Altair

HyperWorks

Altair HyperStudy 2019 Tutorials

HS-4410: Readmac Delegate for Mode Tracking

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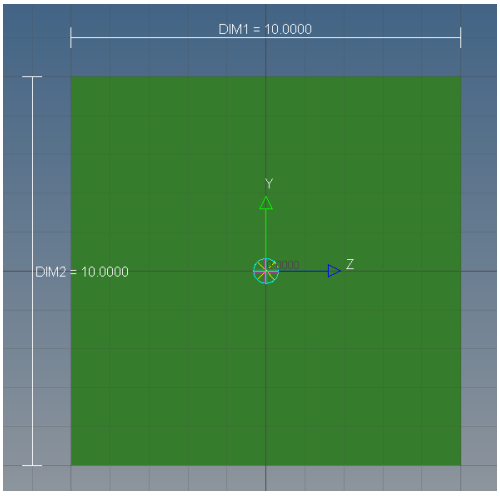
In this tutorial you will learn how to use the Readmac delegate for mode tracking applications. This will be set up as an optimization problem with the objective of maximizing the first natural frequency of a simple rectangular section beam.



Bar cross-section of the beam element from hyperbeam

Model Files

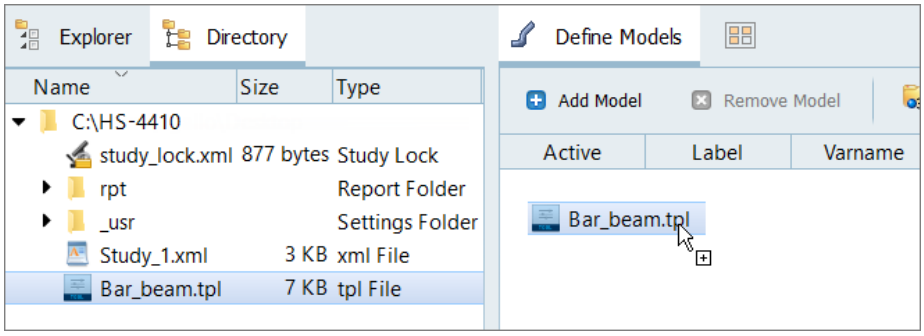
The files used in this tutorial can be found in `<hst.zip>/HS-4410/`. Copy the files from this directory to your working directory.

Exercise

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 `Bar_beam.tpl` file into the work area.



   b. In the Solver input file column, enter `Bar_beam.fem`.

      This is the name of the solver input file HyperStudy writes during any evaluation.

   c. In the Solver execution script column, select **OptiStruct (os)**.

6. Click **Import Variables**.

   Two input variables are imported from the .tpl resource file.

	Active	Label	Varname	Lower Bound	Nominal	Upper Bound	Comment
1	☑	DimA	m_1_varname_1	5.0000000 ...	5.0000000 ...	15.000000 ...	...
2	☑	DimB	m_1_varname_2	5.0000000 ...	10.000000 ...	15.000000 ...	...

7. Go to the **Specifications** step

Step 2: Perform the Nominal run

1. In the work area, set the Mode to **Nominal Run**.

	Mode	Label	Varname	Details
1	◉	Nominal Run	Nom	Run system at nominal values
2	○	System Bounds Check	Chk	Run system at nominal values, then lower and upper values
		Show more ...		

2. Click **Apply**.
3. Go to the **Evaluate** step.
4. Click **Evaluate Tasks**.

   An approaches `/nom_1/` directory is created inside the study directory. `/nom_1/run__00001/m_1` sub-directory contains the `Bar_beam.h3d` which is the result of the nominal run, and will be used for next approach.

5. Go to the **Define Output Responses** step.

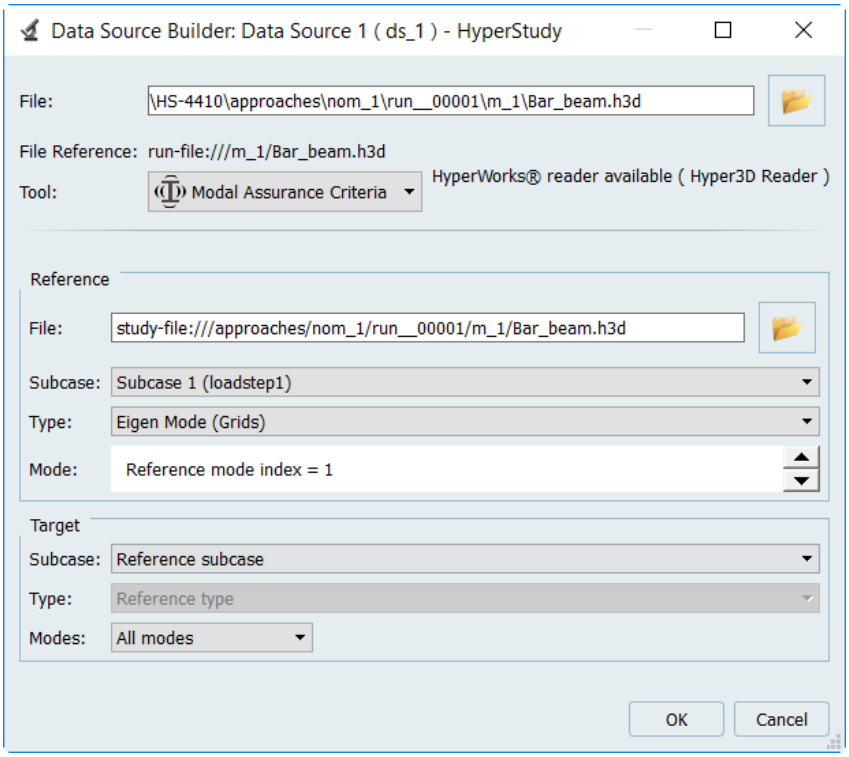
Step 3: Create and Define Output Responses

In this step you will create three output responses that are based on elements of a single data source from the Readmac delegate.

1. Click the **Data Sources** tab.
2. Click **Add Data Source**.
3. In the File column of the data source, click (**...**).
4. In the Data Source Builder dialog, define the data source and click **OK**.
   a. In the File field, navigate to `\nom_1\run__00001\m_1\` inside your working directory and select `Bar_beam.h3d`.
   b. Set Tool to **Modal Assurance Criteria**.
   c. In the References section, File field, navigate to `\nom_1\run__00001\m_1\` inside your working directory and select `Bar_beam.h3d`.
   d. Set Subcase to **Subcase 1 (loadstep1)**.
   e. Set Type to **Eigen Mode (Grids)**.
   f. For Mode, select **Reference mode index = 1**.
   g. In the Target section, leave the settings set to their default values.

      The default Target settings adopt the same Type and Subcase as the Reference settings, which enables HyperStudy to search all modes for the best match in the reference file.

Note: The file source uses a relative position of the `Bar_beam.h3d` file, and updates for successive run numbers. However, the reference file uses an absolute path and points to the given file source throughout all the runs.



5. Click **Evaluate**.

   The Value field for ds_1 displays a row vector of three elements.
6. Click the **Define Output Responses** tab.
7. Create and define output responses.
   a. Click **Add Output Responses** to add three output responses.
   b. Label the output responses Freq of best matched mode, MAC of matched mode, and ID of matched mode.
   c. In the Expression field, enter the following expressions for each output response.
      - Freq of best matched mode = `ds_1[0]`
      - MAC of matched mode = `ds_1[1]`
      - ID of matched mode = `ds_1[2]`
8. Click **Evaluate** to extract the output response values.

	Active	Label	Varname	Expression	Value	Comment
1	☑	Freq of best matched mode	r_1	ds_1[0] ...	16.697069	...
2	☑	MAC of matched mode	r_2	ds_1[1] ...	1.0000000	...
3	☑	ID of matched mode	r_3	ds_1[2] ...	1.0000000	...

Step 4: Run an Optimization

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 Output Responses** step.
4. Apply an objective on the Freq of best matched mode output response.
   a. In the Objectives column for Freq of best matched mode, click ⊕.
   b. In the pop-up window, set Type to **Maximize** and click **OK**.

	Active	Label	Varname	Objectives	Constraints	Evaluate From	Expression
1	☑	Freq of best matched mode	r_1	Maximize ...	⊕	f() Expression	ds_1[0]
2	☑	MAC of matched mode	r_2	⊕	⊕	f() Expression	ds_1[1]
3	☑	ID of matched mode	r_3	⊕	⊕	f() Expression	ds_1[2]

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

10. Click the **Iteration History** tab.

Notice: The frequency of best matched mode in the target file is maximized to 50.067 from 33.388. The readmac function that was running the background was able to track the ID of the matched mode in the target `.h3d` file. The mode ID in the converged solution switched from 1 to 2.

	DimA	DimB	Freq of best matched mode	MAC of matched mode	ID of matched mode	Objective 1	Iteration I
1	5.0000000	10.000000	16.697069	1.0000000	1.0000000	16.697069	1
2	5.8250000	10.000000	19.468361	1.0000000	1.0000000	19.468361	2
3	5.0000000	11.650000	16.697069	1.0000000	1.0000000	16.697069	3
4	5.7500000	10.000000	19.201250	1.0000000	1.0000000	19.201250	4
5	6.6987500	10.000000	22.372990	1.0000000	1.0000000	22.372990	5
6	7.8997306	11.050000	26.378981	1.0000000	1.0000000	26.378981	6
7	9.5925301	10.840651	32.019798	1.0000000	1.0000000	32.019798	7
8	12.049373	10.549620	40.228260	1.0000000	2.0000000	40.228260	8
9	15.000000	9.7387644	50.067039	0.9999999	2.0000000	50.067039	9
10	15.000000	10.761335	50.067039	0.9999999	2.0000000	50.067039	10
11	15.000000	10.248924	50.067039	0.9999999	2.0000000	50.067039	11