Altair

HyperWorks

Altair HyperStudy 2019 Tutorials

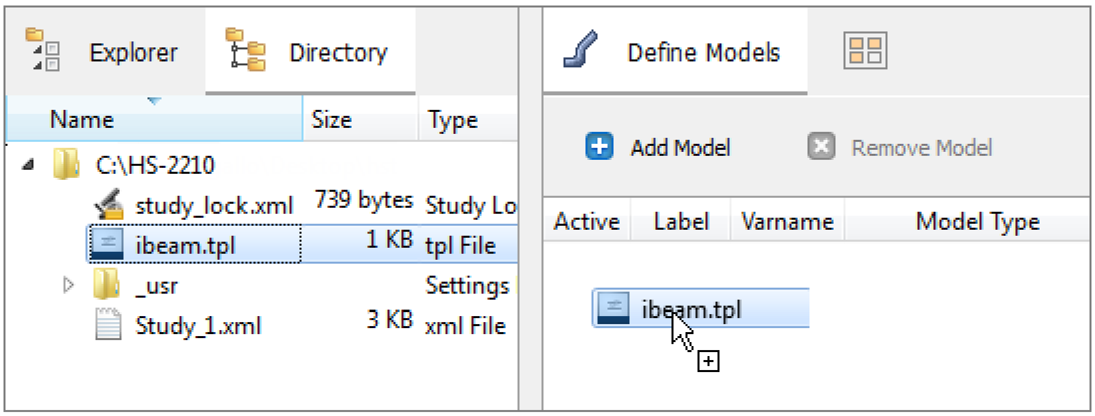
HS-2210: Principle Component Analysis of a Cantilever Ibeam

HS-2210: Principle Component Analysis of a Cantilever Ibeam

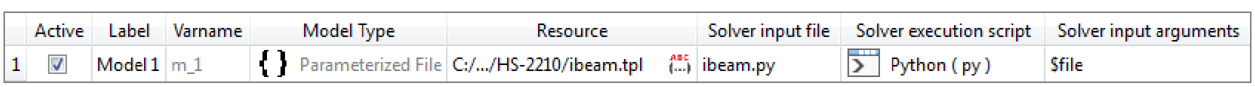
The files used in this tutorial can be found in `<hst.zip>/HS-2210/`. Copy the files from this directory to your working directory.

Step 1: Perform the Study Setup

1. Start HyperStudy.
2. To start a new study, click ***File*** > ***New*** from the menu bar, or click on the toolbar.
3. In the **HyperStudy – Add** dialog, enter a study name, select a location for the study, and click ***OK***.
4. Go to the **Define Models** step.
5. Add a Parameterized File model.
    a. From the **Directory**, drag-and-drop the `ibeam.tpl` file into the work area.



    b. In the **Solver input file** column, enter `ibeam.py`. This is the name of the solver input file Hyper any evaluation.
    c. In the **Solver execution script** column, select ***Python (py)***.



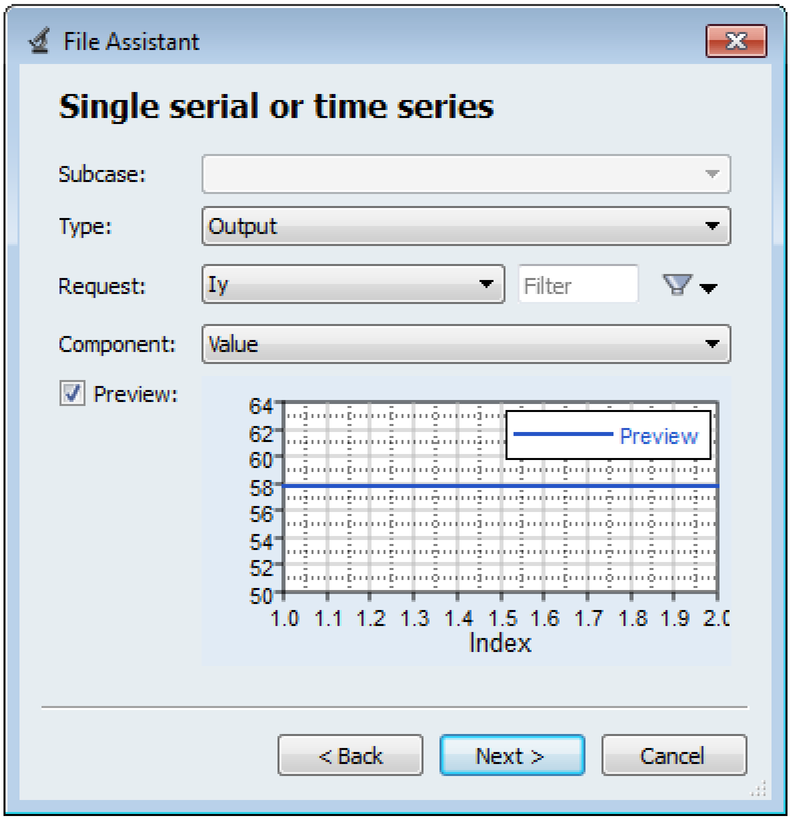
6. Click ***Import Variables***. Four input variables are imported from the `ibeam.tpl` resource file.
7. Go to the **Define Input Variables** step.
8. Review the input variable's lower and upper bound ranges.
9. Go to the **Specifications** step.

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***. An `approaches/nom_1/` directory is created inside the study directory. The `approaches/nom_1/run__00001/m_1` sub-directory contains the `output.hstp` file, which is the result of the nominal run, and will be used during the Optimization.
5. Go to the **Define Output Responses** step.

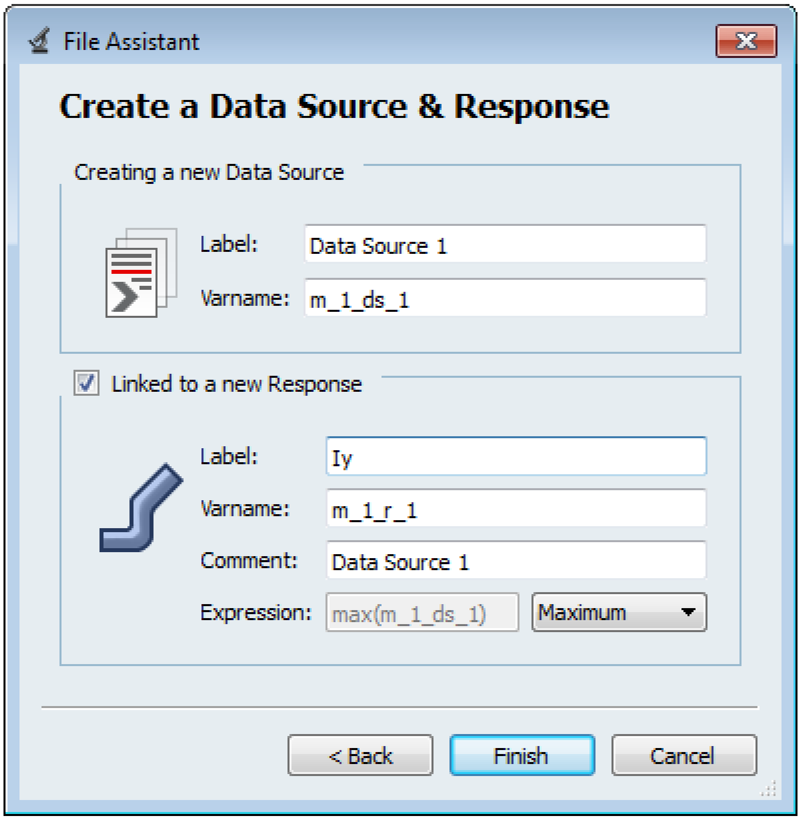
Step 3: Create and Define Output Responses

1. Create the Iy output response for the y-axis moment of inertia.
   a. From the **Directory**, drag-and-drop the `output.hstp` file, located in `approaches/nom_1/run_00001/m_1`, into the work area.
   b. In the **File Assistant** dialog, set the **Reading technology** to ***Altair® HyperWorks® (HstReaderPdd)*** 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 ***Output***.
      - Set **Request** to ***Iy***.
      - Set **Component** to ***Value***.



e. Label the output response Iy.

f. Set **Expression** to ***Maximum***.



g. Click ***Finish***. The Iy output response is added to the work area.

2. Create four more output responses by repeating step 1, except change the component assigned to each output response to the following.

Output Response	Component
Volume	Vol
IZ	Iz
Displacement	d
Frequency1	Freq

3. Click ***Evaluate*** to extract the output response values.

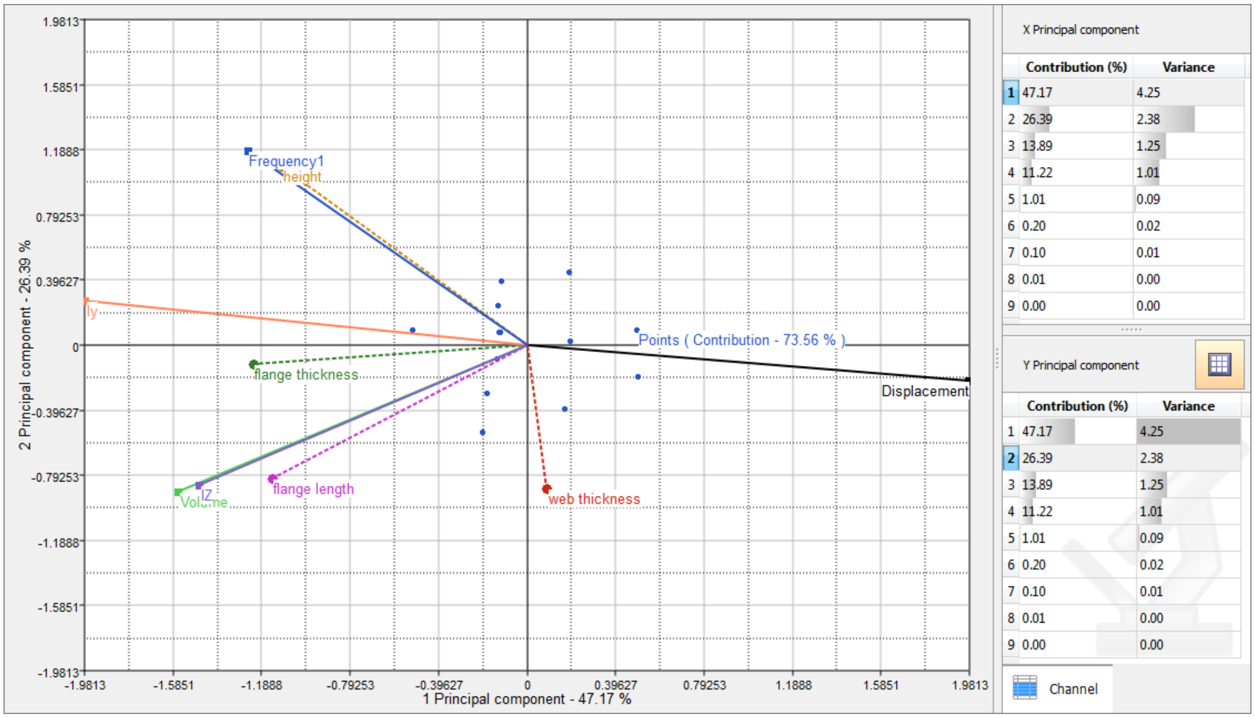
	Active	Label	Varname	Expression	Value	Comment
1	☑	Iy	m_1_r_1	max(m_1_ds_1) ...	57.760000	Data Source 1 ...
2	☑	Volume	m_1_r_2	max(m_1_ds_2) ...	5.4400000	Data Source 2 ...
3	☑	IZ	m_1_r_3	max(m_1_ds_3) ...	8.3381300	Data Source 3 ...
4	☑	Displacement	m_1_r_4	max(m_1_ds_4) ...	5.77e-05	Data Source 4 ...
5	☑	Frequency1	m_1_r_5	max(m_1_ds_5) ...	3044.6300	Data Source 5 ...

4. Click ***OK***. This complete the study setup.

Step 4: Run a D-Optimal DOE Study

1. In the **Explorer**, right-click and select ***Add*** from the context menu.
2. In the **Add - HyperStudy** dialog, select ***Doe*** and click ***OK***.
3. Go to the **Specifications** step.
4. In the work area, set the **Mode** to ***D-Optimal***.
5. In the **Settings** tab, change the **Number of runs** to 13, which is 2 more runs than the minimum re
6. Click ***Apply***.
7. Go to the **Evaluate** step.
8. Click ***Evaluate Tasks***.
9. Go to the **Post-Processing** step, and click the ***Ordination*** tab.

   The biplot is interpreted by looking at the relationship between the lines that each represent one inp responses show a strong negative correlation because they are aligned, but pointing in opposite dire the input variable web thickness, indicated by the orthogonality. Similar strong positive correlations and flange length.


2 Principal component - 26.39 %
1 Principal component - 47.17 %
Frequency1
height
Iy
flange thickness
flange length
Volume
IZ
web thickness
Points (Contribution - 73.56 %)
Displacement
X Principal component
Contribution (%)
Variance
Y Principal component
Channel