Altair

HyperWorks

Altair HyperStudy 2019 Tutorials

HS-1050: Minimization of External Rosenbrock Function

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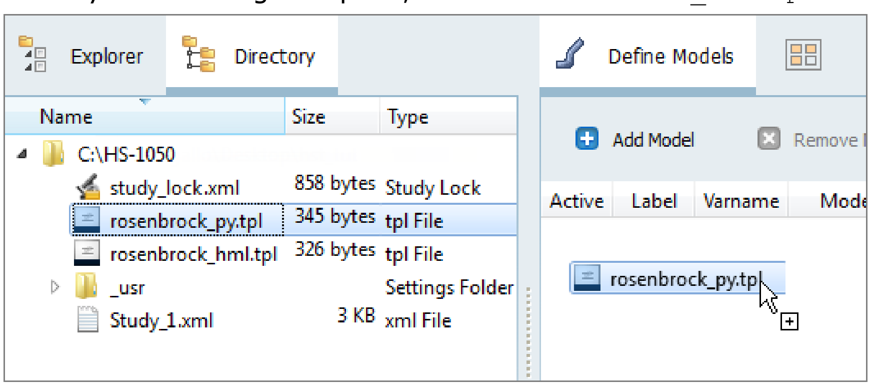
In this tutorial, you will learn how to use Compose or Python within an Optimization study. The example consists of optimizing a 2-dimensional Rosenbrock function. You will be using either Compose or Python as the solvers for HyperStudy. This example defines two input variables, labeled x and y, respectively. The objective of the optimization is to minimize `f(x,y)= 100*(y-x^2)^2 + (1-x)^2`. The range for x and y is set to `[-2 ; -2]`, and the start point is `[-1 ; -1]`.

The files used in this tutorial can be found in `<hst.zip>/HS-1050/`. Copy the tutorial files from this directory to your working directory.

Step 1: Perform the Study Setup

1. To start a new study, click ***File*** > ***New*** from the menu bar, or click  on the toolbar.
2. In the **HyperStudy – Add** dialog, enter a study name, select a location for the study, and click ***OK***.
3. Go to the **Define models** step.
4. Add a Parameterized File model.
   a. From the **Directory**, drag-and-drop the appropriate `.tpl` file into the work area.
      - If you are using Python, use the `rosenbrock_py.tpl` file.
      - If you are using Compose, use the `rosenbrock_oml.tpl` file.



   b. In the **Solver input file** column, enter a name for the solver input file HyperStudy writes during any evaluation.
      - If you are using Python, enter `rosenbrock.py`.
      - If you are using Compose, enter `rosenbrock.oml`.
   c. In the **Solver execution script** column, select either ***Python (py)*** or ***Compose (oml)*** accordingly.

      Note: If you are using Compose as part of the HyperWorks suite, then HyperStudy should automatically point to the correct `.bat` file. If you have Compose as separate installation, then during the **Register Solver Script** step you should point to `Compose_batch.bat`.

   d. If you are using Compose as the Solver execution script, in the **Solver input arguments** column, enter `-f` infront `${file}`.

Note: For solver scripts running on Linux, enter "`-f ${file} -nobg`" in the **Solver input arguments** column to ensure that the Compose batch mode runs in the foreground instead of the background.

5. Click ***Import Variables***. Two input variables are imported from the `.tpl` file.
6. Go to the **Define Input Variables** step.
7. Change both input variable's lower, initial and upper bounds to the values indicated in the image below.

	Active	Label	Varname	Lower Bound	Nominal	Upper Bound
1	☑	x	m_1_varname_1	-2.0000000 ...	-1.0000000 ...	2.0000000 ...
2	☑	y	m_1_varname_2	-2.0000000 ...	-1.0000000 ...	2.0000000 ...

8. Go to the **Specifications** step.

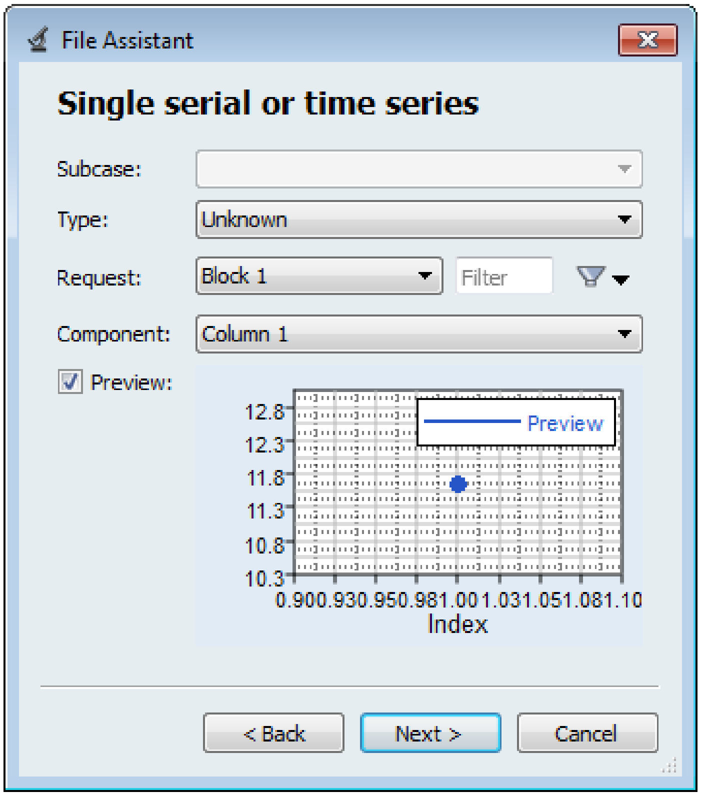
Step 2: Perform the Nominal Run

1. In the work area, set the **Mode** to ***Nominal Run***.
2. Click ***Apply***.
3. Go to the **Evaluate** step.
4. Click ***Evaluate Tasks***.
5. Go to the **Define Output Responses** step.

Step 3: Create and Define Output Responses

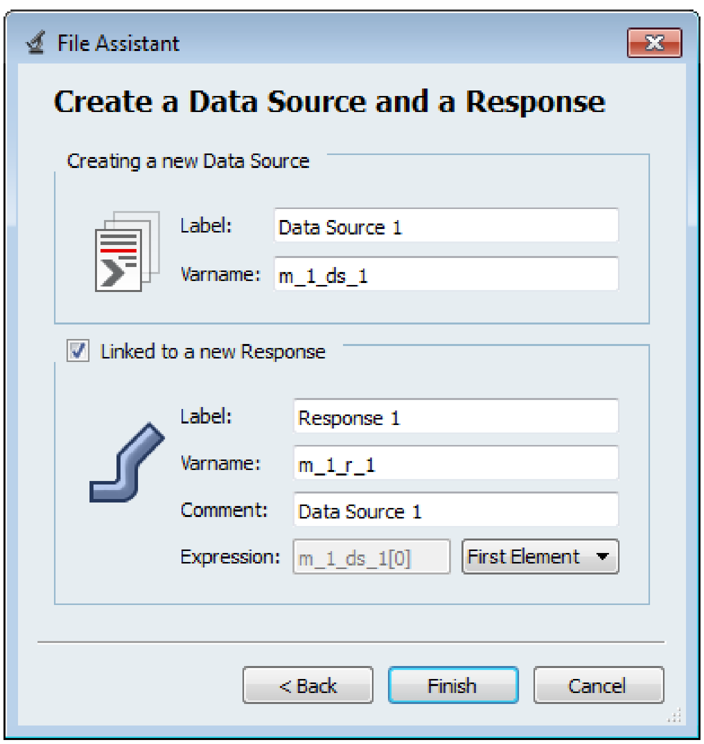
In this step you will create one output responses.

1. Create the output response.
   a. From the **Directory**, drag-and-drop the `rosenbrock.res` file, located in the `approaches/nom_1/run__00001/m_1` directory, into the work area.
   b. In the **File Assistant** dialog, set the **Reading technology** to ***Altair® HyperWorks®*** and click ***Next***.
   c. Select **Single item in a time series**, then click ***Next***.
   d. Define the following options, and then click ***Next***.
      - Set **Type** to ***unknown***.
      - Set **Request** to ***Block 1***.
      - Set **Component** to ***Column 1***.



e. **Optional**. Enter labels for the data source and output response.

f. Set **Expression** to ***First Element***. The expression changes to `m_1_ds_1[0]`.



g. Click ***Finish***. Output response 1 is added to the work area. 2. Click ***Evaluate***. The value for expression m_1_ds_1[0] should be 404.0.

Step 4: Run an Optimization Study

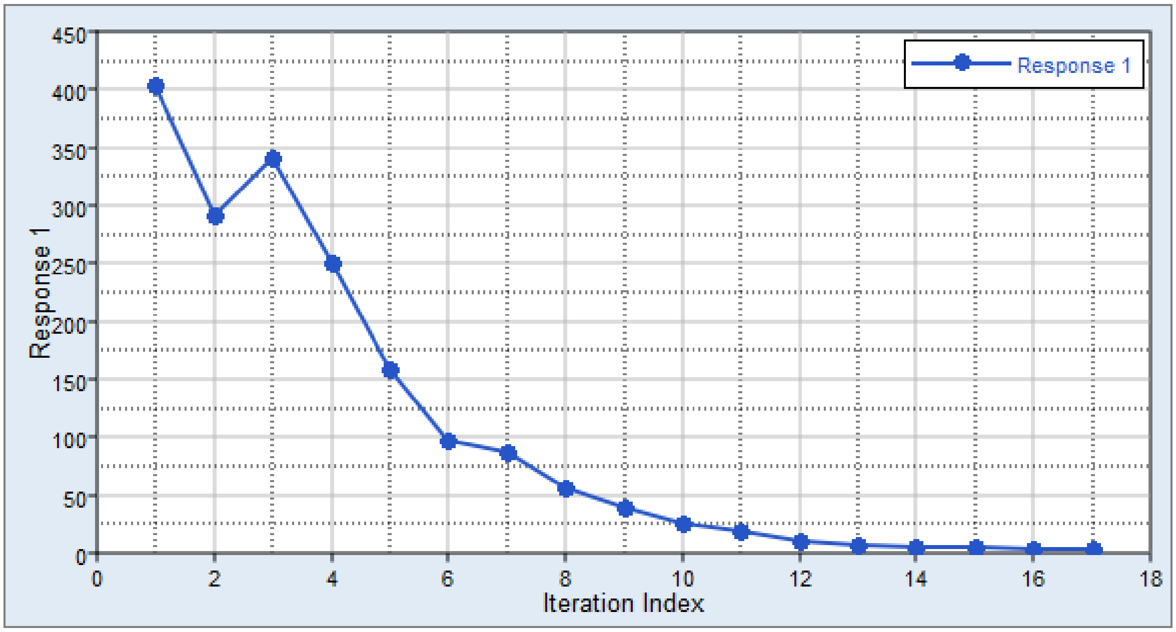
1. In the **Explorer**, right-click and select ***Add*** from the context menu.
2. In the **Add - HyperStudy** dialog, select ***Optimization*** and click ***OK***.
3. Go to the **Select Input Variables** step.
4. Review the input variable's lower and upper bound ranges.
5. Go to the **Select Output Responses** step.
6. Add an objective to Response 1.
    a. In the **Objectives** column of Response 1, click .
    b. In the pop-up window, set **Type** to ***Minimize*** and click ***OK***.

	Active	Label	Varname	Objectives	Constraints	Evaluate From	Expression	Comment
1	☑	Response 1	m_1_r_1	Minimize ...		Solver	m_1_ds_1[0]	Data Source 1 ...

7. Click ***Apply***.
8. Go to the **Specifications** step.
9. In the work area, set the **Mode** to ***Adaptive Response Surface Method (ARSM)***.

    Note: Only the methods that are valid for the problem formulation are enabled.
10. Click ***Apply***.
11. Go to the **Evaluate** step.
12. Click ***Evaluate Tasks***.
13. **Optional**. Click the ***Iteration Plot*** tab to monitor the progress of the optimization.

    The iteration history shows a significant reduction in the objective value. The Rosenbrock function has a global minimum that is difficult for any optimizer to find due to its flatness in the area of the true optimum, and ARSM has not found the theoretical solution at (x,y)=(1,1).



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