLocalMinimizer::approxSubProbModel, SurrBasedLocalMinimizer::approxSubProbObj, SurrBasedMinimizer::augmented_lagrangian_gradient(), SurrBasedMinimizer::augmented_lagrangian_merit(), Response::function_gradient(), Response::function_gradient_view(), Response::function_gradients(), Response::function_value(), Response::function_values(), Iterator::iteratedModel, SurrBasedMinimizer::lagrangian_gradient(), SurrBasedMinimizer::lagrangian_merit(), Model::linear_eq_constraint_targets(), Model::linear_ineq_constraint_lower_bounds(), Model::linear_ineq_constraint_upper_bounds(), Minimizer::numUserPrimaryFns, Minimizer::objective(), Minimizer::objective_gradient(), SurrBasedMinimizer::origNonlinEqTargets, SurrBasedMinimizer::origNonlinIneqLowerBnds, SurrBasedMinimizer::origNonlinIneqUpperBnds, Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), and SurrBasedLocalMinimizer::sblmInstance.

Referenced by SurrBasedLocalMinimizer::SurrBasedLocalMinimizer().

```cpp
void approx_subprob_constraint_eval ( const Variables & surrogate_vars, const Variables & recast_vars, const Response & surrogate_response, Response & recast_response ) [static], [private]
```

static function used to define the approximate subproblem constraints.

Constraint functions evaluator for solution of approximate subproblem using a RecastModel.

References Response::active_set_derivative_vector(), Response::active_set_request_vector(), SurrBasedLocalMinimizer::approxSubProbCon, SurrBasedLocalMinimizer::approxSubProbModel, SurrBasedLocalMinimizer::approxSubProbObj, Variables::continuous_variables(), Response::function_gradient(), Response::function_gradient_view(), Response::function_gradients(), Response::function_value(), Response::function_values(), Minimizer::numUserPrimaryFns, SurrBasedLocalMinimizer::sblmInstance, Appx, SurrBasedLocalMinimizer::sblmInstance, and SurrBasedLocalMinimizer::varsCenter.

Referenced by SurrBasedLocalMinimizer::SurrBasedLocalMinimizer().

```cpp
void hom_objective_eval ( int & mode, int & n, double * tau_and_x, double & f, double * grad_f, int & ) [static], [private]
```

static function used by NPSOL as the objective function in the homotopy constraint relaxation formulation.

NPSOL objective functions evaluator for solution of homotopy constraint relaxation parameter optimization. This constrained optimization problem performs the update of the tau parameter in the homotopy heuristic approach used to relax the constraints in the original problem.

Referenced by SurrBasedLocalMinimizer::relax_constraints().

```cpp
void hom_constraint_eval ( int & mode, int & nln, int & n, int & nrowj, int * needc, double * tau_and_x, double * c, double * cjac, int & nstate ) [static], [private]
```

static function used by NPSOL as the constraint function in the homotopy constraint relaxation formulation.

NPSOL constraint functions evaluator for solution of homotopy constraint relaxation parameter optimization. This constrained optimization problem performs the update of the tau parameter in the homotopy heuristic approach used to relax the constraints in the original problem.

References Response::active_set(), SurrBasedLocalMinimizer::approxSubProbModel, Model::continuous_variables(), Model::current_response(), Model::evaluate(), Response::function_gradients(), Response::function_values(), SurrBasedLocalMinimizer::nonlinEqTargetsSlack, SurrBasedLocalMinimizer::nonlinIneqLowerBndsSlack, SurrBasedLocalMinimizer::nonlinIneqUpperBndsSlack, Model::num_functions(), Minimizer::numNonlinearEqConstraints, Minimizer::numNonlinearIneqConstraints, ActiveSet::request_vector(), SurrBasedLocalMinimizer::sblmInstance, and SurrBasedLocalMinimizer::tau.

Referenced by SurrBasedLocalMinimizer::relax_constraints().

The documentation for this class was generated from the following files:

- SurrBasedLocalMinimizer.hpp
- SurrBasedLocalMinimizer.cpp
13.190 **SurrBasedMinimizer Class Reference**

Base class for local/global surrogate-based optimization/least squares.

Inheritance diagram for SurrBasedMinimizer:

```
    Iterator
     |  \\
     |   \\
     |    Minimizer
     |     |  \\
     |     |   \\
     |     |    SurrBasedMinimizer
     |     |     |  \\
     |     |     |   \\
     |     |     |    EffGlobalMinimizer
     |     |     |     |  \\
     |     |     |     |   \\
     |     |     |     |    SurrBasedGlobalMinimizer
     |     |     |     |     |  \\
     |     |     |     |     |   \\
     |     |     |     |     |    SurrBasedLocalMinimizer
```

**Protected Member Functions**

- **SurrBasedMinimizer** *(ProblemDescDB &problem_db, Model &model)*
  
  *constructor*

- **~SurrBasedMinimizer** ()
  
  *destructor*

- void **derived_init_communicators** (ParLevLIter pl_iter)
  
  derived class contributions to initializing the communicators associated with this *Iterator* instance

- void **derived_set_communicators** (ParLevLIter pl_iter)
  
  derived class contributions to setting the communicators associated with this *Iterator* instance

- void **derived_free_communicators** (ParLevLIter pl_iter)
  
  derived class contributions to freeing the communicators associated with this *Iterator* instance

- void **initialize_graphics** (int iterator_server_id=1)
  
  initialize graphics customized for surrogate-based iteration

- void **print_results** (std::ostream &s)

- void **update_lagrange_multipliers** (const RealVector &fn_vals, const RealMatrix &fn_grads)
  
  initialize and update Lagrange multipliers for basic Lagrangian

- void **update_augmented_lagrange_multipliers** (const RealVector &fn_vals)
  
  initialize and update the Lagrange multipliers for augmented Lagrangian

- bool **update_filter** (const RealVector &fn_vals)

  update a filter from a set of function values

- Real **lagrangian_merit** (const RealVector &fn_vals, const BoolDeque &sense, const RealVector &primary_wts, const RealVector &nln_ineq_l_bnds, const RealVector &nln_ineq_u_bnds, const RealVector &nln_eq_tgts)

  compute a Lagrangian function from a set of function values

- void **lagrangian_gradient** (const RealVector &fn_vals, const RealMatrix &fn_grads, const BoolDeque &sense, const RealVector &primary_wts, const RealVector &nln_ineq_l_bnds, const RealVector &nln_ineq_u_bnds, const RealVector &nln_eq_tgts, RealVector &lag_grad)

  compute the gradient of the Lagrangian function
• Real augmented_lagrangian_merit (const RealVector &fn_vals, const BoolDeque &sense, const RealVector &primary_wts, const RealVector &nln_ineq_l_bnds, const RealVector &nln_ineq_u_bnds, const RealVector &nln_eq_tgts)
  
  compute an augmented Lagrangian function from a set of function values

• void augmented_lagrangian_gradient (const RealVector &fn_vals, const RealMatrix &fn_grads, const BoolDeque &sense, const RealVector &primary_wts, const RealVector &nln_ineq_l_bnds, const RealVector &nln_ineq_u_bnds, const RealVector &nln_eq_tgts, RealVector &alag_grad)
  
  compute the gradient of the augmented Lagrangian function

• Real penalty_merit (const RealVector &fn_vals, const BoolDeque &sense, const RealVector &primary_wts)
  
  compute a penalty function from a set of function values

• void penalty_gradient (const RealVector &fn_vals, const RealMatrix &fn_grads, const BoolDeque &sense, const RealVector &primary_wts, RealVector &pen_grad)
  
  compute the gradient of the penalty function

• Real constraint_violation (const RealVector &fn_vals, const Real &constraint_tol)
  
  compute the constraint violation from a set of function values

Protected Attributes

• Iterator approxSubProbMinimizer
  
  the minimizer used on the surrogate model to solve the approximate subproblem on each surrogate-based iteration

• int sbIterNum
  
  surrogate-based minimization iteration number

• RealVectorList sbFilter
  
  Set of response function vectors defining a filter (objective vs. constraint violation) for iterate selection/rejection.

• RealVector lagrangeMult
  
  Lagrange multipliers for basic Lagrangian calculations.

• RealVector augLagrangeMult
  
  Lagrange multipliers for augmented Lagrangian calculations.

• Real penaltyParameter
  
  the penalization factor for violated constraints used in quadratic penalty calculations; increased in update_penalty()

• RealVector origNonlinIneqLowerBnds
  
  original nonlinear inequality constraint lower bounds (no relaxation)

• RealVector origNonlinIneqUpperBnds
  
  original nonlinear inequality constraint upper bounds (no relaxation)

• RealVector origNonlinEqTargets
  
  original nonlinear equality constraint targets (no relaxation)

• Real eta
  
  constant used in etaSequence updates

• Real alphaEta
  
  power for etaSequence updates when updating penalty

• Real betaEta
  
  power for etaSequence updates when updating multipliers

• Real etaSequence
CHAPTER 13. CLASS DOCUMENTATION

**-decreasing sequence of allowable constraint violation used in augmented Lagrangian updates (refer to Conn, Gould, and Toint, section 14.4)**

- size_t miPLIndex
  - index for the active ParallelLevel within ParallelConfiguration::miPLIters

### Additional Inherited Members

#### 13.190.1 Detailed Description

Base class for local/global surrogate-based optimization/least squares.

These minimizers use a *SurrogateModel* to perform optimization based either on local trust region methods or global updating methods.

#### 13.190.2 Member Function Documentation

**void print_results (std::ostream &s) [protected], [virtual]**

Redefines default iterator results printing to include optimization results (objective functions and constraints). Reimplemented from *Iterator*. References Dakota::abort_handler(), Iterator::activeSet, Minimizer::archive_allocate_best(), Minimizer::archive_best(), Iterator::bestResponseArray, Iterator::bestVariablesArray, Dakota::data_pairs, Model::interface_id(), Iterator::iteratedModel, Dakota::lookup_by_val(), Iterator::methodName, Minimizer::numFunctions, Minimizer::numUserPrimaryFns, Minimizer::optimizationFlag, ActiveSet::request_values(), and Model::truth_model().

**void update_lagrange_multipliers (const RealVector &fn_vals, const RealMatrix &fn_grads) [protected]**

initialize and update Lagrange multipliers for basic Lagrangian

For the Rockafellar augmented Lagrangian, simple Lagrange multiplier updates are available which do not require the active constraint gradients. For the basic Lagrangian, Lagrange multipliers are estimated through solution of a nonnegative linear least squares problem. References Dakota::abort_handler(), Minimizer::bigRealBoundSize, Minimizer::constraintTol, Iterator::iteratedModel, SurrBasedMinimizer::lagrangeMult, Minimizer::numContinuousVars, Minimizer::numNonlinearEqConstraints, Minimizer::numNonlinearIneqConstraints, Minimizer::numUserPrimaryFns, Minimizer::objective_gradient(), SurrBasedMinimizer::origNonlinIneqLowerBnds, SurrBasedMinimizer::origNonlinIneqUpperBnds, Model::primary_response_fn_sense(), and Model::primary_response_fn_weights(). Referenced by SurrBasedLocalMinimizer::hard_convergence_check().

**void update_augmented_lagrange_multipliers (const RealVector &fn_vals) [protected]**

initialize and update the Lagrange multipliers for augmented Lagrangian

For the Rockafellar augmented Lagrangian, simple Lagrange multiplier updates are available which do not require the active constraint gradients. For the basic Lagrangian, Lagrange multipliers are estimated through solution of a nonnegative linear least squares problem. References SurrBasedMinimizer::augLagrangeMult, SurrBasedMinimizer::betaEta, Minimizer::bigRealBoundSize, SurrBasedMinimizer::etaSequence, Minimizer::numNonlinearEqConstraints, Minimizer::numNonlinearIneqConstraints, Minimizer::numUserPrimaryFns, SurrBasedMinimizer::origNonlinEqTargets, SurrBasedMinimizer::origNonlinIneqLowerBnds, SurrBasedMinimizer::origNonlinIneqUpperBnds, and SurrBasedMinimizer::penaltyParameter.

Referenced by SurrBasedLocalMinimizer::hard_convergence_check(), EffGlobalMinimizer::minimize_surrogates_on_model(), and SurrBasedLocalMinimizer::tr_ratio_check().
`bool update_filter ( const RealVector & fn_vals ) [protected]`

update a filter from a set of function values

Update the sbFilter with fn_vals if new iterate is non-dominated.

References SurrBasedMinimizer::constraint_violation(), Iterator::iteratedModel, Minimizer::numNonlinearConstraints, Minimizer::objective(), Model::primary_response_fn_sense(), Model::primary_response_fn_weights(), and SurrBasedMinimizer::sbFilter.

Referenced by SurrBasedLocalMinimizer::hard_convergence_check(), and SurrBasedLocalMinimizer::tr_ratio_check().

`Real lagrangian_merit ( const RealVector & fn_vals, const BoolDeque & sense, const RealVector & primary_wts, const RealVector & nln_ineq_lbnds, const RealVector & nln_ineq_ubnds, const RealVector & nln_eq_tgts ) [protected]`

compute a Lagrangian function from a set of function values

The Lagrangian function computation sums the objective function and the Lagrange multiplier terms for inequality/equality constraints. This implementation follows the convention in Vanderplaats with \(g < 0\) and \(h = 0\). The bounds/targets passed in may reflect the original constraints or the relaxed constraints.

References Minimizer::bigRealBoundSize, Minimizer::constraintTol, SurrBasedMinimizer::lagrangeMult, Minimizer::numNonlinearEqConstraints, Minimizer::numNonlinearIneqConstraints, Minimizer::numUserPrimaryFns, and Minimizer::objective().

Referenced by SurrBasedLocalMinimizer::approx_subprob_objective_eval(), and SurrBasedLocalMinimizer::tr_ratio_check().

`Real augmented_lagrangian_merit ( const RealVector & fn_vals, const BoolDeque & sense, const RealVector & primary_wts, const RealVector & nln_ineq_lbnds, const RealVector & nln_ineq_ubnds, const RealVector & nln_eq_tgts ) [protected]`

compute an augmented Lagrangian function from a set of function values

The Rockafellar augmented Lagrangian function sums the objective function, Lagrange multiplier terms for inequality/equality constraints, and quadratic penalty terms for inequality/equality constraints. This implementation follows the convention in Vanderplaats with \(g < 0\) and \(h = 0\). The bounds/targets passed in may reflect the original constraints or the relaxed constraints.

References SurrBasedMinimizer::augLagrangeMult, Minimizer::bigRealBoundSize, Minimizer::numNonlinearEqConstraints, Minimizer::numNonlinearIneqConstraints, Minimizer::numUserPrimaryFns, Minimizer::objective(), and SurrBasedMinimizer::penaltyParameter.

Referenced by SurrBasedLocalMinimizer::approx_subprob_objective_eval(), EffGlobalMinimizer::get_best_sample(), EffGlobalMinimizer::minimize_surrogates_on_model(), and SurrBasedLocalMinimizer::tr_ratio_check().

`Real penalty_merit ( const RealVector & fn_vals, const BoolDeque & sense, const RealVector & primary_wts ) [protected]`

compute a penalty function from a set of function values

The penalty function computation applies a quadratic penalty to any constraint violations and adds this to the objective function(s) \(p = f + rp_cv\).

References SurrBasedMinimizer::constraint_violation(), Minimizer::constraintTol, Minimizer::objective(), and SurrBasedMinimizer::penaltyParameter.

Referenced by SurrBasedLocalMinimizer::tr_ratio_check().
Real constraint_violation (const RealVector & fn_vals, const Real & constraint_tol) [protected]

compute the constraint violation from a set of function values

Compute the quadratic constraint violation defined as cv = g+^T g+

- h+^T h+. This implementation supports equality constraints and 2-sided inequalities. The constraint_tol allows for a small constraint infeasibility (used for penalty methods, but not Lagrangian methods).

References Minimizer::bigRealBoundSize, Minimizer::numNonlinearEqConstraints, Minimizer::numNonlinearIneqConstraints, Minimizer::numUserPrimaryFns, SurrBasedMinimizer::origNonlinEqTargets, SurrBasedMinimizer::origNonlinIneqLowerBnds, and SurrBasedMinimizer::origNonlinIneqUpperBnds.

Referenced by SurrBasedLocalMinimizer::hard_convergence_check(), EffGlobalMinimizer::minimize_surrogates_on_model(), SurrBasedMinimizer::penalty_merit(), SurrBasedLocalMinimizer::relax_constraints(), SurrBasedLocalMinimizer::tr_ratio_check(), SurrBasedMinimizer::update_filter(), and SurrBasedLocalMinimizer::update_penalty().

The documentation for this class was generated from the following files:

- SurrBasedMinimizer.hpp
- SurrBasedMinimizer.cpp

13.191 SurrogateModel Class Reference

Base class for surrogate models (DataFitSurrModel and HierarchSurrModel).

Inheritance diagram for SurrogateModel:

```
Model

SurrogateModel

DataFitSurrModel HierarchSurrModel
```

Protected Member Functions

- SurrogateModel (ProblemDescDB & problem_db)
  constructor
- SurrogateModel (ProblemDescDB & problem_db, ParallelLibrary & parallel_lib, const SharedVariablesData & svd, const SharedResponseData & srd, const ActiveSet & set, short output_level)
  alternate constructor
- ~SurrogateModel ()
  destructor
- Model & subordinate_model ()
  return truth_model()
- short surrogate_response_mode () const
  return responseMode
- size_t mi_parallel_level_index () const
  return miPLIndex
• **DiscrepancyCorrection** & **discrepancy_correction** ()
  
  *return* deltaCorr

• void **check_submodel_compatibility** (const Model &sub_model)
  
  verify compatibility between SurrogateModel attributes and attributes of the submodel (DataFitSurrModel::actualModel or HierarchSurrModel::highFidelityModel)

• bool **force_rebuild** ()
  
  evaluate whether a rebuild of the approximation should be forced based on changes in the inactive data

• void **asv_mapping** (const ShortArray &orig_asv, ShortArray &actual_asv, ShortArray &approx_asv, bool build_flag)
  
  distributes the incoming orig_asv among actual_asv and approx_asv

• void **asv_mapping** (const ShortArray &actual_asv, const ShortArray &approx_asv, ShortArray &combined_asv)
  
  reconstitutes a combined_asv from actual_asv and approx_asv

• void **response_mapping** (const Response &actual_response, const Response &approx_response, Response &combined_response)
  
  overlays actual_response and approx_response to update combined_response

Protected Attributes

• IntSet **surrogateFnIndices**
  
  for mixed response sets, this array specifies the response function subset that is approximated

• IntResponseMap **surrResponseMap**
  
  map of surrogate responses used in derived_synchronize() and derived_synchronize_nowait() functions

• IntVariablesMap **rawVarsMap**
  
  map of raw continuous variables used by apply_correction(). Model::varsList cannot be used for this purpose since it does not contain lower level variables sets from finite differencing.

• IntIntMap **truthIdMap**
  
  map from actualModel/highFidelityModel evaluation ids to DataFitSurrModel.hppierarchSurrModel ids

• IntIntMap **surrIdMap**
  
  map from approxInterface/lowFidelityModel evaluation ids to DataFitSurrModel.hppierarchSurrModel ids

• IntResponseMap **cachedApproxRespMap**
  
  map of approximate responses retrieved in derived_synchronize_nowait() that could not be returned since corresponding truth model response portions were still pending.

• short **responseMode**
  
  an enumeration that controls the response calculation mode in {DataFit,Hierarch}SurrModel approximate response computations

• size_t **approxBuilds**
  
  number of calls to build_approximation()

• size_t **miPLIndex**
  
  the index of the active metaiterator-iterator parallelism level (corresponding to ParallelConfiguration::miPLIters) used at runtime

• RealVector **referenceCLBnds**
  
  stores a reference copy of active continuous lower bounds when the approximation is built; used to detect when a rebuild is required.

• RealVector **referenceCUBnds**
stores a reference copy of active continuous upper bounds when the approximation is built; used to detect when a rebuild is required.

- **IntVector referenceDILBnds**
  stores a reference copy of active discrete int lower bounds when the approximation is built; used to detect when a rebuild is required.

- **IntVector referenceDIUBnds**
  stores a reference copy of active discrete int upper bounds when the approximation is built; used to detect when a rebuild is required.

- **RealVector referenceDRLBnds**
  stores a reference copy of active discrete real lower bounds when the approximation is built; used to detect when a rebuild is required.

- **RealVector referenceDRUBnds**
  stores a reference copy of active discrete real upper bounds when the approximation is built; used to detect when a rebuild is required.

- **RealVector referenceICVars**
  stores a reference copy of the inactive continuous variables when the approximation is built using a Distinct view; used to detect when a rebuild is required.

- **IntVector referenceIDIVars**
  stores a reference copy of the inactive discrete int variables when the approximation is built using a Distinct view; used to detect when a rebuild is required.

- **StringMultiArray referenceIDSVars**
  stores a reference copy of the inactive discrete string variables when the approximation is built using a Distinct view; used to detect when a rebuild is required.

- **RealVector referenceIDRVars**
  stores a reference copy of the inactive discrete real variables when the approximation is built using a Distinct view; used to detect when a rebuild is required.

- **DiscrepancyCorrection deltaCorr**
  manages construction and application of correction functions that are applied to a surrogate model (DataFitSurr or HierarchSurr) in order to reproduce high fidelity data.

**Private Attributes**

- **Variables truthModelVars**
  copy of the truth model variables object used to simplify conversion among differing variable views in force_rebuild()

- **Constraints truthModelCons**
  copy of the truth model constraints object used to simplify conversion among differing variable views in force_rebuild()

**Additional Inherited Members**

13.19.1 Detailed Description

Base class for surrogate models (DataFitSurrModel and HierarchSurrModel).

The SurrogateModel class provides common functions to derived classes for computing and applying corrections to approximations.
13.191.2 Member Function Documentation

bool force_rebuild( ) [protected], [virtual]

evaluate whether a rebuild of the approximation should be forced based on changes in the inactive data.

This function forces a rebuild of the approximation according to the sub-model variables view, the approximation type, and whether the active approximation bounds or inactive variable values have changed since the last approximation build.

Reimplemented from Model.

References: Constraints::all_continuous_lower_bounds(), Constraints::all_continuous_upper_bounds(), Variables::all_continuous_variables(), Constraints::all_discrete_int_lower_bounds(), Constraints::all_discrete_int_upper_bounds(), Variables::all_discrete_int_variables(), Constraints::all_discrete_real_lower_bounds(), Constraints::all_discrete_real_upper_bounds(), Variables::all_discrete_real_variables(), Variables::all_discrete_string_variables(), Constraints::continuous_lower_bounds(), Model::continuous_lower_bounds(), Constraints::continuous_upper_bounds(), Model::continuous_upper_bounds(), Variables::continuous_variables(), Constraints::copy(), Variables::copy(), Model::current_variables(), Model::currentVariables, Constraints::discrete_int_lower_bounds(), Variables::discrete_int_variables(), Variables::discrete_int_string_variables(), Variables::discrete_int_variables(), Variables::discrete_real_variables(), Variables::discrete_real_string_variables(), Variables::discrete_real_variables(), Variables::inactive_continuous_variables(), Variables::inactive_discrete_int_variables(), Variables::inactive_discrete_real_variables(), Variables::inactive_discrete_string_variables(), Constraints::is_null(), Variables::is_null(), Model::is_null(), Model::model_type(), SurrogateModel::referenceCLBnds, SurrogateModel::referenceCUBnds, SurrogateModel::referenceDILBnds, SurrogateModel::referenceDIUBnds, SurrogateModel::referenceDRLBnds, SurrogateModel::referenceDRUUBnds, SurrogateModel::referenceICVars, SurrogateModel::referenceIDIVars, SurrogateModel::referenceIDRVars, SurrogateModel::referenceDSVars, Dakota::strbegins(), Model::subordinate_model(), Model::surrogate_type(), Model::truth_model(), SurrogateModel::truthModelCons, SurrogateModel::truthModelVars, Model::user_defined_constraints(), Model::userDefinedConstraints, and Variables::view().

Referenced by HierarchSurrModel::derived_evaluate(), DataFitSurrModel::derived_evaluate(), HierarchSurrModel::derived_evaluate_nowait(), and DataFitSurrModel::derived_evaluate_nowait().

13.191.3 Member Data Documentation

short responseMode [protected]

an enumeration that controls the response calculation mode in {DataFit,Hierarch}SurrModel approximate response computations

  SurrogateSurrBasedLocalMinimizer toggles this mode since compute_correction() does not back out old corrections.

  Referenced by HierarchSurrModel::derived_evaluate(), DataFitSurrModel::derived_evaluate(), HierarchSurrModel::derived_evaluate_nowait(), DataFitSurrModel::derived_evaluate_nowait(), HierarchSurrModel::derived_set_communicators(), DataFitSurrModel::derived_synchronize(), DataFitSurrModel::derived_synchronize_approx(), HierarchSurrModel::derived_synchronize_combine(), HierarchSurrModel::derived_synchronize_combine_nowait(), HierarchSurrModel::derived_synchronize_distinct_model(), HierarchSurrModel::derived_synchronize_distinct_model_nowait(), DataFitSurrModel::derived_synchronize_nowait(), HierarchSurrModel::derived_synchronize_same_model(), HierarchSurrModel::derived_synchronize_same_model_nowait(), SurrogateModel::surrogate_response_mode(), HierarchSurrModel::surrogate_response_mode(), and DataFitSurrModel::surrogate_response_mode().

size_t approxBuilds [protected]

number of calls to build_approximation()

  used as a flag to automatically build the approximation if one of the derived evaluate functions is called prior to build_approximation().
## SysCallApplicInterface Class Reference

Derived application interface class which spawns simulation codes using system calls.

Inheritance diagram for SysCallApplicInterface:

```
Interface
    ApplicationInterface
    ProcessApplicInterface
    SysCallApplicInterface
    GridApplicInterface
```

### Public Member Functions

- **SysCallApplicInterface** (const ProblemDescDB &problem_db)
  
  *constructor*

- **~SysCallApplicInterface** ()
  
  *destructor*

### Protected Member Functions

- void **wait_local_evaluations** (PRPQueue &prp_queue)
- void **test_local_evaluations** (PRPQueue &prp_queue)
- int **synchronous_local_analysis** (int analysis_id)
- void **init_communicators_checks** (int max_eval_concurrency)
- void **set_communicators_checks** (int max_eval_concurrency)
- void **map_bookkeeping** (pid_t pid, int fn_eval_id)
  
  *bookkeeping of process and evaluation ids for asynchronous maps*

- pid_t **create_evaluation_process** (bool block_flag)

  *Spawn the evaluation by managing the input filter, analysis drivers, and output filter. Called from derived_map() & derived_map_asynch().*
Private Member Functions

- **bool system_call_file_test (const bfs::path &root_file)**
  detect completion of a function evaluation through existence of the necessary results file(s)
- **void spawn_evaluation_to_shell (bool block_flag)**
  spawn a complete function evaluation
- **void spawn_input_filter_to_shell (bool block_flag)**
  spawn the input filter portion of a function evaluation
- **void spawn_analysis_to_shell (int analysis_id, bool block_flag)**
  spawn a single analysis as part of a function evaluation
- **void spawn_output_filter_to_shell (bool block_flag)**
  spawn the output filter portion of a function evaluation

Private Attributes

- **IntSet sysCallSet**
  set of function evaluation id's for active asynchronous system call evaluations
- **IntShortMap failCountMap**
  map linking function evaluation id's to number of response read failures

Additional Inherited Members

13.192.1 Detailed Description

Derived application interface class which spawns simulation codes using system calls. `system()` is part of the C API and can be used on both Windows and Unix systems.

13.192.2 Member Function Documentation

**void wait_local_evaluations ( PRPQueue & prp_queue )** [inline], [protected], [virtual]

Check for completion of active asynch jobs (tracked with sysCallSet). Wait for at least one completion and complete all jobs that have returned. This satisfies a "fairness" principle, in the sense that a completed job will always be processed (whereas accepting only a single completion could always accept the same completion - the case of very inexpensive fn. evals. - and starve some servers).

Reimplemented from ApplicationInterface.
References ApplicationInterface::completionSet, and SysCallApplicInterface::test_local_evaluations().

**void test_local_evaluations ( PRPQueue & prp_queue )** [protected], [virtual]

Check for completion of active asynch jobs (tracked with sysCallSet). Make one pass through sysCallSet & complete all jobs that have returned.

Reimplemented from ApplicationInterface.
References Dakota::abort_handler(), Response::active_set(), ApplicationInterface::completionSet, SysCallApplicInterface::failCountMap, ProcessApplicInterface::fileNameMap, Interface::final_eval_id_tag(), Dakota::lookup_by_eval_id(), ApplicationInterface::manage_failure(), ProcessApplicInterface::read_results_files(), SysCallApplicInterface::sysCallSet, and SysCallApplicInterface::system_call_file_test().

Referenced by SysCallApplicInterface::wait_local_evaluations().
int synchronous_local_analysis ( int analysis_id ) [inline], [protected], [virtual]

This code provides the derived function used by ApplicationInterface::serve_analyses_synch().
Reimplemented from ApplicationInterface.
References SysCallApplicInterface::spawn_analysis_to_shell().

void init_communicators_checks ( int max_eval_concurrency ) [inline], [protected], [virtual]

No derived interface plug-ins, so perform construct-time checks. However, process init issues as warnings since some contexts (e.g., HierarchSurrModel) initialize more configurations than will be used.
Reimplemented from ApplicationInterface.
References ApplicationInterface::check_multiprocessor_analysis().

void set_communicators_checks ( int max_eval_concurrency ) [inline], [protected], [virtual]

Process run-time issues as hard errors.
Reimplemented from ApplicationInterface.
References Dakota::abort_handler(), and ApplicationInterface::check_multiprocessor_analysis().

void spawn_evaluation_to_shell ( bool block_flag ) [private]

spawn a complete function evaluation
Put the SysCallApplicInterface to the shell. This function is used when all portions of the function evaluation (i.e., all analysis drivers) are executed on the local processor.
References CommandShell::asynch_flag(), ProcessApplicInterface::commandLineArgs, ProcessApplicInterface::curWorkdir, Dakota::flush(), ProcessApplicInterface::iFilterName, ProcessApplicInterface::multipleParamsFiles, ProcessApplicInterface::oFilterName, ProcessApplicInterface::paramsFileName, ProcessApplicInterface::prepare_process_environment(), ProcessApplicInterface::programNames, ProcessApplicInterface::reset_process_environment(), ProcessApplicInterface::resultsFileName, CommandShell::suppress_output_flag(), ApplicationInterface::suppressOutput, and ProcessApplicInterface::useWorkdir.
Referenced by SysCallApplicInterface::create_evaluation_process().

void spawn_input_filter_to_shell ( bool block_flag ) [private]

spawn the input filter portion of a function evaluation
Put the input filter to the shell. This function is used when multiple analysis drivers are spread between processors. No need to check for a Null input filter, as this is checked externally. Use of nonblocking shells is supported in this fn, although its use is currently prevented externally.
References CommandShell::asynch_flag(), ProcessApplicInterface::commandLineArgs, Dakota::flush(), ProcessApplicInterface::iFilterName, ProcessApplicInterface::paramsFileName, ProcessApplicInterface::prepare_process_environment(), ProcessApplicInterface::reset_process_environment(), ProcessApplicInterface::resultsFileName, CommandShell::suppress_output_flag(), and ApplicationInterface::suppressOutput.
Referenced by SysCallApplicInterface::create_evaluation_process().

void spawn_analysis_to_shell ( int analysis_id, bool block_flag ) [private]

spawn a single analysis as part of a function evaluation
Put a single analysis to the shell. This function is used when multiple analysis drivers are spread between processors. Use of nonblocking shells is supported in this fn, although its use is currently prevented externally.
References CommandShell::asynch_flag(), ProcessApplicInterface::commandLineArgs, Dakota::flush(), ProcessApplicInterface::multipleParamsFiles, ProcessApplicInterface::paramsFileName, ProcessApplicInterface::prepare_process_environment(), ProcessApplicInterface::programNames, ProcessApplicInterface::reset_process_environment(), ProcessApplicInterface::resultsFileName, CommandShell::suppress_output_flag(), and ApplicationInterface::suppressOutput.

Referenced by SysCallApplicInterface::create_evaluation_process(), SysCallApplicInterface::synchronous_local_analysis(), and GridApplicInterface::synchronous_local_analysis().

```c++
void spawn_output_filter_to_shell ( bool block_flag ) [private]
```

spawn the output filter portion of a function evaluation

Put the output filter to the shell. This function is used when multiple analysis drivers are spread between processors. No need to check for a Null output filter, as this is checked externally. Use of nonblocking shells is supported in this fn, although its use is currently prevented externally.

References CommandShell::asynch_flag(), ProcessApplicInterface::commandLineArgs, Dakota::flush(), ProcessApplicInterface::FilterName, ProcessApplicInterface::paramsFileName, ProcessApplicInterface::prepare_process_environment(), ProcessApplicInterface::reset_process_environment(), ProcessApplicInterface::resultsFileName, CommandShell::suppress_output_flag(), and ApplicationInterface::suppressOutput.

Referenced by SysCallApplicInterface::create_evaluation_process().

The documentation for this class was generated from the following files:

- SysCallApplicInterface.hpp
- SysCallApplicInterface.cpp

### 13.193 TabularDataTruncated Class Reference

exception thrown when data read truncated

Inheritance diagram for TabularDataTruncated:

```
TabularDataTruncated
    +--- FileReadException
```

#### Public Member Functions

- **TabularDataTruncated** (const std::string &msg)

### 13.193.1 Detailed Description

exception thrown when data read truncated

The documentation for this class was generated from the following file:

- dakota.global_defs.hpp

### 13.194 TabularReader Class Reference

Utility used in derived read_core to read values in tabular format.
Public Member Functions

- \texttt{template<typename ArrayType>} \\
  \texttt{void operator()} (std::istream &\texttt{s}, size_t start_index, size_t num_items, ArrayType &array_data, StringMultiArrayView label_array)

13.194.1 Detailed Description

Utility used in derived read_core to read values in tabular format.

13.194.2 Member Function Documentation

\texttt{void operator()} ( std::istream &\texttt{s}, size_t start_index, size_t num_items, ArrayType & array_data, StringMultiArrayView label_array ) [inline]

The tabular reader doesn't forward the label arrays.

The documentation for this class was generated from the following file:

- DakotaVariables.hpp

13.195 TabularWriter Class Reference

Utility used in derived write_core to write values in tabular format.

Public Member Functions

- \texttt{template<typename ArrayType>} \\
  \texttt{void operator()} (std::ostream &\texttt{s}, size_t start_index, size_t num_items, const ArrayType &array_data, StringMultiArrayConstView label_array)

13.195.1 Detailed Description

Utility used in derived write_core to write values in tabular format.

13.195.2 Member Function Documentation

\texttt{void operator()} ( std::ostream &\texttt{s}, size_t start_index, size_t num_items, const ArrayType & array_data, StringMultiArrayConstView label_array ) [inline]

The tabular writer doesn’t forward the label arrays.

The documentation for this class was generated from the following file:

- DakotaVariables.hpp

13.196 TANA3Approximation Class Reference

Derived approximation class for TANA-3 two-point exponential approximation (a multipoint approximation).

Inheritance diagram for TANA3Approximation:
Public Member Functions

- TANA3Approximation ()
  default constructor
- TANA3Approximation (ProblemDescDB &problem_db, const SharedApproxData &shared_data, const String &approx_label)
  standard constructor
- TANA3Approximation (const SharedApproxData &shared_data)
  alternate constructor
- ~TANA3Approximation ()
  destructor

Protected Member Functions

- int min_coefficients () const
  return the minimum number of samples (unknowns) required to build the derived class approximation type in num-Vars dimensions
- int num_constraints () const
  return the number of constraints to be enforced via an anchor point
- void build ()
  builds the approximation from scratch
- Real value (const Variables &vars)
  retrieve the approximate function value for a given parameter vector
- const RealVector & gradient (const Variables &vars)
  retrieve the approximate function gradient for a given parameter vector
- void clear_current ()

Private Member Functions

- void find_scaled_coefficients ()
  compute TANA coefficients based on scaled inputs
- void offset (const RealVector &x, RealVector &s)
  based on minX, apply offset scaling to x to define s
Private Attributes

- RealVector pExp
  
  *vector of exponent values*

- RealVector minX
  
  *vector of minimum parameter values used in scaling*

- RealVector scX1
  
  *vector of scaled x1 values*

- RealVector scX2
  
  *vector of scaled x2 values*

- Real H
  
  *the scalar Hessian value in the TANA-3 approximation*

Additional Inherited Members

13.196.1 Detailed Description

Derived approximation class for TANA-3 two-point exponential approximation (a multipoint approximation).

The TANA3Approximation class provides a multipoint approximation based on matching value and gradient data from two points (typically the current and previous iterates) in parameter space. It forms an exponential approximation in terms of intervening variables.

13.196.2 Member Function Documentation

void build ( ) [protected], [virtual]

builds the approximation from scratch.

This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations should explicitly invoke (or reimplement) this base class contribution.

Reimplemented from Approximation.

References Dakota::abort_handler(), Approximation::approxData, Approximation::build(), TANA3Approximation::find_scaled_coefficients(), TANA3Approximation::minX, SharedApproxData::numVars, TANA3Approximation::pExp, and Approximation::sharedDataRep.

void clear_current ( ) [inline], [protected], [virtual]

Redefine default implementation to support history mechanism.

Reimplemented from Approximation.

References Approximation::approxData.

The documentation for this class was generated from the following files:

- TANA3Approximation.hpp
- TANA3Approximation.cpp
13.197 TaylorApproximation Class Reference

Derived approximation class for first- or second-order Taylor series (a local approximation).

Inheritance diagram for TaylorApproximation:

```
Approximation

TaylorApproximation
```

Public Member Functions

- **TaylorApproximation()**
  default constructor
- **TaylorApproximation(ProblemDescDB &problem_db, const SharedApproxData &shared_data, const String &approx_label)**
  standard constructor
- **TaylorApproximation(const SharedApproxData &shared_data)**
  alternate constructor
- **~TaylorApproximation()**
  destructor

Protected Member Functions

- **int min_coefficients() const**
  return the minimum number of samples (unknowns) required to build the derived class approximation type in num-Vars dimensions
- **void build()**
  builds the approximation from scratch
- **Real value(const Variables &vars)**
  retrieve the approximate function value for a given parameter vector
- **const RealVector & gradient(const Variables &vars)**
  retrieve the approximate function gradient for a given parameter vector
- **const RealSymMatrix & hessian(const Variables &vars)**
  retrieve the approximate function Hessian for a given parameter vector

Additional Inherited Members

13.197.1 Detailed Description

Derived approximation class for first- or second-order Taylor series (a local approximation).

The TaylorApproximation class provides a local approximation based on data from a single point in parameter space. It uses a zeroth-, first- or second-order Taylor series expansion: f(x) = f(x_c) for zeroth-order, plus grad(x_c)'(x - x_c) for first- and second-order, and plus (x - x_c)'Hess(x_c)(x - x_c) / 2 for second-order.
13.197.2 Member Function Documentation

void build( ) [protected], [virtual]

builds the approximation from scratch
This is the common base class portion of the virtual fn and is insufficient on its own; derived implementations
should explicitly invoke (or reimplement) this base class contribution.
Reimplemented from Approximation.
References Dakota::abort_handler(), Approximation::approxData, Approximation::build(), SharedApproxData::
buildDataOrder, SharedApproxData::numVars, and Approximation::sharedDataRep.
The documentation for this class was generated from the following files:
• TaylorApproximation.hpp
• TaylorApproximation.cpp

13.198 TestDriverInterface Class Reference

Inheritance diagram for TestDriverInterface:

```
  Interface
   |           |
   |           |
  ApplicationInterface
   |           |
   |           |
  DirectApplicInterface
   |           |
   |           |
  TestDriverInterface
```

Public Member Functions

• TestDriverInterface (const ProblemDescDB &problem_db)
  constructor
• ~TestDriverInterface ()
  destructor

Protected Member Functions

• virtual int derived_map_ac (const Dakota::String &ac_name)
  execute an analysis code portion of a direct evaluation invocation

Private Member Functions

• int cantilever ()
  scaled cantilever test function for optimization
• int mod_cantilever ()
  unscaled cantilever test function for UQ
• int cyl_head ()
  the cylinder head constrained optimization test fn
• int multimodal ()
  multimodal UQ test function
• int log_ratio ()
  the log_ratio UQ test function
• int short_column ()
  the short_column UQ/OUU test function
• int lf_short_column ()
  a low fidelity short_column test function
• int mf_short_column ()
  alternate short_column formulations for < multifidelity or model form studies
• int alternate_short_column_forms (int form)
  helper fn for alternate forms
• int side_impact_cost ()
  the side_impact_cost UQ/OUU test function
• int side_impact_perf ()
  the side_impact_perf UQ/OUU test function
• int rosenbrock ()
  the Rosenbrock optimization and least squares test fn
• int generalized_rosenbrock ()
  n-dimensional Rosenbrock (Schittkowski)
• int extended_rosenbrock ()
  n-dimensional Rosenbrock (Nocedal/Wright)
• int lf_rosenbrock ()
  a low fidelity version of the Rosenbrock function
• int mf_rosenbrock ()
  alternate Rosenbrock formulations for < multifidelity or model form studies
• int lf_poly_prod ()
  modified low fidelity Rosenbrock to test SBO with < hierarchical approximations
• int poly_prod ()
  modified low fidelity Rosenbrock to test SBO with < hierarchical approximations
• int gerstner ()
  the isotropic/anisotropic Gerstner test function family
• int scalable_gerstner ()
  scalable versions of the Gerstner test family
• void get_genz_coefficients (int num_dims, Real factor, int c_type, RealVector &c, RealVector &w)
  define coefficients needs for genz model
• int genz ()
  scalable test functions from the Genz test suite
• int damped_oscillator ()
  1d-6d that returns field values (ode solution)
• int steady_state_diffusion_1d ()
solve the 1d steady-state diffusion eqn < with uncertain field diffusivity

- int transient_diffusion_1d ()
  solve the 1d transient diffusion equation < with uncertain scalar diffusivity

- int steel_column_cost ()
  the steel_column_cost UQ/OUU test function

- int steel_column_perf ()
  the steel_column_perf UQ/OUU test function

- int sobol_rational ()
  Sobol SA rational test function.

- int sobol_g_function ()
  Sobol SA discontinuous test function.

- int sobol_ishigami ()
  Sobol SA transcendental test function.

- int text_book ()
  the text_book constrained optimization test function

- int text_book1 ()
  portion of text_book() evaluating the objective fn

- int text_book2 ()
  portion of text_book() evaluating constraint 1

- int text_book3 ()
  portion of text_book() evaluating constraint 2

- int text_book_ouu ()
  the text_book_ouu OUU test function

- int scalable_text_book ()
  scalable version of the text_book test function

- int scalable_monomials ()
  simple monomials for UQ exactness testing

- int mogatest1 ()
  MOP2 from Van Veldhuizen, pp. 5-13.

- int mogatest2 ()

- int mogatest3 ()
  Srinivas’ from Van Veldhuizen, pp. B-5.

- int illumination ()
  illumination example in Boyd as a general < minimization problem

- int barnes ()
  barnes test for SBO perforamnce from Rodriguez, < Perez, Renaud, et al.

- int barnes_if ()
  lo-fi barnes test for SBO perforamnce

- void herbie1D (size_t der_mode, Real xc_loc, std::vector<Real> &w_and_ders)
  1D components of herbie function

- void smooth_herbie1D (size_t der_mode, Real xc_loc, std::vector<Real> &w_and_ders)
  1D components of smooth_herbie function
13.198. TESTDRIVERINTERFACE CLASS REFERENCE

[90x708]void shubert1D (size_t der_mode, Real xc_loc, std::vector<Real> &w_and_ders)

  ID components of shubert function

• int herbie ()
  returns the N-D herbie function

• int smooth_herbie ()
  returns the N-D smooth herbie function

• int shubert ()
  returns the N-D shubert function

• int bayes_linear ()
  Scalable test function for Bayesian methods, to estimate parameters.

• void separable_combine (Real mult_scale_factor, std::vector<Real> &w, std::vector<Real> &d1w, std::vector<Real> &d2w)
  utility to combine components of separable fns

• Real levenshtein_distance (const String &v)
  Compute Levenshtein distance between v and LEV_REF.

• int salinas ()
  direct interface to the SALINAS structural dynamics code

• int mc_api_run ()
  direct interface to ModelCenter via API, HKIM 4/3/03

• int aniso_quad_form ()
  1-D function using an anisotropic quadratic < form

Static Private Attributes

• static StringRealMap levenshteinDistanceCache
  Cache results of Levenshtein distance cale for efficiency.

Additional Inherited Members

13.198.1 Detailed Description

Specialization of DirectApplicInterface to embed algebraic test function drivers directly in Dakota

13.198.2 Member Function Documentation

int derived_map_ac ( const Dakota::String & ac_name ) [protected], [virtual]
execute an analysis code portion of a direct evaluation invocation
  Derived map to evaluate a particular built-in test analysis function
  Reimplemented from DirectApplicInterface.
  References Dakota::abort_handler(), ApplicationInterface::analysisServerId, TestDriverInterface::aniso_quad_form(), TestDriverInterface::barnes(), TestDriverInterface::barnes_if(), TestDriverInterface::bayes_linear(), TestDriverInterface::cantilever(), TestDriverInterface::cyl_head(), TestDriverInterface::damped_oscillator(), DirectApplicInterface::driverTypeMap, TestDriverInterface::extended_rosenbrock(), TestDriverInterface::generalized_rosenbrock(), TestDriverInterface::genz(), TestDriverInterface::gerstner(), TestDriverInterface::herbie(), TestDriverInterface::illumination(), TestDriverInterface::lf_poly_prod(), TestDriverInterface::lf_rosenbrock(), TestDriverInterface::lf_short_column(),
TestDriverInterface::log_ratio(), TestDriverInterface::mc_api_run(), TestDriverInterface::mf_rosenbrock(), TestDriverInterface::mf_short_column(), TestDriverInterface::mod_cantilever(), TestDriverInterface::mogatest1(), TestDriverInterface::mogatest2(), TestDriverInterface::mogatest3(), TestDriverInterface::multimodal(), TestDriverInterface::poly_prod(), TestDriverInterface::rosenbrock(), TestDriverInterface::salinas(), TestDriverInterface::scalable_gerstner(), TestDriverInterface::scalable_monomials(), TestDriverInterface::scalable_text_book(), TestDriverInterface::short_column(), TestDriverInterface::shubert(), TestDriverInterface::side_impact_cost(), TestDriverInterface::side_impact_perf(), TestDriverInterface::smooth_herbie(), TestDriverInterface::sobol_g_function(), TestDriverInterface::sobol_ishigami(), TestDriverInterface::sobol_rational(), TestDriverInterface::steady_state_diffusion_1d(), TestDriverInterface::steel_column_cost(), TestDriverInterface::steel_column_perf(), TestDriverInterface::text_book1(), TestDriverInterface::text_book2(), TestDriverInterface::text_book3(), TestDriverInterface::text_book_ouu(), and TestDriverInterface::transient_diffusion_1d().

```cpp
int lf_poly_prod ( ) [private]
modified low fidelity Rosenbrock to test SBO with < hierarchical approximations
modified lo-fi Rosenbrock to test SBO with hierarchical approximations
References Dakota::abort_handler(), DirectApplicInterface::directFnASV, DirectApplicInterface::fnGrads, DirectApplicInterface::hessFlag, ApplicationInterface::multiProcAnalysisFlag, DirectApplicInterface::numADIV, DirectApplicInterface::numADRV, DirectApplicInterface::numFns, and DirectApplicInterface::xC.
Referenced by TestDriverInterface::derived_map_ac().
```

```cpp
int poly_prod ( ) [private]
modified low fidelity Rosenbrock to test SBO with < hierarchical approximations
modified lo-fi Rosenbrock to test SBO with hierarchical approximations
References Dakota::abort_handler(), DirectApplicInterface::directFnASV, DirectApplicInterface::fnGrads, DirectApplicInterface::hessFlag, ApplicationInterface::multiProcAnalysisFlag, DirectApplicInterface::numADIV, DirectApplicInterface::numADRV, DirectApplicInterface::numFns, and DirectApplicInterface::xC.
Referenced by TestDriverInterface::derived_map_ac().
```

```cpp
int steady_state_diffusion_1d ( ) [private]
solve the 1d steady-state diffusion eqn < with uncertain field diffusivity
Solve the 1D diffusion equation with an uncertain variable coefficient using the spectral Chebyshev collocation method.
\[ \text{del}(k \text{del}(\text{u})) = f \text{ on } [0,1] \text{ subject to } u(0) = 0 \quad u(1) = 0 \]
Here we set \( f = -1 \) and \( k = 1+4.*\sum_{d=1}^{\text{num_dims}} [\cos(2*pi*x)/(pi*d)^2]*z[d] \) \( d=1,...,\text{num_dims} \) where \( z,d \) are random variables, typically i.i.d uniform[-1,1]
References Dakota::NPOS, Dakota::abort_handler(), Dakota::find_index(), DirectApplicInterface::fnGrads, DirectApplicInterface::gradFlag, DirectApplicInterface::hessFlag, ApplicationInterface::multiProcAnalysisFlag, DirectApplicInterface::numADIV, DirectApplicInterface::numADRV, DirectApplicInterface::numFns, and DirectApplicInterface::xC, DirectApplicInterface::xDI, DirectApplicInterface::xDILabels, DirectApplicInterface::xDR, DirectApplicInterface::xDRLabels, DirectApplicInterface::xDS, and DirectApplicInterface::xDSLLabels.
Referenced by TestDriverInterface::derived_map_ac().
```

```cpp
int barnes ( ) [private]
barnes test for SBO performance from Rodriguez, < Perez, Renaud, et al.
```
barnes test for SBO performance from Rodriguez, Perez, Renaud, et al.
References Dakota::abort_handler(), DirectApplicInterface::directFnASV, DirectApplicInterface::directFnDVV, DirectApplicInterface::fnGrads, DirectApplicInterface::fnVals, DirectApplicInterface::gradFlag, DirectApplicInterface::hessFlag, ApplicationInterface::multiProcAnalysisFlag, DirectApplicInterface::numACV, DirectApplicInterface::numADIV, DirectApplicInterface::numADRV, DirectApplicInterface::numDerivVars, DirectApplicInterface::numFns, and DirectApplicInterface::xC.
Referenced by TestDriverInterface::derived_map_ac().

void herbie1D ( size_t der_mode, Real xc_loc, std::vector< Real > & w_and_ders ) [private]
1D components of herbie function
1D Herbie function and its derivatives (apart from a multiplicative factor)
Referenced by TestDriverInterface::herbie().

void smooth_herbie1D ( size_t der_mode, Real xc_loc, std::vector< Real > & w_and_ders ) [private]
1D components of smooth_herbie function
1D Smoothed Herbie = 1DHerbie minus the high frequency sine term, and its derivatives (apart from a multiplicative factor)
Referenced by TestDriverInterface::smooth_herbie().

void shubert1D ( size_t der_mode, Real xc_loc, std::vector< Real > & w_and_ders ) [private]
1D components of shubert function
1D Shubert function and its derivatives (apart from a multiplicative factor)
Referenced by TestDriverInterface::shubert().

int herbie ( ) [private]
returns the N-D herbie function
N-D Herbie function and its derivatives.
References DirectApplicInterface::directFnASV, DirectApplicInterface::directFnDVV, TestDriverInterface::herbie1D(), DirectApplicInterface::numDerivVars, DirectApplicInterface::numVars, TestDriverInterface::separable_combine(), and DirectApplicInterface::xC.
Referenced by TestDriverInterface::derived_map_ac().
int smooth_herbie() [private]

returns the N-D smooth herbie function

N-D Smoothed Herbie function and its derivatives.

References DirectApplicInterface::directFnASV, DirectApplicInterface::directFnDVV, DirectApplicInterface::numDerivVars, DirectApplicInterface::numVars, TestDriverInterface::separable_combine(), TestDriverInterface::smooth_herbie1D(), and DirectApplicInterface::xC.

Referenced by TestDriverInterface::derived_map_ac().

void separable_combine ( Real mult_scale_factor, std::vector<Real> & w, std::vector<Real> & d1w, std::vector<Real> & d2w ) [private]

utility to combine components of separable fns

this function combines N 1D functions and their derivatives to compute a N-D separable function and its derivatives, logic is general enough to support different 1D functions in different dimensions (can mix and match)

References DirectApplicInterface::directFnASV, DirectApplicInterface::directFnDVV, DirectApplicInterface::fnGrads, DirectApplicInterface::fnHessians, DirectApplicInterface::fnVals, DirectApplicInterface::numDerivVars, and DirectApplicInterface::numVars.

Referenced by TestDriverInterface::herbie(), TestDriverInterface::shubert(), and TestDriverInterface::smooth_herbie().

Real levenshtein_distance ( const String & v ) [private]

Compute Levenshtein distance between v and LEV_REF.

Levenshtein distance is the number of changes (single character

References Dakota::LEV_REF, and TestDriverInterface::levenshteinDistanceCache.

Referenced by TestDriverInterface::text_book1(), TestDriverInterface::text_book2(), and TestDriverInterface::text_book3().

int mc_api_run() [private]

direct interface to ModelCenter via API, HKIM 4/3/03

The ModelCenter interface doesn’t have any specific construct vs. run time functions. For now, we manage it along with the integrated test drivers

References Dakota::abort_handler(), DirectApplicInterface::analysisComponents, DirectApplicInterface::analysisDriverIndex, Dakota::dc_ptr_int, DirectApplicInterface::directFnASV, Interface::fnLabels, DirectApplicInterface::fnVals, Dakota::mc_ptr_int, ApplicationInterface::multiProcAnalysisFlag, DirectApplicInterface::numACV, DirectApplicInterface::numADIV, DirectApplicInterface::numADRV, DirectApplicInterface::numFns, DirectApplicInterface::xC, DirectApplicInterface::xCLabels, DirectApplicInterface::xDI, DirectApplicInterface::xDILabels, DirectApplicInterface::xDRI, and DirectApplicInterface::xDRLLabels.

Referenced by TestDriverInterface::derived_map_ac().

The documentation for this class was generated from the following files:

- TestDriverInterface.hpp
- TestDriverInterface.cpp

13.199 TrackerHTTP Class Reference

TrackerHTTP: a usage tracking module that uses HTTP/HTTPS via the curl library.
Public Member Functions

- **TrackerHTTP ()**
  
  default constructor is allowed, but doesn’t generate output

- **TrackerHTTP (int world_rank=0)**
  
  standard constructor with ProblemDescDB, rank

- **~TrackerHTTP ()**
  
  destructor to free handles

- **void post_start (ProblemDescDB &problem_db)**
  
  post the start of an analysis and archive start time

- **void post_finish (unsigned runtime=0)**
  
  post the completion of an analysis including elapsed time

Private Member Functions

- **void initialize (int world_rank=0)**
  
  shared initialization functions across constructors

- **void url_add_field (std::string &url, const char *keyword, const std::string &value, bool delimit=true) const**
  
  append keyword/value pair to url in GET style (with &keyword=value); set delimit = false to omit the &

- **void build_default_data (std::string &url, std::time_t &rawtime, const std::string &mode) const**
  
  construct URL with shared information for start/finish

- **void send_data_using_get (const std::string &urltopost) const**
  
  transmit data to the web server using GET

- **void send_data_using_post (const std::string &datatopost) const**
  
  POST separate location and query; datatopost="name=daniel&project=curl".

- **void populate_method_list (ProblemDescDB &problem_db)**
  
  extract list of methods from problem database

- **std::string get_uid () const**
  
  get the real user ID

- **std::string get_username () const**
  
  get the username as reported by the environment

- **std::string get_hostname () const**
  
  get the system hostname

- **std::string get_os () const**
  
  get the operating system

- **std::string get_datetime (const std::time_t &rawtime) const**
  
  get the date and time as a string YYYYMMDDHHMMSS
Private Attributes

- **CURL** * curlPtr
  pointer to the curl handler instance
- **FILE** * devNull
  pointer to /dev/null
- std::string trackerLocation
  base URL for the tracker
- std::string proxyLocation
  if empty, proxy may still be specified via environment variables (unlike default CURL behavior)
- long timeoutSeconds
  seconds until the request will timeout (may have issues with signals)
- std::string methodList
  list of active methods
- std::string dakotaVersion
  DAKOTA version.
- std::time_t startTime
  cached starting time in raw seconds
- short outputLevel
  verbosity control

13.199.1 Detailed Description

TrackerHTTP: a usage tracking module that uses HTTP/HTTPS via the curl library.

13.199.2 Member Function Documentation

**void send_data_using_get ( const std::string & urltopost ) const [private]**

transmit data to the web server using GET
whole url including location&fields
References TrackerHTTP::curlPtr, and TrackerHTTP::outputLevel.

**void send_data_using_post ( const std::string & datatopost ) const [private]**

POST separate location and query; datatopost="name=daniel&project=curl".
separate location and query; datatopost="name=daniel&project=curl"
References TrackerHTTP::curlPtr, TrackerHTTP::outputLevel, and TrackerHTTP::trackerLocation.
Referenced by TrackerHTTP::post_finish(), and TrackerHTTP::post_start().
The documentation for this class was generated from the following files:

- TrackerHTTP.hpp
- TrackerHTTP.cpp

13.200 UsageTracker Class Reference

Lightweight class to manage conditionally active Curl-based HTTP tracker via PIMPL.
Public Member Functions

- **UsageTracker ()**
  
  *default construction: no output*

- **UsageTracker (int world_rank)**

  *standard constructor; will output on rank 0*

- **void post_start (ProblemDescDB &problem_db)**

  *post the start of an analysis and archive start time*

- **void post_finish (unsigned runtime=0)**

  *post the completion of an analysis including elapsed time*

Private Member Functions

- **UsageTracker (const UsageTracker &)**

  *copy construction is disallowed*

Private Attributes

- **boost::shared_ptr<TrackerHTTP> pTrackerHTTP**

  *posts usage data to Web server; using shared_ptr due to potentially incomplete type and requirements for checked-delete in debug builds (scoped_ptr would suffice)*

13.200.1 Detailed Description

Lightweight class to manage conditionally active Curl-based HTTP tracker via PIMPL.
All conditional compilation in managed in the cpp file; all operations are no-op in this wrapper if not enabling tracking...

13.200.2 Constructor & Destructor Documentation

**UsageTracker ( int world_rank )**

*standard constructor; will output on rank 0*

- **UsageTracker (int world_rank)**

  *standard constructor; will output on rank 0 and only initializes if tracking compiled in and not disable by environment*

  References UsageTracker::pTrackerHTTP.

  The documentation for this class was generated from the following files:

  - UsageTracker.hpp
  - UsageTracker.cpp

13.201 Var_ichk Struct Reference

*structure for verifying bounds and initial point for string-valued vars*
Public Attributes

- const char * name
- size_t DataVariablesRep::* n
- void(* vgen )(DataVariablesRep *, size_t)
- IntVector DataVariablesRep::* L
- IntVector DataVariablesRep::* U
- IntVector DataVariablesRep::* V
- StringArray DataVariablesRep::* Lbl

13.201.1 Detailed Description

structure for verifying bounds and initial point for string-valued vars
structure for verifying bounds and initial point for integer-valued vars
The documentation for this struct was generated from the following file:

- NIDRProblemDescDB.cpp

13.202 Var_rcheck Struct Reference

structure for verifying bounds and initial point for real-valued vars

Public Attributes

- const char * name
- size_t DataVariablesRep::* n
- void(* vgen )(DataVariablesRep *, size_t)
- RealVector DataVariablesRep::* L
- RealVector DataVariablesRep::* U
- RealVector DataVariablesRep::* V
- StringArray DataVariablesRep::* Lbl

13.202.1 Detailed Description

structure for verifying bounds and initial point for real-valued vars
The documentation for this struct was generated from the following file:

- NIDRProblemDescDB.cpp

13.203 Variables Class Reference

Base class for the variables class hierarchy.
Inheritance diagram for Variables:

```
      Variables
       |       |       |
       |       |       |
       |       |       |
       |       MixedVariables       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
       |       |       |
```
Public Member Functions

- Variables ()
  default constructor
- Variables (const ProblemDescDB &problem, db)
  standard constructor (explicit disallows its use for implicit type conversion)
- Variables (const SharedVariablesData &svd)
  alternate constructor for instantiations on the fly (explicit disallows its use for implicit type conversion)
- Variables (const Variables &vars)
  copy constructor
- virtual ~Variables ()
  destructor
- Variables operator= (const Variables &vars)
  assignment operator
- virtual void read (std::istream &s)
  read a variables object from an std::istream
- virtual void write (std::ostream &s) const
  write a variables object to an std::ostream, e.g., the console
- virtual void write_aprepro (std::ostream &s) const
  write a variables object to an std::ostream in aprepro format, e.g., a parameters file
- virtual void read.annotated (std::istream &s)
  read a variables object in annotated format from an istream
- virtual void write.annotated (std::ostream &s) const
  write a variables object in annotated format to an std::ostream
- virtual void read.tabular (std::istream &s, bool active_only=false)
  read a variables object in tabular format from an istream
- virtual void write.tabular (std::ostream &s, bool active_only=false) const
  write a variables object in tabular format to an std::ostream
- virtual void write.tabular_labels (std::ostream &s, bool active_only=false) const
  write the labels in input spec order to a std::ostream
- virtual void read (MPIUnpackBuffer &s)
  read a variables object from a packed MPI buffer
- virtual void write (MPIPackBuffer &s) const
  write a variables object to a packed MPI buffer
- size_t tv () const
  total number of vars
- size_t cv () const
  number of active continuous vars
- size_t cv_start () const
  start index of active continuous vars
- size_t div () const
  number of active discrete int vars
- size_t div_start () const
- `$size_t dsv() const$` 
  number of active discrete string vars
- `$size_t dsv_start() const$` 
  start index of active discrete string vars
- `$size_t drv() const$` 
  number of active discrete real vars
- `$size_t drv_start() const$` 
  start index of active discrete real vars
- `$size_t icv() const$` 
  number of inactive continuous vars
- `$size_t icv_start() const$` 
  start index of inactive continuous vars
- `$size_t idiv() const$` 
  number of inactive discrete int vars
- `$size_t idiv_start() const$` 
  start index of inactive discrete int vars
- `$size_t idsv() const$` 
  number of inactive discrete string vars
- `$size_t idsv_start() const$` 
  start index of inactive discrete string vars
- `$size_t idrv() const$` 
  number of inactive discrete real vars
- `$size_t idrv_start() const$` 
  start index of inactive discrete real vars
- `$size_t acv() const$` 
  total number of continuous vars
- `$size_t adiv() const$` 
  total number of discrete integer vars
- `$size_t adsv() const$` 
  total number of discrete string vars
- `$size_t adrv() const$` 
  total number of discrete real vars
- `$const SharedVariablesData & shared_data() const$` 
  return sharedVarsData
- `$SharedVariablesData & shared_data()$` 
  return sharedVarsData
- `$void shape()$` 
  shape a `Variables` object based on sharedVarsData
- `$void reshape()$` 
  reshape an existing `Variables` object based on updated sharedVarsData
- `$Real continuous_variable(size_t index) const$` 
  return an active continuous variable
• `const RealVector & continuous_variables()` const
  return the active continuous variables (Note: returns a view by const reference, but initializing a RealVector from
  this reference invokes the Teuchos matrix copy constructor to create a Teuchos::Copy instance; to obtain a mutable
  view, use `continuous_variables_view()`)

• `void continuous_variable(Real c_var, size_t index)`
  set an active continuous variable

• `void continuous_variables(const RealVector &c_vars)`
  set the active continuous variables

• `int discrete_int_variable(size_t index) const`
  return an active discrete integer variable

• `const IntVector & discrete_int_variables()` const
  return the active discrete integer variables (Note: returns a view by const reference, but initializing an IntVector
  from this reference invokes the Teuchos matrix copy constructor to create a Teuchos::Copy instance; to obtain a
  mutable view, use `discrete_int_variables_view()`)

• `void discrete_int_variable(int di_var, size_t index)`
  set an active discrete integer variable

• `void discrete_int_variables(const IntVector &di_vars)`
  set the active discrete integer variables

• `const String & discrete_string_variable(size_t index) const`
  return an active discrete string variable

• `StringMultiArrayConstView discrete_string_variables()` const
  return the active discrete string variables (Note: returns a view by const reference, but initializing a StringArray
  from this reference invokes the Teuchos matrix copy constructor to create a Teuchos::Copy instance; to obtain a
  mutable view, use `discrete_string_variables_view()`)

• `void discrete_string_variable(const String &ds_var, size_t index)`
  set an active discrete string variable

• `void discrete_string_variables(StringMultiArrayConstView ds_vars)`
  set the active discrete string variables

• `Real discrete_real_variable(size_t index) const`
  return an active discrete real variable

• `const RealVector & discrete_real_variables()` const
  return the active discrete real variables (Note: returns a view by const reference, but initializing a RealVector from
  this reference invokes the Teuchos matrix copy constructor to create a Teuchos::Copy instance; to obtain a mutable
  view, use `discrete_real_variables_view()`)

• `void discrete_real_variable(Real dr_var, size_t index)`
  set an active discrete real variable

• `void discrete_real_variables(const RealVector &dr_vars)`
  set the active discrete real variables

• `void active_variables(const Variables &vars)`
  copy the active cv/div/dsv/drv variables from vars

• `RealVector & continuous_variables_view()`
  return a mutable view of the active continuous variables

• `IntVector & discrete_int_variables_view()`
  return a mutable view of the active discrete integer variables

• `StringMultiArrayView discrete_string_variables_view()`
return a mutable view of the active discrete string variables

- RealVector & discrete_real_variable_view ()

return a mutable view of the active discrete real variables

- StringMultiArrayConstView continuous_variable_labels () const

return the active continuous variable labels

- void continuous_variable_labels (StringMultiArrayConstView cv_labels)

set the active continuous variable labels

- void continuous_variable_label (const String &cv_label, size_t index)

set an active continuous variable label

- StringMultiArrayConstView discrete_int_variable_labels () const

return the active discrete integer variable labels

- void discrete_int_variable_labels (StringMultiArrayConstView div_labels)

set the active discrete integer variable labels

- void discrete_int_variable_label (const String &div_label, size_t index)

set an active discrete integer variable label

- StringMultiArrayConstView discrete_string_variable_labels () const

return the active discrete string variable labels

- void discrete_string_variable_labels (StringMultiArrayConstView dsv_labels)

set the active discrete string variable labels

- void discrete_string_variable_label (const String &dsv_label, size_t index)

set an active discrete string variable label

- StringMultiArrayConstView discrete_real_variable_labels () const

return the active discrete real variable labels

- void discrete_real_variable_labels (StringMultiArrayConstView drv_labels)

set the active discrete real variable labels

- void discrete_real_variable_label (const String &drv_label, size_t index)

set an active discrete real variable label

- UShortMultiArrayConstView continuous_variable_types () const

return the active continuous variable types

- void continuous_variable_types (UShortMultiArrayConstView cv_types)

set the active continuous variable types

- void continuous_variable_type (unsigned short cv_type, size_t index)

set an active continuous variable type

- UShortMultiArrayConstView discrete_int_variable_types () const

return the active discrete integer variable types

- void discrete_int_variable_types (UShortMultiArrayConstView div_types)

set the active discrete integer variable types

- void discrete_int_variable_type (unsigned short div_type, size_t index)

set an active discrete integer variable type

- UShortMultiArrayConstView discrete_string_variable_types () const

return the active discrete string variable types

- void discrete_string_variable_types (UShortMultiArrayConstView dsv_types)

set the active discrete string variable types
• void discrete_string_variable_type (unsigned short dsv_type, size_t index)  
  set an active discrete string variable type
• UShortMultiArrayConstView discrete_real_variable_types () const  
  return the active discrete real variable types
• void discrete_real_variable_types (UShortMultiArrayConstView drv_types)  
  set the active discrete real variable types
• void discrete_real_variable_type (unsigned short drv_type, size_t index)  
  set an active discrete real variable type
• SizetMultiArrayConstView continuous_variable_ids () const  
  return the active continuous variable position identifiers
• void continuous_variable_ids (SizetMultiArrayConstView cv_ids)  
  set the active continuous variable position identifiers
• void continuous_variable_id (size_t cv_id, size_t index)  
  set an active continuous variable position identifier
• const RealVector & inactive_continuous_variables () const  
  return the inactive continuous variables
• void inactive_continuous_variables (const RealVector &ic_vars)  
  set the inactive continuous variables
• void inactive_continuous_variable (Real ic_var, size_t index)  
  set an inactive continuous variable
• const IntVector & inactive_discrete_int_variables () const  
  return the inactive discrete int variables
• void inactive_discrete_int_variables (const IntVector &idi_vars)  
  set the inactive discrete int variables
• void inactive_discrete_int_variable (int idi_var, size_t index)  
  set an inactive discrete int variable
• StringMultiArrayConstView inactive_discrete_string_variables () const  
  return the inactive discrete string variables
• void inactive_discrete_string_variables (StringMultiArrayConstView ids_vars)  
  set the inactive discrete string variables
• void inactive_discrete_string_variable (const String &ids_var, size_t index)  
  set an inactive discrete string variable
• const RealVector & inactive_discrete_real_variables () const  
  return the inactive discrete real variables
• void inactive_discrete_real_variables (const RealVector &idr_vars)  
  set the inactive discrete real variables
• void inactive_discrete_real_variable (Real idr_var, size_t index)  
  set an inactive discrete real variable
• StringMultiArrayConstView inactive_continuous_variable_labels () const  
  return the inactive continuous variable labels
• void inactive_continuous_variable_labels (StringMultiArrayConstView ic_vars)  
  set the inactive continuous variable labels
• StringMultiArrayConstView inactive_discrete_int_variable_labels () const
return the inactive discrete variable labels

- void **inactive_discrete_int_variable_labels** (StringMultiArrayConstView `idi_vars`)
  
  set the inactive discrete variable labels

- StringMultiArrayConstView **inactive_discrete_string_variable_labels** () const
  
  return the inactive discrete variable labels

- void **inactive_discrete_string_variable_labels** (StringMultiArrayConstView `ids_vars`)
  
  set the inactive discrete variable labels

- StringMultiArrayConstView **inactive_discrete_real_variable_labels** () const
  
  return the inactive discrete variable labels

- void **inactive_discrete_real_variable_labels** (StringMultiArrayConstView `idr_vars`)
  
  set the inactive discrete variable labels

- UShortMultiArrayConstView **inactive_continuous_variable_types** () const
  
  return the inactive continuous variable types

- UShortMultiArrayConstView **inactive_discrete_int_variable_types** () const
  
  return the inactive discrete integer variable types

- UShortMultiArrayConstView **inactive_discrete_string_variable_types** () const
  
  return the inactive discrete string variable types

- UShortMultiArrayConstView **inactive_discrete_real_variable_types** () const
  
  return the inactive discrete real variable types

- SizetMultiArrayConstView **inactive_continuous_variable_ids** () const
  
  return the inactive continuous variable position identifiers

- const RealVector & **all_continuous_variables** () const
  
  returns a single array with all continuous variables

- void **all_continuous_variables** (const RealVector &`ac_vars`)
  
  sets all continuous variables using a single array

- void **all_continuous_variable** (Real `ac_var`, size_t `index`)
  
  set a variable within the all continuous array

- const IntVector & **all_discrete_int_variables** () const
  
  returns a single array with all discrete variables

- void **all_discrete_int_variables** (const IntVector &`adi_vars`)
  
  sets all discrete variables using a single array

- void **all_discrete_int_variable** (int `adi_var`, size_t `index`)
  
  set a variable within the all discrete array

- StringMultiArrayConstView **all_discrete_string_variables** () const
  
  returns a single array with all discrete variables

- void **all_discrete_string_variables** (StringMultiArrayConstView `ads_vars`)
  
  sets all discrete variables using a single array

- void **all_discrete_string_variable** (const String &`ads_var`, size_t `index`)
  
  set a variable within the all discrete array

- const RealVector & **all_discrete_real_variables** () const
  
  returns a single array with all discrete variables

- void **all_discrete_real_variables** (const RealVector &`adr_vars`)
  
  sets all discrete variables using a single array
void all_discrete_real_variable (Real adr_var, size_t index)
set a variable within the all discrete array

void as_vector (const StringSetArray &dss_vals, RealVector &var_values) const
get the active variables as a vector of reals, converting string values to zero-based set indices

StringMultiArrayView all_continuous_variable_labels () const
returns a single array with all continuous variable labels

void all_continuous_variable_labels (StringMultiArrayConstView acv_labels)
sets all continuous variable labels using a single array

void all_continuous_variable_label (const String &acv_label, size_t index)
set a label within the all continuous label array

StringMultiArrayView all_discrete_int_variable_labels () const
returns a single array with all discrete variable labels

void all_discrete_int_variable_labels (StringMultiArrayConstView adiv_labels)
sets all discrete variable labels using a single array

void all_discrete_int_variable_label (const String &adiv_label, size_t index)
set a label within the all discrete label array

StringMultiArrayView all_discrete_string_variable_labels () const
returns a single array with all discrete variable labels

void all_discrete_string_variable_labels (StringMultiArrayConstView adsv_labels)
sets all discrete variable labels using a single array

void all_discrete_string_variable_label (const String &adsv_label, size_t index)
set a label within the all discrete label array

StringMultiArrayView all_discrete_real_variable_labels () const
returns a single array with all discrete variable labels

void all_discrete_real_variable_labels (StringMultiArrayConstView adrv_labels)
sets all discrete variable labels using a single array

void all_discrete_real_variable_label (const String &adrv_label, size_t index)
set a label within the all discrete label array

UShortMultiArrayConstView all_continuous_variable_types () const
return all continuous variable types

UShortMultiArrayConstView all_discrete_int_variable_types () const
return all discrete variable types

UShortMultiArrayConstView all_discrete_string_variable_types () const
return all discrete variable types

UShortMultiArrayConstView all_discrete_real_variable_types () const
return all discrete variable types

SizeMultiArrayConstView all_continuous_variable_ids () const
return all continuous variable position identifiers

Variables copy (bool deep_svd=false) const
a deep variables copy for use in history mechanisms (SharedVariablesData uses a shallow copy by default)

const std::pair< short, short > & view () const
returns variablesView

std::pair< short, short > get_view (const ProblemDescDB &problem_db) const
defines variablesView from problem_db attributes

- **void inactive_view** (short view2)
  
  sets the inactive view based on higher level (nested) context

- **const String & variables_id () const**
  
  returns the variables identifier string

- **const SizetArray & variables_components_totals () const**
  
  returns the number of variables for each of the constitutive components

- **bool is_null () const**
  
  function to check variablesRep (does this envelope contain a letter)

### Protected Member Functions

- **Variables (BaseConstructor, const ProblemDescDB &problem_db, const std::pair< short, short > &view)**
  
  constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

- **Variables (BaseConstructor, const SharedVariablesData &svd)**
  
  constructor initializes the base class part of letter classes (BaseConstructor overloading avoids infinite recursion in the derived class constructors - Coplien, p. 139)

- **void build_views ()**
  
  construct active/inactive views of all variables arrays

- **void build_active_views ()**
  
  construct active views of all variables arrays

- **void build_inactive_views ()**
  
  construct inactive views of all variables arrays

### Protected Attributes

- **SharedVariablesData sharedVarsData**
  
  reference-counted instance of shared variables data: id’s, labels, counts

- **RealVector allContinuousVars**
  
  array combining all of the continuous variables

- **IntVector allDiscreteIntVars**
  
  array combining all of the discrete integer variables

- **StringMultiArray allDiscreteStringVars**
  
  array combining all of the discrete string variables

- **RealVector allDiscreteRealVars**
  
  array combining all of the discrete real variables

- **RealVector continuousVars**
  
  the active continuous variables array view

- **IntVector discreteIntVars**
  
  the active discrete integer variables array view

- **RealVector discreteRealVars**
  
  the active discrete real variables array view

- **RealVector inactiveContinuousVars**
the inactive continuous variables array view
- IntVector inactiveDiscreteIntVars
  the inactive discrete integer variables array view
- RealVector inactiveDiscreteRealVars
  the inactive discrete real variables array view

Private Member Functions
- Variables * get_variables (const ProblemDescDB &problem db)
  Used by the standard envelope constructor to instantiate the correct letter class.
- Variables * get_variables (const SharedVariablesData &svd) const
  Used by the alternate envelope constructors, by read functions, and by copy() to instantiate a new letter class.
- short method_map (short view_spec, bool relaxed) const
  infer domain from method selection
- short method_domain (const ProblemDescDB &problem db) const
  infer domain from method selection
- short method_view (const ProblemDescDB &problem db) const
  infer view from method selection
- short response_view (const ProblemDescDB &problem db) const
  infer view from type of response data set
- void check_view_compatibility ()
  perform sanity checks on view.first and view.second after update
- template<class Archive >
  void load (Archive &ar, const unsigned int version)
  read a Variables object from an archive
- template<class Archive >
  void save (Archive &ar, const unsigned int version) const
  write a Variables object to an archive
- BOOST_SERIALIZATION_SPLIT_MEMBER () Variables *variablesRep
  pointer to the letter (initialized only for the envelope)

Private Attributes
- int referenceCount
  number of objects sharing variablesRep

Friends
- class boost::serialization::access
  for serializing private data members
- bool operator== (const Variables &vars1, const Variables &vars2)
  strict equality operator (for boost hash-based lookups)
- bool operator!=(const Variables &vars1, const Variables &vars2)
  strict inequality operator
- bool nearby (const Variables &vars1, const Variables &vars2, Real rel_tol)
tolerance-based equality operator
• std::size_t hash_value (const Variables &vars)

hash_value

13.203.1 Detailed Description

Base class for the variables class hierarchy.

The Variables class is the base class for the class hierarchy providing design, uncertain, and state variables for continuous and discrete domains within a Model. Using the fundamental arrays from the input specification, different derived classes define different views of the data. For memory efficiency and enhanced polymorphism, the variables hierarchy employs the "letter/envelope idiom" (see Coplien "Advanced C++", p. 133), for which the base class (Variables) serves as the envelope and one of the derived classes (selected in Variables::get_variables()) serves as the letter.

13.203.2 Member Function Documentation

StringMultiArrayView discrete_string_variables_view() [inline]

return a mutable view of the active discrete string variables
same as discrete_string_variables(), except mutable view
References Variables::allDiscreteStringVars, SharedVariablesData::dsv(), SharedVariablesData::dsv_start(), and Variables::sharedVarsData.

The documentation for this class was generated from the following file:
• DakotaVariables.hpp

13.204 Verification Class Reference

Base class for managing common aspects of verification studies.

Inheritance diagram for Verification:

```
  Iterator
  Analyzer
  Verification
  RichExtrapVerification
```

Public Member Functions

• bool resize()

reinitializes iterator based on new variable size
Protected Member Functions

- **Verification (ProblemDescDB &problem_db, Model &model)**
  
  *constructor*

- **Verification (unsigned short method_name, Model &model)**
  
  *alternate constructor for instantiations "on the fly"*

- **~Verification ()**
  
  *destructor*

- **void print_results (std::ostream &s)**
  
  *print the final iterator results*

Additional Inherited Members

13.204.1 Detailed Description

Base class for managing common aspects of verification studies.

The Verification base class manages common data and functions, such as those involving ...

13.204.2 Member Function Documentation

**void print_results ( std::ostream &s ) [protected], [virtual]**

print the final iterator results

This virtual function provides additional iterator-specific final results outputs beyond the function evaluation summary printed in finalize_run().

Reimplemented from Analyzer.

Reimplemented in RichExtrapVerification.

References Analyzer::print_results().

Referenced by RichExtrapVerification::print_results().

The documentation for this class was generated from the following files:

- DakotaVerification.hpp
- DakotaVerification.cpp

13.205 VLint Struct Reference

structure for validating integer uncertain variable labels, bounds, values

Public Attributes

- int n
- VarLabel Var_Info::* VL
- Var_uinfo * vui
- StringArray DataVariablesRep::* Labels
- IntVector DataVariablesRep::* LowerBnds
- IntVector DataVariablesRep::* UpperBnds
- IntVector DataVariablesRep::* UncVars
13.205.1 Detailed Description

structure for validating integer uncertain variable labels, bounds, values

The documentation for this struct was generated from the following file:

- NIDRProblemDescDB.cpp

13.206 VLreal Struct Reference

structure for validating real uncertain variable labels, bounds, values

Public Attributes

- int n
- VarLabel Var_Info::* VL
- Var_uinfo * vui
- StringArray DataVariablesRep::* Labels
- RealVector DataVariablesRep::* LowerBnds
- RealVector DataVariablesRep::* UpperBnds
- RealVector DataVariablesRep::* UncVars

13.206.1 Detailed Description

structure for validating real uncertain variable labels, bounds, values

The documentation for this struct was generated from the following file:

- NIDRProblemDescDB.cpp

13.207 VLstr Struct Reference

structure for validating string uncertain variable labels, bounds, values

Public Attributes

- int n
- VarLabel Var_Info::* VL
- Var_uinfo * vui
- StringArray DataVariablesRep::* Labels
- StringArray DataVariablesRep::* LowerBnds
- StringArray DataVariablesRep::* UpperBnds
- StringArray DataVariablesRep::* UncVars

13.207.1 Detailed Description

structure for validating string uncertain variable labels, bounds, values

The documentation for this struct was generated from the following file:

- NIDRProblemDescDB.cpp
13.208 VPSApproximation Class Reference

Derived approximation class for VPS implementation.

Inheritance diagram for VPSApproximation:

```
Approximation
    \------>
VPSApproximation
```

Public Member Functions

- **VPSApproximation ()**
  *default constructor*

- **VPSApproximation (const ProblemDescDB &problem_db, const SharedApproxData &shared_data, const String &approx_label)**
  *standard constructor (to call VPS from an input deck)*

- **VPSApproximation (const SharedApproxData &shared_data)**
  *Alternate constructor (to call VPS from another method like POF-darts)*

- **~VPSApproximation ()**
  *destructor*

- **bool VPS_execute ()**

- **void VPS_create_containers ()**

- **void VPS_retrieve_neighbors (size_t ipoint, bool update_point_neighbors)**

- **void VPS_adjust_extend_neighbors_of_all_points ()**

- **void VPS_extend_neighbors (size_t ipoint)**

- **void VPS_build_local_surrogate (size_t cell_index)**

- **double VPS_evaluate_surrogate (double *x)**

- **void VPS_destroy_global_containers ()**

- **void retrieve_permutations (size_t &m, size_t **perm, size_t num_dim, size_t upper_bound, bool force_sum_constraint, size_t sum_constraint)**

- **void build_radial_basis_function (size_t icell)**

- **void VPS_LS_retrieve_weights (size_t cell_index)**

- **double evaluate_basis_function (double *x, size_t icell, size_t ibasis)**

- **int constrained_LeastSquare (size_t n, size_t m, double **H, double *w, double *f)**

- **double vec_dot_vec (size_t n, double *vec_a, double *vec_b)**

- **double vec_pow_vec (size_t num_dim, double *vec_a, size_t *vec_b)**

- **bool Cholesky (int n, double **A, double **LD)**

- **void Cholesky_solver (int n, double **LD, double *b, double *x)**

- **void GMRES (size_t n, double **A, double *b, double *x, double eps)**

- **void printMatrix (size_t m, size_t n, double **M)**

- **void initiate_random_number_generator (unsigned long x)**

- **double generate_a_random_number ()**

- **size_t retrieve_closest_cell (double *x)**

- **bool trim_line_using_Hyperplane (size_t num_dim, double *st, double *end, double *qH, double *nH)**
• double f_test (double **x)
• double * grad f_test (double **x)
• double ** hessian f_test (double **x)
• void generate_poisson_disk_sample (double r)
• void generate_MC_sample ()
• void isocontouring (std::string file_name, bool plot_test function, bool plot surrogate, std::vector<double> contours)
• void isocontouring_solid (std::string file_name, bool plot_test function, bool plot surrogate, std::vector<double> contours)
• void plot_neighbors ()

Protected Member Functions

• int min_coefficients () const
  return the minimum number of samples (unknowns) required to build the derived class approximation type in num-Vars dimensions
• int num_constraints () const
  return the number of constraints to be enforced via an anchor point
• void build ()
  builds the approximation from scratch
• Real value (const Variables &vars)
  retrieve the predicted function value for a given parameter set
• const RealVector & gradient (const Variables &vars)
  retrieve the function gradient at the predicted value for a given parameter set
• Real prediction_variance (const Variables &vars)
  retrieve the variance of the predicted value for a given parameter set

Private Types

• enum subsurrogate { LS, GP }
• enum subsurrogate_basis { polynomial, radial }
• enum testfunction {
  SmoothHerbie, Herbie, Cone, Cross,
  UnitSphere, Linear34 }

Private Member Functions

• void VPSmodel_build ()
  Function to compute coefficients governing the VPS surrogates.
• void VPSmodel_apply (const RealVector &new_x, bool variance_flag, bool gradients_flag)
  Function returns a response value using the VPS surface.
Private Attributes

- Real approxValue
  value of the approximation returned by value()
- Real approxVariance
  value of the approximation returned by prediction_variance()
- RealMatrix trainPoints
  A 2-D array (num sample sites = rows, num vars = columns) used to create the Gaussian process.
- RealMatrix trainValues
  An array of response values; one response value per sample site.
- size_t numObs
  The number of observations on which the GP surface is built.
- int surrogateOrder
  The order of the polynomial in each Voronoi cell.
- subsurrogate _vps_subsurrogate
- subsurrogate_basis _vps_subsurrogate_basis
- testfunction _vps_test_function
- double Q [1220]
- int index
- double cc
- double c
- double zc
- double zx
- double zy
- size_t qlen
- size_t _n_dim
- double * _xmin
- double * _xmax
- double _diag
- size_t _num_inserted_points
- double ** _sample_points
- double * _fval
- double ** _fgrad
- double *** _fhess
- size_t ** _sample_neighbors
- size_t ** _vps_ext_neighbors
- size_t _vps_order
- size_t _num_GMRES
- size_t * _num_cell_basis_functions
- double * _sample_vsize
- double * _vps_dfar
- double *** _sample_basis
- double _max_vsize
- double _disc_min_jump
- double _disc_min_grad
- double _f_min
• double _f_max
• size_t *** _vps_t
• double ** _vps_w
• SharedApproxData sharedData
• std::vector< Approximation > gpApproximations
• Variables gpEvalVars
• bool _use_derivatives
• bool _use_gradient
• bool _use_hessian

Static Private Attributes

• static VPSApproximation * VPSinstance

  pointer to the active object instance used within the static evaluator

Additional Inherited Members

13.208.1 Detailed Description

Derived approximation class for VPS implementation.

The VPSApproximation class provides a set of piecewise surrogate approximations

each of which is valid within a Voronoi cell.

13.208.2 Member Function Documentation

void VPSmodel_apply ( const RealVector & new_x, bool variance_flag, bool gradients_flag ) [private]

Function returns a response value using the VPS surface.

  The response value is computed at the design point specified by the RealVector function argument.
  References VPSApproximation::approxValue.
  Referenced by VPSApproximation::gradient(), VPSApproximation::prediction_variance(), and VPSApproximation::value().

13.208.3 Member Data Documentation

VPSApproximation * VPSinstance [static], [private]

pointer to the active object instance used within the static evaluator

default constructor

The documentation for this class was generated from the following files:

• VPSApproximation.hpp
• VPSApproximation.cpp
13.209 WorkdirHelper Class Reference

Static Public Member Functions

- static void initialize ()
  
  initialize (at runtime) cached values for paths and environment
- static const std::string & startup_pwd ()
  
  Query for dakota’s startup $PWD.
- static void change_directory (const bfs::path &new_dir)
  
  change current directory
- static void prepend_preferred_env_path (const std::string &extra_path)
  
  Prepend cached preferredEnvPath with extra_path and update $PATH environment variable.
- static void set_environment (const std::string &env_name, const std::string &env_val, bool overwrite_flag=true)
  
  Set an environment variable.
- static bfs::path which (const std::string &driver_name)
  
  Returns the bfs::path for the analysis driver, supporting typical windows filename extensions, or empty if not found.
- static bfs::path rel_to_abs (const bfs::path &subdir_path)
  
  get a valid absolute bfs::path to a subdirectory relative to rundir
- static StringArray tokenize_driver (const String &user_an_driver)
  
  tokenize a white-space separated analysis driver, respecting escapes and nested quotes
- static bool resolve_driver_path (String &an_driver)
  
  parse off the first whitespace-separated entry in the user’s analysis_driver, and convert it to an absolute path if it begins with ./ or ../, replacing the passed string if needed. Returns true if the first token was modified.
- static void split_wildcard (const std::string &path with wc, bfs::path &search_dir, bfs::path &wildcard)
  
  given a string with an optional path and a wildcard, e.g., /tmp/D*?.pp, parse it into the search path /tmp (default .) and the wildcard D*?.pp. Return wildcard as path to reduce wstring conversions
- static bfs::path concat_path (const bfs::path &p_in, const String &tag)
  
  concatenate a string onto the end of a path
- static bfs::path system_tmp_file (const std::string &prefix)
  
  generate a valid temporary file name <prefix>_%%_%%_%%_%%
- static bfs::path system_tmp_path ()
  
  get the system tmp path, e.g., /tmp or C:
- static bool create_directory (const bfs::path &dir_path, short mkdir_option)
  
  Create a directory, with options for remove or error.
- static void recursive_remove (const bfs::path &rm_path, short fileop_option)
  
  Remove a path (file, directory, or symlink) without regard to its type. Only error if existed and there’s an error in the remove.
- static void rename (const bfs::path &old_path, const bfs::path &new_path, short fileop_option)
  
  Rename a file, catching any errors and optionally warning/erroring.
- static void link_items (const StringArray &source_itemsss, const bfs::path &dest_dir, bool overwrite)
  
  top-level link a list of source_paths (files, directories, symlinks), potentially including wildcards, from destination_dir, which must exist
- static void copy_items (const StringArray &source_items, const bfs::path &dest_dir, bool overwrite)
  
  copy a list of source_paths (files, directories, symlinks), potentially including wildcards into destination_dir, which must exist
• static void prepend_path_items (const StringArray &source_items)
  prepend any directories (including wildcards) found in source_items to the preferred environment path; this will
  update cached preferred path and PATH

• static bool check_equivalent_dest (const StringArray &source_items, const bfs::path &dest_dir)
  check whether any of the passed source items are filesystem equivalent to the destination path, return true if any
  one is equivalent to dest

• static bool find_driver (const StringArray &source_items, const bfs::path &search_driver)
  check whether the any of the passed source items (possibly including wildcards to be expanded) matches the passed
  search driver

• static bool link (const bfs::path &src_path, const bfs::path &dest_dir, bool overwrite)
  create link from dest_dir/src_path.filename() to a single path (file, dir, link) in source directory

• static bool recursive_copy (const bfs::path &src_path, const bfs::path &dest_dir, bool overwrite)
  Recursive copy of src_path into dest_dir, with optional top-level overwrite (remove/recreate) of dest_dir/src_path.-
  filename()

• static bool prepend_path_item (const bfs::path &src_path, const bfs::path &dest_dir, bool overwrite)
  prepend the preferred env path with source path if it’s a directory; this will update cached preferred path and
  manipulate PATH

• static bool check_equivalent (const bfs::path &src_path, const bfs::path &dest_dir, bool overwrite)
  return true if the src and dest are filesystem equivalent

• static bool find_file (const bfs::path &src_path, const bfs::path &search_file, bool overwrite)
  return true if the src_path is a regular file and has same filename as search_file

• static bool file_op_items (const file_op_function &file_op, const StringArray &source_paths, const bfs::path
  &dest_dir, bool overwrite)
  recursively perform file_op (copy, path adjust, etc.) on a list of source_paths (files, directories, symlinks), which
  potentially include wildcards, w.r.t. destination_dir

• static void set_preferred_path ()
  set/reset PATH to dakPreferredEnvPath

• static void set_preferred_path (const boost::filesystem::path &extra_path)
  set PATH to absolute(extra_path):dakPreferredEnvPath, without changing cached preferred PATH

• static void reset ()
  Resets the working directory ”state” to its initial state when DAKOTA was launched.

Private Member Functions

• WorkdirHelper ()
  default constructor

• WorkdirHelper (const WorkdirHelper &)
  copy constructor

• ~WorkdirHelper ()
  destructor

• WorkdirHelper & operator= (const WorkdirHelper &)
  assignment operator
13.209. WORKDIRHELPER CLASS REFERENCE

**Static Private Member Functions**

- static bfs::path po_which (const std::string &driver_name)
  
  *Returns the bfs::path for the analysis driver - POSIX-style implementation, returns empty if not found.*

- static std::string init_startup_path ()

  *Initializes class member, startupPATH.*

- static std::string init_preferred_env_path ()

  *Initializes class member, dakPreferredEnvPath.*

- static std::vector<std::string> tokenize_env_path (const std::string &path)

  *Tokenizes $PATH environment variable into a "list" of directories.*

**Static Private Attributes**

- static std::string startupPWD = ".

  *Value of $PWD var upon entry to dakota main()*

- static std::string startupPATH = ""

  *Value of $PATH (PATH% on windows) var upon entry to dakota main(), omitting any leading PATH= or Path=.*

- static std::string dakPreferredEnvPath = "..

  *Dakota preferred search PATH/Path = "./startupPWD:startupPATH", omitting any leading PATH= or Path=.*

13.209.1 Detailed Description

Utility class for cross-platform management of environment and paths. Including directory and file operations. On initialization, this class does not manipulate the present working directory, nor the PATH environment variable, but stores context to manipulate them later.

13.209.2 Member Function Documentation

```cpp
void initialize ( ) [static]
```

Initialize (at runtime) cached values for paths and environment

  Initialize defers calls to Boost filesystem utilities until runtime (required on some operating systems.

  References WorkdirHelper::dakPreferredEnvPath, WorkdirHelper::init_preferred_env_path(), WorkdirHelper::init_startup_path(), WorkdirHelper::startupPATH, and WorkdirHelper::startupPWD.

  Referenced by Environment::Environment().

```cpp
void prepend_preferred_env_path ( const std::string & extra_path ) [static]
```

Prepend cached preferredEnvPath with extra_path and update $PATH environment variable.

  Overwrites $PATH with an additional directory prepended, typically for the purpose of ensuring templatedir

  is in the $PATH; updates cached preferred PATH and environment PATH, so exercise caution with repeated calls.

  References WorkdirHelper::dakPreferredEnvPath, WorkdirHelper::set_environment(), and WorkdirHelper::startup-PWD.

  Referenced by WorkdirHelper::prepend_path_item().
bfs::path which (const std::string & driver_name) [static]

Returns the bfs::path for the analysis driver, supporting typical windows filename extensions, or empty if not found.

Uses string representing $PATH to locate an analysis driver on the host computer. Returns the path to the driver (as a string).

This version is a wrapper over the "plain ol’ which" implementation, allowing an array of windows, 3-letter extensions to be checked.

References Dakota::get_pathext(), and WorkdirHelper::po.which().

Referenced by NIDRProblemDescDB::check_driver().

void split wildcard (const std::string & path with wc, bfs::path & search dir, bfs::path & wildcard) [static]

given a string with an optional path and a wildcard, e.g., /tmp/D*?.pp, parse it into the search path /tmp (default .) and the wildcard D*?.pp. Return wildcard as path to reduce wstring conversions

Input: path with wc; Output: search_dir, wildcard

Referenced by WorkdirHelper::file_op_items().

bool create directory (const bfs::path & dir_path, short mkdir_option) [static]

Create a directory, with options for remove or error.

mkdir_option is DIR_CLEAN (remove and recreate), DIR_PERSIST (leave existing), or DIR_ERROR (don’t allow existing) returns whether a new directory was created.

References Dakota::abort_handler(), and WorkdirHelper::recursive_remove().

Referenced by ProcessApplicInterface::define_filenames().

void link items (const StringArray & source_items, const bfs::path & dest_dir, bool overwrite) [static]

top-level link a list of source_paths (files, directories, symlinks), potentially including wildcards, from destination_dir, which must exist

Iterate source items (paths or wildcards), linking each of them from the destination. If overwrite, remove and replace any existing destination target, otherwise, allow to persist

References WorkdirHelper::file_op_items(), and WorkdirHelper::link().

Referenced by ProcessApplicInterface::define_filenames().

void copy items (const StringArray & source_items, const bfs::path & dest_dir, bool overwrite) [static]

copy a list of source_paths (files, directories, symlinks), potentially including wildcards into destination_dir, which must exist

Iterate source items (paths or wildcards), copying each of them into the destination. If overwrite, remove and replace any existing destination target, otherwise, allow to persist

References WorkdirHelper::file_op_items(), and WorkdirHelper::recursive_copy().

Referenced by ProcessApplicInterface::define_filenames().
bool link ( const bfs::path & src_path, const bfs::path & dest_dir, bool overwrite ) [static]  
create link from dest_dir/src_path.filename() to a single path (file, dir, link) in source directory  
  Assumes source file exists since it was iterated in the calling context. If overwrite, any existing file in dest_dir will be removed prior to creating the new link.  
  References Dakota::abort_handler().  
  Referenced by WorkdirHelper::link_items().

bool recursive_copy ( const bfs::path & src_path, const bfs::path & dest_dir, bool overwrite ) [static]  
Recursive copy of src_path into dest_dir, with optional top-level overwrite (remove/recreate) of dest_dir/src_path.filename()  
  note dest_dir is the containing folder for the src_path contents to be placed in for consistency with other convenience functions (may need to reconsider)  
  References Dakota::abort_handler().  
  Referenced by WorkdirHelper::copy_items().

bool prepend_path_item ( const bfs::path & src_path, const bfs::path & dest_dir, bool overwrite ) [static]  
prepend the preferred env path with source path if it’s a directory; this will update cached preferred path and manipulate PATH  
  prepend the env path with source path if it’s a directory or directory symlink  
  References Dakota::abort_handler(), and WorkdirHelper::prepend_preferred_env_path().  
  Referenced by WorkdirHelper::prepend_path_items().

bool file_op_items ( const file_op_function & file_op, const StringArray & source_items, const bfs::path & dest_dir, bool overwrite ) [static]  
recursively perform file_op (copy, path adjust, etc.) on a list of source_paths (files, directories, symlinks), which potentially include wildcards, w.r.t. destination_dir  
  Iterator implementation for copy, link, etc file operation. Iterate source items (paths or wildcards), performing file_op on each w.r.t. destination. If overwrite, remove and replace any existing destination target (at top-level), otherwise, allow to persist. Return code true indicates abnormal behavior.  
  References WorkdirHelper::split_wildcard(), and Dakota::strcontains().  
  Referenced by WorkdirHelper::check_equivalent_dest(), WorkdirHelper::copy_items(), WorkdirHelper::find_driver(), WorkdirHelper::link_items(), and WorkdirHelper::prepend_path_items().

void set_preferred_path ( const boost::filesystem::path & extra_path ) [static]  
set PATH to absolute(extra_path):dakPreferredEnvPath, without changing cached preferred PATH  
  If needed, convert the passed item to an absolute path (while could make sense to prepend a relative path, no current use cases) and prepend when setting environment. Does not update cached preferred path.  
  References WorkdirHelper::dakPreferredEnvPath, WorkdirHelper::rel_to_abs(), and WorkdirHelper::set_environment().

bfs::path po_which ( const std::string & driver_name ) [static], [private]  
Returns the bfs::path for the analysis driver - POSIX-style implementation, returns empty if not found.  
  For absolute driver_name, validates that is regular file. For relative, uses string representing $PATH (preferred path) to locate an analysis driver on the host computer. Returns the path to the driver, or empty if not found.  
  This is the "plain ol’ which" impl that worked well, historically, on POSIX.
std::string init_startup_path() [static], [private]

Initializes class member, startupPATH.
  Gets the $PATH (PATH% on windows) and returns the std::string value
  References Dakota::abort_handler().
  Referenced by WorkdirHelper::initialize().

std::string init_preferred_env_path() [static], [private]

Initializes class member, dakPreferredEnvPath.
  Prepends '.' and the startupPWD to the initial startup $PATH string so that analysis driver detection is more robust
  References WorkdirHelper::startupPATH, and WorkdirHelper::startupPWD.
  Referenced by WorkdirHelper::initialize().

std::vector<std::string> tokenize_env_path(const std::string &env_path) [static], [private]

Tokenizes $PATH environment variable into a "list" of directories.
  Creates a vector of directories (as an aid to search) by breaking up the $PATH environment variable (passed in as a string argument)
  Referenced by WorkdirHelper::po_which().
  The documentation for this class was generated from the following files:

  • WorkdirHelper.hpp
  • WorkdirHelper.cpp
Chapter 14

File Documentation

14.1  dakota_dll_api.cpp File Reference

This file contains a DakotaRunner class, which launches DAKOTA.

Namespaces

- Dakota
  
  The primary namespace for DAKOTA.

Constant Groups

- Dakota
  
  The primary namespace for DAKOTA.

Functions

- void DAKOTA_DLL_FN dakota_create (int *dakota_ptr_int, const char *logname)
  
  create and configure a new DakotaRunner, adding it to list of instances

- int DAKOTA_DLL_FN dakota_readInput (int id, const char *dakotaInput)
  
  command DakotaRunner instance id to read from file dakotaInput

- void DAKOTA_DLL_FN dakota_get_variable_info (int id, char ***pVarNames, int *pNumVarNames, char ***pRespNames, int *pNumRespNames)
  
  return the variable and response names

- int DAKOTA_DLL_FN dakota_start (int id)
  
  command DakotaRunner instance id to start (plugin interface and run strategy)

- void DAKOTA_DLL_FN dakota_destroy (int id)
  
  delete Dakota runner instance id and remove from active list

- void DAKOTA_DLL_FN dakota_stop (int *id)
  
  command DakotaRunner instance id to stop execution

- const char *DAKOTA_DLL_FN dakota_getStatus (int id)
  
  return current results output as a string

- int get_mc_ptr_int ()
CHAPTER 14. FILE DOCUMENTATION

get the DAKOTA pointer to ModelCenter
• void set_mc_ptr_int (int ptr_int)
  set the DAKOTA pointer to ModelCenter
• int get_dc_ptr_int ()
  get the DAKOTA pointer to ModelCenter current design point
• void set_dc_ptr_int (int ptr_int)
  set the DAKOTA pointer to ModelCenter current design point

14.1.1 Detailed Description
This file contains a DakotaRunner class, which launches DAKOTA.

14.1.2 Function Documentation

void DAKOTA_DLL_FN dakota_stop ( int * id )
command DakotaRunner instance id to stop execution
  TODO: trick application to quit through the syscall interface or throw exception.

14.2 dakota_dll_api.h File Reference
API for DLL interactions.

Functions
• void DAKOTA_DLL_FN dakota_create (int *dakota_ptr_int, const char *logname)
  create and configure a new DakotaRunner, adding it to list of instances
• int DAKOTA_DLL_FN dakota_readInput (int id, const char *dakotaInput)
  command DakotaRunner instance id to read from file dakotaInput
• int DAKOTA_DLL_FN dakota_start (int id)
  command DakotaRunner instance id to start (plugin interface and run strategy)
• void DAKOTA_DLL_FN dakota_destroy (int id)
  delete Dakota runner instance id and remove from active list
• void DAKOTA_DLL_FN dakota_stop (int *id)
  command DakotaRunner instance id to stop execution
• const char *DAKOTA_DLL_FN dakota_getStatus (int id)
  return current results output as a string
• int DAKOTA_DLL_FN get_mc_ptr_int ()
  get the DAKOTA pointer to ModelCenter
• void DAKOTA_DLL_FN set_mc_ptr_int (int ptr_int)
  set the DAKOTA pointer to ModelCenter
• int DAKOTA_DLL_FN get_dc_ptr_int ()
  get the DAKOTA pointer to ModelCenter current design point
• void DAKOTA_DLL_FN set_dc_ptr_int (int ptr_int)
  set the DAKOTA pointer to ModelCenter current design point
14.2.1 Detailed Description

API for DLL interactions.

14.2.2 Function Documentation

void DAKOTA_DLL_FN dakota_stop ( int *id )
command DakotaRunner instance id to stop execution
   TODO: trick application to quit through the syscall interface or throw exception.

14.3 dakota_linear_algebra.hpp File Reference

Dakota linear algebra utilities.

Namespaces

- Dakota
  The primary namespace for DAKOTA.

Constant Groups

- Dakota
  The primary namespace for DAKOTA.

Functions

- void svd (RealMatrix &matrix, RealVector &singular_vals, RealMatrix &v_trans)
  Compute the SVD of an arbitrary matrix \( A = USV^T \).
- int qr (RealMatrix &A)
  Compute an in-place QR factorization \( A = QR \).
- int qr_resolve (const RealMatrix &q_r, bool transpose, RealMatrix &rhs)
  Perform a multiple right-hand sides \( Rinv \ast rhs \) solve using the \( R \) from a \( qr \) factorization.

14.3.1 Detailed Description

Dakota linear algebra utilities. Convenience functions to perform Teuchos::LAPACK operations on Dakota RealMatrix/RealVector

14.4 dakota_tabular_io.hpp File Reference

Utility functions for reading and writing tabular data files Emerging utilities for tabular file I/O. For now, just extraction of capability from separate contexts to facilitate rework. These augment (and leverage) those in data_-util.h.
Namespaces

- Dakota

  The primary namespace for DAKOTA.

Constant Groups

- Dakota

  The primary namespace for DAKOTA.

Functions

- **String format** (unsigned short tabular_format)
  
  Translate tabular format into a user-friendly name.

- **void print_expected_format** (std::ostream &s, unsigned short tabular_format, size_t num_rows, size_t num_cols)

  Describe the expected data file format based on passed parameters.

- **void print_unexpected_data** (std::ostream &s, const String &filename, const String &context_message, unsigned short tabular_format)

  Print a warning if there's extra data in the file.

- **void open_file** (std::ifstream &data_file, const std::string &input_filename, const std::string &context_message)

  open the file specified by name for reading, using passed input stream, presenting context-specific error on failure

- **void open_file** (std::ofstream &data_file, const std::string &output_filename, const std::string &context_message)

  open the file specified by name for writing, using passed output stream, presenting context-specific error on failure

- **void close_file** (std::ifstream &data_file, const std::string &input_filename, const std::string &context_message)

  close the file specified by name after reading, using passed input stream, presenting context-specific error on failure

- **void close_file** (std::ofstream &data_file, const std::string &output_filename, const std::string &context_message)

  close the file specified by name after writing, using passed output stream, presenting context-specific error on failure

- **void write_header_tabular** (std::ostream &tabular_ostream, const Variables &vars, const Response &response, const std::string &counter_label, unsigned short tabular_format)

  Output the header row (labels) for a tabular data file for variables and responses, with variables in input spec order. Conditionally include interface ID. Primary uses: environment tabular data, pre-run output, surrogate approx evals.

- **void write_header_tabular** (std::ostream &tabular_ostream, const Variables &vars, const StringArray &addtl_labels, const std::string &counter_label, unsigned short tabular_format)

  Output the header row (labels) for a tabular data file for variables and additional labels not tied to a response. Variables are in input spec order. Conditionally include interface ID. Primary uses: MCMC chain export, including calibration sigmas.

- **void write_leading_columns** (std::ostream &tabular_ostream, size_t eval_id, const String &iface_id, unsigned short tabular_format)

  Write the leading column with eval ID and conditionally, the interface ID.

- **void write_data_tabular** (std::ostream &tabular_ostream, const Variables &vars, const String &iface, const Response &response, size_t counter, unsigned short tabular_format)
14.4. DAKOTA_TABULAR_IO.HPP FILE REFERENCE

Output a row of tabular data from variables and response object used by graphics to append to tabular file during iteration. All active/inactive variables written in input spec order. Conditionally include interface ID. Primary uses: environment tabular data, pre-run output, surrogate approx evals.

- void **write_data_tabular** (const std::string &output_filename, const std::string &context_message, const RealVectorArray &output_coeffs, const UShort2DArray &output_indices)

  PCE export: write freeform format file with whitespace-separated data where each row has num_fns reals from coeffs, followed by num_vars unsigned shorts from indices.

- bool **exists_extra_data** (std::istream &tabular_file)

  Check if an input stream contains unexpected additional data.

- void **read_header_tabular** (std::istream &input_stream, unsigned short tabular_format)

  read and discard header line from the stream

- size_t **read_leading_columns** (std::istream &input_stream, unsigned short tabular_format)

  read leading columns [ int eval_id [ String iface_id ] ]

- void **read_data_tabular** (const std::string &input_filename, const std::string &context_message, RealVector &input_data, size_t num_entries, unsigned short tabular_format)

  read possibly header-annotated whitespace-separated data into a vector of length num_entries; if annotated then it’s a column vector for now

- void **read_data_tabular** (const std::string &input_filename, const std::string &context_message, Variables vars, size_t num_fns, RealMatrix &vars_matrix, RealMatrix &resp_matrix, unsigned short tabular_format, bool active_only)

  Tabular read for ApproximationInterface challenge data: read possibly header-annotated whitespace-separated data of possible mixed Variables, followed by num_fns, each into RealMatrix with minimal error checking.

- void **read_data_tabular** (const std::string &input_filename, const std::string &context_message, Variables vars, Response resp, VariablesList &input_vars, ResponseList &input_resp, unsigned short tabular_format, bool verbose=false, bool active_only=false)

  Tabular read for DataFitSurrModel (build points): read whitespace-separated data with optional row and column headers into lists of Variables and Responses until out of data.

- void **read_data_tabular** (const std::string &input_filename, const std::string &context_message, RealMatrix &input_matrix, size_t record_len, unsigned short tabular_format, bool verbose=false)

  Tabular read for import_approx_points file: read whitespace-separated data with optional row and column headers into a single matrix, with length of record as specified and number of records to be determined by file content. The matrix is stored as record_len rows by num_records columns.

- void **read_data_tabular** (const std::string &input_filename, const std::string &context_message, RealMatrix &input_matrix, size_t num_rows, size_t num_cols, unsigned short tabular_format, bool verbose=false)

  Tabular read for GPMSA data: read whitespace-separated data with optional row and column headers into a single matrix, with size as specified (one experiment per row)

- size_t **read_data_tabular** (const std::string &input_filename, const std::string &context_message, RealVectorArray &cva, IntVectorArray &diva, StringMulti2DArray &dsva, RealVectorArray &drva, unsigned short tabular_format, bool active_only, Variables vars)

  Tabular read for ParamStudy: read specified input data file into arrays with sizes specified by the passed vc_totals array.
14.4.1 Detailed Description

Utility functions for reading and writing tabular data files Emerging utilities for tabular file I/O. For now, just extraction of capability from separate contexts to facilitate rework. These augment (and leverage) those in data-util.h. Design/capability goals: Ability to read / write data with row/col headers or in free-form Detect premature end of file, report if extra data More consistent and reliable checks for file open errors Require right number of cols in header mode; only total data checking in free-form (likely) Allow comment character for header rows or even in data? variables vs. variables/responses for both read and write Should we support CSV? delimiter = ‘,’; other? Verify treatment of trailing newline without reading a zero Allow reading into the transpose of the data structure

14.5 dll_tester.cpp File Reference

Test the DLL with a DAKOTA input file.

Functions

- **int main (int argc, char ∗argv[ ] )**

  *The main program for exercising the DLL API with a simple command-line.*

14.5.1 Detailed Description

Test the DLL with a DAKOTA input file.

14.6 JEGAOptimizer.cpp File Reference

Contains the implementation of the JEGAOptimizer class.

Classes

- **class JEGAOptimizer::Evaluator**
  
  An evaluator specialization that knows how to interact with Dakota.

- **class JEGAOptimizer::EvaluatorCreator**
  
  A specialization of the JEGA::FrontEnd::EvaluatorCreator that creates a new instance of a Evaluator.

- **class JEGAOptimizer::Driver**
  
  A subclass of the JEGA front end driver that exposes the individual protected methods to execute the algorithm.

Namespaces

- **Dakota**

  *The primary namespace for DAKOTA.*

Constant Groups

- **Dakota**

  *The primary namespace for DAKOTA.*
14.7. JEGAOPTIMIZER.HPP FILE REFERENCE

Functions

- template<typename T>
  string asstring (const T &val)

  Creates a string from the argument val using an ostringstream.

14.6.1 Detailed Description

Contains the implementation of the JEGAOptimizer class.

14.7 JEGAOptimizer.hpp File Reference

Contains the definition of the JEGAOptimizer class.

Classes

- class JEGAOptimizer

  A version of Dakota::Optimizer for instantiation of John Eddy’s Genetic Algorithms (JEGA).

Namespaces

- Dakota

  The primary namespace for DAKOTA.

Constant Groups

- Dakota

  The primary namespace for DAKOTA.

14.7.1 Detailed Description

Contains the definition of the JEGAOptimizer class.

14.8 library_mode.cpp File Reference

file containing a mock simulator main for testing Dakota in library mode

Classes

- struct callback_data

Functions

- void fpinit_AS
- void run_dakota_parse (const char *dakota_input_file)

  Run a Dakota LibraryEnvironment, mode 1: parsing an input file.
- void run_dakota_data ()
Run a Dakota LibraryEnvironment, mode 2: from C++ API inserted data.

- **void run_dakota_data()**
  - Run a Dakota LibraryEnvironment, mode 2: from C++ API inserted data.
  
  Rather than parsing from an input file, this function populates Data class objects directly using a minimal specification and relies on constructor defaults and post-processing in post_process() to fill in the rest.

- **void callback_function(Dakota::ProblemDescDB *db, void *ptr)**
  - Example: user-provided post-parse callback (Dakota::DbCallbackFunction)

- **void fpinit_ASL()**
  - Floating-point initialization from AMPL: switch to 53-bit rounding if appropriate, to eliminate some cross-platform differences.
  
  Referenced by main().

- **void run_dakota_parse(const char *dakota_input_file)**
  - Run a Dakota LibraryEnvironment, mode 1: parsing an input file.
  
  Simplest library case: this function parses from an input file to define the ProblemDescDB data.
  
  References Environment::execute(), ProgramOptions::input_file(), Environment::mpi_manager(), MPIManager::<mpirun_flag(), parallel_interface_plugin(), serial_interface_plugin(), and MPIManager::world_rank().
  
  Referenced by main().

Variables

- **static const char serial_input[]**
  - Default Dakota input string for serial case (rosenbrock):

- **static const char parallel_input[]**
  - Default Dakota input string for parallel case (textbook)

### 14.8.1 Detailed Description

file containing a mock simulator main for testing Dakota in library mode

### 14.8.2 Function Documentation

- **void parallel_interface_plugin(Dakota::LibraryEnvironment &env)**
  - Convenience function to plug a library client’s interface into the appropriate model, demonstrating use of Dakota parallel configuration in constructing the plugin Interface on the right MPI_Comm.

- **void serial_interface_plugin(Dakota::LibraryEnvironment &env)**
  - Convenience function with simplest example of interface plugin: plugin a serial DirectApplicInterface that can be constructed independent of Dakota’s configuration details.

- **void run_dakota_parse()**
  - Run a Dakota LibraryEnvironment, from string or input file input, supplemented with additional C++ API adjustments.

- **void run_dakota_data()**
  - Run a Dakota LibraryEnvironment, mode 2: from C++ API inserted data.

- **void callback_function(Dakota::ProblemDescDB *db, void *ptr)**
  - Example: user-provided post-parse callback (Dakota::DbCallbackFunction)

- **int main(int argc, char *argv[])**
  - A mock simulator main for testing Dakota in library mode.
References DataInterface::data_rep(), DataResponses::data_rep(), DataVariables::data_rep(), DataMethod::data_rep(), LibraryEnvironment::done_modifying_db(), Environment::execute(), Environment::exit_mode(), DataResponsesRep::gradientType, DataResponsesRep::hessianType, LibraryEnvironment::insert_nodes(), DataMethodRep::method_Name, Environment::mpi_manager(), MPIManager::mpirun_flag(), ParallelLibrary::mpirun_flag(), DataVariablesRep::numContinuousDesVars, DataResponsesRep::numNonlinearIneqConstraints, DataResponsesRep::numObjectiveFunctions, parallel interface_plugin(), Environment::parallel_library(), serial_interface_plugin(), and ParallelLibrary::world_rank().

Referenced by main().

```c++
void run_dakota_mixed ( const char * dakota_input_file, bool mpirun_flag )
```

Run a Dakota LibraryEnvironment, from string or input file input, supplemented with additional C++ API adjustments.

Function to encapsulate the Dakota object instantiations for mode 3: mixed parsing and direct updating.

This function showcases multiple features. For parsing, either an input file (dakota_input_file != NULL) or a default input string (dakota_input_file == NULL) are shown. This parsed input is then mixed with input from three sources: (1) input from a user-supplied callback function, (2) updates to the DB prior to Environment instantiation, (3) updates directly to Iterators/Models following Environment instantiation.

References callback_function(), LibraryEnvironment::done_modifying_db(), ProgramOptions::echo_input(), Environment::execute(), LibraryEnvironment::filtered_model_list(), ProblemDescDB::get_sa(), ProgramOptions::input_file(), ProgramOptions::input_string(), Environment::mpi_manager(), MPIManager::mpirun_flag(), parallel_input, parallel_interface_plugin(), Environment::parallel_library(), Environment::problem_description_db(), ProblemDescDB::resolve_top_method(), callback_data::rosen_cdv.upper_bd, serial_input, serial_interface_plugin(), ProblemDescDB::set(), and ParallelLibrary::world_rank().

Referenced by main().

```c++
void serial_interface_plugin ( Dakota::LibraryEnvironment & env )
```

Convenience function with simplest example of interface plugin: plug a serial DirectApplicInterface that can be constructed independent of Dakota’s configuration details.

Demonstration of simple plugin where client code doesn’t require access to detailed Dakota data (such as Model-based parallel configuration information) to construct the DirectApplicInterface. This example plugs-in a derived serial direct application interface instance (“plugin_rosenbrock”).

References Dakota::abort_handler(), LibraryEnvironment::plugin_interface(), and Environment::problem_description_db().

Referenced by run_dakota_data(), run_dakota_mixed(), and run_dakota_parse().

```c++
void parallel_interface_plugin ( Dakota::LibraryEnvironment & env )
```

Convenience function to plug a library client’s interface into the appropriate model, demonstrating use of Dakota parallel configuration in constructing the plugin Interface on the right MPI_Comm.

From a filtered list of Model candidates, plug-in a derived direct application interface instance (“plugin_text_book” for parallel). This approach provides more complete access to the Model, e.g., for access to analysis communicators.

References Dakota::abort_handler(), Interface::assign_rep(), LibraryEnvironment::filtered_model_list(), ProblemDescDB::get_db_model_node(), Environment::problem_description_db(), and ProblemDescDB::set_db_model_nodes().

Referenced by run_dakota_data(), run_dakota_mixed(), and run_dakota_parse().
static void callback_function ( Dakota::ProblemDescDB * db, void * ptr ) [static]

Example: user-provided post-parse callback (Dakota::DbCallbackFunction)

Example of user-provided callback function (an instance of Dakota::DbCallbackFunction) to override input provided by parsed Dakota input file or input string data.

References Dakota::contains(), ProblemDescDB::get_sa(), ProblemDescDB::get_ushort(), ProblemDescDB::resolve_top_method(), callback_data::rosen_cdv_upper_bd, and ProblemDescDB::set().

Referenced by run_dakota_mixed().

int main ( int argc, char * argv[] )

A mock simulator main for testing Dakota in library mode.

Overall Usage: dakota_library_mode [-mixed] [dakota.in]

Uses alternative instantiation syntax as described in the library mode documentation within the Developers Manual. Tests several problem specification modes:

1) run_dakota_parse: reads all problem specification data from a Dakota input file. Usage: dakota_library_mode dakota.in

2) run_dakota_data: creates all problem specification from direct Data instance instantiations in the C++ code. Usage: dakota_library_mode

3) run_dakota_mixed: a mixture of input parsing and direct data updates, where the data updates occur: (a) via the DB during Environment instantiation, and (b) via Iterators/Models following Environment instantiation. Usage: dakota_library_mode -mixed (input from default string) dakota_library_mode -mixed dakota.in (input from specified file)

Serial cases use a plugin rosenbrock model, while parallel cases use textbook.

References MPIManager::detect_parallel_launch(), fpinit_ASL(), Dakota::mpi_debug_hold(), run_dakota_data(), run_dakota_mixed(), and run_dakota_parse().

14.8.3 Variable Documentation

const char serial_input[] [static]

Initial value:

" " method,"
" optpp_g_newton"
" max_iterations = 50"
" convergence_tolerance = 1e-4"
" variables,"
" continuous_design = 2"
" descriptors 'x1' 'x2'"
" interface,"
" direct"
" analysis_driver = 'plugin_rosenbrock'"
" responses,"
" num_objective_functions = 1"
" analytic_gradients"
" no_hessians"

Default Dakota input string for serial case (rosenbrock):

Referenced by run_dakota_mixed().

const char parallel_input[] [static]

Initial value:
14.9  library_split.cpp File Reference

documentation for a file containing a mock simulator main for testing DAKOTA in library mode on a split communicator

Functions

- void manage_mpi (MPI_Comm &my_comm, int &color)
  
  *Split MPI_COMM_WORLD, returning the comm and color.*

- void gen_dakota_input (const int &color, std::string &input)
  
  *Return the appropriate DAKOTA input based on color (1 or 2)*

- void run_dakota (const MPI_Comm &comm, const std::string &input, const int &color)
  
  *Launch DAKOTA on passed communicator, tagging output/error with color.*

- void collect_results ()

  *Wait for and collect results from DAKOTA runs.*

- int main (int argc, char ∗argv[])

  *Driver routine for testing library mode with partitioned MPI_Comm. This test fixture requires MPI and can be run on 3–8 processors.*

14.9.1 Detailed Description

documentation for a file containing a mock simulator main for testing DAKOTA in library mode on a split communicator

14.10  main.cpp File Reference

documentation for a file containing the main program for DAKOTA

Functions

- void fpinit_AS ()

- int main (int argc, char ∗argv[])
14.10.1 Detailed Description

file containing the main program for DAKOTA

14.10.2 Function Documentation

void fpinit_AS ( )

Floating-point initialization from AMPL: switch to 53-bit rounding if appropriate, to eliminate some cross-
platform differences.

int main ( int argc, char * argv[] )

The main DAKOTA program.
Manage command line inputs, input files, restart file(s), output streams, and top level parallel iterator commu-
nicators. Instantiate the ExecutableEnvironment and invoke its execute() virtual function.
References Environment::check(), ExecutableEnvironment::execute(), fpinit_AS(), Dakota::mpi_debug hold(),
and Dakota::register_signal_handlers().

14.11 restart_util.cpp File Reference

file containing the DAKOTA restart utility main program

Namespaces

• Dakota

The primary namespace for DAKOTA.

Constant Groups

• Dakota

The primary namespace for DAKOTA.

Functions

• void print_usage (std::ostream &s)

  print restart utility help message

• void print_restart (StringArray pos_args, String print_dest)

  print a restart file

• void print_restart_pdb (StringArray pos_args, String print_dest)

  print a restart file (PDB format)

• void print_restart_tabular (StringArray pos_args, String print_dest, unsigned short tabular_format)

  print a restart file (tabular format)

• void read_neutral (StringArray pos_args)

  read a restart file (neutral file format)

• void repair_restart (StringArray pos_args, String identifier_type)

  repair a restart file by removing corrupted evaluations

• void concatenate_restart (StringArray pos_args)


concatenate multiple restart files

- int main (int argc, char *argv[])

  The main program for the DAKOTA restart utility.

### 14.11.1 Detailed Description

file containing the DAKOTA restart utility main program

### 14.11.2 Function Documentation

```
int main ( int argc, char * argv[] )
```

The main program for the DAKOTA restart utility.

Parse command line inputs and invoke the appropriate utility function (print_restart(), print_restart_tabular(), read_neutral(), repair_restart(), or concatenate_restart()).

References Dakota::concatenate_restart(), Dakota::print_restart(), Dakota::print_restart_pdb(), Dakota::print_restart_tabular(), Dakota::print_usage(), Dakota::read_neutral(), and Dakota::repair_restart().
Index

~Approximation
   Dakota::Approximation, 290
~Constraints
   Dakota::Constraints, 340
~DataFitSurrModel
   Dakota::DataFitSurrModel, 351
~EffGlobalMinimizer
   Dakota::EffGlobalMinimizer, 424
~Environment
   Dakota::Environment, 430
~Interface
   Dakota::Interface, 479
~Iterator
   Dakota::Iterator, 489
~Model
   Dakota::Model, 552
~NonDAdaptiveSampling
   Dakota::NonDAdaptiveSampling, 618
~ProblemDescDB
   Dakota::ProblemDescDB, 792
~SharedApproxData
   Dakota::SharedApproxData, 872
   initPts
   Dakota::JEGAOptimizer, 507
   _model
   Dakota::JEGAOptimizer::Evaluator, 438
A
   Dakota::CONMINOptimizer, 331
   APPSEvalMgr, 299
   Dakota::APPSEvalMgr, 301
   APPSOptimizer, 302
   abort_handler_t
   Dakota, 150
   abort_mode
   Dakota, 156
   acceptanceChain
   Dakota::NonDBayesCalibration, 625
   accepts_multiple_points
   Dakota::JEGAOptimizer, 506
   ActiveSet, 255
   ActiveSubspaceModel, 257
   Dakota::ActiveSubspaceModel, 261
   activeVarsCompsTotals
   Dakota::SharedVariablesDataRep, 892
   actualModel
   Dakota::DataFitSurrModel, 358
   actualReducedRank
   Dakota::RandomFieldModel, 820
   add_anchor_to_surfdata
   Dakota::SurfpackApproximation, 915
   add_datapoint
   Dakota::Graphics, 465
   Dakota::OutputManager, 741
   aggregate_acceptance_chain
   Dakota::NonDQUESOBayesCalibration, 703
   algorithm_space_model
   Dakota::Analyzer, 269
   Dakota::EffGlobalMinimizer, 424
   Dakota::Minimizer, 523
   Dakota::NonDBayesCalibration, 624
   Dakota::NonDExpansion, 639
   Dakota::NonDGlobalInterval, 645
   Dakota::NonDReliability, 706
   allContinuousIds
   Dakota::SharedVariablesDataRep, 892
   Analyzer, 263
   anisotropic_order_to_dimension_preference
   Dakota::NonDIntegration, 657
   append_approximation
   Dakota::ApproximationInterface, 297
   Dakota::DataFitSurrModel, 354, 355
   ApplicationInterface, 270
   approx_subprob_constraint_eval
   Dakota::SurrogateLocalMinimizer, 923
   approx_subprob_objective_eval
   Dakota::SurrogateLocalMinimizer, 922
   approxBuilds
   Dakota::SurrogateModel, 931
   Approximation, 286
   Dakota::Approximation, 290, 291
ApproximationInterface, 293
ApreproWriter, 304
array insert
  Dakota::ResultsDBAny, 844
asmInstance
  Dakota::ActiveSubspaceModel, 263
assign_rep
  Dakota::Interface, 480
  Dakota::Iterator, 493
  Dakota::Model, 557
asstring
  Dakota, 153
asynchronous_local_analyses
  Dakota::ProcessHandleApplicInterface, 801
asynchronous_local_evaluations
  Dakota::ApplicationInterface, 282
asynchronous_local_evaluations_nowait
  Dakota::ApplicationInterface, 284
augmented_lagrangian_merit
  Dakota::SurrBasedMinimizer, 927
autotag_files
  Dakota::ProcessApplicInterface, 797
B
  Dakota::CONMINOptimizer, 331
barnes
  Dakota::TestDriverInterface, 944
barnes_lf
  Dakota::TestDriverInterface, 945
BaseConstructor, 305
bootstrapRNG
  Dakota::BootstrapSamplerBase, 309
BootstrapSampler< Data >, 305
BootstrapSampler< Teuchos::SerialDenseMatrix< OrdinalType, ScalarType > >, 306
BootstrapSamplerBase< Data >, 307
BootstrapSamplerWithGS< Data, Getter, Setter >, 309
brent_minimize
  Dakota::NonlinearCGOptimizer, 728
build
  Dakota::Approximation, 291
  Dakota::PecosApproximation, 776
  Dakota::SurfpackApproximation, 914
  Dakota::TANA3Approximation, 938
  Dakota::TaylorApproximation, 940
build_approximation
  Dakota::ApproximationInterface, 298
  Dakota::DataFitSurrModel, 352, 353
build_global
  Dakota::DataFitSurrModel, 356
build_gradient_of_sum_square_residuals_from_function_data
  Dakota::ExperimentData, 445
build_hessian_of_sum_square_residuals_from_function_data
  Dakota::ExperimentData, 445
build_local_multipoint
  Dakota::DataFitSurrModel, 357
buildDataOrder
  Dakota::SharedApproxData, 873
C
  Dakota::CONMINOptimizer, 331
CAUVL.bl
  Dakota, 248
CEUVL.bl
  Dakota, 249
COLINAApplication, 310
COLINOptimizer, 313
  Dakota::COLINOptimizer, 315, 316
CONMINOptimizer, 325
CT
  Dakota::CONMINOptimizer, 330
cache_chain
  Dakota::NonDDREAMBayesCalibration, 633
callback_data, 310
callback_function
  library_mode.cpp, 981
ccv_index_map
  Dakota::NestedModel, 578
cdiv_index_map
  Dakota::NestedModel, 579
cdrv_index_map
  Dakota::NestedModel, 579
cdsv_index_map
  Dakota::NestedModel, 579
check_and_broadcast
  Dakota::ProblemDescDB, 793
check_driver
  Dakota::NIDRProblemDescDB, 585
check_input
  Dakota::ProblemDescDB, 793
check_variables
  Dakota::NonDIntegration, 657
check_wait
  Dakota::ProcessHandleApplicInterface, 801
clear
  Dakota::ParallelLevel, 749
clear_all
  Dakota::Approximation, 293
clear_current
   Dakota::Approximation, 292
   Dakota::TANA3Approximation, 938
Clone
   Dakota::JEGAOptimizer::Evaluator, 437
colin_cache_lookup
   Dakota::COLINOptimizer, 317
colin_request_to_dakota_request
   Dakota::COLINApplication, 313
CollabHybridMetaIterator, 318
collect_evaluation_impl
   Dakota::COLINApplication, 312
CommandLineHandler, 319
CommandShell, 320
calculate
   Dakota::DiscrepancyCorrection, 416
calculate_correlations
   Dakota::SensAnalysisGlobal, 862, 863
calculate_covariance_metric
   Dakota::NonDExpansion, 639
   Dakota::NonDStochCollocation, 723
calculate_densities
   Dakota::NonD, 608
calculate_final_statistics_metric
   Dakota::NonDExpansion, 639
   Dakota::NonDStochCollocation, 723
calculate_level_mappings
   Dakota::NonDSampling, 715
calculate_statistics
   Dakota::NonDExpansion, 640
concatenate_restart
   Dakota, 156
ConcurrentMetaIterator, 322
configure
   Dakota::IteratorScheduler, 500
conminInfo
   Dakota::CONMINOptimizer, 329
ConsoleRedirector, 332
constraint0_evaluator
   Dakota::SNLLOptimizer, 907
constraint1_evaluator
   Dakota::SNLLOptimizer, 907
constraint1_evaluator_gn
   Dakota::SNLLLeastSq, 901
constraint2_evaluator
   Dakota::SNLLOptimizer, 908
constraint2_evaluator_gn
   Dakota::SNLLLeastSq, 901
constraint_violation
   Dakota::COLINOptimizer, 317
   Dakota::SurfBasedMinimizer, 927
constraintMappingIndices
   Dakota::CONMINOptimizer, 329
   Dakota::DOTOptimizer, 420
constraintMappingMultipliers
   Dakota::CONMINOptimizer, 329
   Dakota::DOTOptimizer, 420
constraintMappingOffsets
   Dakota::CONMINOptimizer, 329
   Dakota::DOTOptimizer, 420
constraintValues
   Dakota::CONMINOptimizer, 329
   Dakota::DOTOptimizer, 420
Constraints, 333
   Dakota::Constraints, 340, 341
contains
   Dakota, 156
control_variate_mc
   Dakota::NonDMultilevelSampling, 685
converge_order
   Dakota::RichExtrapVerification, 852
converge_qoi
   Dakota::RichExtrapVerification, 852
copy
   Dakota::Constraints, 341
   Dakota::SharedResponseData, 878
   Dakota::SharedVariablesData, 887
copy_data
   Dakota::DDACEDesignCompExp, 408
copy_field_data
   Dakota, 152
copy_items
   Dakota::WorkdirHelper, 970
copy_rep
   Dakota::SharedResponseDataRep, 880
   Dakota::SharedVariablesDataRep, 891
core_run
   Dakota::APPSOptimizer, 303
   Dakota::COLINOptimizer, 316
   Dakota::CONMINOptimizer, 328
   Dakota::DDACEDesignCompExp, 408
   Dakota::DOTOptimizer, 419
   Dakota::EffGlobalMinimizer, 424
   Dakota::FSUDesignCompExp, 454
   Dakota::Iterator, 491
   Dakota::JEGAOptimizer, 506
   Dakota::NCSUOptimizer, 569
   Dakota::NL2SOLLeastSq, 588
Dakota::NLPQLPOptimizer, 593
Dakota::NLSSOLLeastSq, 595
Dakota::NonDAAdaptiveSampling, 619
Dakota::NonDDREAMBayesCalibration, 633
Dakota::NonDGGlobalReliability, 647
Dakota::NonDGPImpSampling, 652
Dakota::NonDGPImpSmABayesCalibration, 654
Dakota::NonDIntegration, 657
Dakota::NonDLHSSampling, 665
Dakota::NonDMultilevelSampling, 684
Dakota::NonDQuesoBayesCalibration, 703
Dakota::NonDRKDDarts, 709
Dakota::NonDSampling, 715
Dakota::NonDWASABIBayesCalibration, 726
Dakota::NonlinearCGOptimizer, 728
Dakota::NPSOLOptimizer, 732
Dakota::ParamStudy, 766
Dakota::PebblldMinimizer, 772
Dakota::PSUADEDesignCompExp, 811
Dakota::RichExtrapVerification, 851
Dakota::SurrBasedLocalMinimizer, 921
cov_determinant
Dakota::ExperimentData, 446
create_command_arguments
Dakota::ProcessHandleApplicInterface, 802
create_directory
Dakota::WorkdirHelper, 970
create_evaluation_process
Dakota::ProcessHandleApplicInterface, 800
create_plots_2d
Dakota::Graphics, 465
create_tabular_datastream
Dakota::OutputManager, 742
CreateEvaluator
Dakota::JEGAOptimizer::EvaluatorCreator, 438
cv_index_map
Dakota::NestedModel, 578
cv_scaled2native
Dakota::ScalingModel, 856
d_optimal_parameter_set
Dakota::NonDLHSSampling, 665
DAUIVLbl
Dakota, 248
DAURVLbl
Dakota, 249
DEUSVLbl
Dakota, 249
DF
Dakota::CONMINOptimizer, 331
DOTOptimizer, 417
dacelIterator
Dakota::RandomFieldModel, 819
DakFuncs0
Dakota, 157
Dakota, 73
abort_handler_t, 150
abort_mode, 156
asstring, 153
CAUVLbl, 248
CEUVLbl, 249
concatenate_restart, 156
contains, 156
copy_field_data, 152
DAUIVLbl, 248
DAURVLbl, 249
DAUSVLbl, 248
DEUIVLbl, 249
DEURVLbl, 249
DEUSVLbl, 249
DakFuncs0, 157
DesignAndStateLabelsCheck, 250
DiscSetLbl, 249
FIELD_NAMex, 157
flush, 150
get_pathext, 156
getRmax, 153
getdist, 153
gtidist, 153
id_vars_exact_compare, 154
kw_1, 157
kw_10, 159
kw_100, 175
kw_101, 175
kw_102, 176
kw_103, 176
kw_104, 176
kw_105, 176
kw_106, 176
kw_107, 177
kw_108, 177
kw_109, 177
DACEDesignCompExp, 405
Dakota::DACEDesignCompExp, 407
INDEX

kw_11, 159   kw_154, 186
kw_110, 177  kw_155, 186
kw_111, 177  kw_156, 187
kw_112, 178  kw_157, 187
kw_113, 178  kw_158, 187
kw_114, 178  kw_159, 187
kw_115, 178  kw_16, 160
kw_116, 178  kw_160, 187
kw_117, 179  kw_161, 188
kw_118, 179  kw_162, 188
kw_119, 179  kw_163, 188
kw_12, 159   kw_164, 188
kw_120, 179  kw_165, 188
kw_121, 179  kw_166, 188
kw_122, 179  kw_167, 189
kw_123, 180  kw_168, 189
kw_124, 180  kw_169, 189
kw_125, 180  kw_17, 160
kw_126, 180  kw_170, 189
kw_127, 180  kw_171, 189
kw_128, 181  kw_172, 190
kw_129, 181  kw_173, 190
kw_13, 159   kw_174, 190
kw_130, 181  kw_175, 190
kw_131, 181  kw_176, 190
kw_132, 182  kw_177, 191
kw_133, 182  kw_178, 191
kw_134, 182  kw_179, 191
kw_135, 182  kw_18, 160
kw_136, 183  kw_180, 191
kw_137, 183  kw_181, 191
kw_138, 183  kw_182, 191
kw_139, 183  kw_183, 192
kw_14, 160   kw_184, 192
kw_140, 184  kw_185, 192
kw_141, 184  kw_186, 192
kw_142, 184  kw_187, 192
kw_143, 184  kw_188, 192
kw_144, 184  kw_189, 193
kw_145, 185  kw_19, 160
kw_146, 185  kw_190, 193
kw_147, 185  kw_191, 193
kw_148, 185  kw_192, 193
kw_149, 185  kw_193, 193
kw_15, 160   kw_194, 194
kw_150, 186  kw_195, 194
kw_151, 186  kw_196, 194
kw_152, 186  kw_197, 194
kw_153, 186  kw_198, 194
INDEX
INDEX

kw_378, 228
kw_379, 228
kw_38, 164
kw_380, 228
kw_381, 228
kw_382, 228
kw_383, 228
kw_384, 229
kw_385, 229
kw_386, 229
kw_387, 229
kw_388, 229
kw_389, 230
kw_39, 164
kw_390, 230
kw_391, 230
kw_392, 231
kw_393, 231
kw_394, 231
kw_395, 231
kw_396, 231
kw_397, 231
kw_398, 232
kw_399, 232
kw_4, 158
kw_40, 164
kw_400, 232
kw_401, 232
kw_402, 232
kw_403, 233
kw_404, 233
kw_405, 233
kw_406, 233
kw_407, 234
kw_408, 234
kw_409, 234
kw_41, 164
kw_410, 234
kw_411, 235
kw_412, 235
kw_413, 235
kw_414, 235
kw_415, 235
kw_416, 235
kw_417, 236
kw_418, 236
kw_419, 236
kw_42, 164
kw_420, 236
kw_421, 237
kw_422, 237
kw_423, 237
kw_424, 237
kw_425, 238
kw_426, 238
kw_427, 238
kw_428, 238
kw_429, 239
kw_43, 165
kw_430, 239
kw_431, 239
kw_432, 239
kw_433, 240
kw_434, 240
kw_435, 240
kw_436, 240
kw_437, 240
kw_438, 241
kw_439, 241
kw_44, 165
kw_440, 241
kw_441, 241
kw_442, 242
kw_443, 242
kw_444, 242
kw_445, 242
kw_446, 243
kw_447, 243
kw_448, 243
kw_449, 243
kw_45, 165
kw_450, 243
kw_451, 244
kw_452, 244
kw_453, 244
kw_454, 244
kw_455, 245
kw_456, 245
kw_457, 245
kw_458, 245
kw_459, 245
kw_46, 166
kw_460, 246
kw_461, 246
kw_462, 246
kw_463, 246
kw_464, 247
kw_465, 247
INDEX

var mp_check_deus, 252
var mp_check_dset, 251
var mp_drange, 253
write_ordered, 152
Dakota::GetLongOpt
  MandatoryValue, 462
  OptionalValue, 462
  Valueless, 462
Dakota::APPSEvalMgr
  APPSEvalMgr, 301
  isReadyForWork, 301
  recv, 301
  submit, 301
Dakota::APPSOptimizer
  core run, 303
  initialize_variables_and_constraints, 304
  set_apps_parameters, 304
Dakota::ActiveSet
  derivVarsVector, 257
  requestVector, 257
Dakota::ActiveSubspaceModel
  ActiveSubspaceModel, 261
  asmInstance, 263
  derived_init_communicators, 261
  initialize_mapping, 261
  initialize_recast, 262
  response_mapping, 263
  set_mapping, 262
  uncertain_vars_to_subspace, 262
  vars_mapping, 262
Dakota::Analyzer
  algorithm_space_model, 269
  evaluate_parameter_sets, 269
  finalize_run, 268
  initialize_run, 267
  num_samples, 267
  post_run, 268
  pre_output, 268
  pre_run, 267
  print_results, 268
  print_sobol_indices, 270
  read_variables_responses, 269
  sample_to_variables, 267
  variables_to_sample, 270
  variance_based_decomp, 269
Dakota::ApplicationInterface
  asynchronous_local_evaluations, 282
  asynchronous_local_evaluations_nowait, 284
  duplication_detect, 281
  init_communicators_checks, 280
  init_default_asv, 281
  init_serial, 278
  map, 278
  master_dynamic_schedule_analyses, 280
  master_dynamic_schedule_evaluations, 281
  master_dynamic_schedule_evaluations_nowait, 283
  peer_dynamic_schedule_evaluations, 282
  peer_dynamic_schedule_evaluations_nowait, 284
  peer_static_schedule_evaluations, 282
  peer_static_schedule_evaluations_nowait, 283
  serve_analyses_synch, 280
  serve_evaluations, 279
  serve_evaluations_asynch, 285
  serve_evaluations_asynch_peer, 285
  serve_evaluations_synch, 285
  serve_evaluations_synch_peer, 285
  set_communicators_checks, 280
  stop_evaluation_servers, 279
  synch, 278
  synch_nowait, 279
  synchronous_local_evaluations, 283
Dakota::Approximation
  ~Approximation, 290
  Approximation, 290, 291
  build, 291
  clear_all, 293
  clear_current, 292
  export_model, 291
  finalize, 292
  get_approx, 293
  operator=, 291
  pop, 292
  push, 292
  rebuild, 292
Dakota::ApproximationInterface
  append_approximation, 297
  build_approximation, 298
  export_approximation, 298
  functionSurfaces, 299
  pop_approximation, 298
  push_approximation, 298
  read_challenge_points, 298
  rebuild_approximation, 298
  update_approximation, 297
Dakota::BootstrapSampler
  operator(), 306
Dakota::BootstrapSampler<Teuchos::SerialDenseMatrix<OrdinalType, ScalarType>>
operator(), 307
Dakota::BootstrapSamplerBase
  bootstrapRNG, 309
Dakota::COLINApplication
  colin_request_to_dakota_request, 313
  collect_evaluation_impl, 312
  dakota_response_to_colin_response, 313
  evaluation_available, 312
  map_domain, 313
  perform_evaluation_impl, 312
  set_problem, 312
  spawn_evaluation_impl, 312
Dakota::COLINOptimizer
  COLINOptimizer, 315, 316
  colin_cache_lookup, 317
  constraintViolation, 317
  core_run, 316
  post_run, 317
  returns_multiple_points, 316
  set_rng, 316
  set_solver_parameters, 316
  solver_setup, 316
Dakota::CONMINOptimizer
  A, 331
  B, 331
  C, 331
  CT, 330
  conminInfo, 329
  constraintMappingIndices, 329
  constraintMappingMultipliers, 329
  constraintMappingOffsets, 329
  constraintValues, 329
  core_run, 328
  DF, 331
  G1, 330
  G2, 330
  IC, 332
  ISC, 331
  MS1, 331
  N1, 329
  N2, 330
  N3, 330
  N4, 330
  N5, 330
  printControl, 329
  S, 330
  SCAL, 331
Dakota::CommandLineHandler
  output_helper, 320
Dakota::CommandShell
  flush, 322
  operator<<, 321
Dakota::ConcurrentMetaIterator
  pre_run, 324
  print_results, 324
Dakota::Constraints
  ~Constraints, 340
  Constraints, 340, 341
    copy, 341
    get_constraints, 342
    manage_linear_constraints, 342
    operator=, 341
    reshape, 342
    shape, 341
Dakota::DDACEDesignCompExp
  copy_data, 408
  core_run, 408
  DDACEDesignCompExp, 407
  num_samples, 408
  post_run, 408
  pre_run, 407
  resolve_samples_symbols, 408
Dakota::DOTOptimizer
  constraintMappingIndices, 420
  constraintMappingMultipliers, 420
  constraintMappingOffsets, 420
  constraintValues, 420
  core_run, 419
  dotFDSinfo, 419
  dotInfo, 419
  dotMethod, 419
  intCntlParmArray, 420
  printControl, 420
  realCntlParmArray, 420
Dakota::DataFitSurrModel
  ~DataFitSurrModel, 351
  actualModel, 358
  append_approximation, 354, 355
  build_approximation, 352, 353
  build_global, 356
  build_local_multipoint, 357
  derived_evaluate, 351
  derived_evaluate_nowait, 351
  derived_init_communicators, 355
  derived_synchronize, 352
  derived_synchronize_nowait, 352
  evaluation_id, 355
  export_point, 356
<table>
<thead>
<tr>
<th>Term</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>finalize_export</td>
<td>356</td>
</tr>
<tr>
<td>import_points</td>
<td>355</td>
</tr>
<tr>
<td>initialize_export</td>
<td>355</td>
</tr>
<tr>
<td>manage_data_recastings</td>
<td>356</td>
</tr>
<tr>
<td>update_actual_model</td>
<td>357</td>
</tr>
<tr>
<td>update_approximation</td>
<td>353, 354</td>
</tr>
<tr>
<td>update_from_actual_model</td>
<td>358</td>
</tr>
<tr>
<td>Dakota::DataTransformModel</td>
<td></td>
</tr>
<tr>
<td>data_difference_core</td>
<td>389</td>
</tr>
<tr>
<td>DataTransformModel</td>
<td>389</td>
</tr>
<tr>
<td>dtModelInstance</td>
<td>390</td>
</tr>
<tr>
<td>expand_scales_array</td>
<td>390</td>
</tr>
<tr>
<td>set_mapping</td>
<td>389</td>
</tr>
<tr>
<td>variables_expand</td>
<td>389</td>
</tr>
<tr>
<td>Dakota::DirectApplicInterface</td>
<td></td>
</tr>
<tr>
<td>derived_map_ac</td>
<td>413</td>
</tr>
<tr>
<td>init_communicators_checks</td>
<td>412</td>
</tr>
<tr>
<td>set_communicators_checks</td>
<td>412</td>
</tr>
<tr>
<td>synchronous_local_analysis</td>
<td>412</td>
</tr>
<tr>
<td>Dakota::DiscrepancyCorrection</td>
<td></td>
</tr>
<tr>
<td>compute</td>
<td>416</td>
</tr>
<tr>
<td>Dakota::EffGlobalMinimizer</td>
<td></td>
</tr>
<tr>
<td>~EffGlobalMinimizer</td>
<td>424</td>
</tr>
<tr>
<td>algorithm_space_model</td>
<td>424</td>
</tr>
<tr>
<td>core_run</td>
<td>424</td>
</tr>
<tr>
<td>get_best_sample</td>
<td>425</td>
</tr>
<tr>
<td>Dakota::Environment</td>
<td></td>
</tr>
<tr>
<td>~Environment</td>
<td>430</td>
</tr>
<tr>
<td>Environment</td>
<td>429, 430</td>
</tr>
<tr>
<td>exit_mode</td>
<td>430</td>
</tr>
<tr>
<td>get_environment</td>
<td>431</td>
</tr>
<tr>
<td>operator=</td>
<td>430</td>
</tr>
<tr>
<td>parse</td>
<td>431</td>
</tr>
<tr>
<td>Dakota::ExperimentData</td>
<td></td>
</tr>
<tr>
<td>cov_determinant</td>
<td>446</td>
</tr>
<tr>
<td>form_residuals</td>
<td>444</td>
</tr>
<tr>
<td>half_log_cov_det_gradient</td>
<td>446</td>
</tr>
<tr>
<td>half_log_cov_det_hessian</td>
<td>446</td>
</tr>
<tr>
<td>half_log_cov_determinant</td>
<td>446</td>
</tr>
<tr>
<td>load_experiment</td>
<td>447</td>
</tr>
<tr>
<td>parse_sigma_types</td>
<td>447</td>
</tr>
<tr>
<td>recover_model</td>
<td>445</td>
</tr>
<tr>
<td>residuals_per_multiplier</td>
<td>446</td>
</tr>
<tr>
<td>scale_residuals</td>
<td>446</td>
</tr>
<tr>
<td>Dakota::FSUDesignCompExp</td>
<td></td>
</tr>
<tr>
<td>core_run</td>
<td>454</td>
</tr>
<tr>
<td>enforce_input_rules</td>
<td>455</td>
</tr>
<tr>
<td>FSUDesignCompExp</td>
<td>454</td>
</tr>
<tr>
<td>num_samples</td>
<td>455</td>
</tr>
<tr>
<td>post_run</td>
<td>454</td>
</tr>
<tr>
<td>pre_run</td>
<td>454</td>
</tr>
<tr>
<td>Dakota::GaussProcApproximation</td>
<td></td>
</tr>
<tr>
<td>GPmodel_apply</td>
<td>460</td>
</tr>
<tr>
<td>GaussProcApproximation</td>
<td>460</td>
</tr>
<tr>
<td>trendOrder</td>
<td>460</td>
</tr>
<tr>
<td>Dakota::GetLongOpt</td>
<td></td>
</tr>
<tr>
<td>enroll</td>
<td>463</td>
</tr>
<tr>
<td>GetLongOpt</td>
<td>463</td>
</tr>
<tr>
<td>OptType</td>
<td>462</td>
</tr>
<tr>
<td>parse</td>
<td>463</td>
</tr>
<tr>
<td>retrieve</td>
<td>463</td>
</tr>
<tr>
<td>usage</td>
<td>464</td>
</tr>
<tr>
<td>Dakota::Graphics</td>
<td></td>
</tr>
<tr>
<td>add_datapoint</td>
<td>465</td>
</tr>
<tr>
<td>create_plots_2d</td>
<td>465</td>
</tr>
<tr>
<td>new_dataset</td>
<td>465</td>
</tr>
<tr>
<td>Dakota::GridApplicInterface</td>
<td></td>
</tr>
<tr>
<td>synchronous_local_analysis</td>
<td>467</td>
</tr>
<tr>
<td>Dakota::HierarchSurrModel</td>
<td></td>
</tr>
<tr>
<td>derived_evaluate</td>
<td>471</td>
</tr>
<tr>
<td>derived_evaluate_nowait</td>
<td>471</td>
</tr>
<tr>
<td>derived_synchronize</td>
<td>471</td>
</tr>
<tr>
<td>derived_synchronize_nowait</td>
<td>472</td>
</tr>
<tr>
<td>evaluation_id</td>
<td>472</td>
</tr>
<tr>
<td>Dakota::Interface</td>
<td></td>
</tr>
<tr>
<td>~Interface</td>
<td>479</td>
</tr>
<tr>
<td>assign_rep</td>
<td>480</td>
</tr>
<tr>
<td>eval_tag_prefix</td>
<td>480</td>
</tr>
<tr>
<td>get_interface</td>
<td>481</td>
</tr>
<tr>
<td>Interface</td>
<td>479</td>
</tr>
<tr>
<td>operator=</td>
<td>480</td>
</tr>
<tr>
<td>rawResponseMap</td>
<td>481</td>
</tr>
<tr>
<td>response_mapping</td>
<td>480</td>
</tr>
<tr>
<td>Dakota::Iterator</td>
<td></td>
</tr>
<tr>
<td>~Iterator</td>
<td>489</td>
</tr>
<tr>
<td>assign_rep</td>
<td>493</td>
</tr>
<tr>
<td>core_run</td>
<td>491</td>
</tr>
<tr>
<td>eval_tag_prefix</td>
<td>493</td>
</tr>
<tr>
<td>finalize_run</td>
<td>491</td>
</tr>
<tr>
<td>get_iterator</td>
<td>493, 494</td>
</tr>
<tr>
<td>gnnewton_set_recast</td>
<td>493</td>
</tr>
<tr>
<td>initialize_graphics</td>
<td>491</td>
</tr>
<tr>
<td>initialize_run</td>
<td>490</td>
</tr>
<tr>
<td>Iterator</td>
<td>489, 490</td>
</tr>
<tr>
<td>maxEvalConcurrency</td>
<td>495</td>
</tr>
<tr>
<td>operator=</td>
<td>490</td>
</tr>
<tr>
<td>post_run</td>
<td>491</td>
</tr>
<tr>
<td>pre_run</td>
<td>490</td>
</tr>
</tbody>
</table>
print
results, 492
probDescDB, 494
run, 492
uses_method, 492

Dakota::IteratorScheduler
configure, 500
free_iterator, 499
init_iterator, 498, 499
IteratorScheduler, 498
master_dynamic_schedule_iterators, 501
partition, 500
run_iterator, 499
schedule_iterators, 500
serve_iterators, 501
set_iterator, 499

Dakota::JEGAOptimizer
_initPts, 507
accepts_multiple_points, 506
core_run, 506
GetBestMOSolutions, 506
GetBestSOSolutions, 506
GetBestSolutions, 505
initial_points, 507
JEGAOptimizer, 503
LoadAlgorithmConfig, 504
LoadDakotaResponses, 504
LoadProblemConfig, 504
LoadTheConstraints, 505
LoadTheDesignVariables, 505
LoadTheObjectiveFunctions, 505
LoadTheParameterDatabase, 504
returns_multiple_points, 506
ToDoubleMatrix, 506

Dakota::JEGAOptimizer::Driver
DestroyAlgorithm, 422
Driver, 421
ExtractAllData, 422
PerformIterations, 422

Dakota::JEGAOptimizer::Evaluator
_model, 438
Clone, 437
Description, 435
Evaluate, 436, 437
Evaluator, 434, 435
GetDescription, 437
GetName, 437
GetNumberOfLinearConstraints, 436
GetNumberOfNonLinearConstraints, 436
Name, 435

RecordResponses, 436
SeparateVariables, 435
Dakota::JEGAOptimizer::EvaluatorCreator
CreateEvaluator, 438
EvaluatorCreator, 438

Dakota::LabelsWriter
operator(), 508

Dakota::LeastSq
finalize_run, 510
going_confidence_intervals, 510
initialize_run, 510
LeastSq, 509
post_run, 510
primary_resp_weighter, 511
print_results, 510
weight_model, 511

Dakota::LibraryEnvironment
filtered_interface_list, 513
filtered_model_list, 513
LibraryEnvironment, 513

Dakota::MatlabInterface
derived_map_ac, 515
matlab_engine_run, 516

Dakota::MetaIterator
post_run, 517

Dakota::Minimizer
algorithm_space_model, 523
data_transform_model, 523
finalize_run, 523
initialize_run, 522
local_recast_retrieve, 525
Minimizer, 522
objective, 524
objective_gradient, 524
objective_hessian, 524
post_run, 522
resize_best_resp_array, 525
resize_best_vars_array, 524
scale_model, 523

Dakota::MixedVarConstraints
MixedVarConstraints, 526

Dakota::MixedVariables
MixedVariables, 528
read_core, 528
read_tabular, 528

Dakota::Model
~Model, 552
assign_rep, 557
derivative_concurrency, 558
post_run, 709
pre_run, 709
Dakota::NonDReliability
algorithm_space_model, 706
Dakota::NonDSampling
compute_level_mappings, 715
core_run, 715
get_lhs_samples, 718
get_parameter_sets, 715, 716
mode_counts, 717
NonDSampling, 714
num_samples, 715
samplesIncrement, 718
sampling_reset, 715
variables_to_sample, 716
view_aleatory_uncertain_counts, 716
view_design_counts, 716
view_epistemic_uncertain_counts, 717
view_uncertain_counts, 717
Dakota::NonDSparseGrid
NonDSparseGrid, 720
num_samples, 721
sampling_reset, 721
Dakota::NonDStochCollocation
compute_covariance_metric, 723
core_run, 726
compute_final_statistics_metric, 723
NonDStochCollocation, 722
Dakota::NonDWASABIBayesCalibration
core_run, 726
NonDWASABIBayesCalibration, 725
print_results, 726
Dakota::NonlinearCGOptimizer
brent_minimize, 728
core_run, 728
Dakota::Optimizer
finalize_run, 737
initialize_run, 737
objective_reduction, 738
post_run, 737
primary_res_redcuer, 738
print_results, 737
reduce_model, 737
Dakota::OutputManager
add_datapoint, 741
core_run, 715
create_tabular_datastream, 742
make_resultsdataname, 749
OutputManager, 741
pop_output_tag, 741
Dakota::PSUADEDesignCompExp
core_run, 811
enforce_input_rules, 811
num_samples, 811
PSUADEDesignCompExp, 811
post_run, 811
pre_run, 811
Dakota::PStudyDACE
print_results, 808
volumetric_quality, 808
Dakota::ParallelConfiguration
mi_parallel_level, 745
mi_parallel_level_iterator, 745
Dakota::ParallelLevel
clear, 749
Dakota::ParallelLibrary
increment_parallel_configuration, 757
init_communicators, 758
init_mpi_comm, 757
ParallelLibrary, 756
push_output_tag, 757
resolve_inputs, 758
terminate_modelcenter, 757
Dakota::ParamResponsePair
evalInterfaceIds, 761
ParamResponsePair, 761
read, 761
write, 761
Dakota::ParamStudy
core_run, 766
distribute_list_of_points, 767
load_distribute_points, 766
post_run, 766
pre_run, 766
Dakota::PebbldMinimizer
core_run, 772
PebbldMinimizer, 771
print_results, 772
Dakota::PecosApproximation
build, 776
finalize, 777
pop, 776
push, 776
rebuild, 776
Dakota::ProbabilityTransformModel
initialize_random_variable_parameters, 782
initialize_random_variable_types, 782
initialize_random_variables, 782
ptmInstance, 783
set_u_to_x_mapping, 783
vars_u_to_x_mapping, 783
vars_x_to_u_mapping, 783
Dakota::ProblemDescDB
~ProblemDescDB, 792
check_and_broadcast, 793
get_db, 793
operator=, 792
parse_inputs, 792
post_process, 793
ProblemDescDB, 792
Dakota::ProcessApplicInterface
autotag_files, 797
file_cleanup, 797
prepare_process_environment, 797
read_results_file, 798
reset_process_environment, 798
synchronous_local_analyses, 797
Dakota::ProcessHandleApplicInterface
asynchronous_local_analyses, 801
check_wait, 801
create_command_arguments, 802
create_evaluation_process, 800
init_communicators_checks, 800
ProcessHandleApplicInterface, 800
serve_analyses_async, 801
set_communicators_checks, 800
synchronous_local_analysis, 800
Dakota::ProgramOptions
split_filenames, 807
Dakota::PythonInterface
derived_map_ac, 813
python_convert_int, 813
Dakota::QuesoJointPdf
QuesoJointPdf, 815
Dakota::QuesoVectorRV
QuesoVectorRV, 815
Dakota::RandomFieldModel
actualReducedRank, 820
dac_iterator, 819
expansionForm, 820
get_field_data, 818
initialize_mapping, 818
initialize_recast, 818
initialize_rf_coeffs, 819
rf_suite_identify_field_model, 818
rfm_instance, 820
variables_resize, 819
vars_mapping, 819
Dakota::RecastModel
derived_evaluate, 828
eval_tag_prefix, 828
init_maps, 828
RecastModel, 827
update_from_sub_model, 828
Dakota::RelaxedVarConstraints
RelaxedVarConstraints, 831
Dakota::RelaxedVariables
read_core, 833
read_tabular, 833
RelaxedVariables, 833
Dakota::Response
functionGradients, 841
Dakota::ResultsDBAny
array_insert, 844
extract_data, 844
insert, 844
Dakota::ResultsEntry
ResultsEntry, 845
Dakota::RichExtrapVerification
converge_order, 852
converge_qoi, 852
core_run, 851
estimate_order, 852
print_results, 852
Dakota::SNLLLeastSq
constraint1_evaluator_gn, 901
constraint2_evaluator_gn, 901
nlf2_evaluator_gn, 901
post_run, 900
Dakota::SNLLOptimizer
constraint0_evaluator, 907
constraint1_evaluator, 907
constraint2_evaluator, 908
nlf0_evaluator, 906
nlf1_evaluator, 907
nlf2_evaluator, 907
SNLLOptimizer, 905, 906
Dakota::ScalingModel
cv_scaled2native, 856
initialize_scaling, 856
lin_coeffs_modify_n2s, 857
modify_n2s, 857
modify_s2n, 858
need_resp_trans_byvars, 857
resp_scaled2native, 856
response_modify_n2s, 858
response_modify_s2n, 858
scaleModelInstance, 859
ScalingModel, 855
secondary_resp_scaled2native, 856
secondary_resp_scaler, 857
variables_scaler, 857
Dakota::SensAnalysisGlobal
compute_correlations, 862, 863
partial_corr, 863
simple_corr, 863
values_to_ranks, 863
Dakota::SeqHybridMetaIterator
extract_parameter_sets, 867
print_results, 866
run_sequential, 866
run_sequential_adaptive, 866
Dakota::SharedApproxData
~SharedApproxData, 872
buildDataOrder, 873
get_shared_data, 873
operator=, 873
SharedApproxData, 871, 872
Dakota::SharedResponseData
copy, 878
Dakota::SharedResponseDataRep
copy_rep, 880
Dakota::SharedSurfpackApproxData
SharedSurfpackApproxData, 882
Dakota::SharedVariablesData
copy, 887
Dakota::SharedVariablesDataRep
activeVarsCompsTotals, 892
allContinuousIds, 892
copy_rep, 891
inactiveVarsCompsTotals, 892
variablesCompsTotals, 892
Dakota::SimulationModel
eval_tag_prefix, 895
Dakota::SurfpackApproximation
add_anchor_to_surfdata, 915
build, 914
hessian, 914, 915
SurfpackApproximation, 914
surrogates_to_surf_data, 915
Dakota::SurrBasedLocalMinimizer
approx_subprob_constraint_eval, 923
approx_subprob_objective_eval, 922
core_run, 921
hard_convergence_check, 921
hom_constraint_eval, 923
hom_objective_eval, 923
Dakota::SurrBasedMinimizer
augmented_lagrangian_merit, 927
constraintViolation, 927
lagrangian_merit, 927
penalty_merit, 927
print_results, 926
update_augmented_lagrange_multipliers, 926
update_filter, 926
update_lagrange_multipliers, 926
Dakota::SurrogateModel
approxBuilds, 931
force_rebuild, 931
responseMode, 931
Dakota::SysCallApplicInterface
init_communicators_checks, 934
set_communicators_checks, 934
spawn_analysis_to_shell, 934
spawn_evaluation_to_shell, 934
spawn_input_filter_to_shell, 934
spawn_output_filter_to_shell, 935
synchronous_local_analysis, 933
test_local_evaluations, 933
wait_local_evaluations, 933
Dakota::TANA3Approximation
build, 938
clear_current, 938
Dakota::TabularReader
operator(), 936
Dakota::TabularWriter
operator(), 936
Dakota::TaylorApproximation
build, 940
Dakota::TestDriverInterface
barnes, 944
barnes_lf, 945
derived_map_ac, 943
herbie, 945
herbie1D, 945
levenshtein_distance, 946
lf_poly_prod, 944
mc_api_run, 946
poly_prod, 944
separable_combine, 946
shubert1D, 945
smooth_herbie, 945
smooth_herbie1D, 945
steady_state_diffusion_1d, 944
Dakota::TrackerHTTP
  send_data_using_get, 948
  send_data_using_post, 948
Dakota::UsageTracker
  UsageTracker, 949
Dakota::VPSApproximation
  VPSInstance, 966
  VPSmodel_apply, 966
Dakota::Variables
  discrete_string_variables_view, 960
Dakota::Verification
  print_results, 961
Dakota::WorkdirHelper
  copy_items, 970
  create_directory, 970
  file_op_items, 971
  init_preferred_env_path, 972
  init_startup_path, 972
  initialize, 969
  link, 970
  link_items, 970
  po_which, 971
  prepend_path_item, 971
  prepend_preferred_env_path, 969
  recursive_copy, 971
  set_preferred_path, 971
  split wildcard, 970
  tokenize_env_path, 972
  which, 969
  dakota_dll_api.cpp, 973
  dakota_stop, 974
  dakota_dll_api.h, 974
  dakota_stop, 975
dakota_linear_algebra.hpp, 975
dakota_response_to_colin_response
  Dakota::COLINApplication, 313
dakota_stop
  dakota_dll_api.cpp, 974
  dakota_dll_api.h, 975
dakota_tabular_io.hpp, 975
data_difference_core
  Dakota::DataTransformModel, 389
data_transform_model
  Dakota::Minimizer, 523
DataEnvironment, 343
DataEnvironmentRep, 344
DataFitSurrModel, 346
DataInterface, 359
DataMethod, 360
DataMethodRep, 361
DataModel, 376
DataModelRep, 377
DataResponses, 382
DataResponsesRep, 383
DataTransformModel, 387
  Dakota::DataTransformModel, 389
  DataVariables, 390
  DataVariablesRep, 392
derivVarsVector
  Dakota::ActiveSet, 257
derivative_concurrency
  Dakota::Model, 558
derived_evaluate
  Dakota::DataFitSurrModel, 351
  Dakota::HierarchSurrModel, 471
  Dakota::NestedModel, 576
  Dakota::RecastModel, 828
derived_evaluate_nowait
  Dakota::DataFitSurrModel, 351
  Dakota::HierarchSurrModel, 471
  Dakota::NestedModel, 576
derived_init_communicators
  Dakota::ActiveSubspaceModel, 261
  Dakota::DataFitSurrModel, 355
  Dakota::NestedModel, 577
derived_interface
  Dakota::Model, 554
derived_map_ac
  Dakota::DirectApplicInterface, 413
  Dakota::MatlabInterface, 515
  Dakota::PythonInterface, 813
  Dakota::TestDriverInterface, 943
derived_master_overload
  Dakota::NestedModel, 577
derived_parse_inputs
  Dakota::NIDRProblemDescDB, 585
derived_synchronize
  Dakota::DataFitSurrModel, 352
  Dakota::HierarchSurrModel, 471
  Dakota::NestedModel, 576
derived_synchronize_nowait
  Dakota::DataFitSurrModel, 352
  Dakota::HierarchSurrModel, 472
Description
  Dakota::JEGAOptimizer::Evaluator, 435
DesignAndStateLabelsCheck
  Dakota, 250
DestroyAlgorithm
Dakota::JEGAOptimizer::Driver, 422
dg_ds_eval
   Dakota::NonDLocalReliability, 679
dimension_preference_to_anisotropic_order
   Dakota::NonDIntegration, 657
DirectApplicInterface, 409
DiscSetLbl
   Dakota, 249
DiscrepancyCorrection, 413
discrete_string_variables_view
   Dakota::Variables, 960
distribute_list_of_points
   Dakota::ParamStudy, 767
div_index_map
   Dakota::NestedModel, 578
dll_tester.cpp, 978
dotFDInfo
   Dakota::DOTOptimizer, 419
dotInfo
   Dakota::DOTOptimizer, 419
dotMethod
   Dakota::DOTOptimizer, 419
dp2_dbeta_factor
   Dakota::NonDLocalReliability, 679
Driver
   Dakota::JEGAOptimizer::Driver, 421
drv_index_map
   Dakota::NestedModel, 578
dsv_index_map
   Dakota::NestedModel, 578
dtModelInstance
   Dakota::DataTransformModel, 390
duplication_detect
   Dakota::ApplicationInterface, 281
EffGlobalMinimizer, 423
EmbedHybridMetaIterator, 425
enforce_input_rules
   Dakota::FSUDesignCompExp, 455
   Dakota::PSUADEDesignCompExp, 811
enroll
   Dakota::GetLongOpt, 463
Environment, 427
   Dakota::Environment, 429, 430
estimate_derivatives
   Dakota::Model, 558
estimate_message_lengths
   Dakota::Model, 557
estimate_order
   Dakota::RichExtrapVerification, 852
eval_tag_prefix
   Dakota::Interface, 480
   Dakota::Iterator, 493
   Dakota::Model, 556
   Dakota::RecastModel, 828
   Dakota::SimulationModel, 895
eval_x
   Dakota::NomadOptimizer::Evaluator, 432
evalInterfaceIds
   Dakota::ParamResponsePair, 761
Evaluate
   Dakota::JEGAOptimizer::Evaluator, 436, 437
evaluate_parameter_sets
   Dakota::Analyzer, 269
evaluation_available
   Dakota::COLINAApplication, 312
evaluation_cache
   Dakota::Model, 556
evaluation_id
   Dakota::DataFitSurrModel, 355
   Dakota::HierarchSurrModel, 472
   Dakota::NestedModel, 577
Evaluator
   Dakota::JEGAOptimizer::Evaluator, 434, 435
   Dakota::NomadOptimizer::Evaluator, 432
EvaluatorCreator
   Dakota::JEGAOptimizer::EvaluatorCreator, 438
ExecutableEnvironment, 439
exit_mode
   Dakota::Environment, 430
expand_scales_array
   Dakota::DataTransformModel, 390
expansionForm
   Dakota::RandomFieldModel, 820
ExperimentData, 439
ExperimentResponse, 447
export_approximation
   Dakota::ApproximationInterface, 298
export_model
   Dakota::Approximation, 291
export_point
   Dakota::DataFitSurrModel, 356
extract_data
   Dakota::ResultsDBAny, 844
extract_parameter_sets
   Dakota::SeqHybridMetaIterator, 867
ExtractAllData
   Dakota::JEGAOptimizer::Driver, 422
FDstep1
Dakota::Model, 560
FDstep2
Dakota::Model, 560
FIELD_NAMES
Dakota, 157
FSUDesignCompExp, 451
Dakota::FSUDesignCompExp, 454
fdGradStepSize
Dakota::Model, 560
fdHessByFnStepSize
Dakota::Model, 561
fdHessByGradStepSize
Dakota::Model, 561
file_cleanup
Dakota::ProcessApplicInterface, 797
file_op_items
Dakota::WorkdirHelper, 971
FileReadException, 449
filtered_interface_list
Dakota::LibraryEnvironment, 513
filtered_model_list
Dakota::LibraryEnvironment, 513
finalize
Dakota::Approximation, 292
Dakota::PecosApproximation, 777
finalize_export
Dakota::DataFitSurrModel, 356
finalize_run
Dakota::Analyzer, 268
Dakota::Iterator, 491
Dakota::LeastSq, 510
Dakota::Minimizer, 523
Dakota::NonD, 608
Dakota::Optimizer, 737
flush
Dakota, 150
Dakota::CommandLineShell, 322
force rebuild
Dakota::SurrogateModel, 931
ForkApplicInterface, 449
form_residuals
Dakota::ExperimentData, 444
fpinit_ASL
library_mode.cpp, 980
main.cpp, 984
free_iterator
Dakota::IteratorScheduler, 499
FunctionEvalFailure, 455
functionGradients
Dakota::Response, 841
functionSurfaces
Dakota::ApproximationInterface, 299
G1
Dakota::CONMINOptimizer, 330
G2
Dakota::CONMINOptimizer, 330
GPmodel_apply
Dakota::GaussProcApproximation, 460
GaussProcApproximation, 455
Dakota::GaussProcApproximation, 460
GeneralReader, 460
GeneralWriter, 461
get_approx
Dakota::Approximation, 293
get_best_sample
Dakota::EffGlobalMinimizer, 425
get_confidence_intervals
Dakota::LeastSq, 510
get_constraints
Dakota::Constraints, 342
get_db
Dakota::ProblemDescDB, 793
get_environment
Dakota::Environment, 431
get_field_data
Dakota::RandomFieldModel, 818
get_interface
Dakota::Interface, 481
get_iterator
Dakota::Iterator, 493, 494
get_lhs_samples
Dakota::NonDSampling, 718
get_model
Dakota::Model, 558
get_parameter_sets
Dakota::NonDSampling, 715, 716
get_pathext
Dakota, 156
get_shared_data
Dakota::SharedApproxData, 873
GetBestMOSolutions
Dakota::JEGAOptimizer, 506
GetBestSOsolutions
Dakota::JEGAOptimizer, 506
GetBestSolutions
Dakota::JEGAOptimizer, 505
GetDescription
Dakota::JEGAOptimizer::Evaluator, 437
GetLongOpt, 461
   Dakota::GetLongOpt, 463
GetName
   Dakota::JEGAOptimizer::Evaluator, 437
GetNumberLinearConstraints
   Dakota::JEGAOptimizer::Evaluator, 436
GetNumberNonLinearConstraints
   Dakota::JEGAOptimizer::Evaluator, 436
getRmax
   Dakota, 153
gdist
   Dakota, 153
gnewton_set_recast
   Dakota::Iterator, 493
Graphics, 464
GridApplicInterface, 466
half_log_cov_det_gradient
   Dakota::ExperimentData, 446
half_log_cov_det_hessian
   Dakota::ExperimentData, 446
half_log_cov_determinant
   Dakota::ExperimentData, 446
hard_convergence_check
   Dakota::SurrBasedLocalMinimizer, 921
herbie
   Dakota::TestDriverInterface, 945
herbie1D
   Dakota::TestDriverInterface, 945
hessian
   Dakota::SurfpackApproximation, 914, 915
HierarchSurrModel, 467
hom_constraint_eval
   Dakota::SurrBasedLocalMinimizer, 923
hom_objective_eval
   Dakota::SurrBasedLocalMinimizer, 923
IC
   Dakota::CONMINOptimizer, 332
ISC
   Dakota::CONMINOptimizer, 331
id_vars_exact_compare
   Dakota, 154
import_points
   Dakota::DataFitSurrModel, 355
inactiveVarsCompsTotals
   Dakota::SharedVariablesDataRep, 892
increment_grid_from_order
   Dakota::NonDPolynomialChaos, 694
increment_grid_preference
   Dakota::NonDCubature, 629
increment_order_and_grid
   Dakota::NonDPolynomialChaos, 694
increment_order_from_grid
   Dakota::NonDPolynomialChaos, 694
increment_parallel_configuration
   Dakota::ParallelLibrary, 757
increment_reference
   Dakota::NonDCubature, 630
increment_specification_sequence
   Dakota::NonDExpansion, 639
Dakota::NonDPolynomialChaos, 694
init_communicators
   Dakota::Model, 556
   Dakota::ParallelLibrary, 758
init_communicators_checks
   Dakota::ApplicationInterface, 280
   Dakota::DirectApplicInterface, 412
   Dakota::ProcessHandleApplicInterface, 800
   Dakota::SysCallApplicInterface, 934
init_default_asv
   Dakota::ApplicationInterface, 281
init_iterator
   Dakota::IteratorScheduler, 498, 499
init_maps
   Dakota::RecastModel, 828
init_mpi_comm
   Dakota::ParallelLibrary, 757
init_preferred_env_path
   Dakota::WorkdirHelper, 972
init_serial
   Dakota::ApplicationInterface, 278
   Dakota::Model, 557
init_startup_path
   Dakota::WorkdirHelper, 972
initial_points
   Dakota::JEGAOptimizer, 507
initial_taylor_series
   Dakota::NonDLocalReliability, 677
initialize
   Dakota::NonDAdaptImpSampling, 613
   Dakota::WorkdirHelper, 969
initialize_class_data
   Dakota::NonDLocalReliability, 677
initialize_export
   Dakota::DataFitSurrModel, 355
initialize_final_statistics
   Dakota::NonD, 608
initialize_graphics
Dakota::Iterator, 491
initialize_grid
Dakota::NonDQuadrature, 698
initialize_h
Dakota::Model, 560
initialize_level_data
Dakota::NonDLocalReliability, 677
initialize_mapping
Dakota::ActiveSubspaceModel, 261
Dakota::RandomFieldModel, 818
initialize_mpp_search_data
Dakota::NonDLocalReliability, 678
initialize_random_variable_parameters
Dakota::NonD, 607
Dakota::ProbabilityTransformModel, 782
initialize_random_variable_types
Dakota::NonD, 607
Dakota::ProbabilityTransformModel, 782
initialize_random_variables
Dakota::NonD, 606
Dakota::ProbabilityTransformModel, 782
initialize_recast
Dakota::ActiveSubspaceModel, 262
Dakota::RandomFieldModel, 818
initialize_rf_coeffs
Dakota::RandomFieldModel, 819
initialize_run
Dakota::Analyzer, 267
Dakota::Iterator, 490
Dakota::LeastSq, 510
Dakota::Minimizer, 522
Dakota::NonD, 608
Dakota::Optimizer, 737
initialize_scaling
Dakota::ScalingModel, 856
initialize_variables_and_constraints
Dakota::APPSOptimizer, 304
insert
Dakota::ResultsDBAny, 844
intCntlParmArray
Dakota::DOTOptimizer, 420
Interface, 472
Dakota::Interface, 479
interface_id
Dakota::Model, 555
isReadyForWork
Dakota::APPSEvalMgr, 301
Iterator, 481
Dakota::Iterator, 489, 490
IteratorScheduler, 495
Dakota::IteratorScheduler, 498
JEGAOptimizer, 501
Dakota::JEGAOptimizer, 503
JEGAOptimizer.cpp, 978
JEGAOptimizer.hpp, 979
JEGAOptimizer::Driver, 421
JEGAOptimizer::Evaluator, 433
JEGAOptimizer::EvaluatorCreator, 438
kw_1
Dakota, 157
kw_10
Dakota, 159
kw_100
Dakota, 175
kw_101
Dakota, 175
kw_102
Dakota, 176
kw_103
Dakota, 176
kw_104
Dakota, 176
kw_105
Dakota, 176
kw_106
Dakota, 176
kw_107
Dakota, 177
kw_108
Dakota, 177
kw_109
Dakota, 177
kw_11
Dakota, 177
kw_110
Dakota, 177
kw_111
Dakota, 177
kw_112
Dakota, 178
kw_113
Dakota, 178
kw_114
Dakota, 178
kw_115
Dakota, 178
kw_116
| Dakota, 178 | kw_139 | Dakota, 183 |
| Dakota, 179 | kw_14 | Dakota, 160 |
| Dakota, 179 | kw_140 | Dakota, 184 |
| Dakota, 179 | kw_141 | Dakota, 184 |
| Dakota, 179 | kw_142 | Dakota, 184 |
| Dakota, 179 | kw_143 | Dakota, 184 |
| Dakota, 179 | kw_144 | Dakota, 184 |
| Dakota, 179 | kw_145 | Dakota, 184 |
| Dakota, 180 | kw_146 | Dakota, 185 |
| Dakota, 180 | kw_147 | Dakota, 185 |
| Dakota, 180 | kw_148 | Dakota, 185 |
| Dakota, 180 | kw_149 | Dakota, 185 |
| Dakota, 181 | kw_15 | Dakota, 160 |
| Dakota, 181 | kw_150 | Dakota, 186 |
| Dakota, 181 | kw_151 | Dakota, 186 |
| Dakota, 159 | kw_152 | Dakota, 186 |
| Dakota, 181 | kw_153 | Dakota, 186 |
| Dakota, 181 | kw_154 | Dakota, 186 |
| Dakota, 182 | kw_155 | Dakota, 186 |
| Dakota, 182 | kw_156 | Dakota, 187 |
| Dakota, 182 | kw_157 | Dakota, 187 |
| Dakota, 182 | kw_158 | Dakota, 187 |
| Dakota, 183 | kw_159 | Dakota, 187 |
| Dakota, 183 | kw_16 | Dakota, 160 |
| Dakota, 183 | kw_160 |   |
INDEX

Dakota, 195
kw_205
Dakota, 196
kw_206
Dakota, 196
kw_207
Dakota, 196
kw_208
Dakota, 196
kw_209
Dakota, 196
kw_21
Dakota, 161
kw_210
Dakota, 196
kw_211
Dakota, 197
kw_212
Dakota, 197
kw_213
Dakota, 197
kw_214
Dakota, 197
kw_215
Dakota, 197
kw_216
Dakota, 198
kw_217
Dakota, 198
kw_218
Dakota, 198
kw_219
Dakota, 198
kw_22
Dakota, 161
kw_220
Dakota, 198
kw_221
Dakota, 199
kw_222
Dakota, 199
kw_223
Dakota, 199
kw_224
Dakota, 199
kw_225
Dakota, 199
kw_226
Dakota, 200
kw_227
Dakota, 200
kw_228
Dakota, 200
kw_229
Dakota, 200
kw_23
Dakota, 161
kw_230
Dakota, 200
kw_231
Dakota, 201
kw_232
Dakota, 201
kw_233
Dakota, 201
kw_234
Dakota, 201
kw_235
Dakota, 201
kw_236
Dakota, 201
kw_237
Dakota, 201
kw_238
Dakota, 201
kw_239
Dakota, 201
kw_24
Dakota, 161
kw_240
Dakota, 201
kw_241
Dakota, 202
kw_242
Dakota, 202
kw_243
Dakota, 202
kw_244
Dakota, 203
kw_245
Dakota, 203
kw_246
Dakota, 203
kw_247
Dakota, 203
kw_248
Dakota, 204
kw_249
INDEX

Dakota, 212
kw_295
Dakota, 212
kw_296
Dakota, 212
kw_297
Dakota, 213
kw_298
Dakota, 213
kw_299
Dakota, 213
kw_3
Dakota, 158
kw_30
Dakota, 162
kw_300
Dakota, 213
kw_301
Dakota, 213
kw_302
Dakota, 213
kw_303
Dakota, 214
kw_304
Dakota, 214
kw_305
Dakota, 214
kw_306
Dakota, 214
kw_308
Dakota, 214
kw_309
Dakota, 214
kw_31
Dakota, 163
kw_310
Dakota, 215
kw_311
Dakota, 215
kw_312
Dakota, 215
kw_313
Dakota, 216
kw_314
Dakota, 216
kw_315
Dakota, 216
kw_316
Dakota, 216
kw_317
Dakota, 216
kw_318
Dakota, 217
kw_319
Dakota, 217
kw_32
Dakota, 217
kw_320
Dakota, 163
kw_321
Dakota, 217
kw_322
Dakota, 217
kw_323
Dakota, 218
kw_324
Dakota, 218
kw_325
Dakota, 218
kw_326
Dakota, 218
kw_327
Dakota, 218
kw_328
Dakota, 218
kw_329
Dakota, 218
kw_33
Dakota, 163
kw_330
Dakota, 219
kw_331
Dakota, 219
kw_332
Dakota, 219
kw_333
Dakota, 219
kw_334
Dakota, 220
kw_335
Dakota, 220
kw_336
Dakota, 220
kw_337
Dakota, 221
kw_339
Dakota, 221
kw_34
INDEX

Dakota, 229
kw_385
Dakota, 229
kw_386
Dakota, 229
kw_387
Dakota, 229
kw_388
Dakota, 229
kw_389
Dakota, 230
kw_39
Dakota, 164
kw_390
Dakota, 230
kw_391
Dakota, 230
kw_392
Dakota, 231
kw_393
Dakota, 231
kw_394
Dakota, 231
kw_395
Dakota, 231
kw_396
Dakota, 231
kw_397
Dakota, 231
kw_398
Dakota, 232
kw_399
Dakota, 232
kw_4
Dakota, 158
kw_40
Dakota, 164
kw_400
Dakota, 232
kw_401
Dakota, 232
kw_402
Dakota, 232
kw_403
Dakota, 233
kw_404
Dakota, 233
kw_405
Dakota, 233
kw_406
Dakota, 233
kw_407
Dakota, 234
kw_408
Dakota, 234
kw_409
Dakota, 234
kw_41
Dakota, 164
kw_410
Dakota, 234
kw_411
Dakota, 235
kw_412
Dakota, 235
kw_413
Dakota, 235
kw_414
Dakota, 235
kw_415
Dakota, 235
kw_416
Dakota, 235
kw_417
Dakota, 236
kw_418
Dakota, 236
kw_419
Dakota, 236
kw_42
Dakota, 164
kw_420
Dakota, 236
kw_421
Dakota, 237
kw_422
Dakota, 237
kw_423
Dakota, 237
kw_424
Dakota, 237
kw_425
Dakota, 238
kw_426
Dakota, 238
kw_427
Dakota, 238
kw_428
Dakota, 238
kw_429
Dakota, 239
kw_43
Dakota, 165
kw_430
Dakota, 239
kw_431
Dakota, 239
kw_432
Dakota, 239
kw_433
Dakota, 240
kw_434
Dakota, 240
kw_435
Dakota, 240
kw_436
Dakota, 240
kw_437
Dakota, 240
kw_438
Dakota, 241
kw_439
Dakota, 241
kw_44
Dakota, 165
kw_440
Dakota, 241
kw_441
Dakota, 241
kw_442
Dakota, 242
kw_443
Dakota, 242
kw_444
Dakota, 242
kw_445
Dakota, 242
kw_446
Dakota, 243
kw_447
Dakota, 243
kw_448
Dakota, 243
kw_449
Dakota, 243
kw_45
Dakota, 165

kw_450
Dakota, 243
kw_451
Dakota, 244
kw_452
Dakota, 244
kw_453
Dakota, 244
kw_454
Dakota, 244
kw_455
Dakota, 245
kw_456
Dakota, 245
kw_457
Dakota, 245
kw_458
Dakota, 245
kw_459
Dakota, 245
kw_46
Dakota, 166
kw_460
Dakota, 246
kw_461
Dakota, 246
kw_462
Dakota, 246
kw_463
Dakota, 246
kw_464
Dakota, 247
kw_465
Dakota, 247
kw_466
Dakota, 247
kw_467
Dakota, 247
kw_468
Dakota, 247
kw_469
Dakota, 248
kw_47
Dakota, 166
kw_48
Dakota, 166
kw_49
Dakota, 166
kw_5
Dakota, 158
kw_50
INDEX

Dakota, 166
kw_51
Dakota, 167
kw_52
Dakota, 167
kw_53
Dakota, 167
kw_54
Dakota, 167
kw_55
Dakota, 167
kw_56
Dakota, 168
kw_57
Dakota, 168
kw_58
Dakota, 168
kw_59
Dakota, 168
kw_6
Dakota, 158
kw_60
Dakota, 168
kw_61
Dakota, 168
kw_62
Dakota, 169
kw_63
Dakota, 169
kw_64
Dakota, 169
kw_65
Dakota, 169
kw_66
Dakota, 169
kw_67
Dakota, 169
kw_68
Dakota, 170
kw_69
Dakota, 170
kw_7
Dakota, 158
kw_70
Dakota, 170
kw_71
Dakota, 170
kw_72
Dakota, 170
kw_73
Dakota, 171
kw_74
Dakota, 171
kw_75
Dakota, 171
kw_76
Dakota, 171
kw_77
Dakota, 171
kw_78
Dakota, 172
kw_79
Dakota, 172
kw_8
Dakota, 158
kw_80
Dakota, 172
kw_81
Dakota, 172
kw_82
Dakota, 172
kw_83
Dakota, 172
kw_84
Dakota, 173
kw_85
Dakota, 173
kw_86
Dakota, 173
kw_87
Dakota, 173
kw_88
Dakota, 173
kw_89
Dakota, 173
kw_9
Dakota, 159
kw_90
Dakota, 174
kw_91
Dakota, 174
kw_92
Dakota, 174
kw_93
Dakota, 174
kw_94
Dakota, 174
kw_95
INDEX

Dakota, 174
kw_96  
  Dakota, 175
kw_97  
  Dakota, 175
kw_98  
  Dakota, 175
kw_99  
  Dakota, 175

LabelsWriter, 507
lagrangian
  merit
  Dakota::SurrBasedMinimizer, 927
LeastSq, 508
  Dakota::LeastSq, 509
level_mappings_file
  Dakota::NonD, 609
levenshtein_distance
  Dakota::TestDriverInterface, 946
lf_poly_prod
  Dakota::TestDriverInterface, 944
library_mode.cpp, 979
  callback_function, 981
  fpinit_ASIL, 980
  main, 982
  parallel_input, 982
  parallel_interface_plugin, 981
  run_dakota_data, 980
  run_dakota_mixed, 981
  run_dakota_parse, 980
  serial_input, 982
  serial_interface_plugin, 981
library_split.cpp, 983
LibraryEnvironment, 511
  Dakota::LibraryEnvironment, 513
LightWtBaseConstructor, 514
  lin_coeffs_modify_n2s
    Dakota::ScalingModel, 857
link
  Dakota::WorkdirHelper, 970
link_items
  Dakota::WorkdirHelper, 970
load_distribute_points
  Dakota::ParamStudy, 766
load_experiment
  Dakota::ExperimentData, 447
load_parameters
  Dakota::NomadOptimizer, 598
LoadAlgorithmConfig
  Dakota::JEGAOptimizer, 504
  LoadDakotaResponses
    Dakota::JEGAOptimizer, 504
  LoadProblemConfig
    Dakota::JEGAOptimizer, 504
  LoadTheConstraints
    Dakota::JEGAOptimizer, 505
  LoadTheDesignVariables
    Dakota::JEGAOptimizer, 505
  LoadTheObjectiveFunctions
    Dakota::JEGAOptimizer, 505
  LoadTheParameterDatabase
    Dakota::JEGAOptimizer, 505
local_eval_concurrency
  Dakota::Model, 555
  Dakota::NestedModel, 577
local_eval_synchronization
  Dakota::Model, 555
  Dakota::NestedModel, 577
local_recast_retrieve
  Dakota::Minimizer, 525
log_likelihood
  Dakota::NonDBayesCalibration, 624
logitTransform
  Dakota::NonDQUESOBayesCalibration, 704
lookup_by_val
  Dakota, 154, 155
MPIManager, 561
MPIPackBuffer, 562
MPIUnpackBuffer, 564
MS1
  Dakota::CONMINOptimizer, 331
main
  library_mode.cpp, 982
  main.cpp, 984
  restart_util.cpp, 985
  main.cpp, 983
  fpinit_ASIL, 984
  main, 984
make_variable_defaults
  Dakota::NIDRProblemDescDB, 585
manage_asv
  Dakota::Model, 560
manage_data_recastings
  Dakota::DataFitSurrModel, 356
manage_linear_constraints
  Dakota::Constraints, 342
MandatoryValue
  Dakota::GetLongOpt, 462
map
INDEX

Dakota::ApplicationInterface, 278
map_domain
Dakota::COLINApplication, 313
master_dynamic_schedule_analyses
Dakota::ApplicationInterface, 280
master_dynamic_schedule_evaluations
Dakota::ApplicationInterface, 281
master_dynamic_schedule_evaluations_nowait
Dakota::ApplicationInterface, 283
master_dynamic_schedule_iterators
Dakota::IteratorSchedulers, 501
MatchesWC, 514
matlab_engine_run
Dakota::MatlabInterface, 516
MatlabInterface, 515
maxEvalConcurrency
Dakota::Iterator, 495
mc_api_run
Dakota::TestDriverInterface, 946
MetaIterator, 516
mi_parallel_level
Dakota::ParallelConfiguration, 745
mi_parallel_level_iterator
Dakota::ParallelConfiguration, 745
mindist
Dakota::Minimizer, 518
Dakota::Minimizer, 522
MixedVarConstraints, 525
Dakota::MixedVarConstraints, 526
MixedVariables, 526
Dakota::MixedVariables, 528
mode_counts
Dakota::NonDSampling, 717
Model, 528
Dakota::Model, 552
modify_n2s
Dakota::ScalingModel, 857
modify_s2n
Dakota::ScalingModel, 858
mpi_debug_hold
Dakota::NonD, 150
multilevel_control_variate_mc
Dakota::NonDMultilevelSampling, 686
multilevel_mc
Dakota::NonDMultilevelSampling, 685
N1
Dakota::CONMINOptimizer, 329
N2
Dakota::CONMINOptimizer, 330
N3
Dakota::CONMINOptimizer, 330
N4
Dakota::CONMINOptimizer, 330
N5
Dakota::CONMINOptimizer, 330
NCSUOptimizer, 566
Dakota::NCSUOptimizer, 568, 569
NIDRProblemDescDB, 580
NL2Res, 585
NL2SOLLeastSq, 586
NLPQLPOptimizer, 588
NLSSOLLeastSq, 593
Dakota::NLSSOLLeastSq, 595
NPSOLOptimizer, 729
Dakota::NPSOLOptimizer, 731
NUMBER_OF_FIELDS
Dakota, 157
Name
Dakota::JEGAOptimizer::Evaluator, 435
need_resp_trans_byvars
Dakota::ScalingModel, 857
neg_log_post_resp_mapping
Dakota::NonDBayesCalibration, 625
NestedModel, 570
new_dataset
Dakota::Graphics, 465
nlf0_evaluator
Dakota::SNLLOptimizer, 906
nlf1_evaluator
Dakota::SNLLOptimizer, 907
nlf2_evaluator
Dakota::SNLLOptimizer, 907
nlf2_evaluator_gn
Dakota::SNLLLeastSq, 901
NoDBaseConstructor, 596
NomadOptimizer, 596
Dakota::NomadOptimizer, 598
NomadOptimizer::Evaluator, 431
NonD, 599
NonDAdaptImpSampling, 610
Dakota::NonDAdaptImpSampling, 613
NonDAdaptiveSampling, 614
Dakota::NonDAdaptiveSampling, 618
NonDBayesCalibration, 619
Dakota::NonDBayesCalibration, 623
INDEX

PMA2_constraint_eval
   Dakota::NonDLocalReliability, 676
PMA_constraint_eval
   Dakota::NonDLocalReliability, 676
PMA_objective_eval
   Dakota::NonDLocalReliability, 676
PRPMultiIndexCache
   Dakota, 149
PRPMultiIndexQueue
   Dakota, 149
PSUADEDesignCompExp, 809
   Dakota::PSUADEDesignCompExp, 811
PStudyDACE, 807
parallel_input
   library_mode.cpp, 982
parallel_interface_plugin
   library_mode.cpp, 981
ParallelConfiguration, 743
ParallelDirectApplicationInterface, 745
ParallelLevel, 746
ParallelLibrary, 749
   Dakota::ParallelLibrary, 756
ParamResponsePair, 758
   Dakota::ParamResponsePair, 761
ParamStudy, 762
parse
   Dakota::Environment, 431
   Dakota::GetLongOpt, 463
parse_inputs
   Dakota::ProblemDescDB, 792
parse_sigma_types
   Dakota::ExperimentData, 447
partial_corr
   Dakota::SensAnalysisGlobal, 863
partial_prp_equality, 767
partial_prp_hash, 767
partition
   Dakota::IteratorScheduler, 500
PebbldBranchSub, 769
PebbldBranching, 768
PebbldMinimizer, 770
   Dakota::PebbldMinimizer, 771
PecosApproximation, 772
peer_dynamic_schedule_evaluations
   Dakota::ApplicationInterface, 282
peer_dynamic_schedule_evaluations_nowait
   Dakota::ApplicationInterface, 284
peer_static_schedule_evaluations
   Dakota::ApplicationInterface, 282
peer_static_schedule_evaluations_nowait
   Dakota::ApplicationInterface, 283
penalty_merit
   Dakota::SurrBasedMinimizer, 927
perform_analysis
   Dakota, 153
perform_evaluation_impl
   Dakota::COLINApplication, 312
PerformIterations
   Dakota::JEGAOptimizer::Driver, 422
po_which
   Dakota::WorkdirHelper, 971
poly_prod
   Dakota::TestDriverInterface, 944
pop
   Dakota::Approximation, 292
   Dakota::PecosApproximation, 776
pop_approximation
   Dakota::ApproximationInterface, 298
pop_output_tag
   Dakota::OutputManager, 741
post_process
   Dakota::ProblemDescDB, 793
post_run
   Dakota::Analyzer, 268
   Dakota::COLINOptimizer, 317
   Dakota::DDACEDesignCompExp, 408
   Dakota::FSUDesignCompExp, 454
   Dakota::Iterator, 491
   Dakota::LeastSq, 510
   Dakota::MetaIterator, 517
   Dakota::Minimizer, 522
   Dakota::NonDMultilevelSampling, 685
   Dakota::NonDRKDDarts, 709
   Dakota::Optimizer, 737
   Dakota::ParamStudy, 766
   Dakota::PSUADEDesignCompExp, 811
   Dakota::SNLLLeastSq, 900
pre_output
   Dakota::Analyzer, 268
pre_run
   Dakota::Analyzer, 267
   Dakota::ConcurrentMetaIterator, 324
   Dakota::DDACEDesignCompExp, 407
   Dakota::FSUDesignCompExp, 454
   Dakota::Iterator, 490
   Dakota::NonDMultilevelSampling, 684
   Dakota::NonDRKDDarts, 709
   Dakota::ParamStudy, 766
Dakota::PSUADesignCompExp, 811
prepare_process_environment
  Dakota::ProcessApplicInterface, 797
prepend_path_item
  Dakota::WorkdirHelper, 971
prepend_preferred_env_path
  Dakota::WorkdirHelper, 969
primary_responder
  Dakota::Optimizer, 738
primary_weighter
  Dakota::LeastSq, 511
print_level_map
  Dakota::NonD, 609
print_level_mappings
  Dakota::NonD, 607
print_restart
  Dakota, 155
print_restart_pdb
  Dakota, 155
print_restart_tabular
  Dakota, 155
print_results
  Dakota::Analyzer, 268
  Dakota::ConcurrentMetaIterator, 324
  Dakota::Iterator, 492
  Dakota::LeastSq, 510
  Dakota::NonDAdaptiveSampling, 619
  Dakota::NonDBayesCalibration, 624
  Dakota::NonDDREAMBayesCalibration, 633
  Dakota::NonDGlobalReliability, 647
  Dakota::NonDMultilevelSampling, 685
  Dakota::NonDQUESOBayesCalibration, 703
  Dakota::NonDWASABIBayesCalibration, 726
  Dakota::Optimizer, 737
  Dakota::PebblMinimizer, 772
  Dakota::PStudyDACE, 808
  Dakota::RichExtrapVerification, 852
  Dakota::SeqHybridMetalaterator, 866
  Dakota::SurrBasedMinimizer, 926
  Dakota::Verification, 961
print_sobol_indices
  Dakota::Analyzer, 270
printControl
  Dakota::CONMINOptimizer, 329
  Dakota::DOTOptimizer, 420
prior_density
  Dakota::NonDDREAMBayesCalibration, 633
prior_proposal_covariance
  Dakota::NonDQUESOBayesCalibration, 704
prior_sample
  Dakota::NonDDREAMBayesCalibration, 633
probDescDB
  Dakota::Iterator, 494
  Dakota::Model, 561
probability
  Dakota::NonDLocalReliability, 680
ProbabilityTransformModel, 777
problem_size
  Dakota::NonDDREAMBayesCalibration, 632
problem_value
  Dakota::NonDDREAMBayesCalibration, 632
ProblemDescDB, 784
  Dakota::ProblemDescDB, 792
ProcessApplicInterface, 794
ProcessHandleApplicInterface, 798
  Dakota::ProcessHandleApplicInterface, 800
ProgramOptions, 802
ptmInstance
  Dakota::ProbabilityTransformModel, 783
push
  Dakota::Approximation, 292
  Dakota::PecosApproximation, 776
push_approximation
  Dakota::ApproximationInterface, 298
push_output_tag
  Dakota::ParallelLibrary, 757
python_convert_int
  Dakota::PythonInterface, 813
PythonInterface, 812
qr
  Dakota, 151
qr_rsolve
  Dakota, 151
QuesoJointPdf
  Dakota::QuesoJointPdf, 815
QuesoJointPdf< V, M >, 814
QuesoVectorRV
  Dakota::QuesoVectorRV, 815
QuesoVectorRV< V, M >, 815
RIA_constraint_eval
  Dakota::NonDLocalReliability, 676
RIA_objective_eval
  Dakota::NonDLocalReliability, 675
RandomFieldModel, 815
rawResponseMap
  Dakota::Interface, 481
read
read, 1025
Dakota::ParamResponsePair, 761
readchallenge_points
Dakota::ApproximationInterface, 298
read_core
Dakota::MixedVariables, 528
Dakota::RelaxedVariables, 833
read_neutral
Dakota, 156
read_results_file
Dakota::ProcessApplicInterface, 798
read_tabular
Dakota::MixedVariables, 528
Dakota::RelaxedVariables, 833
read_variables_responses
Dakota::Analyzer, 269
realCntlParmArray
Dakota::DOTOptimizer, 420
rebuild
Dakota::Approximation, 292
Dakota::PecosApproximation, 776
rebuild_approximation
Dakota::ApproximationInterface, 298
RecastModel, 820
Dakota::RecastModel, 827
RecordResponses
Dakota::JEGAOptimizer::Evaluator, 436
recover_model
Dakota::ExperimentData, 445
recursive_copy
Dakota::WorkdirHelper, 971
recv
Dakota::AppSEvalMgr, 301
reduce_model
Dakota::Optimizer, 737
ReducedBasis, 829
register_signal_handlers
Dakota, 150
RelaxedVarConstraints, 830
Dakota::RelaxedVarConstraints, 831
RelaxedVariables, 832
Dakota::RelaxedVariables, 833
repair_restart
Dakota, 156
requestVector
Dakota::ActiveSet, 257
reset_process_environment
Dakota::ProcessApplicInterface, 798
reshape
Dakota::Constraints, 342
residuals_per_multiplier
Dakota::ExperimentData, 446
resize_best_resp_array
Dakota::Minimizer, 525
resize_best_vars_array
Dakota::Minimizer, 524
resolve_inputs
Dakota::ParallelLibrary, 758
resolve_samples_symbols
Dakota::DDACEDesignCompExp, 408
resp_scaled2native
Dakota::ScalingModel, 856
Response, 834
response_mapping
Dakota::ActiveSubspaceModel, 263
Dakota::Interface, 480
Dakota::NestedModel, 579
response_modify_n2s
Dakota::ScalingModel, 858
response_modify_s2n
Dakota::ScalingModel, 858
responseMode
Dakota::SurrogateModel, 931
restart_util.cpp, 984
main, 985
RestartWriter, 841
ResultsDBAny, 842
ResultsEntry
Dakota::ResultsEntry, 845
ResultsEntry < StoredType >, 844
ResultsFileError, 845
ResultsID, 846
ResultsManager, 847
ResultsNames, 849
retrieve
Dakota::GetLongOpt, 463
returns_multiple_points
Dakota::COLINOptimizer, 316
Dakota::JEGAOptimizer, 506
rf_suite_identify_field_model
Dakota::RandomFieldModel, 818
rfmInstance
Dakota::RandomFieldModel, 820
RichExtrapVerification, 850
run
Dakota::Iterator, 492
run_dakota_data
library_mode.cpp, 980
run_dakota_mixed
library_mode.cpp, 981
run_dakota_parse
    library_mode.cpp, 980
run_iterator
    Dakota::IteratorScheduler, 499
run_sequential
    Dakota::SeqHybridMetaIterator, 866
run_sequential_adaptive
    Dakota::SeqHybridMetaIterator, 866
S
    Dakota::CONMINOptimizer, 330
SUBMETHOD_COLLABORATIVE
    Dakota, 150
SCAL
    Dakota::CONMINOptimizer, 331
SCI_FIELD_NAMES
    Dakota, 253
SIM, 254
SIM::ParallelDirectApplicInterface
    test_local_evaluations, 746
SIM::SerialDirectApplicInterface
    test_local_evaluations, 868
SNLLBase, 896
SNLLLeastSq, 898
SNLLOptimizer, 902
    Dakota::SNLLOptimizer, 905, 906
SOLBase, 908
sample_likelihood
    Dakota::NonDDREAMBayesCalibration, 633
sample_to_variables
    Dakota::Analyzer, 267
samplesIncrement
    Dakota::NonDSampling, 718
sampling_reset
    Dakota::NonDCubature, 629
    Dakota::NonDQuadrature, 698
    Dakota::NonDSampling, 715
    Dakota::NonD SparseGrid, 721
scale_model
    Dakota::Minimizer, 523
scale_residuals
    Dakota::ExperimentData, 446
scaleModelInstance
    Dakota::ScalingModel, 859
ScalingModel, 853
    Dakota::ScalingModel, 855
ScalingOptions, 859
schedule_iterators
    Dakota::IteratorScheduler, 500
ScilabInterface, 860
secondary_resp_scaled2native
    Dakota::ScalingModel, 856
secondary_resp_scaler
    Dakota::ScalingModel, 857
send_data_using_get
    Dakota::TrackerHTTP, 948
send_data_using_post
    Dakota::TrackerHTTP, 948
SensAnalysisGlobal, 860
separable_combine
    Dakota::TestDriverInterface, 946
SeparateVariables
    Dakota::JEGAOptimizer::Evaluator, 435
SeqHybridMetaIterator, 864
serial_input
    library_mode.cpp, 982
serial_interface_plugin
    library_mode.cpp, 981
SerialDirectApplicInterface, 867
serve_analyses_async
    Dakota::ProcessHandleApplicInterface, 801
serve_analyses_synchronize
    Dakota::ApplicationInterface, 280
serve_evaluations
    Dakota::ApplicationInterface, 279
serve_evaluations_async
    Dakota::ApplicationInterface, 285
serve_evaluations_synchronize
    Dakota::ApplicationInterface, 285
serve_evaluations_synchronize_peer
    Dakota::ApplicationInterface, 285
serve_iterators
    Dakota::IteratorScheduler, 501
set_apps_parameters
    Dakota::APPSOptimizer, 304
set_communicators_checks
    Dakota::ApplicationInterface, 280
    Dakota::DirectApplicInterface, 412
    Dakota::ProcessHandleApplicInterface, 800
    Dakota::SysCallApplicInterface, 934
set_compare
    Dakota, 154
set_ip_options
    Dakota::NonDQUESOBayesCalibration, 704
set_iterator
    Dakota::IteratorScheduler, 499
INDEX

set_mapping
   Dakota::ActiveSubspaceModel, 262
   Dakota::DataTransformModel, 389
set_preferred_path
   Dakota::WorkdirHelper, 971
set_problem
   Dakota::COLINApplication, 312
set_rng
   Dakota::COLINOptimizer, 316
set_solver_parameters
   Dakota::COLINOptimizer, 316
set_u_to_x_mapping
   Dakota::NonD, 609
   Dakota::ProbabilityTransformModel, 783
shape
   Dakota::Constraints, 341
   SharedApproxData, 868
   Dakota::SharedApproxData, 871, 872
   SharedPecosApproxData, 873
   SharedResponseData, 876
   SharedResponseDataRep, 879
   SharedSurfpackApproxData, 880
   Dakota::SharedSurfpackApproxData, 882
   SharedVariablesData, 882
   SharedVariablesDataRep, 887
shubert1D
   Dakota::TestDriverInterface, 945
simple_corr
   Dakota::SensAnalysisGlobal, 863
   SimulationModel, 893
   SimulationResponse, 895
smooth_herbie
   Dakota::TestDriverInterface, 945
   smooth_herbie1D
   Dakota::TestDriverInterface, 945
solution_level_index
   Dakota::Model, 555
solution_levels
   Dakota::Model, 555
solver_setup
   Dakota::COLINOptimizer, 316
spawn_analysis_to_shell
   Dakota::SysCallApplicInterface, 934
spawn_evaluation_impl
   Dakota::COLINApplication, 312
spawn_evaluation_to_shell
   Dakota::SysCallApplicInterface, 934
spawn_input_filter_to_shell
   Dakota::SysCallApplicInterface, 934
spawn_output_filter_to_shell
   Dakota::SysCallApplicInterface, 935
SpawnApplicInterface, 910
split_filenames
   Dakota::ProgramOptions, 807
split wildcard
   Dakota::WorkdirHelper, 970
start_dakota_heartbeat
   Dakota, 154
start_grid_computing
   Dakota, 153
steady_state_diffusion_1d
   Dakota::TestDriverInterface, 944
stop_evaluation_servers
   Dakota::ApplicationInterface, 279
stop_grid_computing
   Dakota, 153
subModel
   Dakota::NestedModel, 580
submit
   Dakota::APPSEvalMgr, 301
subordinate_iterator
   Dakota::Model, 553
subordinate_model
   Dakota::Model, 553
subordinate_models
   Dakota::Model, 556
SurfpackApproximation, 912
   Dakota::SurfpackApproximation, 914
SurrBasedGlobalMinimizer, 915
SurrBasedLocalMinimizer, 917
SurrBasedMinimizer, 924
surrogate_model
   Dakota::Model, 553
SurrogateModel, 928
surrogates_to_surf_data
   Dakota::SurfpackApproximation, 915
svd
   Dakota, 150
symmetric_eigenvalue_decomposition
   Dakota, 153
synch
   Dakota::ApplicationInterface, 278
synch_nowait
   Dakota::ApplicationInterface, 279
synchronize_derivatives
   Dakota::Model, 559
synchronous_local_analyses
   Dakota::ProcessApplicInterface, 797
synchronous_local_analysis
  Dakota::DirectApplicInterface, 412
  Dakota::GridApplicInterface, 467
  Dakota::ProcessHandleApplicInterface, 800
  Dakota::SysCallApplicInterface, 933
synchronous_local_evaluations
  Dakota::ApplicationInterface, 283
  SysCallApplicInterface, 932
TANA3Approximation, 936
TabularDataTruncated, 935
TabularReader, 935
TabularWriter, 936
TaylorApproximation, 939
terminate_modelcenter
  Dakota::ParallelLibrary, 757
test_local_evaluations
  Dakota::SysCallApplicInterface, 933
  SIM::ParallelDirectApplicInterface, 746
  SIM::SerialDirectApplicInterface, 868
TestDriverInterface, 940
ToDoubleMatrix
  Dakota::JEGAOptimizer, 506
tokenize_env_path
  Dakota::WorkdirHelper, 972
tr_ratio_check
  Dakota::SurrBasedLocalMinimizer, 922
TrackerHTTP, 946
trendOrder
  Dakota::GaussProcApproximation, 460
truth_model
  Dakota::Model, 554
uncertain_vars_to_subspace
  Dakota::ActiveSubspaceModel, 262
update_actual_model
  Dakota::DataFitSurrModel, 357
update_approximation
  Dakota::ApproximationInterface, 297
  Dakota::DataFitSurrModel, 353, 354
update_augmented_lagrange_multipliers
  Dakota::SurrBasedMinimizer, 926
update_filter
  Dakota::SurrBasedMinimizer, 926
update_from_actual_model
  Dakota::DataFitSurrModel, 358
update_from_sub_model
  Dakota::RecastModel, 828
update_from_subordinate_model
  Dakota::Model, 554
update_lagrange_multipliers
  Dakota::SurrBasedMinimizer, 926
update_level_data
  Dakota::NonDLocalReliability, 679
update_mpp_search_data
  Dakota::NonDLocalReliability, 678
update_penalty
  Dakota::SurrBasedLocalMinimizer, 922
update_quasi_hessians
  Dakota::Model, 559
update_response
  Dakota::Model, 559
usage
  Dakota::GetLongOpt, 464
UsageTracker, 948
  Dakota::UsageTracker, 949
useDerivs
  Dakota::NonDExpansion, 640
user_proposal_covariance
  Dakota::NonDOUESOBayesCalibration, 704
uses_method
  Dakota::Iterator, 492
VLUncertainInt
  Dakota, 250
VLUncertainReal
  Dakota, 250
VLUncertainStr
  Dakota, 251
VLint, 961
VLreal, 962
VLstr, 962
VPSApproximation, 963
VPSinstance
  Dakota::VPSApproximation, 966
VPSmodel_apply
  Dakota::VPSApproximation, 966
Valueless
  Dakota::GetLongOpt, 462
values_to_ranks
  Dakota::SensAnalysisGlobal, 863
Var_iCHECK, 949
var_mp_cbound
  Dakota, 253
var_mp_check_cau
  Dakota, 251
var_mp_check_ceu
  Dakota, 252
var_mp_check_cv
  Dakota, 251
INDEX

var_mp_check_daui
  Dakota, 252
var_mp_check_daur
  Dakota, 252
var_mp_check_daus
  Dakota, 252
var_mp_check_dieu
  Dakota, 252
var_mp_check_deur
  Dakota, 252
var_mp_check_deus
  Dakota, 252
var_mp_check_dset
  Dakota, 251
var_mp_drange
  Dakota, 253
Var_rcheck, 950
Variables, 950
variables_expand
  Dakota::DataTransformModel, 389
variables_resize
  Dakota::RandomFieldModel, 819
variables_scaler
  Dakota::ScalingModel, 857
variables_to_sample
  Dakota::Analyzer, 270
  Dakota::NonDSampling, 716
variablesCompsTotals
  Dakota::SharedVariablesDataRep, 892
variance_based_decomp
  Dakota::Analyzer, 269
vars_mapping
  Dakota::ActiveSubspaceModel, 262
  Dakota::RandomFieldModel, 819
vars_u_to_x_mapping
  Dakota::NonD, 609
  Dakota::ProbabilityTransformModel, 783
vars_x_to_u_mapping
  Dakota::NonD, 609
  Dakota::ProbabilityTransformModel, 783
Verification, 960
view_aleatory_uncertain_counts
  Dakota::NonDSampling, 716
view_design_counts
  Dakota::NonDSampling, 716
view_epistemic_uncertain_counts
  Dakota::NonDSampling, 717
view_uncertain_counts
  Dakota::NonDSampling, 717
volumetric_quality
  Dakota::PStudyDACE, 808
wait_local_evaluations
  Dakota::SysCallApplicInterface, 933
weight_model
  Dakota::LeastSq, 511
which
  Dakota::WorkdirHelper, 969
WorkdirHelper, 967
write
  Dakota::ParamResponsePair, 761
write_ordered
  Dakota, 152