



National  
Laboratories

# Multifidelity UQ Workflows with Dakota's Graphical User Interface

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```
$ dakota -v
```

```
Dakota version 6.16+ (stable) released May 23 2022.
```

```
Repository revision 63d6cbe86 (2022-05-17) built May 23 2022 22:17:44.
```





### Main features

- IDE for Dakota (as Visual Studio is to C++)
- Lightweight version of the Sandia Analysis Workbench (SAW)
- Support for Windows, Mac and RHEL7
- Open-source
- Publicly released every six months

# DAKOTA GUI

## FEATURES – WELCOME




Dakota GUI

File Edit Run Window Help

Welcome x

## Welcome to the Dakota GUI


### Getting Started

 [Search the Dakota examples repository.](#)  
Browse through various example projects curated by the Dakota team.

[Define a simulation model.](#)  
Define a variable/response model for your black-box simulation.

[Create a new Dakota project.](#)  
A project helps to organize and associate your files.

### Dakota Studies

 [Import a Dakota study from your filesystem.](#)  
If you already have a Dakota study file, select this option.

[Open the default Dakota Editing perspective.](#)  
Start from scratch in an empty workspace.

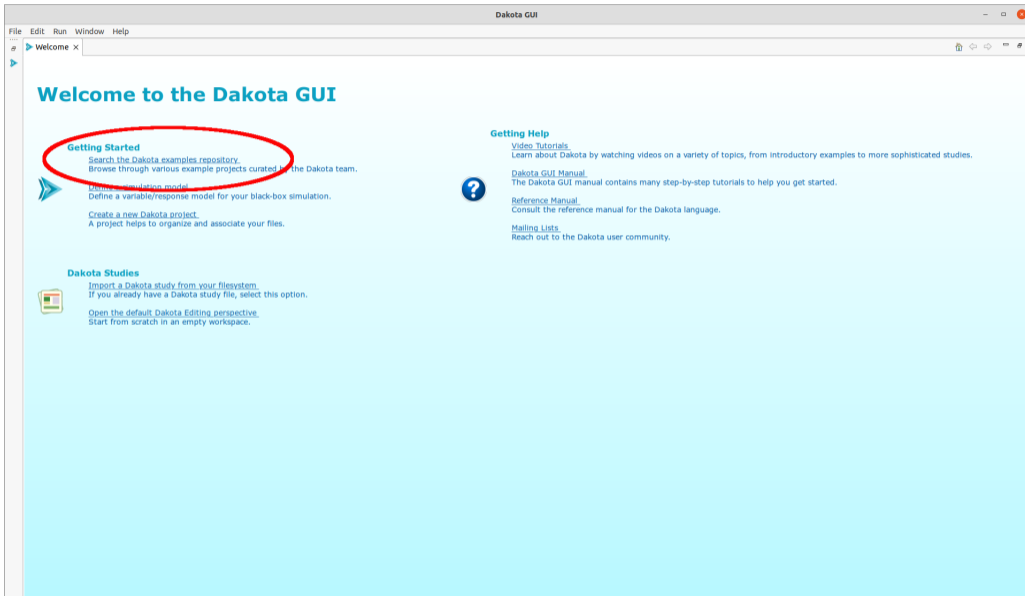
### Getting Help

[Video Tutorials](#)  
Learn about Dakota by watching videos on a variety of topics, from introductory examples to more sophisticated studies.

[Dakota GUI Manual](#)  
The Dakota GUI manual contains many step-by-step tutorials to help you get started.

[Reference Manual](#)  
Consult the reference manual for the Dakota language.

[Mailing Lists](#)  
Reach out to the Dakota user community.



The screenshot shows the Dakota GUI application window. The main window has a menu bar (File, Edit, Run, Window, Help) and a toolbar. The main content area displays a 'Welcome to the Dakota GUI' message. Below this, there are three sections: 'Getting Started', 'Getting Help', and 'Dakota Studies'. Each section contains links to various resources. A 'Dakota Examples Search' dialog box is open in the foreground, showing search results for the query 'multilevel'.

**Getting Started**

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**Dakota Studies**

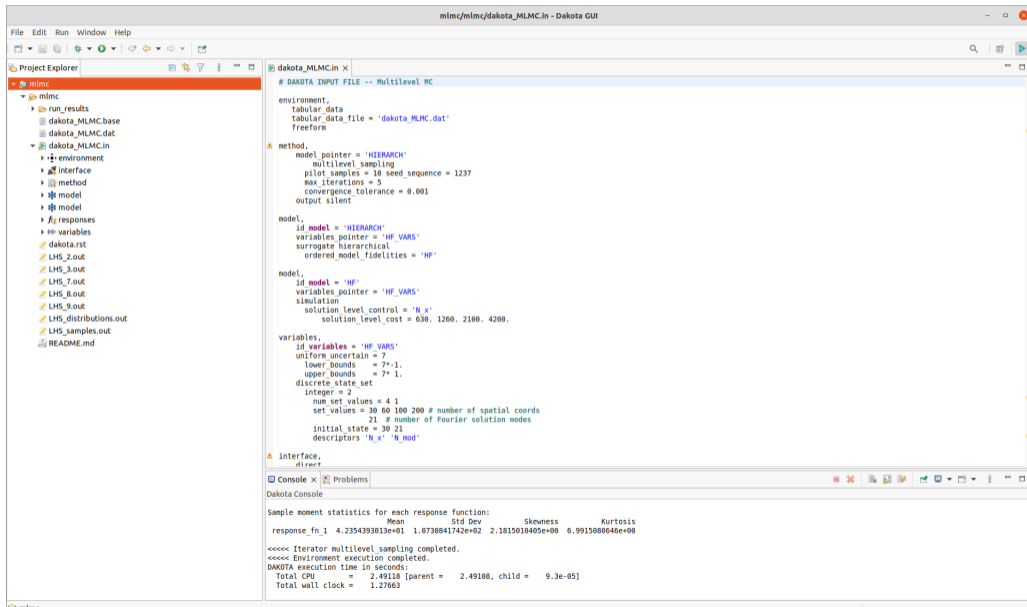
- [Import a Dakota study from your filesystem](#)  
If you already have a Dakota study file, select this option.
- [Open the default Dakota Editing perspective.](#)  
Start from scratch in an empty workspace.

**Dakota Examples Search**

Search Results

- dakota-examples
- dakota-examples/official/case\_studies/bayesian\_ml\_emulator
- dakota-examples/official/uncertainty\_quantification/mlmf
- dakota-examples/official/uncertainty\_quantification/mlmf/cv
- dakota-examples/official/uncertainty\_quantification/mlmf/mc
- dakota-examples/official/uncertainty\_quantification/mlmf/mlmc**
- dakota-examples/official/uncertainty\_quantification/mlmf/mlmf

Buttons: Cancel, Import



The screenshot displays the Dakota GUI interface with the following components:

- Project Explorer:** A tree view on the left showing the project structure. The 'dakota\_MLMC.in' file is selected under the 'mlmc' project.
- Input File Editor:** The main window displays the 'dakota\_MLMC.in' file, which is a Dakota input file. The file content is as follows:
 

```
# DAKOTA INPUT FILE -- Multilevel MC

environment,
  tabular_data
  tabular_data_file = 'dakota_MLMC.dat'
  freeform

method,
  model_pointer = 'HIERARCH'
  multilevel_sampling
  pilot_samples = 10 seed_sequence = 1237
  max_iterations = 5
  convergence_tolerance = 0.001
  output_silent

model,
  id_model = 'HIERARCH'
  variables_pointer = 'HF_VARS'
  surrogate_hierarchical
  ordered_model_fidelities = 'HF'

model,
  id_model = 'HF'
  variables_pointer = 'HF_VARS'
  simulation
  solution_level_control = 'N X'
  solution_level_cost = 638. 1260. 2180. 4200.

variables,
  id_variables = 'HF_VARS'
  uniform_uncertain = 7
  lower_bounds = 7*-1.
  upper_bounds = 7* 1.
  discrete_state_set
  integer = 2
  num_set_values = 4 1
  set_values = 30 60 100 200 # number of spatial coords
  21 # number of Fourier solution nodes
  initial_state = 30 21
  descriptors 'N_X' 'N_mod'

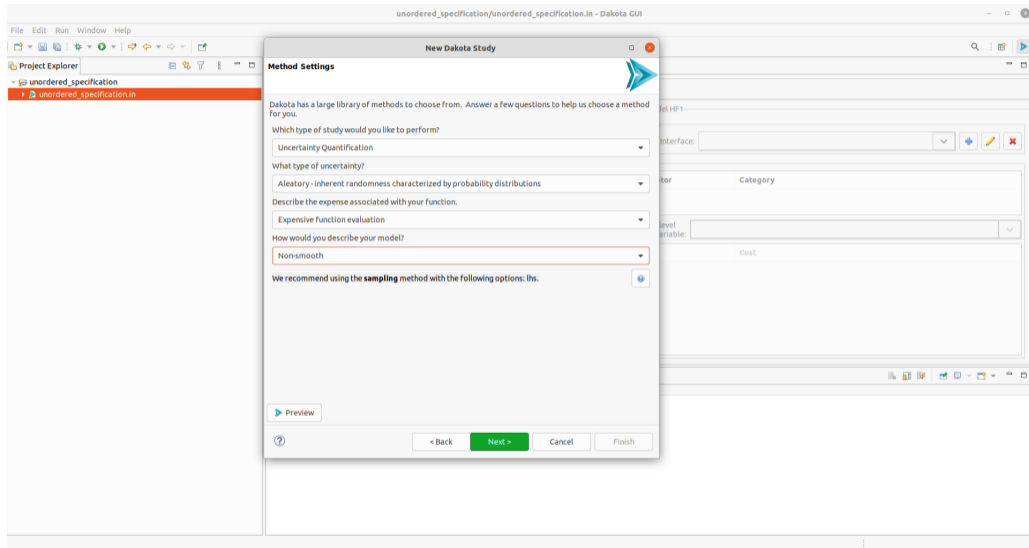
interface,
  direct
```
- Console:** The bottom panel shows the output of the Dakota GUI. It includes sample moment statistics for each response function and execution details:
 

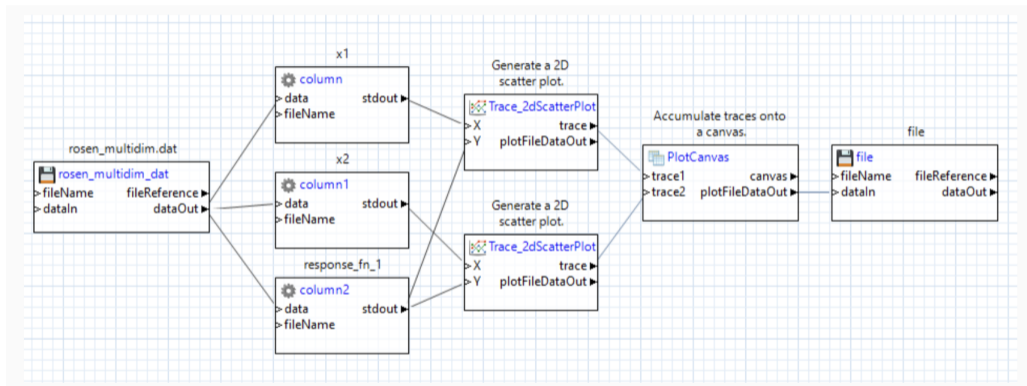
```
Sample moment statistics for each response function:
              Mean      Std Dev      Skewness      Kurtosis
response_fn_1  4.2354393813e+01  1.0738841742e+02  2.1815010405e+00  6.9915088646e+00

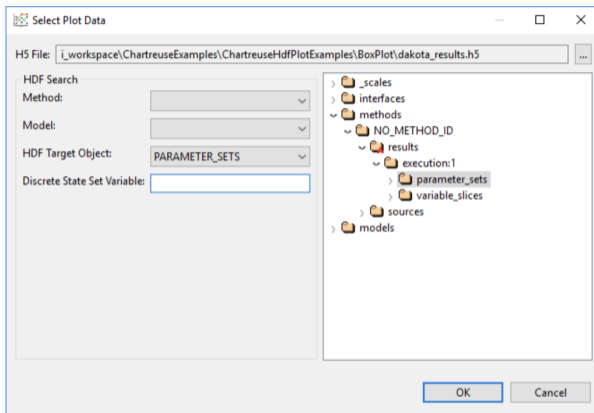
<<<< Iterator multilevel sampling completed.
<<<< Environment execution completed.
DAKOTA execution time in seconds:
Total CPU      = 2.49118 [parent = 2.49108, child = 9.3e-05]
Total wall clock = 1.27663
```

# DAKOTA GUI

## FEATURES – WIZARD







Dakota natively supports **HDF5 format for the result file**

```
environment
```

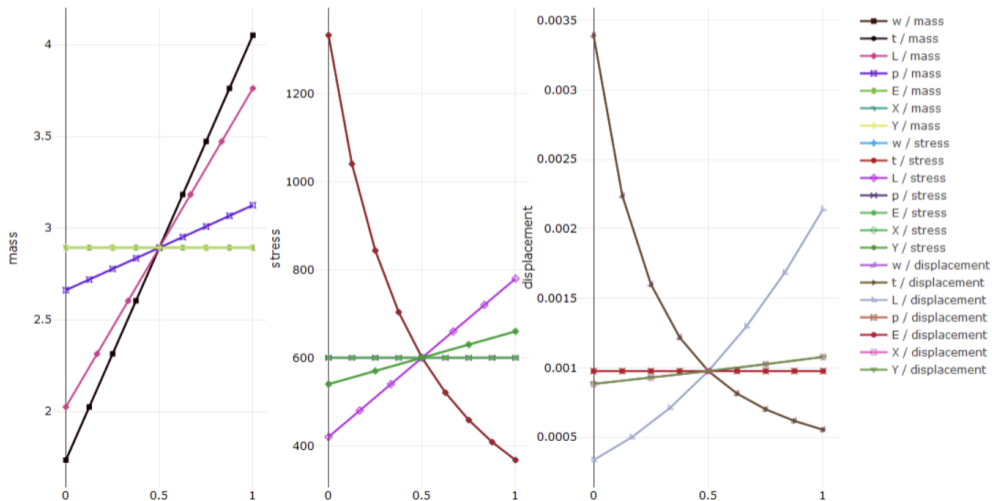
```
  results_output
```

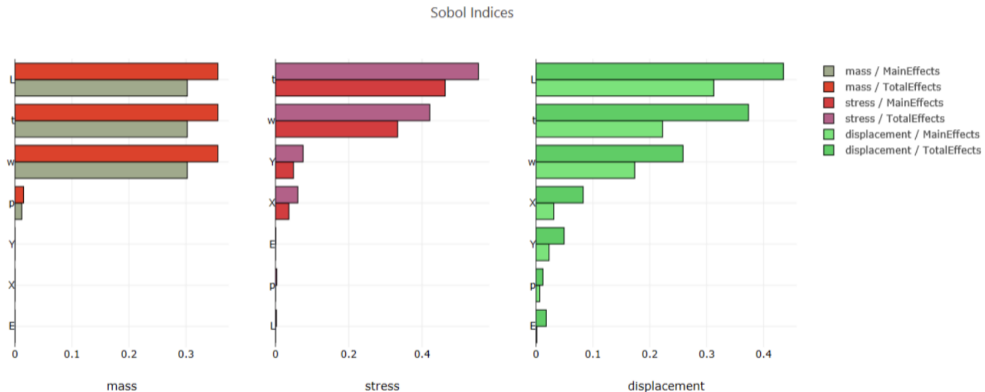
```
    hdf5
```

```
    results_output_file 'my_results' # The .h5 extension will be added
```



Centered Parameter Study Response Comparison - Tabular Data Set 1





## **Multilevel and Multifidelity Capabilities**

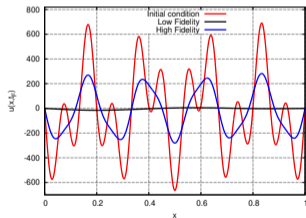
# CONFIGURING A MLMC STUDY

## STANDARD HEAT EQUATION CASE IN DAKOTA



Heat-equation in presence of uncertain thermal diffusivity and initial condition<sup>1</sup>

$$\begin{cases} \frac{\partial u(x, \xi, t)}{\partial t} - \alpha(\xi) \frac{\partial^2 u(x, \xi, t)}{\partial x^2} = 0, & \alpha > 0, x \in [0, L] = \Omega \subset \mathbb{R} \\ u(x, \xi, 0) = u_0(x, \xi), & t \in [0, t_F] \text{ and } \xi \in \Xi \subset \mathbb{R}^d \\ u(x, \xi, t)|_{\partial\Omega} = 0 \\ u_0(x, \xi) = \mathcal{G}(\xi)\mathcal{F}_1(x) + \mathcal{I}(\xi)\mathcal{F}_2(x) \end{cases}$$

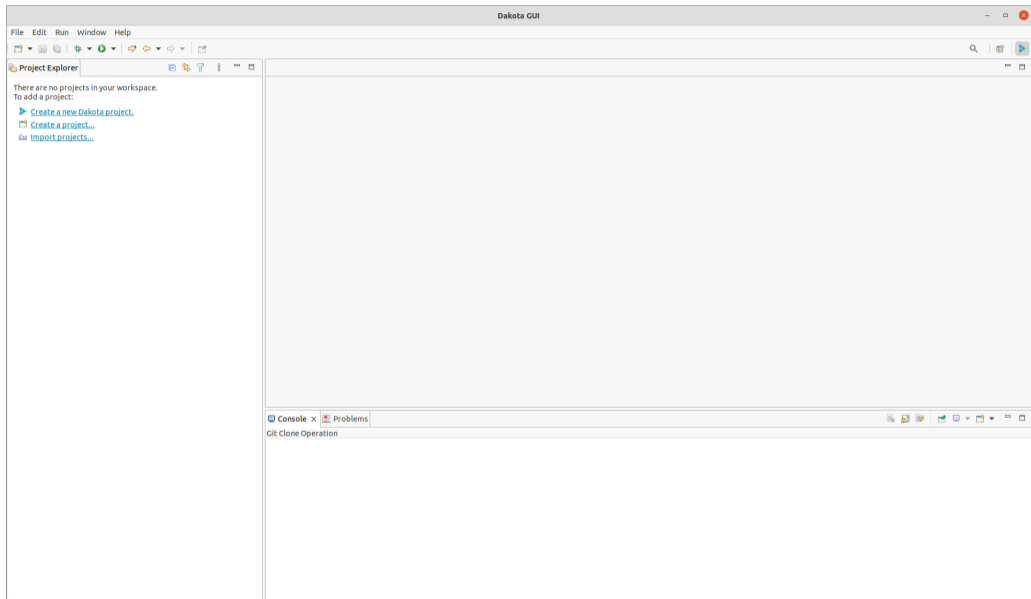


|            | LF       | HF  |
|------------|----------|-----|
| # modes    | 3        | 21  |
|            | $N_x$    |     |
| $\ell = 0$ | 5        | 30  |
| $\ell = 1$ | 15       | 60  |
| $\ell = 2$ | 30       | 100 |
| $\ell = 3$ | 60       | 200 |
|            | $w_\ell$ |     |
|            | 42       | 28  |
|            | 23       | 23  |

<sup>1</sup>G. Geraci, M.S. Eldred, and G. Iaccarino. "A multifidelity control variate approach for the multilevel Monte Carlo technique". In: *Center for Turbulence Research 2015* (2015).

# MLMC STUDY EDITOR

## CREATION



New Dakota Project

Create New Dakota Project

A Dakota project helps organize and associate your Dakota files.

Project name:

mlmc\_creation

☒ Use default location

Location: /home/ggeraci/dakota\_gui\_workspace\_NEW/mlmc\_crea

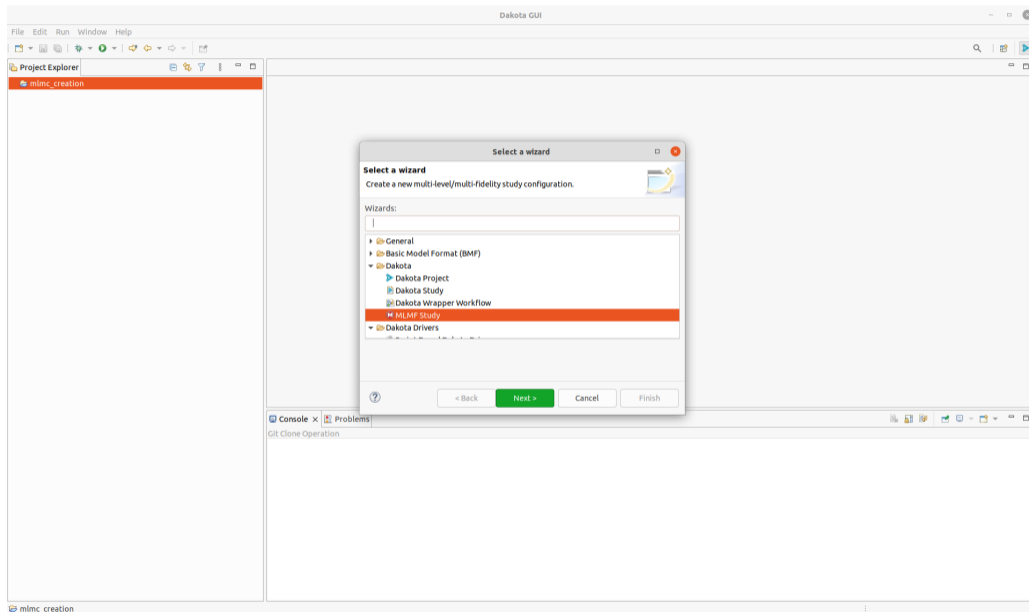
Browse...

Cancel

Finish

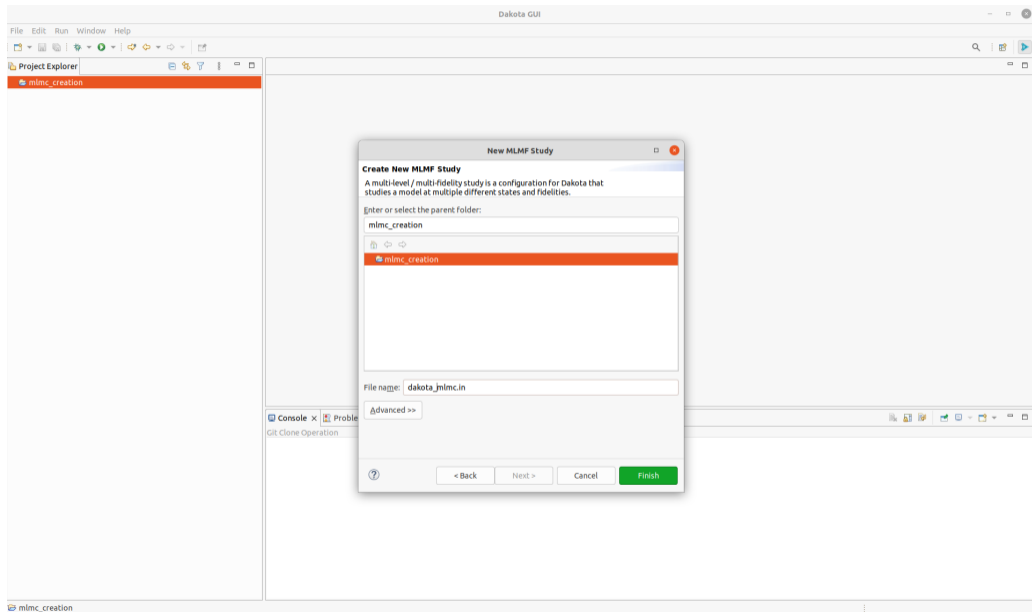
# MLMC STUDY EDITOR

## CREATION



# MLMC STUDY EDITOR

## CREATION



# MLMC STUDY EDITOR

## CREATION



mlmc\_creation/dakota\_mlmc.in - Dakota GUI

File Edit Run Window Help

Project Explorer

- mlmc\_creation

dakota\_mlmc.in x

☒ Hierarchical  
☐ Ensemble

No Model Selected

Models

- \* MODEL\_HIERARCHICAL

Method

Method Recipe:

Console x Problems

Git Clone Operation

mlmc creation

# MLMC STUDY EDITOR

## CREATION



mlmc\_creation/dakota\_mlmc.in - Dakota GUI

File Edit Run Window Help

Project Explorer

- mlmc\_creation
  - \*dakota\_mlmc.in x

Models

- MODEL\_HIERARCHICAL
  - MODEL\_1 (Highest fidelity)

Method

Method Recipe: [v]

Editing model MODEL\_1

Interfaces

Selected Interface: [v] [+] [p] [x]

Variables

| Descriptor | Category |
|------------|----------|
|------------|----------|

Solution level control variable: [v]

| Level | Cost |
|-------|------|
|-------|------|

Console x Problems

Git Clone Operation

# MLMC STUDY EDITOR

## CREATION



mlmc\_creation/dakota\_mlmc.in - Dakota GUI

File Edit Run Window Help

Project Explorer

- mlmc\_creation
  - \*dakota\_mlmc.in x

Models

- MODEL\_HIERARCHICAL
  - MODEL\_1 (Highest fidelity)

Method

Method Recipe:

Editing model MODEL\_1

Interfaces

Selected Interface: <None>

Variables

| Descriptor | Category |
|------------|----------|
|------------|----------|

Solution level control variable:

| Level | Cost |
|-------|------|
|-------|------|

Console x Problems

Git Clone Operation

Buttons: Add External Analysis Driver, Add Direct Analysis Driver

# MLMC STUDY EDITOR

## CREATION



mlmc\_creation/dakota\_mlmc.in - Dakota GUI

File Edit Run Window Help

Project Explorer

- mlmc\_creation
  - \*dakota\_mlmc.in x

Hierarchical  
Ensemble

Models

- MODEL\_HIERARCHICAL
  - MODEL\_1 (Highest fidelity)

Name your Interface

INTERFACE\_1

Cancel OK

Editing model MODEL\_1

Interfaces

Selected Interface: <None>

Variables

| Descriptor | Category |
|------------|----------|
|------------|----------|

Solution level control variable:

Level Cost

Method

Method Recipe:

Console x Problems

Git Clone Operation

# MLMC STUDY EDITOR

## CREATION



The screenshot displays the MLMC Study Editor interface, which is divided into several panels. The top panel contains a menu bar (File, Edit, Run, Window, Help) and a toolbar. Below this is the Project Explorer, which shows a tree view of the project structure. The 'mlmc\_creation' folder is selected, and it contains a sub-folder named 'MODEL\_HIERARCHICAL'. Inside this folder, 'MODEL\_1 (Highest fidelity)' is highlighted. To the right of the Project Explorer is a list of models, including 'ir\_rosenbrock', 'lf\_short\_column', 'log\_ratio', 'mc\_apl\_run', 'mf\_rosenbrock', 'mf\_short\_column', 'mod\_cantilever', 'modelcenter', 'modified\_rosenbrock', 'mogatest1', 'mogatest2', 'mogatest3', 'multimodal', 'poly\_prod', 'predator\_pre', 'problem18', 'rosenbrock', 'salinas', 'scalable\_gerstner', 'scalable\_monomials', 'scalable\_text\_book', 'short\_column', 'shubert', 'side\_impact\_cost', 'side\_impact\_perf', 'smooth\_herbie', 'sobel\_g\_function', 'sobel\_lshigami', 'sobel\_rational', 'steady\_state\_diffusion\_1d', 'steel\_column\_cost', 'steel\_column\_perf', 'text\_book', 'text\_book1', 'text\_book2', 'text\_book3', 'text\_book\_ouu', and 'transient\_diffusion\_1d'. The 'Method' dropdown menu is set to 'Method Recipe:'. The bottom panel shows the Console and Problems tabs, with the Console displaying 'Git Clone Operation'. On the right side of the interface, the 'kota GUI' window is visible, showing the 'Editing model MODEL\_1' dialog. This dialog has tabs for 'Interfaces' and 'Variables'. The 'Interfaces' tab is active, showing a 'Selected Interface: <None>' dropdown. The 'Variables' tab shows a table with columns 'Descriptor' and 'Category'. Below this is a 'Solution level control variable:' dropdown. The bottom of the dialog shows a table with columns 'Level' and 'Cost'.

# MLMC STUDY EDITOR

## CREATION



The screenshot displays the MLMC Study Editor interface. The main window is titled "mimc\_creation/dakota\_mimc.in - Dakota GUI". The Project Explorer on the left shows the "mimc\_creation" project. The Models pane shows a hierarchy with "MODEL\_HIERARCHY" and "MODEL\_1 (HIERARCHY)". A tooltip "Edit All Variables..." is visible over the "Edit All Variables..." button in the Models pane. The Variable Set Editor dialog box is open, showing a list of variables for "INTERFACE\_1". The variables are:

- N\_mod ✓
- N\_x ✓
- UUV\_1 ✓
- UUV\_2 ✓
- UUV\_3 ✓
- UUV\_4 ✓
- UUV\_5 ✓
- UUV\_6 ✓
- UUV\_7 ✓

The dialog box also contains a text area with the following text:

Welcome to the MLMF variable editor. In order to prepare multiple interfaces for use in a multi-level/multi-fidelity study, you must assign each interface's UQ variables to uncertain categories. Additionally, if the study has multiple levels (ML or MLMF) you must indicate which are the "solution level control variables" by specifying a category of "discrete\_state\_set."

The dialog box has "Cancel" and "OK" buttons at the bottom.

# MLMC STUDY EDITOR

## CREATION



mlmc\_creation/dakota\_mlmc.in - Dakota GUI

File Edit Run Window Help

Project Explorer

mlmc\_creation

Hierarchical  
Ensemble

Models

MODEL\_HIERARCHY

MODEL\_1 (High)

Variable Set Editor

Variable INTERFACES

N\_mod ✓

N\_x ✓

uuv\_1 ✓

uuv\_2 ✓

uuv\_3 ✓

uuv\_4 ✓

uuv\_5 ✓

uuv\_6 ✓

uuv\_7 ✓

Editing variable N\_x

discrete\_state\_set

Discrete State Set

Type: integer

Initial State: 30

Elements

Category

discrete\_state\_set

discrete\_state\_set

Cost

Method

Method Recipe:

Console x Problem

Git Clone Operation

Welcome to the multi-level/multi-categories. Add which are the "solution level control variables" by specifying a category of "discrete\_state\_set."

Cancel Save

Cancel OK



The screenshot displays the MLMC Study Editor interface. At the top, a window title bar shows the file name "dakota\_mlmc.in". Below the title bar is a toolbar with icons for file operations. The main interface is divided into several sections:

- Model Selection:** On the left, under the "Models" section, there are two options: "MODEL\_HIERARCHICAL" and "MODEL\_1 (Highest fidelity)". "MODEL\_1" is currently selected and highlighted in orange.
- Method Selection:** At the bottom left, under the "Method" section, there is a "Method Recipe:" label and a dropdown menu.
- Editing model MODEL\_1:** On the right side, the "Editing model MODEL\_1" panel is active. It contains:
  - Interfaces:** A section with a "Selected Interface:" dropdown menu set to "INTERFACE\_1".
  - Variables:** A table with two columns: "Descriptor" and "Category".

| Descriptor | Category           |
|------------|--------------------|
| N_x        | discrete_state_set |
| N_mod      | discrete_state_set |
  - Solution level control variable:** A dropdown menu.
  - Level and Cost:** A table with two columns: "Level" and "Cost".

| Level | Cost |
|-------|------|
|-------|------|

# MLMC STUDY EDITOR

## CREATION



mlmc\_creation/mlmc\_pilot\_proj.in - Dakota GUI

File Edit Run Window Help

Project Explorer

- mlmc\_creation
  - dakota\_mlmc.in
  - mlmc\_pilot\_proj.in
  - mlmc\_pilot\_proj.out

\*mlmc\_pilot\_proj.in x

Hierarchical  
Ensemble

Models

- HIERARCH
  - HF1 (Highest fidelity)
  - HF2
  - HF3
  - HF4 (Lowest fidelity)

Editing model HF4

Interfaces

Selected interface: ID\_INTERFACE\_1

Variables

| Descriptor | Category          |
|------------|-------------------|
| uuv_1      | uniform_uncertain |
| uuv_2      | uniform_uncertain |

Solution level control variable: N\_x

| Level | Cost  |
|-------|-------|
| 30    | 630.0 |

Method

Method Recipe: ML MC (multilevel\_sam)

- ML MC (multilevel\_sam)
- MF MC (CV MC, multifidelity\_sampling)
- MLMF MC (multilevel\_multifidelity\_sampling)
- Sampling (LHS)
- Sampling (Random)

Console x

Git Clone Operati

# MLMC STUDY EDITOR

## CREATION



mlmc\_creation/mlmc\_pilot\_proj.in - Dakota GUI

File Edit Run Window Help

Project Explorer

- mlmc\_creation
  - run\_results
  - dakota\_mlmc.in
  - LHS\_2.out
  - LHS\_3.out
  - LHS\_7.out
  - LHS\_8.out
  - LHS\_9.out
  - LHS\_distributions.out
  - LHS\_samples.out
  - mlmc\_pilot\_proj.in
  - mlmc\_pilot\_proj.out

\*mlmc\_pilot\_proj.in x

Run Dakota...

Hier  
Ens

Models

- HIERARCH
  - HF1 (Highest fidelity)
  - HF2
  - HF3
  - HF4 (Lowest fidelity)

Editing model HF4

Interfaces

Selected interface: ID\_INTERFACE\_1

Variables

| Descriptor | Category          |
|------------|-------------------|
| uuv_1      | uniform_uncertain |
| uuv_2      | uniform_uncertain |

Solution level control variable: N\_x

| Level | Cost  |
|-------|-------|
| 30    | 630.0 |

Method

Method Recipe: MLMC (multilevel\_sam)

Console x Problems

Dakota Console

```
25
Model Form HF1:
25
<<<< Projected number of equivalent high fidelity evaluations: 5.6075000000e+02
<<<< Variance for mean estimator:
  Initial MLMC (pilot samples): 6.8682015124e+02
  Projected MLMC (sample profile): 5.2680840619e+00
  Projected MLMC / pilot ratio: 7.6586847344e-03
  Equivalent MC ( 561 HF samples): 3.0668285752e+01
  Equivalent MLMC / MC ratio: 1.7151542491e-01
<<<< Iterator multilevel sampling completed.
<<<< Environment execution completed.
DAKOTA execution time in seconds:
  Total CPU = 1.29859 [parent = 1.2985, child = 9e-05]
  Total wall clock = 0.168531
```

# MLMC STUDY EDITOR

## CREATION



mlmc\_creation/mlmc\_pilot\_proj.in - Dakota GUI

File Edit Run Window Help

Project Explorer

- mlmc\_creation
  - run\_results
  - dakota\_mlmc.in
  - LHS\_2.out
  - LHS\_3.out
  - LHS\_7.out
  - LHS\_8.out
  - LHS\_9.out
  - LHS\_distributions.out
  - LHS\_samples.out
  - mlmc\_pilot\_proj.in
  - mlmc\_pilot\_proj.out

\*mlmc\_pilot\_proj.in x

Preview Dakota Study...

Models

- HIERARCH
  - HF1 (Highest fidelity)
  - HF2
  - HF3
  - HF4 (Lowest fidelity)

Method

Method Recipe: ML MC (multilevel sampling)

Console

Dakota Console

```
Model Form HF1: 25
25
<<<< Projected number of equivalent high fidelity samples: 25
<<<< Variance for mean estimator:
  Initial MLMC (pilot samples): 6.1
  Projected MLMC (sample profile): 5.1
  Projected MLMC / pilot ratio: 7.1
  Equivalent MC ( 561 HF samples): 3.1
  Equivalent MLMC / MC ratio: 1.1
<<<< Iterator multilevel_sampling completed.
<<<< Environment execution completed.
DAKOTA execution time in seconds:
  Total CPU = 1.29859 [parent = 1.2985, child = 9e-05]
  Total wall clock = 0.160531
```

Dakota Study Preview

```
environment
method
  multilevel_sampling
  allocation_target
    mean
  qoi_aggregation
    sum
  convergence_tolerance 0.1
  max_iterations 5
  model_pointer "HIERARCH"
model
  id_model "HF1"
  single
  interface_pointer "ID_INTERFACE_1"
  solution_level_control "N_x"
  solution_level_cost 4200.
  variables_pointer "HF1_VARS"
model
  id_model "HF2"
  single
  interface_pointer "ID_INTERFACE_1"
  solution_level_control "N_x"
  solution_level_cost 2100.
  variables_pointer "HF2_VARS"
model
  id_model "HF3"
  single
  interface_pointer "ID_INTERFACE_1"
  solution_level_control "N_x"
  solution_level_cost 1260.
  variables_pointer "HF3_VARS"
model
  id_model "HF4"
  single
  interface_pointer "ID_INTERFACE_1"
```

OK

# MLMC STUDY EDITOR

## CREATION



mlmc\_creation/mlmc\_pilot\_proj.in - Dakota GUI

File Edit Run Window Help

Project Explorer

- mlmc\_creation
  - run\_results
  - dakota\_rst
  - LHS\_2.out
  - LHS\_3.out
  - LHS\_7.out
  - LHS\_8.out
  - LHS\_9.out
  - LHS\_distributions.out
  - LHS\_samples.out
  - mlmc\_pilot\_proj.in**
  - mlmc\_pilot\_proj.out

environment

```
method
  multilevel_sampling
  pilot_samples 25 25 25
  solution_mode
    pilot_projection
    max_function_evaluations 500
    model_pointer "HIERARCH"

model
  id_model "HF4"
  single
  interface_pointer "ID_INTERFACE_1"
  solution_level_control "N_x"
  solution_level_cost 630.
  variables_pointer "HF4_VARS"
```

del

```
id_model "HF3"
single
```

INTERFACE\_1\*

```
1 "N_x"
266.
RS*
```

INTERFACE\_1\*

```
1 "N_x"
100.
RS*
```

del

```
id_model "HF1"
```

Console

```
Model Form HF1:
25
Projected number of equivalent high fidelity evaluations: 5.6075000000e+02
Variance for mean estimator:
initial MLMC (pilot samples): 6.8682015124e+02
Projected MLMC (sample profile): 5.2600040619e+00
Projected MLMC / pilot ratio: 7.6506047344e-03
Equivalent MC ( 501 HF samples): 3.0060285752e+01
Equivalent MLMC / MC ratio: 1.7151542491e-01

<<<< Iterator multilevel sampling completed.
<<<< Environment execution completed.
DAKOTA execution time in seconds:
Total CPU = 1.29859 [parent = 1.2985, child = 9e-05]
Total wall clock = 0.160531
```

# MFMC STUDY EDITOR

## IMPORT CAPABILITY (1/2)



test\_import/mfmc\_pilot\_proj.in - Dakota GUI

File Edit Run Window Help

Project Explorer

- test\_import

mfmc\_pilot\_proj.in x mfmc\_pilot\_proj.in

Models

- NONHIER
  - HF1 (Truth model)
  - HF2
  - HF3
  - HF4
  - LF1
  - LF2
  - LF3
  - LF4

Method

Method Recipe:

Editing model HF1

Interfaces

Selected Interface: ID\_INTERFACE\_1

Variables

| Descriptor | Category          |
|------------|-------------------|
| UUV_1      | uniform_uncertain |
| UUV_2      | uniform_uncertain |

Solution level control variable:

Level Cost

Console x Problems

Dakota Console

Model Form HF1:

```
26
<<<< Projected number of equivalent high fidelity evaluations: 5.0711785714285713e+02
<<<< Variance for mean estimator:
  Initial MC ( 25 HF samples): 5.0485757739179883e+02
  Projected MC ( 26 HF samples): 4.8543997826134506e+02
  Projected MFMC (sample profile): 6.3611691628817979e-01
  Projected MFMC ratio (1 - R^2): 1.3183925197238359e-03
  Equivalent MC ( 587 HF samples): 2.4888572265834174e+01
  Equivalent MFMC ratio: 2.5558594100691355e-02

<<<< Iterator multifidelity sampling completed.
<<<< Environment execution completed.
DAKOTA execution time in seconds:
  Total CPU = 1.49162 [parent = 1.49159, child = 3.7e-05]
  Total wall clock = 0.207925
```

# MFMC STUDY EDITOR

## IMPORT CAPABILITY (2/2)



test\_import/mfmc\_pilot\_proj.in - Dakota GUI

File Edit Run Window Help

Project Explorer

test\_import

mfmc\_pilot\_proj.in

```
1 environment
2   output_precision = 16
3   tabular_data
4     tabular_data_file = 'dakota_heat_eq_ACV_pilot_proj.dat'
5
6 method,
7   model_pointer = 'NONHIER'
8   multifidelity_sampling
9     solution_mode pilot_projection
10    max_function_evaluations = 500
11    pilot_samples = 25
12    convergence_tolerance = .1
13    output_verbose
14
15 model,
16   id_model = 'NONHIER'
17   variables_pointer = 'HF1_VARS' 'HF2_VARS' 'HF3_VARS' 'HF4_VARS' 'LF1_VARS' 'LF2_VARS' 'LF3_VARS' 'LF4_VARS'
18   surrogate_model_ensemble
19     truth_model = 'HF1'
20     unordered_model_fidelities = 'HF2' 'HF3' 'HF4' 'LF1' 'LF2' 'LF3' 'LF4'
21
22 model,
23   id_model = 'HF1'
24   variables_pointer = 'HF1_VARS'
25   simulation
26     solution_level_control = 'N_X'
27     solution_level_cost = 4200.
28
29 model,
30   id_model = 'HF2'
31   variables_pointer = 'HF2_VARS'
32   simulation
33     solution_level_control = 'N_X'
34     solution_level_cost = 2100.
35
36 model
```

Console x Problems

Dakota Console

Model Form HF1:

26

<<<< Projected number of equivalent high fidelity evaluations: 5.0711785714285713e+02

<<<< Variance for mean estimator:

Initial MC ( 25 HF samples): 5.0485757739179883e+02

Projected MC ( 26 HF samples): 4.8543997826134506e+02

Projected MFMC (sample profile): 6.3611691628817979e-01

Projected MFMC ratio (1 - R^2): 1.3183925197236359e-03

Equivalent MC ( 507 HF samples): 2.4888572265834174e+01

Equivalent MFMC ratio: 2.5558594100691355e-02

<<<< Iterator multifidelity sampling completed.

<<<< Environment execution completed.

DAKOTA execution time in seconds:

Total CPU = 1.49162 [parent = 1.49159, child = 3.7e-05]

Total wall clock = 0.207925



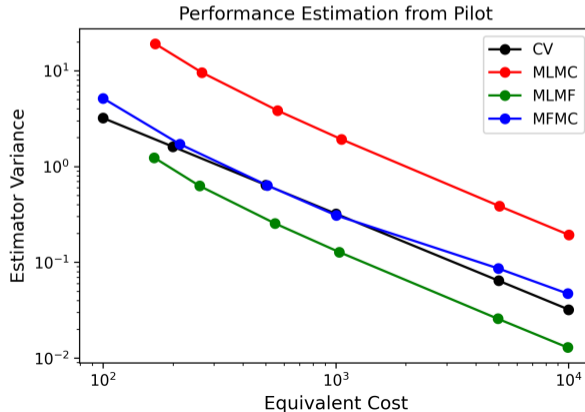
**Coming Soon...**

# ENSEMBLE MODEL SPECIFICATION

## FROM UNORDERED MODEL SPECIFICATION TO ESTIMATORS PERFORMANCE COMPARISON



- 1 Unordered models specification, e.g. 8 models for the heat equation
- 2 Dakota unrolls the models and obtains the pilot samples, e.g. 25 samples per model
- 3 Several estimators are evaluated (from pilot, no additional cost!) and compared for different convergence or cost targets
- 4 Recommendation on the best estimators are issued

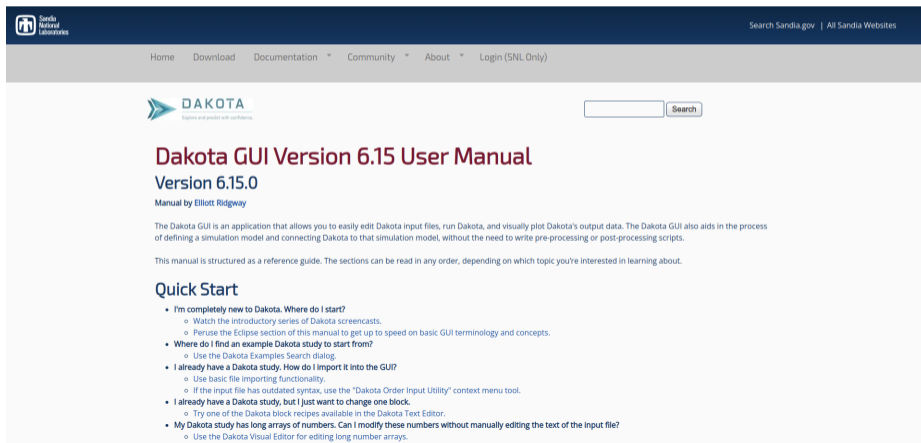




## **Closing remarks**

### Summary

- Dakota GUI allows you to easily edit Dakota input files, run Dakota, and visually plot Dakota's output data
- The Dakota GUI also aids in the process of defining a simulation model and connecting Dakota to that simulation model, without the need to write pre-processing or post-processing scripts
- The novel *MLMF Study Editor* supports a variety of features aiding ensemble/hierarchy definition and processing



The screenshot shows the top of a web browser displaying the Dakota GUI User Manual. The header is dark blue with the Sandia National Laboratories logo on the left and a search bar on the right. Below the header is a navigation bar with links: Home, Download, Documentation, Community, About, and Login (SNL Only). The main content area has a white background. At the top, there is a Dakota logo with the tagline 'Explore and predict with confidence.' and a search bar. Below this is the title 'Dakota GUI Version 6.15 User Manual' in a large, dark red font, followed by 'Version 6.15.0' in a smaller, dark blue font. The author 'Manual by Elliott Ridgway' is listed below. A paragraph of text describes the Dakota GUI's capabilities. Another paragraph states that the manual is structured as a reference guide. Below this is a 'Quick Start' section with a bulleted list of topics for users, ranging from being new to Dakota to modifying long arrays of numbers.

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 **DAKOTA**  
Explore and predict with confidence.

## Dakota GUI Version 6.15 User Manual

### Version 6.15.0

Manual by Elliott Ridgway

The Dakota GUI is an application that allows you to easily edit Dakota input files, run Dakota, and visually plot Dakota's output data. The Dakota GUI also aids in the process of defining a simulation model and connecting Dakota to that simulation model, without the need to write pre-processing or post-processing scripts.

This manual is structured as a reference guide. The sections can be read in any order, depending on which topic you're interested in learning about.

### Quick Start

- I'm completely new to Dakota. Where do I start?
  - Watch the introductory series of Dakota screencasts.
  - Peruse the Eclipse section of this manual to get up to speed on basic GUI terminology and concepts.
- Where do I find an example Dakota study to start from?
  - Use the Dakota Examples Search dialog.
- I already have a Dakota study. How do I import it into the GUI?
  - Use basic file importing functionality.
  - If the input file has outdated syntax, use the "Dakota Order Input Utility" context menu tool.
- I already have a Dakota study, but I just want to change one block.
  - Try one of the Dakota block recipes available in the Dakota Text Editor.
- My Dakota study has long arrays of numbers. Can I modify these numbers without manually editing the text of the input file?
  - Use the Dakota Visual Editor for editing long number arrays.



# THANKS!

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