

# Introductory Course: Using LS-OPT<sup>®</sup> on the TRACC Cluster

## 1.4a -Introduction to LS-OPT GUI

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# What is LS-OPT?

## LS-OPT UI

- Preprocessor
- Postprocessor

## LS-DYNA Manager

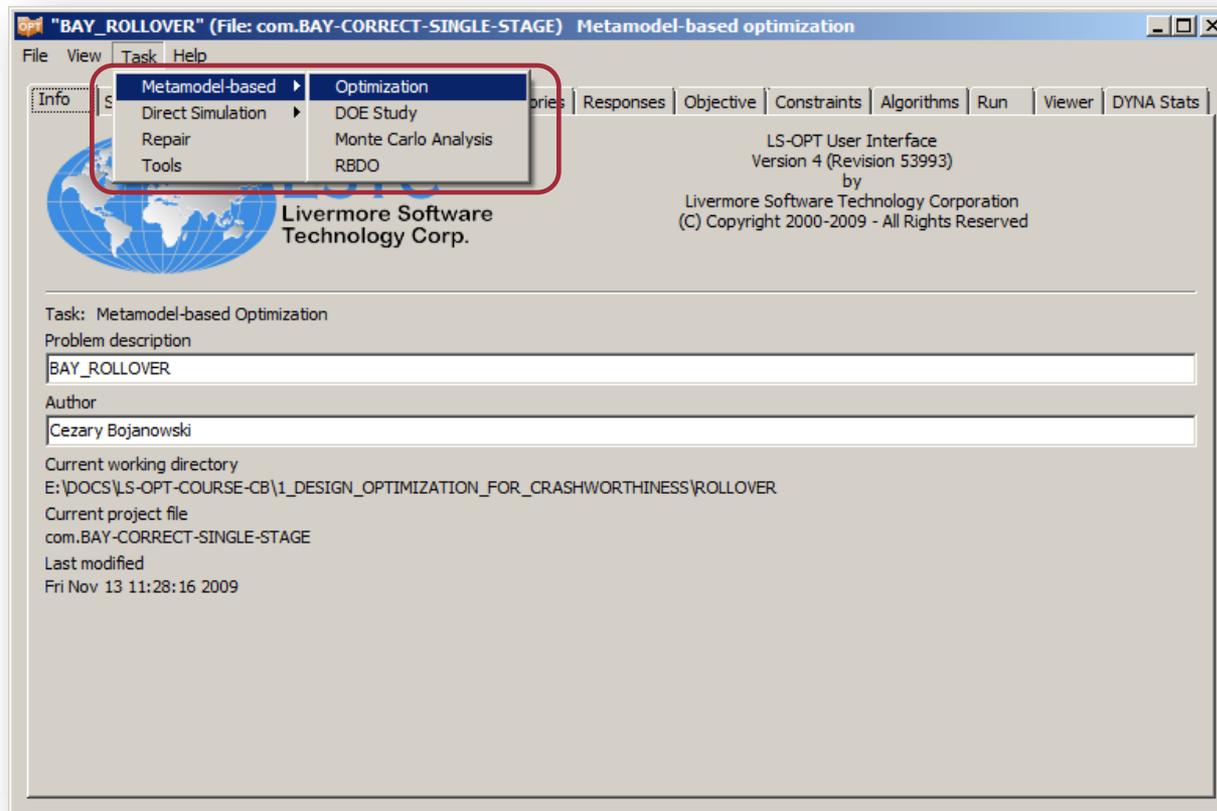
- Variable Input
- Job Scheduling
- Job Monitoring
- Result Retrieval

## Technologies for Design Improvement

- Experimental Design
- Approximation
- Variable Screening
- Probabilistic Analysis
- Optimization

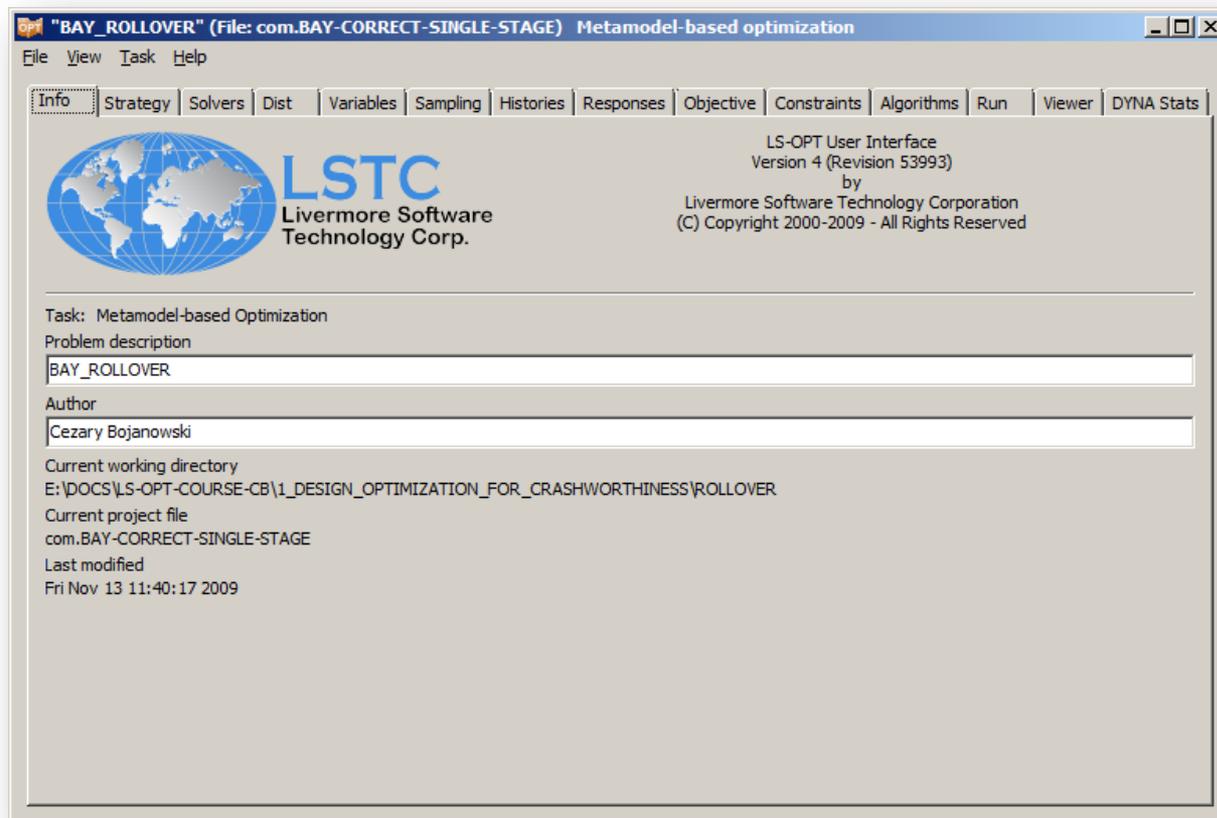
# Task Selection

- Choose type of analysis:
  - Metamodel based
  - Direct Simulations
  - Repair tasks



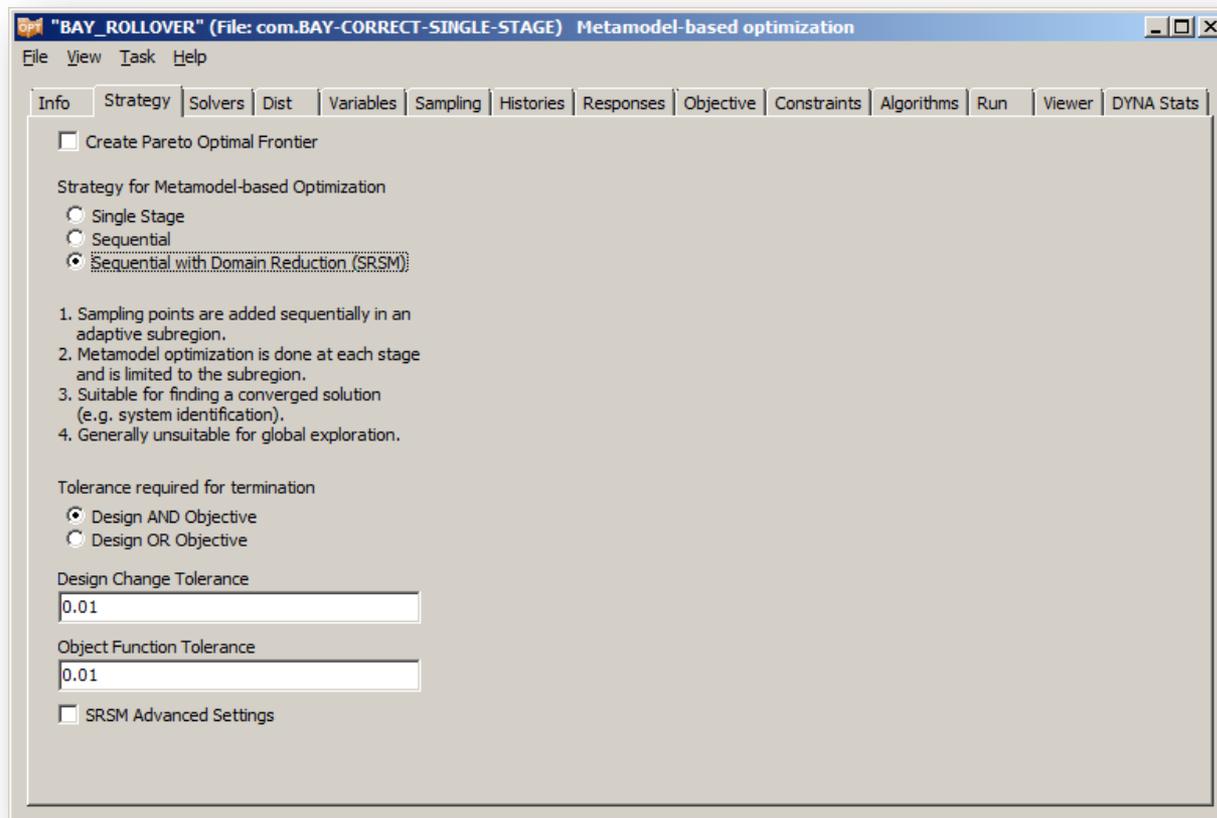
# Info Tab

- Problem description
- Author information



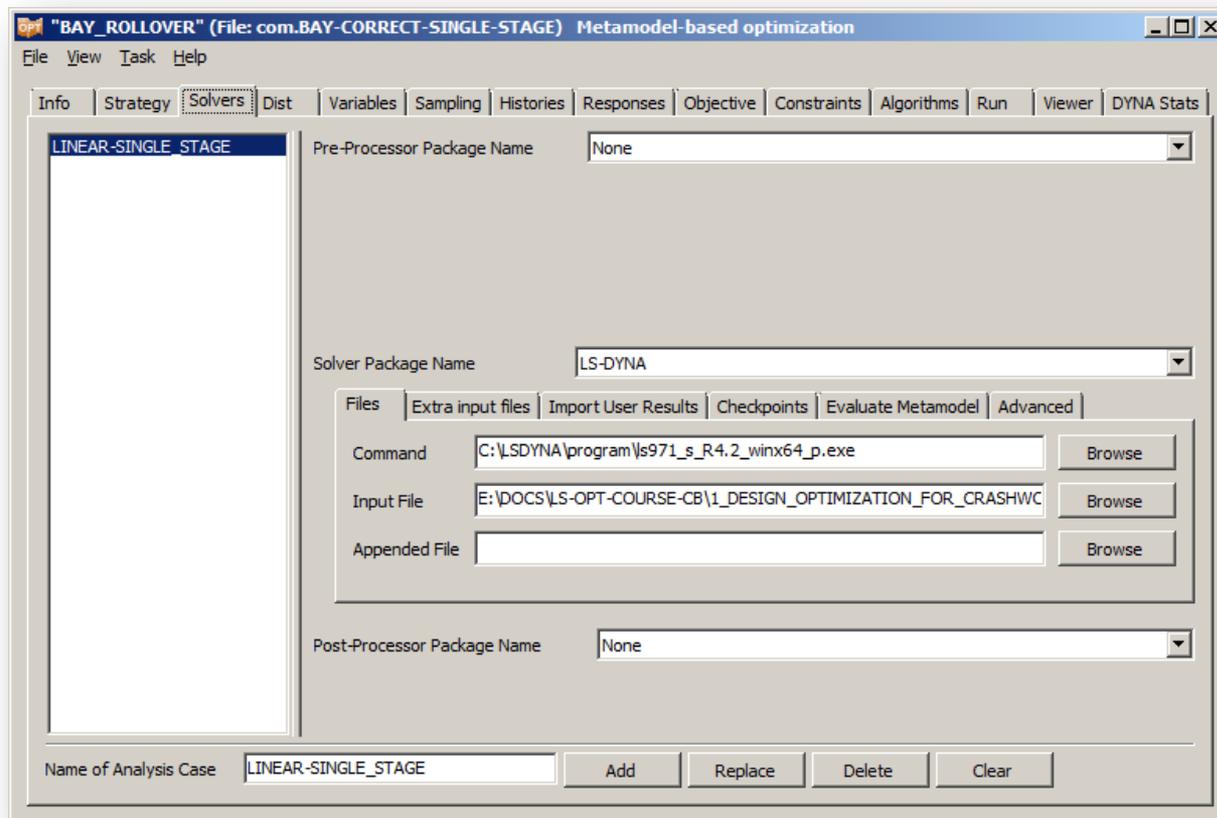
# Strategy Tab

- Strategy for the analysis
- Tolerance for termination



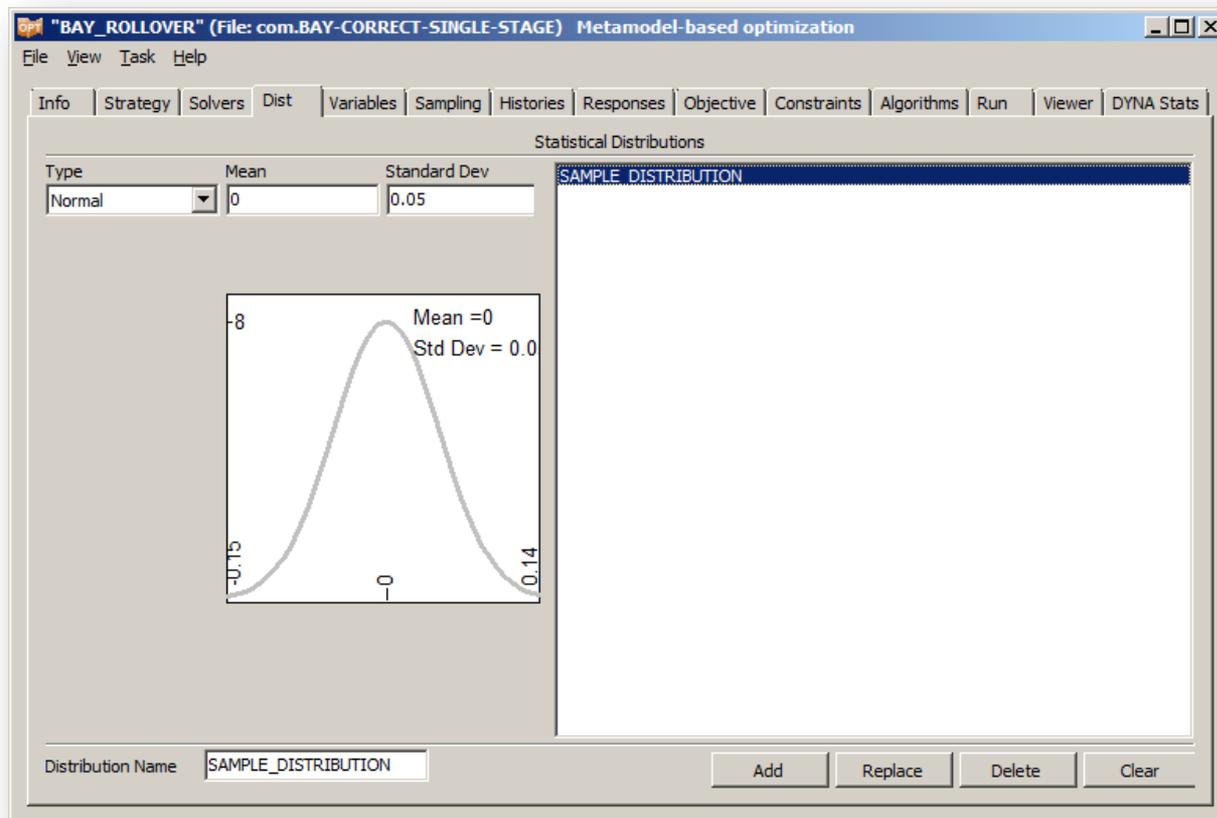
# Solver Tab

- Define path to the input file
- Define path to the solver



# Distributions Tab

- Define distributions of variables for probabilistic studies



# Variables Tab

- Define: Variables, Constants, Dependents, Noise variables, Discrete variables
- To ensure communication between LS-DYNA and LS-OPT definition of variables and constants will require modification of your key word file.

Type	Name	Starting	Init. Range	Minimum	Maximum
Discrete Var	tbotwal	1.27	Values	1.111 1.27 1.429 1.5875 1.	
Discrete Var	trbow	1.27	Values	1.111 1.27 1.429 1.5875 1.	
Discrete Var	tfloc	1.984	Values	1.429 1.588 1.786 1.984 2.	
Discrete Var	troofu	3.174	Values	1.786 1.984 2.381 2.778 3.	
Discrete Var	tfjol	4.762	Values	1.786 1.984 2.381 2.778 3.	
Discrete Var	troofi	1.27	Values	1.111 1.27 1.429 1.5875 1.	
Discrete Var	tupwal	1.27	Values	1.111 1.27 1.429 1.5875 1.	
Discrete Var	twaist	1.27	Values	1.111 1.27 1.429 1.5875 1.	
Constant	a	2400			
Constant	b	788			
Constant	e	1027			

# Variables Tab

In the LS-DYNA input file the variables should be defined in the following way:

```
*PARAMETER  
r<your-variable-1>, <initial-value-1>  
r<your-variable-n>, <initial-value-n>
```

For example:

```
*PARAMETER  
rvarone, 1.0  
rvartwo, 4.5
```

In the place where the variable should be used type **&varone** and so one.

For example:

```
*SECTION_SHELL  
2,2,0.,0.,0.,0.,0.,0.  
&varone,&varone,&varone,&varone
```

# Variables Tab

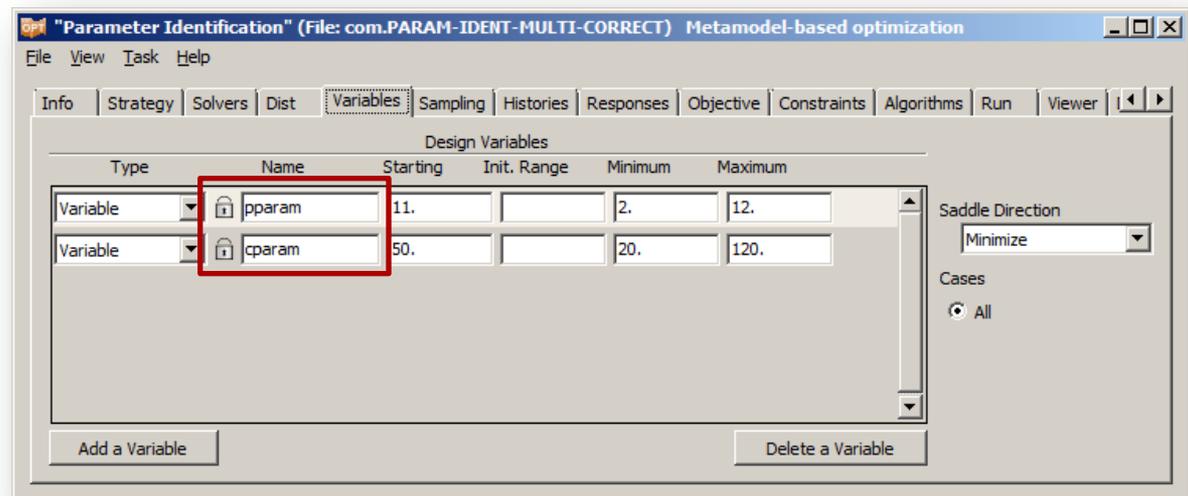
Another method to feed the data from LS-OPT® to an input file is by using:  
<< >> symbols

For example:

```
*MAT_ISOTROPIC_ELASTIC_PLASTIC
$#      MID      RO      G      SIGY      ETAN      BULK
      1 9.999E-06      7. <<sigy>>      0.      16.
```

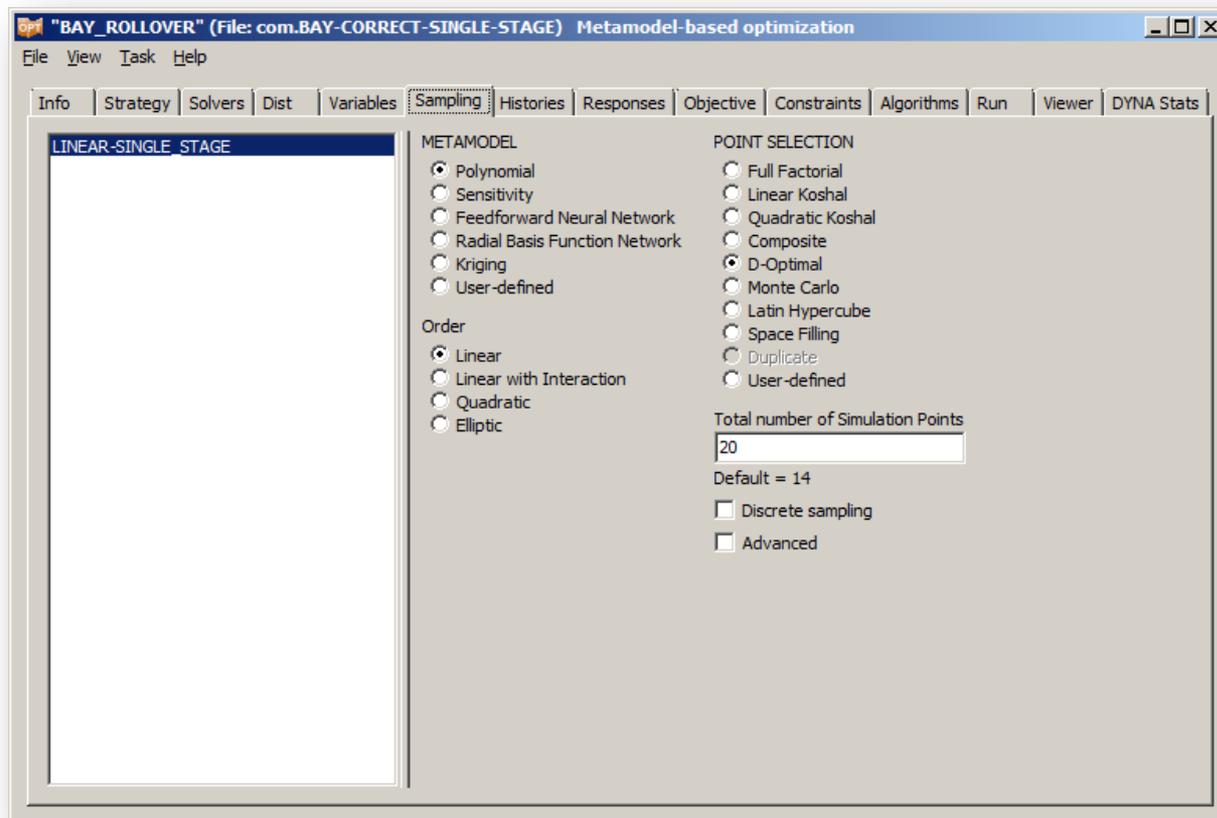
This approach is more general and can be used also when other solvers are involved.

For example in Perl scripts:  
`$variable=<<value>>;`



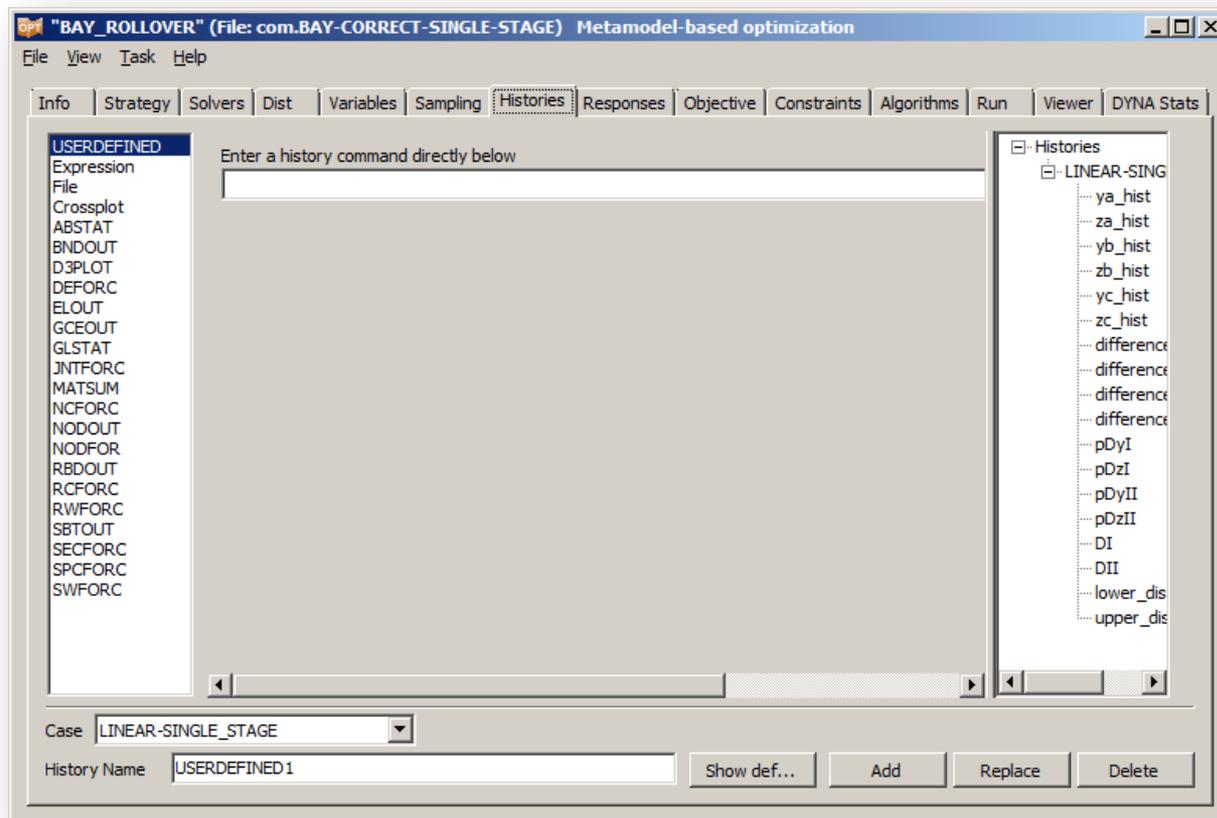
# Sampling Tab

- Metamodel type selection
- Sampling method



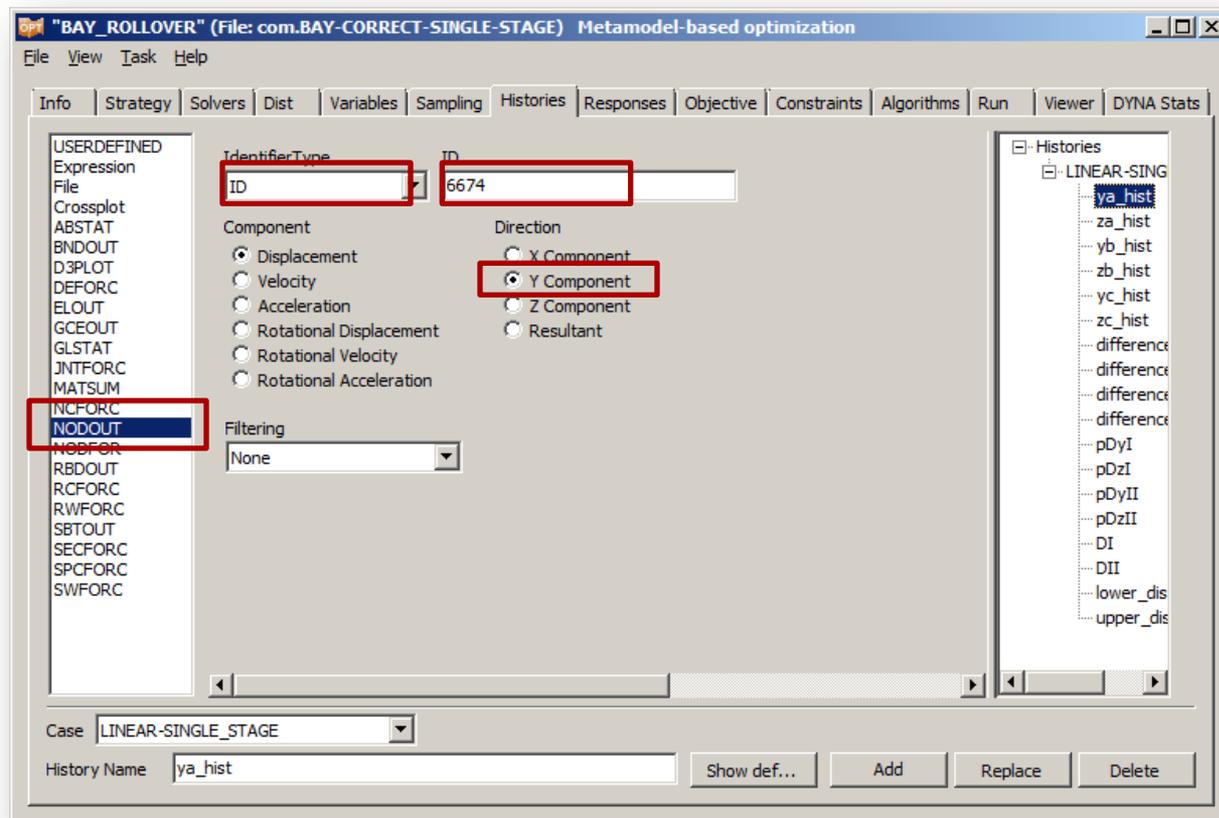
# Histories Tab

- Defining time history curves from LS-DYNA output



# Histories Tab

- For example y-displacement of node ID 6674



# Histories Tab

- Binary output has to be requested in \*DATABASE\_OPTION card BINARY = 3

The screenshot shows the 'KEYWORD INPUT' dialog box with the following settings:

Option	DT	BINARY	LCUR	IOOPT	DTHF	BINHF
<input checked="" type="checkbox"/> MPGS	0	0	0	1		
<input checked="" type="checkbox"/> NCFORC	0	0	0	1		
<input checked="" type="checkbox"/> NODFOR	0	0	0	1		
<input checked="" type="checkbox"/> NODOUT	0.1	3	0	1	0	0
<input checked="" type="checkbox"/> RBDOUT	0.5	0	0	1		
<input checked="" type="checkbox"/> RCFORC	0.1	0	0	1		
<input checked="" type="checkbox"/> RWFORC	0.1	0	0	1		
<input checked="" type="checkbox"/> SBTOUT						

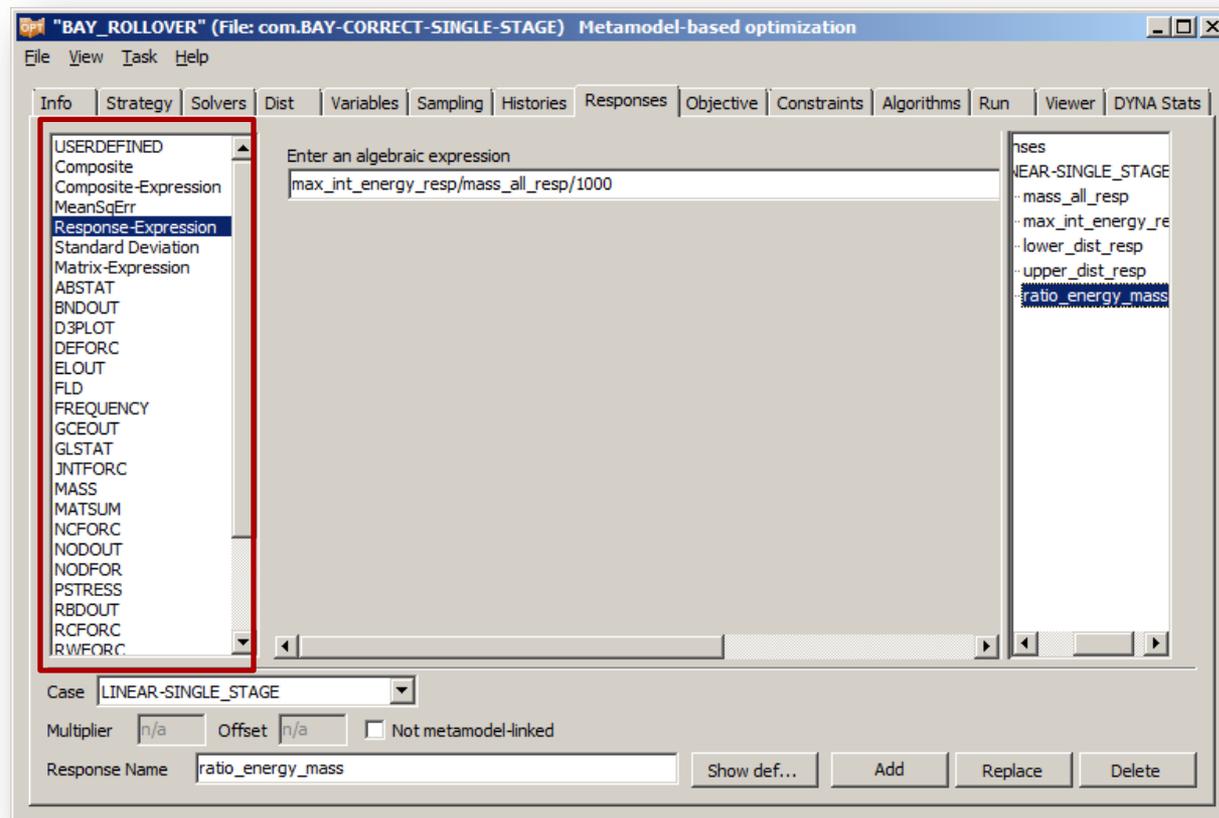
Buttons: Accept, Done, Setting

(Subsys: 4 )

\*DATABASE\_OPTION ( 23 )

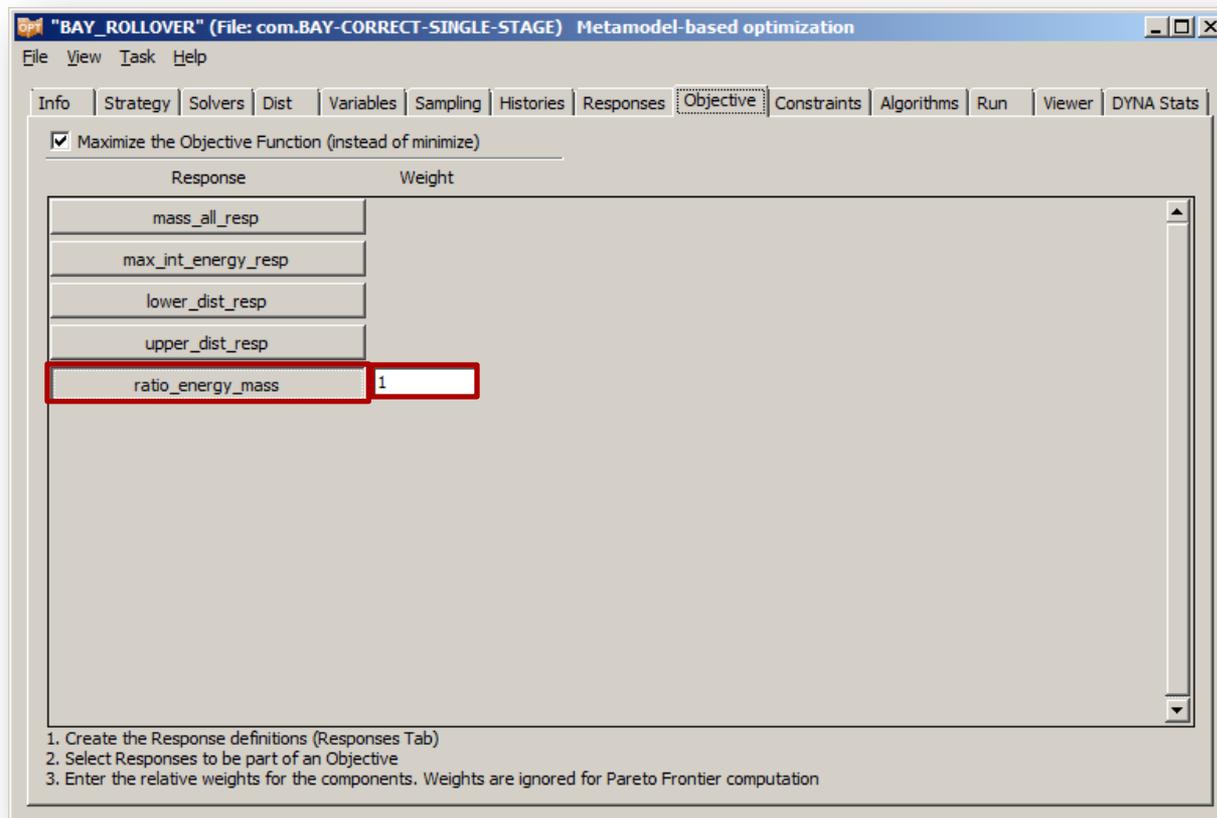
# Responses Tab

- Calculate values for defined responses
- The response can be a result of mathematical expression or some quantity directly extracted from LS-DYNA output files



# Objective Tab

- Define objectives in terms of responses
- Multiple objectives are admissible



# Constraints Tab

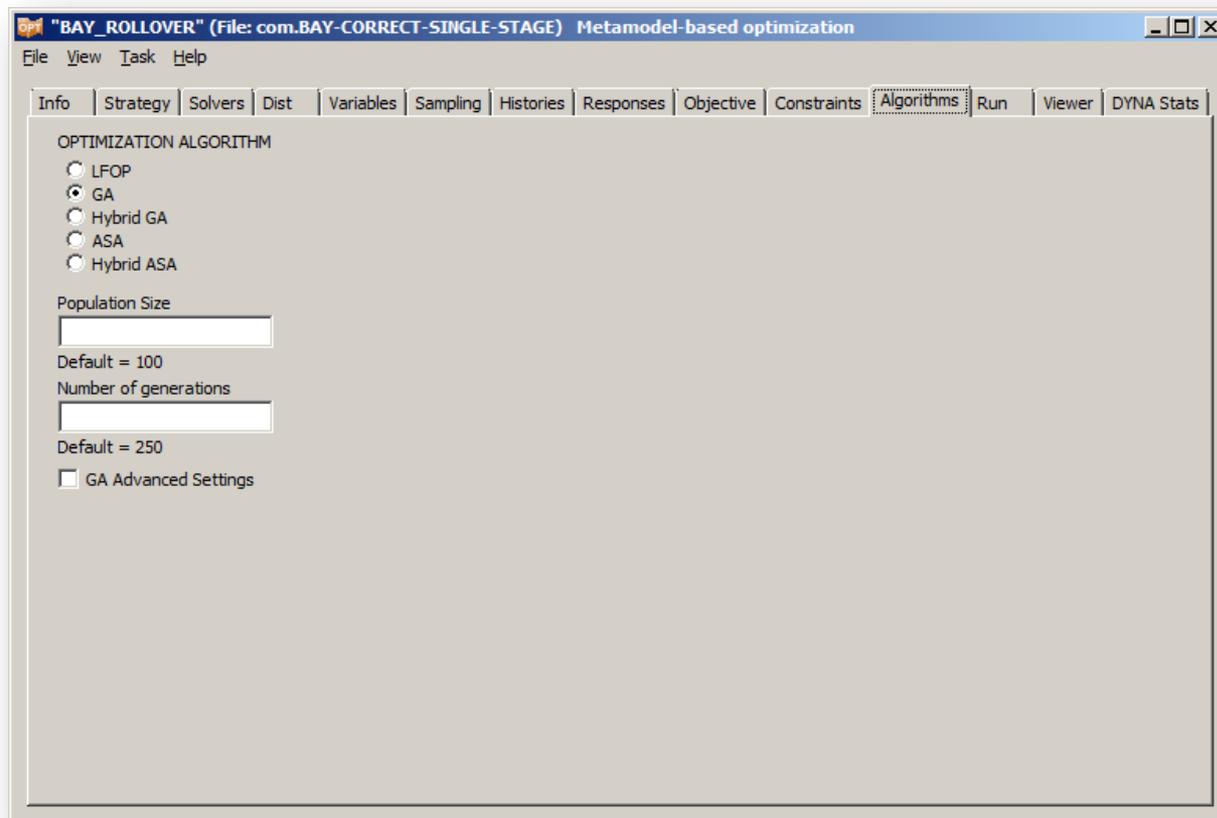
- Impose constraints on the Responses

Response	Lower Bound	Strict	Upper Bound	Strict	Move
mass_all_resp	0.1149	<input type="checkbox"/>	0.14	<input type="checkbox"/>	<input type="checkbox"/>
max_int_energy_resp	2438.7	<input type="checkbox"/>	+inf	<input type="checkbox"/>	<input type="checkbox"/>
lower_dist_resp	2692.1	<input type="checkbox"/>	+inf	<input type="checkbox"/>	<input type="checkbox"/>
upper_dist_resp					
ratio_energy_mass					

1. Create the Response definitions (Responses Tab).  
2. Select Responses to use as Constraints.  
3. Enter the Constraint Bounds.

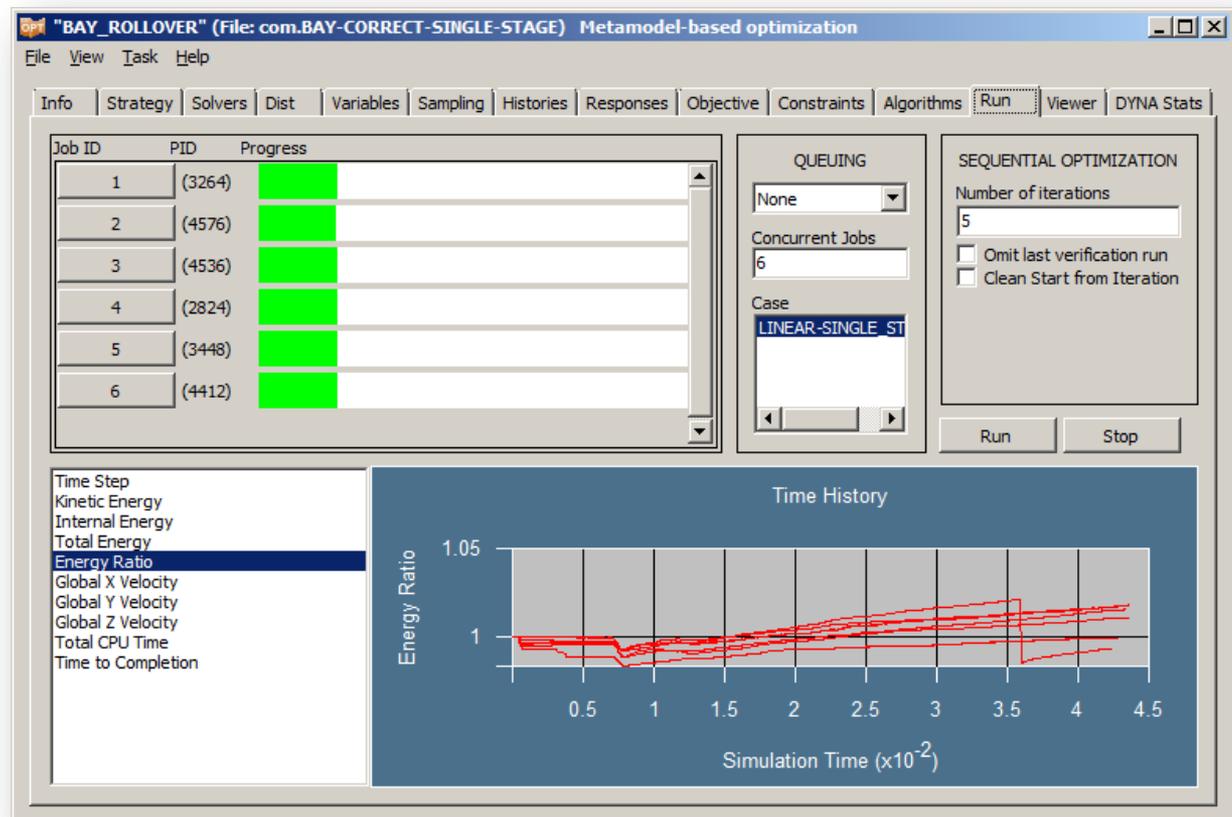
# Algorithms Tab

- Choose the optimization algorithm



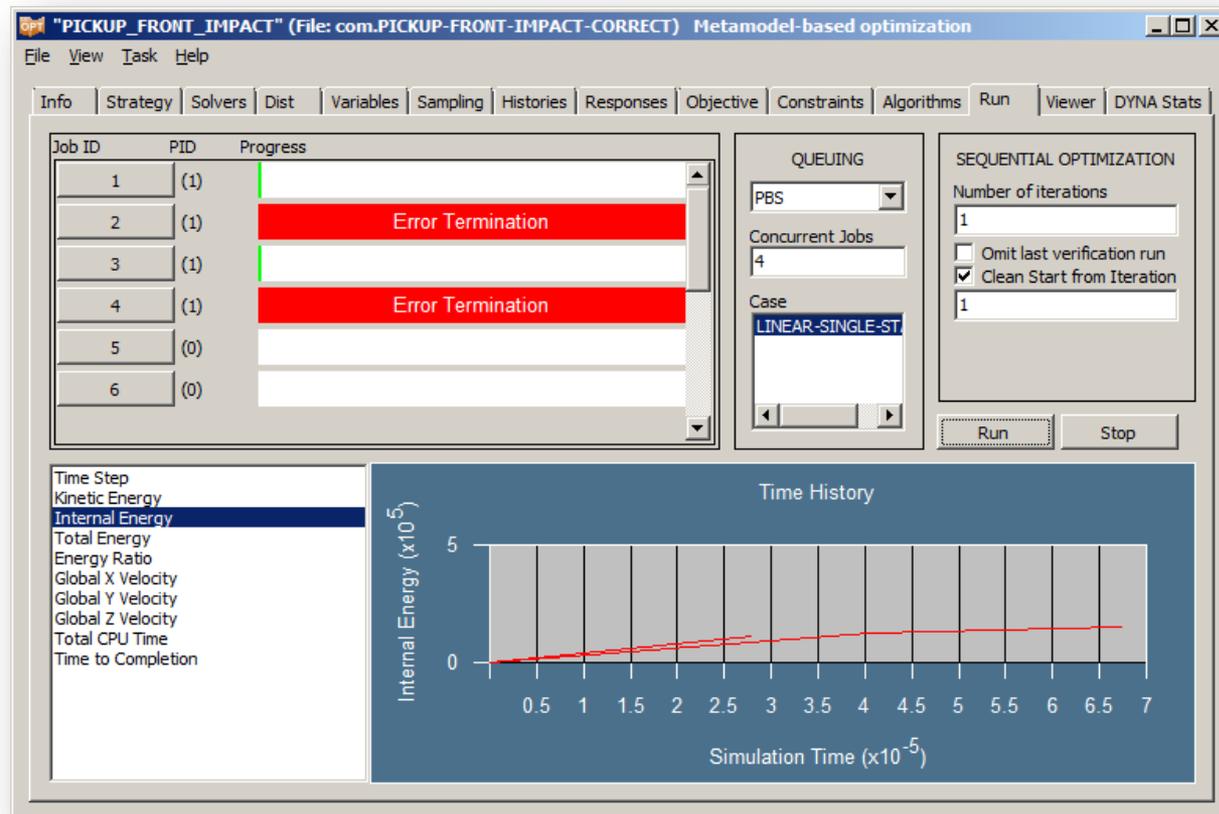
# Run Tab - Tracking Jobs Progress

- #of iterations
- # of concurrent jobs
- scheduler type
- tracking progress



# Run Tab

- The job scheduler will mark an error-terminated job.
- Results of abnormally terminated jobs are ignored.
- If there are not enough results to construct the approximate design surfaces, LS-OPT will terminate with an appropriate message.





# Command File

- Commands

**solvers** *number\_of\_solvers*  
**constants** *number\_of\_constants*  
**variables** *number\_of\_variables*  
**dependents** *number\_of\_dependent\_variables*  
**histories** *number\_of\_response\_histories*  
**responses** *number\_of\_responses*  
**composites** *number\_of\_composites*  
**objectives** *number\_of\_objectives*  
**constraints** *number\_of\_constraints*  
**distributions** *number\_of\_distributions*