Altair

HyperWorks

Altair HyperStudy 2019 Tutorials

HS-1030: Parameterize a MotionView Model

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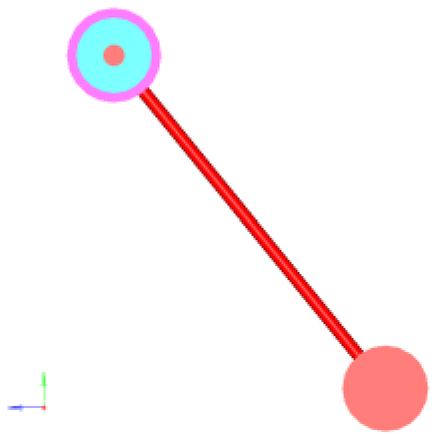
In this tutorial you will learn how to use HyperStudy to perform an optimization with MotionSolve. The input variable is the angle q (swing angle) of the pendulum. The output response target is to achieve Y-velocity of 6m/s at the tip of the pendulum. At the end of this tutorial, you will know how to:

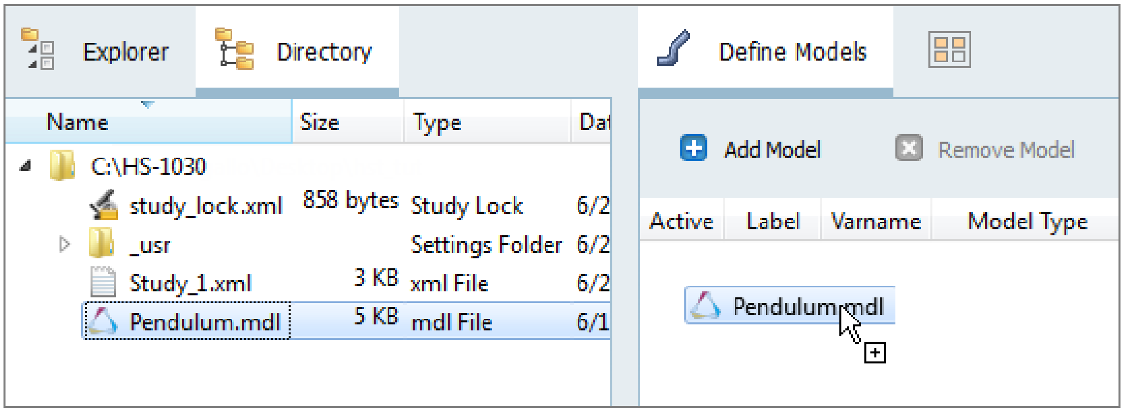
- Use MotionView to start HyperStudy and create the input variables.
- Setup a study.
- Run a system identification optimization study.

The files used in this tutorial can be found in `<hst.zip>/HS-1030/`. Copy the tutorial files from this directory to your working directory.



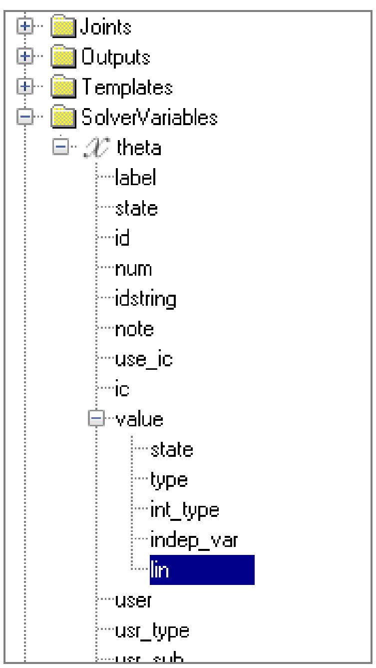
Step 1: Perform the Study Setup

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 MotionView model.
   a. From the **Directory**, drag-and-drop the MotionView (`.mdl`) file `Pendulum.mdl` into the work area.



b. In the **Solver input file** column, enter `m1.xml`. This is the name of the solver input file HyperStudy writes for any evaluation.

6. Click ***Import Variables***.
7. In the **Model Parameter Tree** dialog, select parameters to import into HyperStudy.
   a. Expand **SolverVariables** > **theta** > **value**, and select ***lin*** (scalar value for the swing angle).



   b. Click ***Add.***
   c. Click ***OK***.
8. Go to the **Define Input Variables** step.
9. In the work area, change the **Lower Bound** to `0` and the **Upper Bound** to `2`.

	Active	Label	Varname	Lower Bound	Nominal	Upper Bound
1	☑	theta-value-lin	var_1	0.0000000 ...	0.7000000 ...	2.0000000 ...

10. Go to the **Specifications** step.

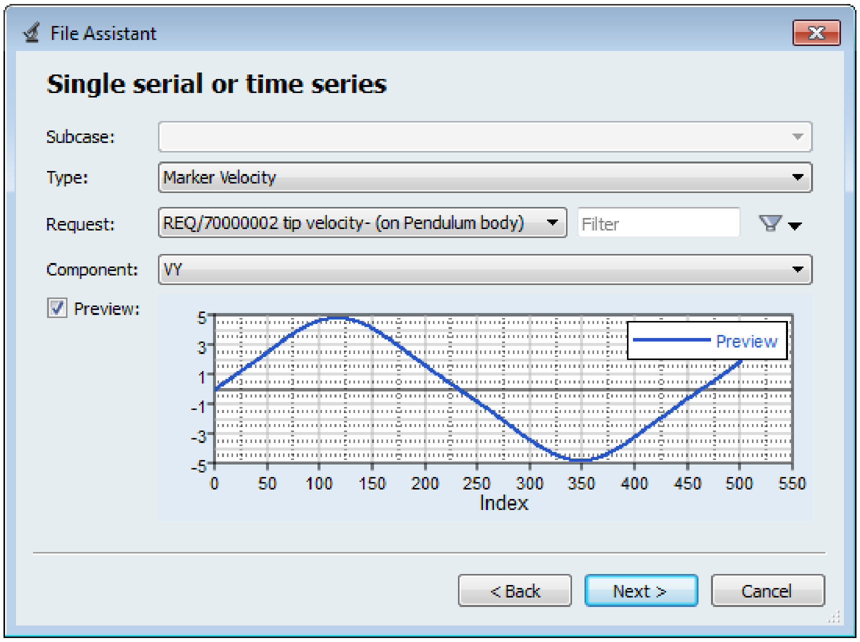
Step 2: Perform the Nominal Run

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 `approach/nom_1/` directory is created inside the study directory. The `approaches/nom_1/run__00001/m_1` directory contains the `.res` file, which is the result of the nominal run.
5. Go to the **Define Output Responses** step.

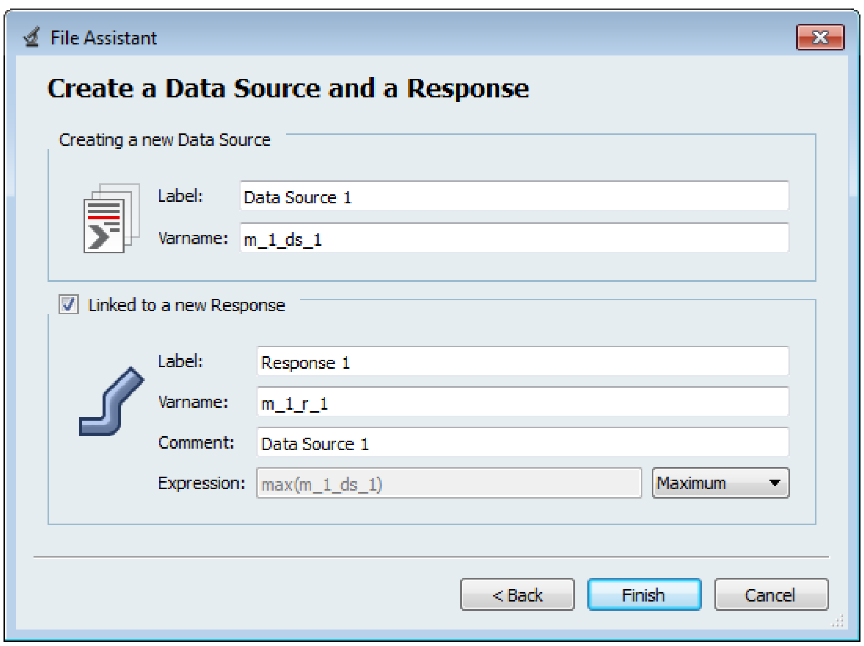
Step 3: Create and Define Output Responses

In this step you will create one output response.

1. From the **Directory**, drag-and-drop the `m1.mrf` file, located in `approaches/nom_1/run_00001/m_1`, into the work area.
2. In the **File Assistant** dialog, set the **Reading technology** to ***Altair® HyperWorks®*** and click ***Next***.
3. Select **Single item in a time series**, then click ***Next***.
4. Define the following options, and then click ***Next***.
   a. Set **Type** to ***Marker Velocity***.
   b. Set **Request** to ***REQ/70000002 tip velocity- (on Pendulum body)***.
   c. Set **Component** to ***VY***.



5. Optional. Enter labels for the data source and output response.
6. Set **Expression** to ***Maximum***.



7. Click ***Finish***. The output response is displayed in the work area.

	Active	Label	Varname	Expression	Value	Comment
1	☑	Response 1	m_1_r_1	max(m_1_ds_1) ...	Not Extracted	Data Source 1 ...

8. Click ***Evaluate*** to extract the output response value.

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. Apply an objective on Response 1.
   a. In the **Objectives** column of Response 1, click ⊕.
   b. In the pop-up window, define the following settings and click ***OK***.
      - Set **Type** to ***System Identification***.
      - For **Target Value**, enter `6.0`.

	Active	Label	Varname	Objectives	Constraints	Evaluate From	Expression	Comment
1	☑	Response 1	m_1_r_1	System Identification ...	⊕	Solver	max(m_1_ds_1)	Data Source 1 ...

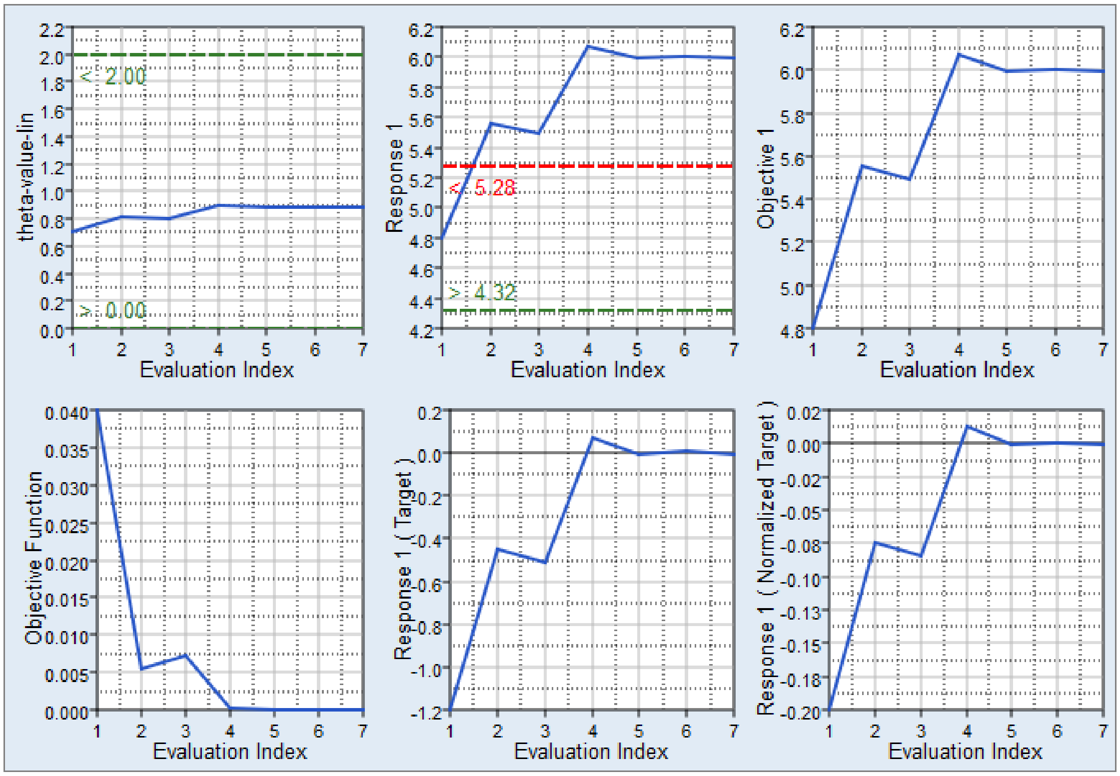
7. Click ***Apply***.
8. Go to the **Specifications** step.
9. In the work area, set the **Mode** to ***Adaptive Response Surface Method (ARSM)***.

   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*** to start the optimization.

Step 5: View the Iteration History of an Optimization Study

1. Click the ***Iteration History*** tab to view a table with the Optimization's iteration results. The optimal design is highlighted in green.
2. Click the ***Evaluation Plot*** tab to compare all of the entities of the Optimization (input variables, output responses, and objectives) against the iteration.

   Use the **Channel** selector to select all of the input variables, output responses, and objectives.



3. Go to the **Post-Processing** step.

Step 6: Post-Processing of an Optimization Study

The **Post-Processing** step in an optimization approach offers additional tools to review the results. Statistics, histograms, and scatter plots can be used to help compare and analyze designs.

Click the ***Integrity*** tab to view a series of statistical measures on input variables and output responses.

	Label	Varname	Category	Variance	Std. Dev.	Avg. Dev.	CoV.	Skewness	Kurtosis	RMS
1	theta-value-lin	var_1	Variable	0.0050876	0.0713274	0.0558252	0.0850524	-1.4361751	1.7248959	0.8412254
2	Response 1	m_1_r_1	Response	0.2132648	0.4618060	0.3601725	0.0809898	-1.4554659	1.8136211	5.7180348
3	Objective 1	obj_1	Objective	0.2132648	0.4618060	0.3601725	0.0809898	-1.4554659	1.8136211	5.7180348
4	Objective Function	Objective_Function_Val	Objective	2.13e-04	0.0145924	0.0092497	1.9342907	2.4201855	6.0361371	0.0154735
5	Response 1 (Target)	m_1_r_1_DTV	Response	0.2132648	0.4618060	0.3601725	1.5498306	-1.4554659	1.8136211	0.5211388
6	Response 1 (Normalized Target)	m_1_r_1_DTVN	Response	0.0059240	0.0769677	0.0600288	1.5498306	-1.4554659	1.8136211	0.0868565

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