Argonne NATIONAL LABORATORY

Introductory Course: Using LS-OPT® on the TRACC Cluster

1.4b – Introduction to LS-OPT GUI; Simple Optimization Problem

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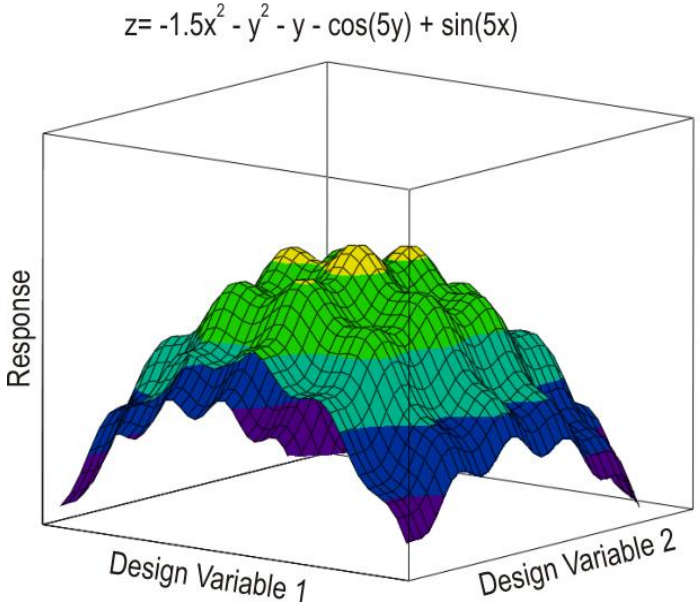
U.S. DEPARTMENT OF ENERGY

Problem Description

- Objective: find global maximum of a function:

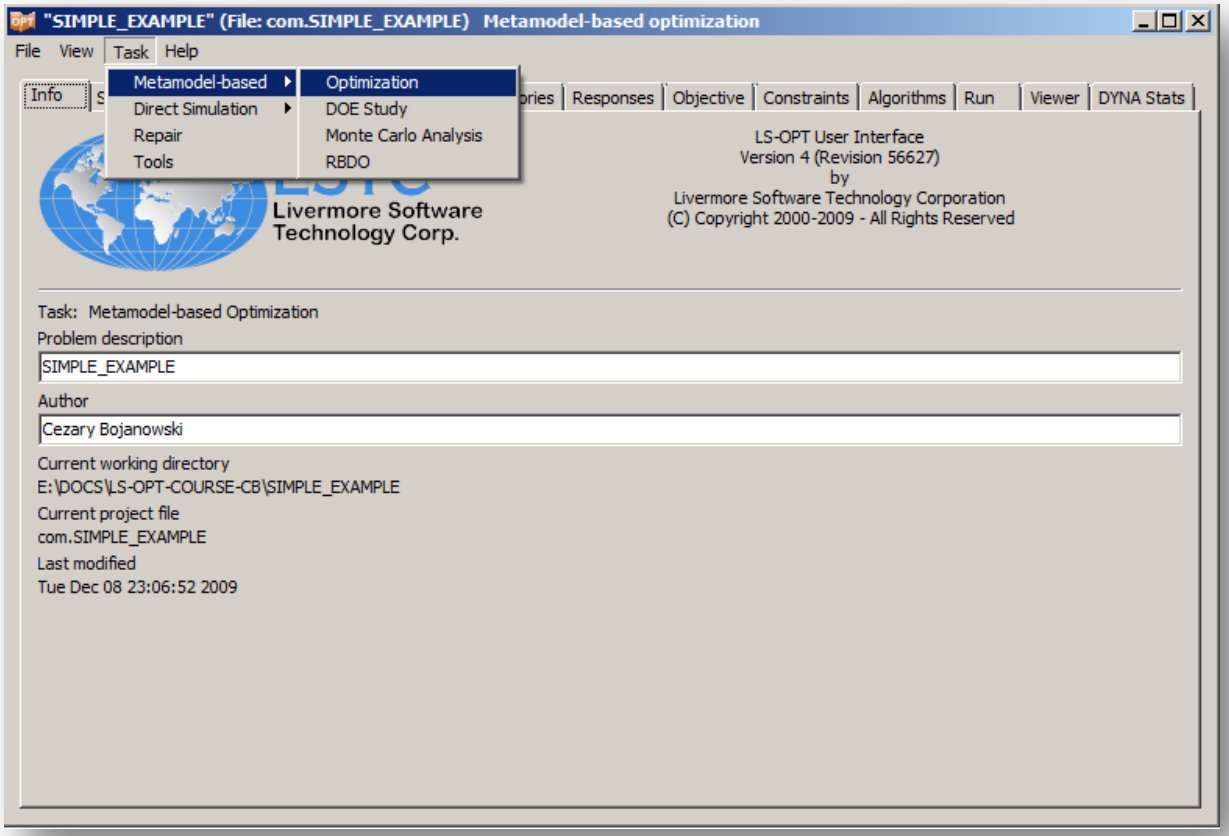
$$z=-1.5x^2-y^2-y-\cos(5y)+\sin(5x)$$

- Two design variables: x and y in the range (`-3,3`)
- Use LS-OPT as a solver and linear metamodel
- Check the adequacy of the metamodel



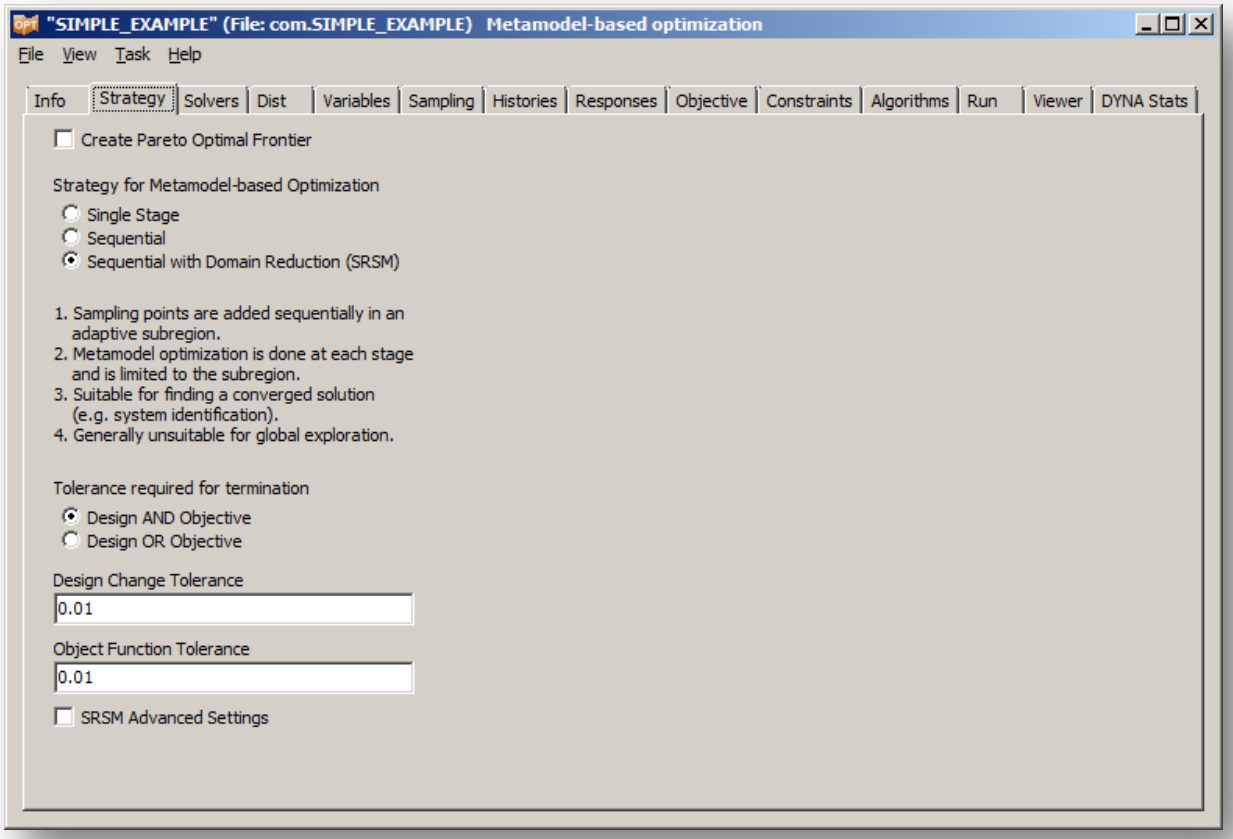
Task Selection

- Go to Task Tab and
- Select Metamodel – based Optimization



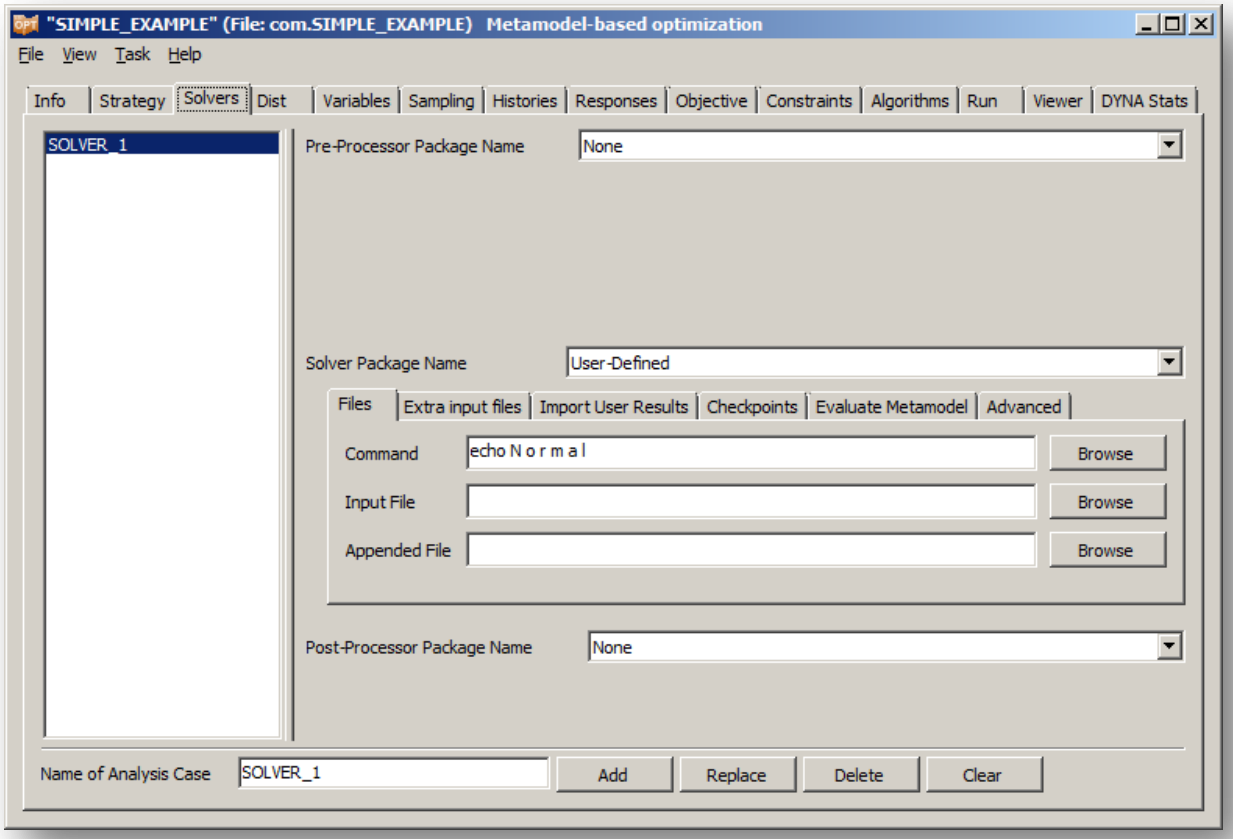
Strategy Tab

- Go to the Strategy panel
- Choose Sequential with Domain Reduction (SRSM)
- Leave the defaults for the convergence tolerance



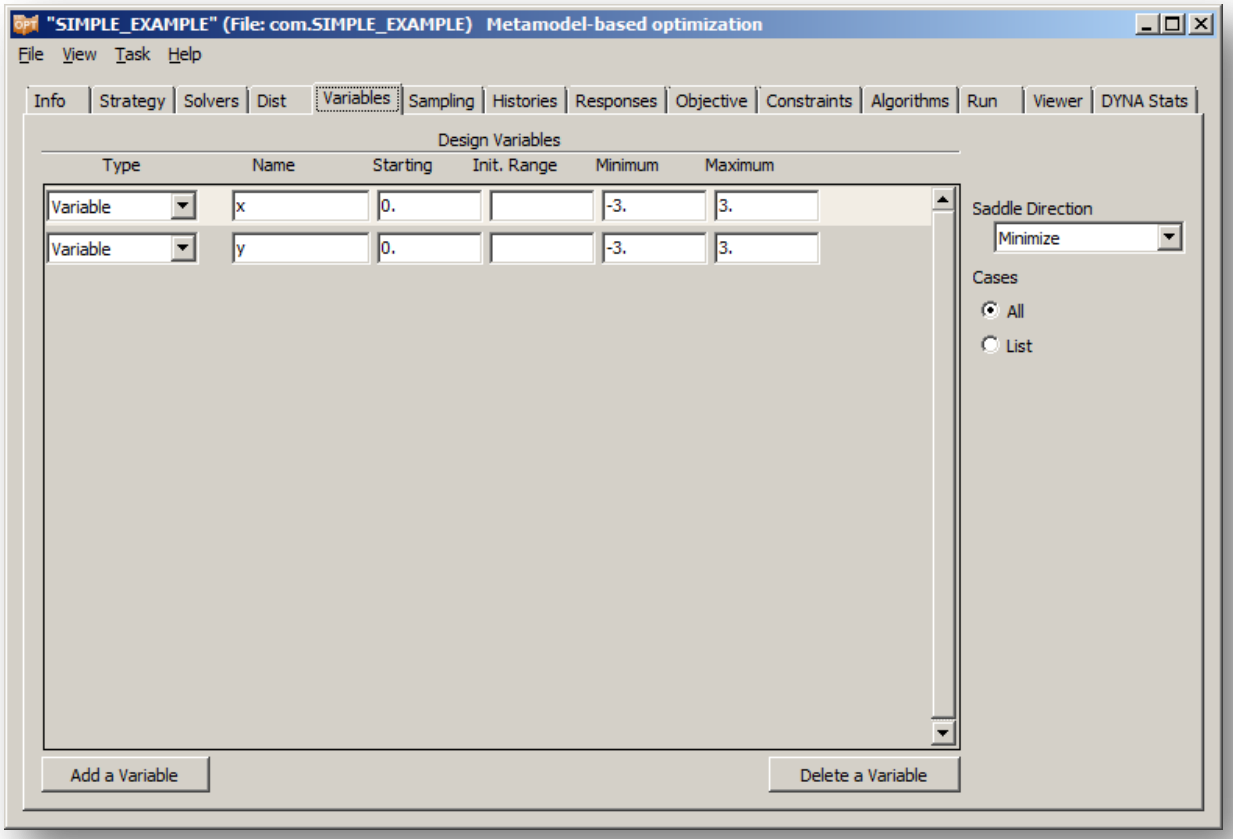
Solvers Tab

- In the Solvers panel type `echo N o r m a l` in Command line
- Type `SOLVER_1` in the Name of Analysis Case field and press Add



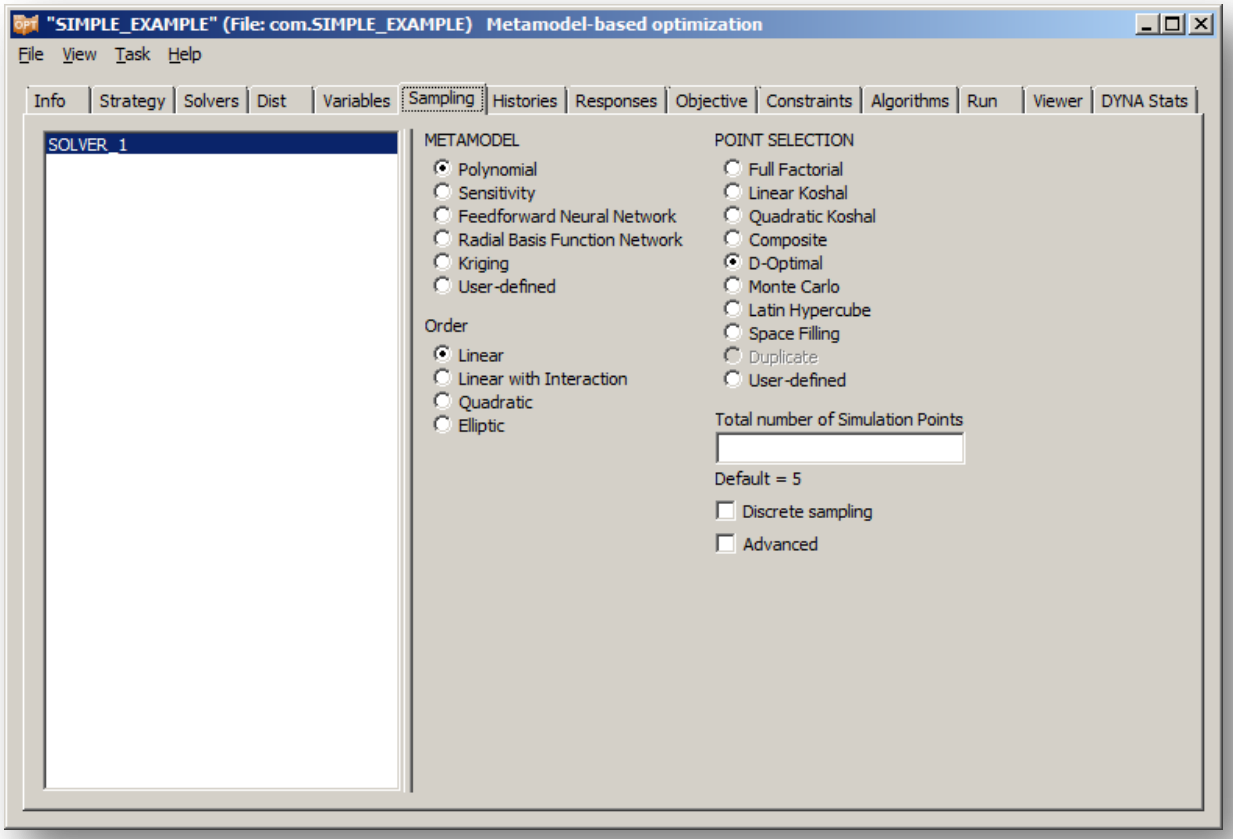
Variables Tab

- In the Variables panel Add two variables:
  - x with starting value of 0 with lower bound -3 and upper bound 3
  - y with starting value of 0 with lower bound -3 and upper bound 3



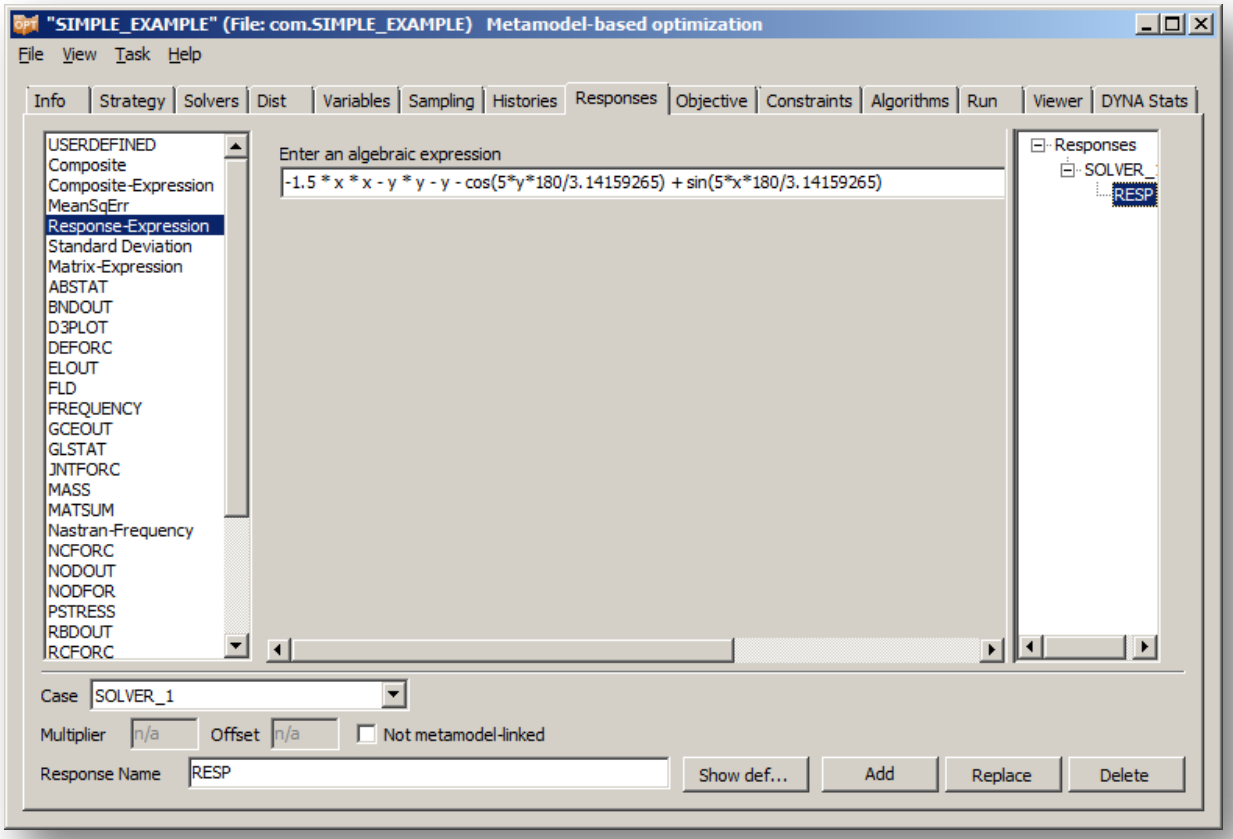
Sampling Tab

- In the Sampling panel select Polynomial Metamodel with Linear Order
- For Point Selection choose D-Optimal criterion
- Leave default number of Simulation Points



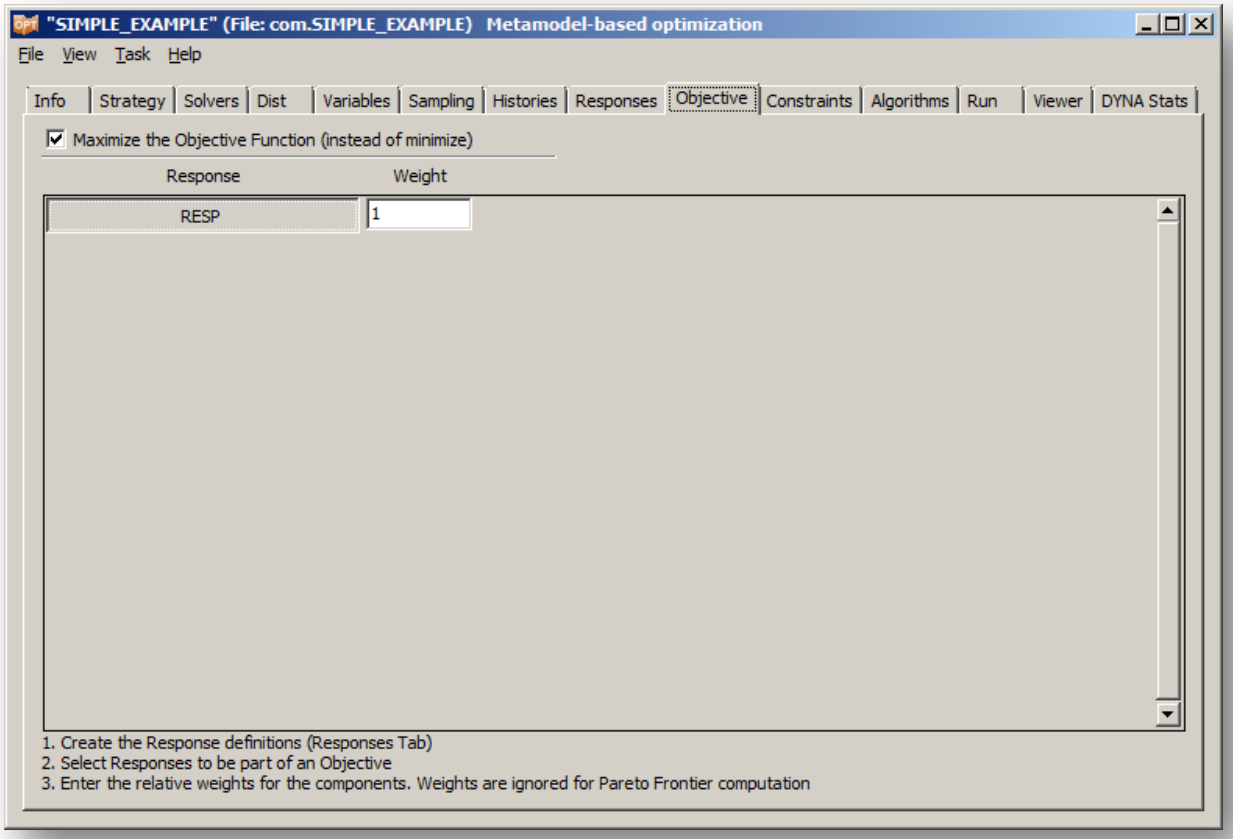
Responses Tab

- In the Responses Tab select Response-Expression type
- Enter an algebraic expression `-1.5*x*x-y*y-y-cos(5*y*180/3.14159265) +sin(5*x*180/3.14159265)`
- Type `RESP` for Response Name and press Add



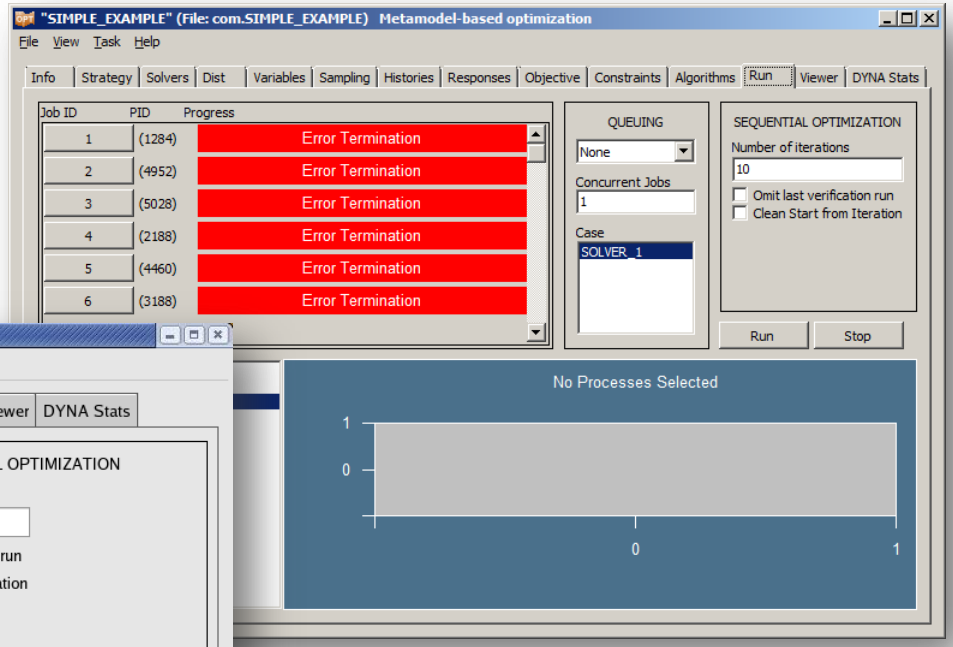
Objective Tab

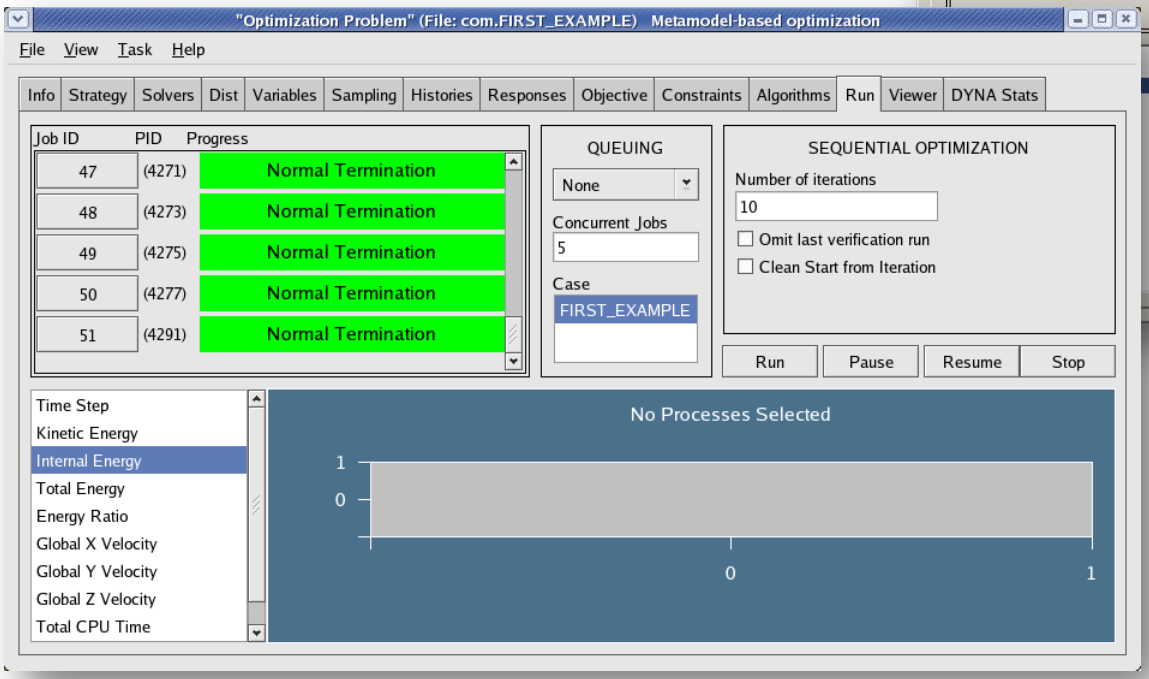
- In the Objective Tab select `RESP` with weight `1.0`
- Select Maximize the Objective Function (Instead of Minimize)



Run Tab

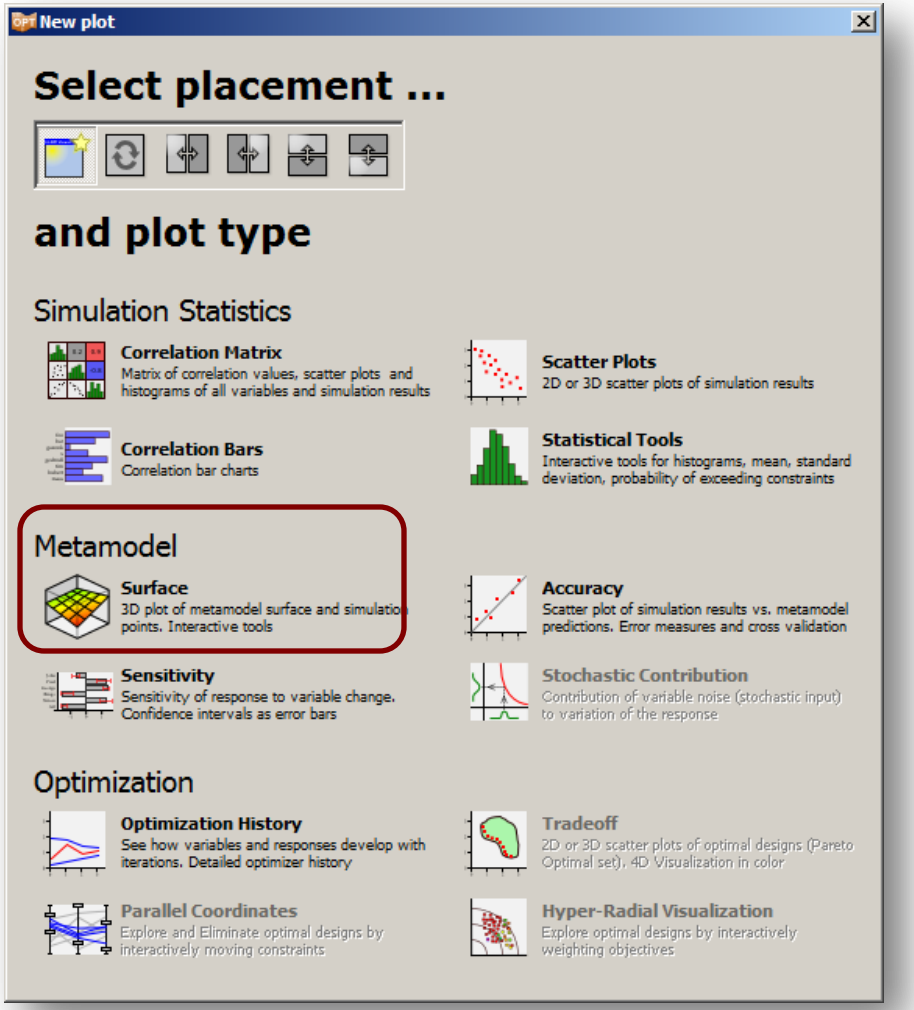
- Leave None for QUEUING software
- For Concurrent Jobs enter 5
- For Number of Iteration enter 10
- Hit Run to start simulations
- On Linux machine only Normal Termination will be displayed





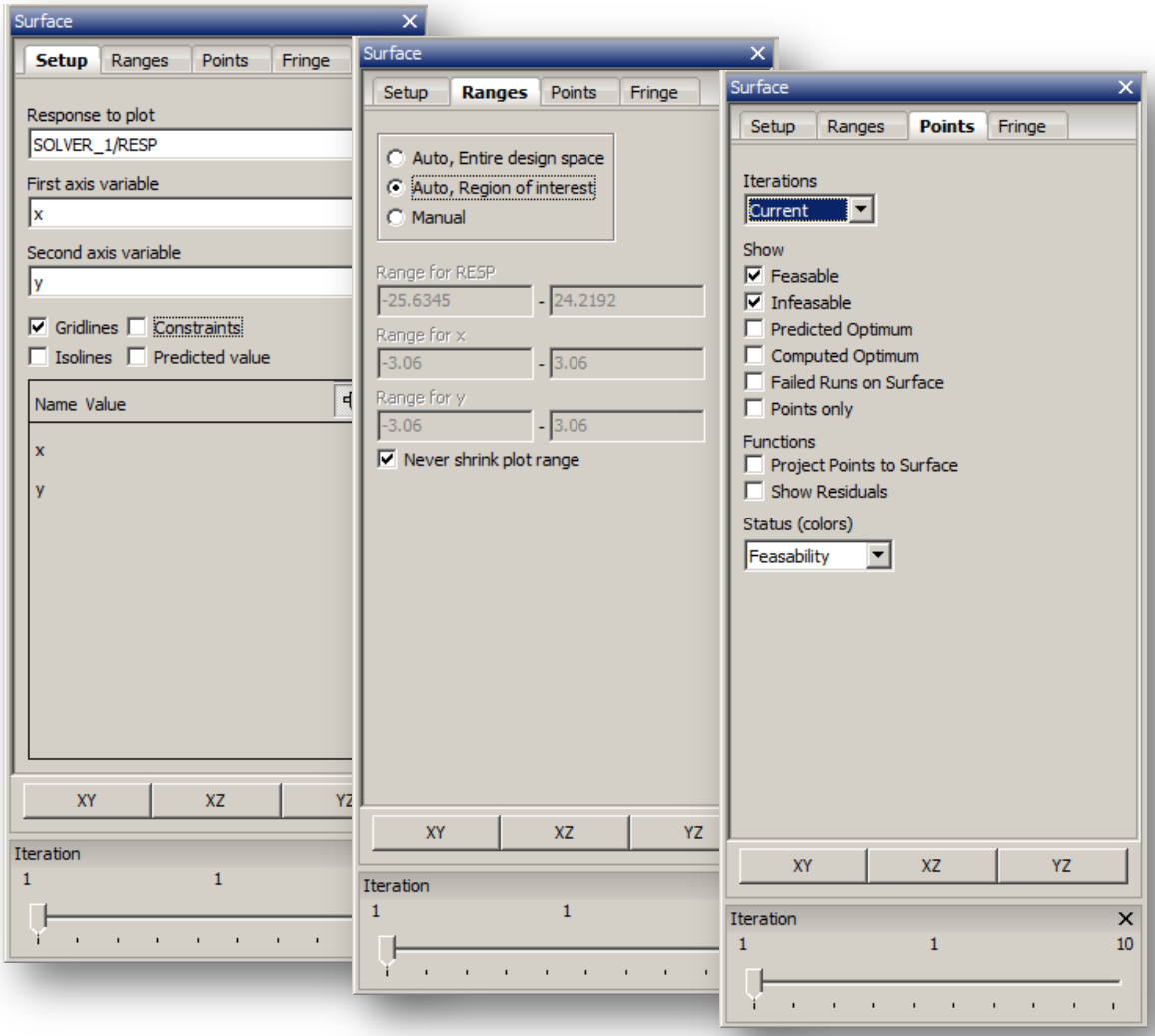
Viewer

- Go to Viewer panel and the viewer options should pop up automatically
- From Metamodel menu select Surface
- New window should appear

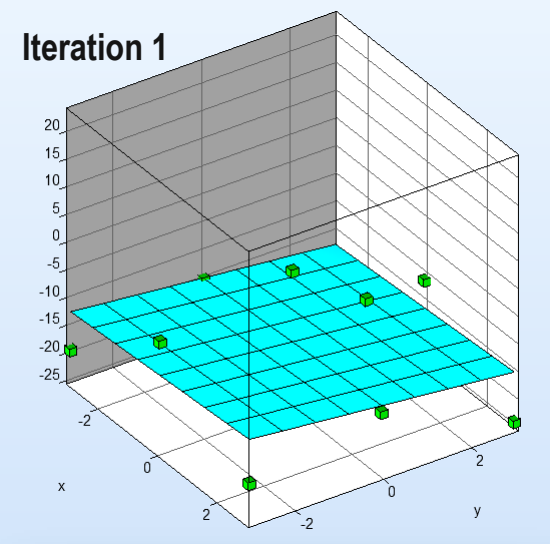


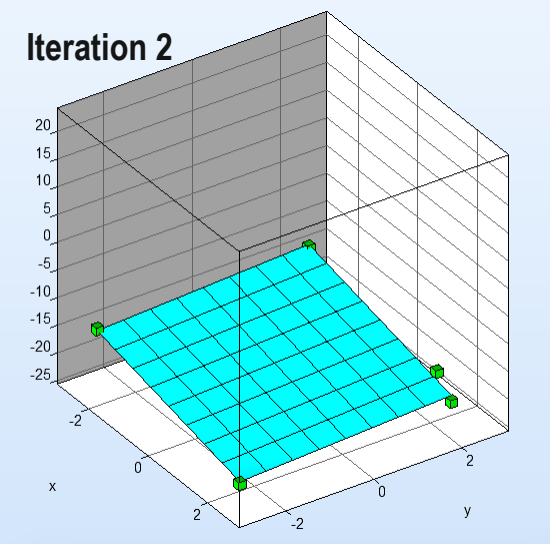
Response Surface

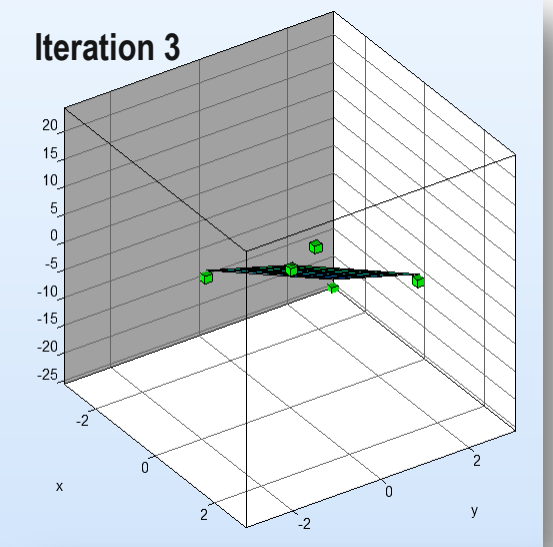
- Set all the options as shown below:
- In Ranges: Auto, Region of interest
- Check Never shrink the plot range
- In Points: Current Iterations
- Use slider at the bottom to see the surface in specific iterations

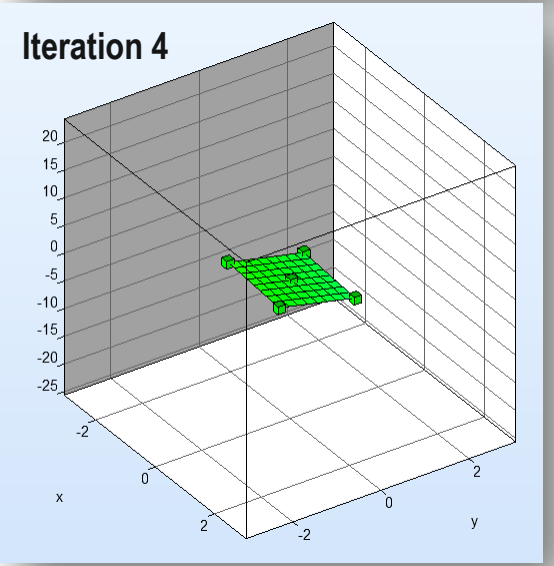


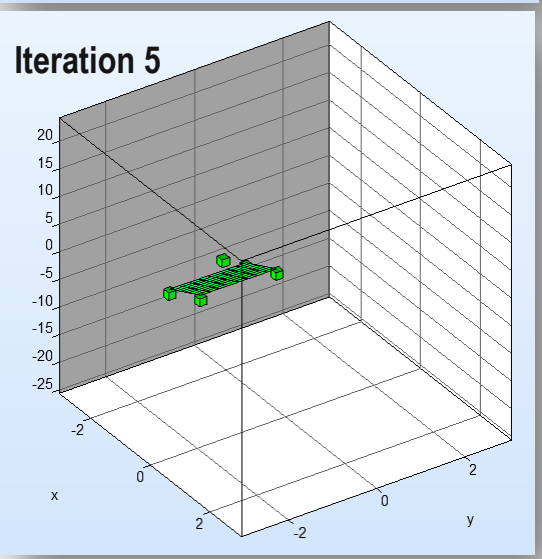
Response Surface

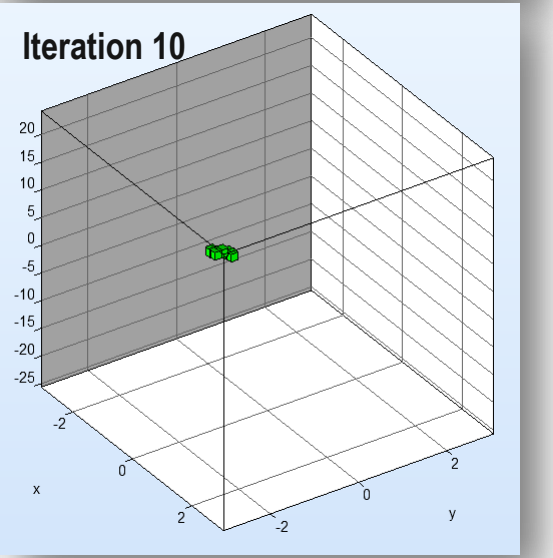






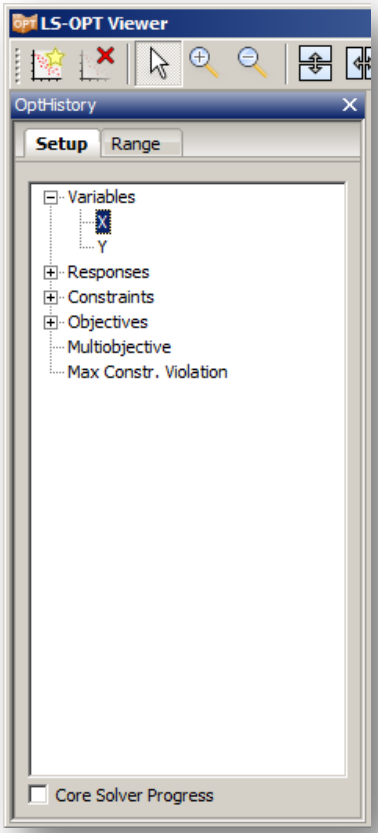


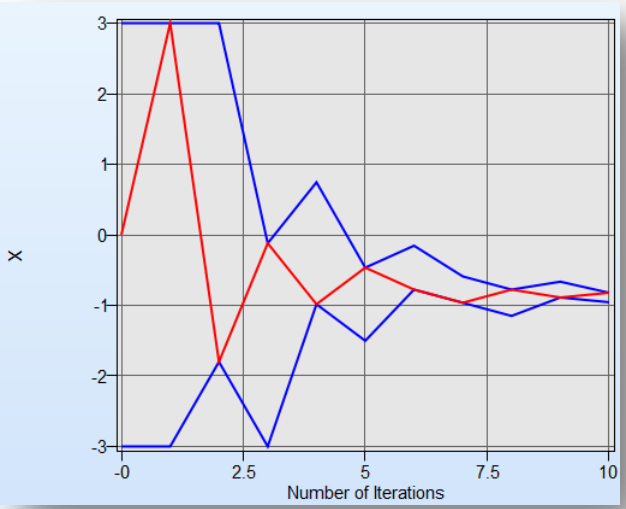


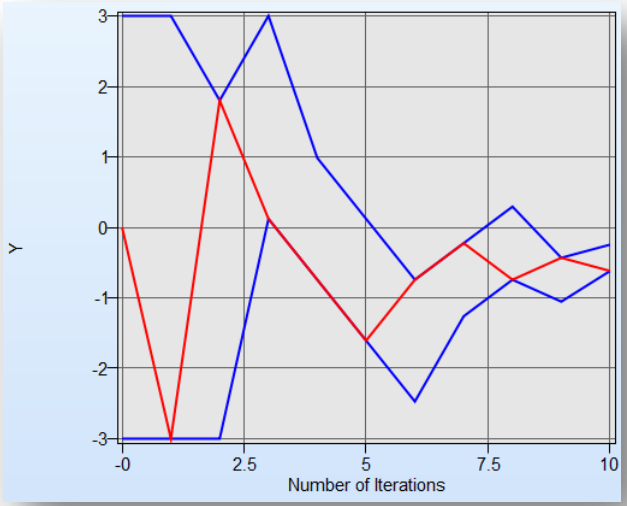


Viewer - Optimization History

- Go to Viewer Panel
- Select Optimization History from the pop-up window
- From the variables select X, then Y

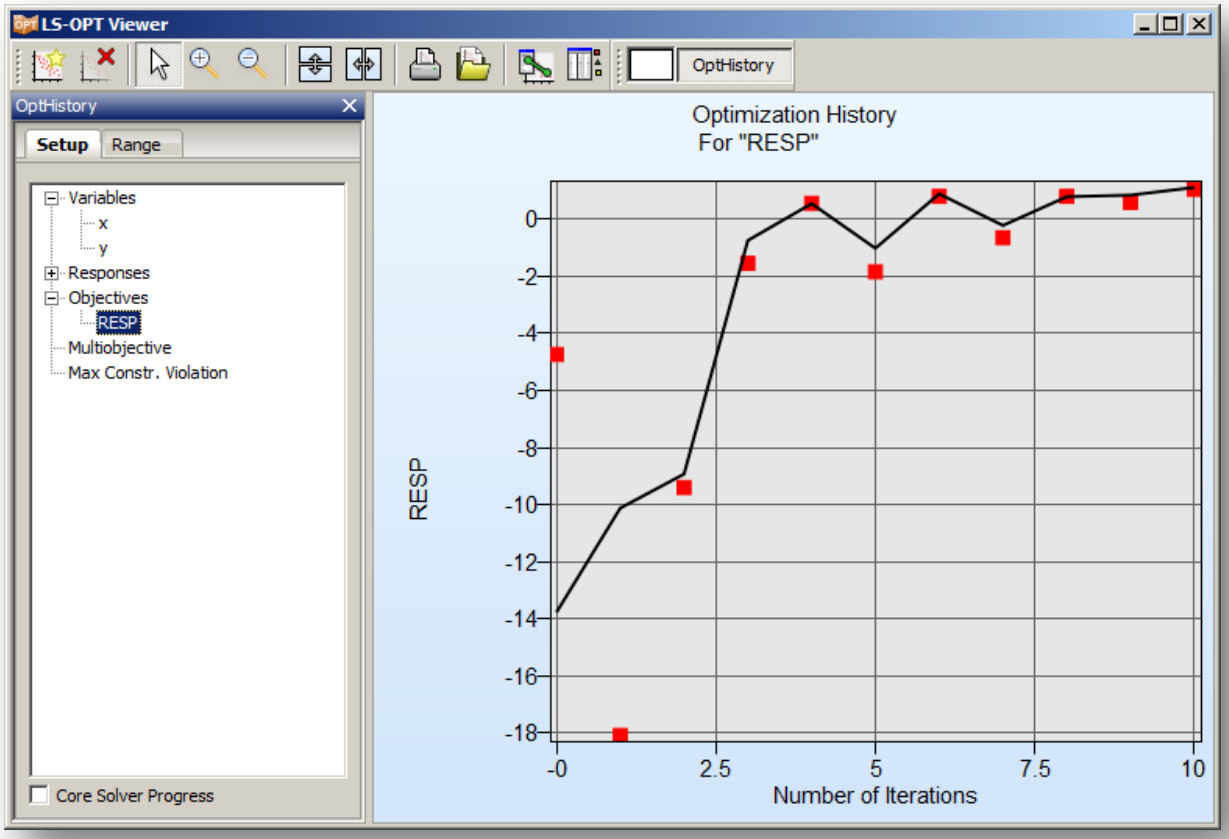


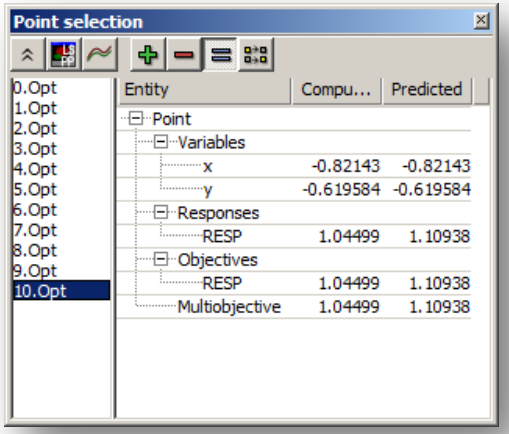




Optimization History - Objective

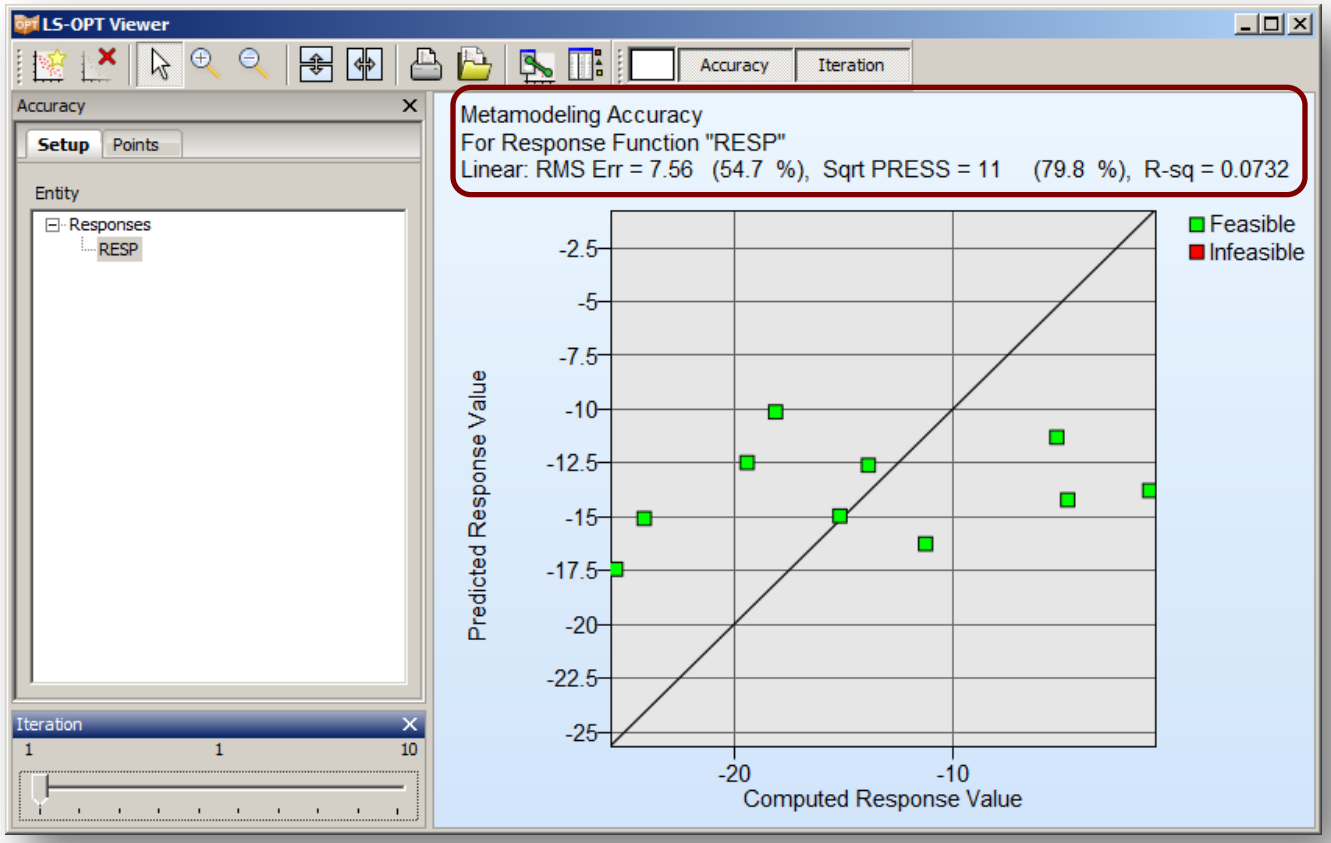
- From the Setup tab in Optimization History window Select RESP from Objectives
- Indicate with the cursor the last point on the graph
- Read from Point Selection window the values of design variables for the optimal design





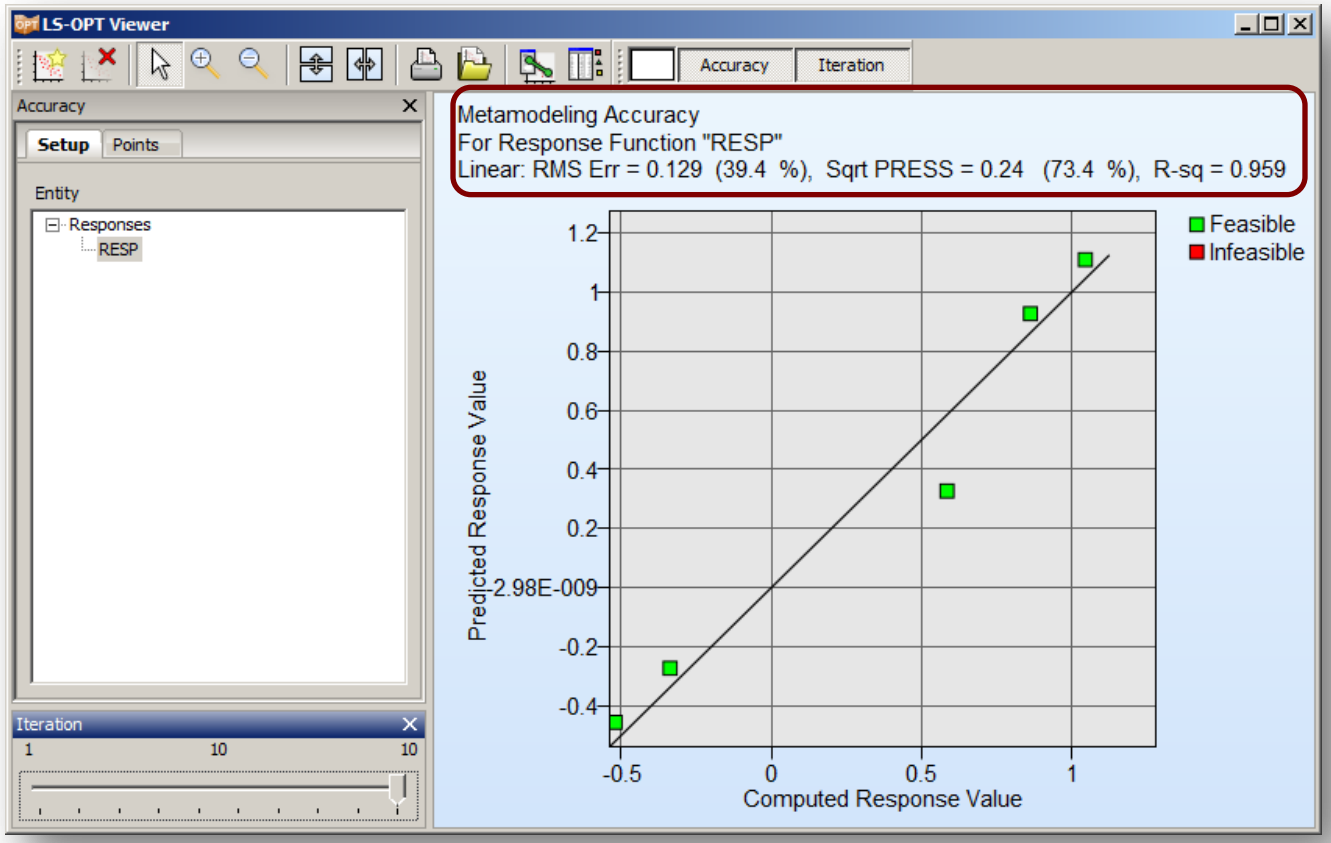
Accuracy of the Metamodel

- Go to Viewer Panel and Press Restart Viewer
- Select Accuracy from Metamodel menu
- Check RMS and R-sq errors – what they indicate?



Accuracy of the Metamodel

- Go to Viewer Panel and Press Restart Viewer
- Select Accuracy from Metamodel menu
- Check RMS and R-sq errors – what they indicate?
- Higher order of the Response Surface might be required for better accuracy.



Homework

- Change the metamodel to quadratic
- Check the metamodeling errors
- Compare the results with linear metamodel