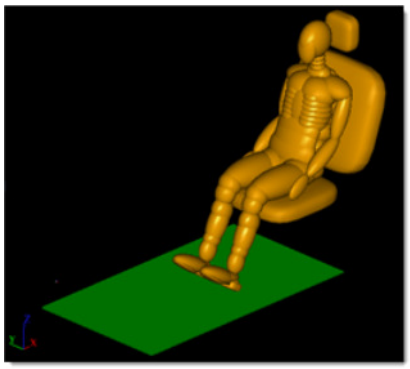
HyperStudy

HS-1590: DOE Study Using Madymo

In this tutorial, you will learn how setup a DOE study using Madymo as a solver. Madymo simulation is a crash occupant safety application. The design variables you will be using in this tutorial are the scale of force-penetration curve, the scale of recliner loading function and the position of the head rest. The objective of this tutorial is to study the effect of changing the dummy-seat contact stiffness, seat recliner loading function and the distance between the dummy head and the head rest on the dummy's neck injury criteria.

The files used in this tutorial can be found in `<install_directory>/tutorials/hst/hs-1590/`. To run this tutorial, copy the following files to your working/study directory: `A_hffoam_TEST.xml` (Input file for Madymo), `d_hyb350el_inc.xml`, and `madymo_DOE.bat` (Batch file for Madymo V7.5).

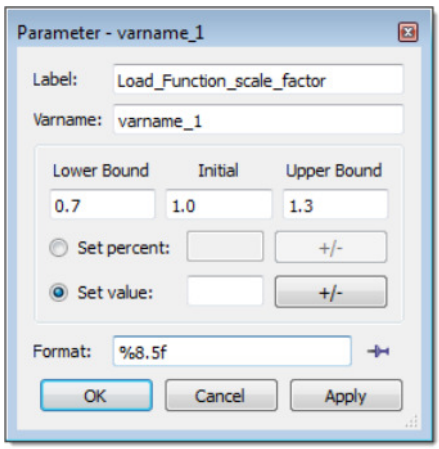


Step 1: Create the Base Import Template in HyperStudy

1. Click ***Tools*** > ***Editor*** from the menu bar. The **Parameter Editor** opens.
2. In the **File** field, navigate to your working directory and open the `a_hffoam_TEST.xml` file.
3. In the **Search** area, enter `GROUP_DEFINE`.
4. Click ▶. HyperStudy highlights GROUP_DEFINE.
5. Under the variable **Load_Function_scale_factor**, highlight the value 1.0.

```
      <DEFINE
        VAR_NAME="Load_Function_scale_factor"
        VALUE="1.0"
      />
      <DEFINE
        VAR_NAME="Head_Rest_position"
        VALUE="0.02"
      />
      <DEFINE
        VAR_NAME="Force_Penetration_scale_factor"
```

6. To create a parameter, right-click on the highlighted fields and select ***Create Parameter*** from the context sensitive menu.
7. In the **Parameter - varname_1** dialog, enter `Load_Function_scale_factor` in the **Label** field.
8. Set the **Lower Bound** to `0.7`, the **Initial value** to `1.0`, and the **Upper bound** to `1.3`.
9. Set the **Format** to `%8.5f`.
10. Click ***OK***.



11. Repeat steps 1.3 through 1.10 to create two more parameters using the information provided in the table below.

Label	Lower Bound	Initial value	Upper Bound	Format
Head_Rest_position	0.00	0.02	0.04	%8.5f
Force_Penetration_scale_factor	0.8	1.0	1.2	%8.5f

12. Click ***Save***.
13. In the **Save Template** dialog, navigate to your working directory and save the file as `a_hffoam_TEST.tpl`.
14. Close the **Parameter Editor** dialog.

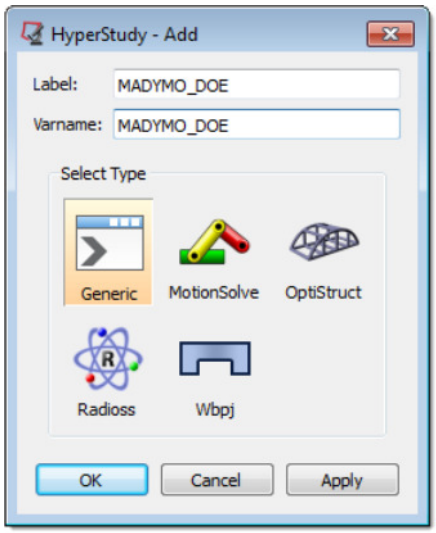
Step 2: Create the madymo_DOE.bat File

1. In your favorite text editor, open a new file.
2. Enter the following text line: `"C:\Program Files\Madymo\madymo_75\em64t-win\bin\madymo75.exe" -i a_hffoam_TEST.xml`

   Note: This example assumes that you are using MADYMO V7.5 on a Microsoft Windows platform.
3. Save the file as `madymo_DOE.bat`.
4. Close the text editor.

Step 3: Register Madymo as a Solver Script

1. From the menu bar, click ***Edit*** > ***Register Solver Script***.
2. In the **Register Solver Script** dialog, click ***Add Solver Script***.
3. In the **HyperStudy - Add** dialog, enter `MADYMO_DOE` in the **Label** and **Varname** fields.
4. For solver script type, select ***Generic***.
5. Click ***OK***.

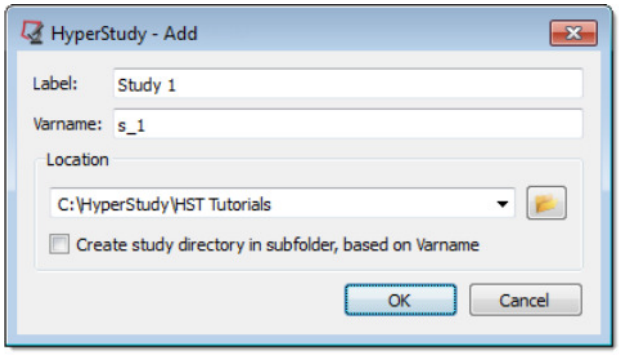


6. In the **Path** column of the script **MADYMO_DOE**, click .
7. In the **Open** dialog, navigate to your working directory and open the `madymo_DOE.bat` file.
8. Click ***Close***.

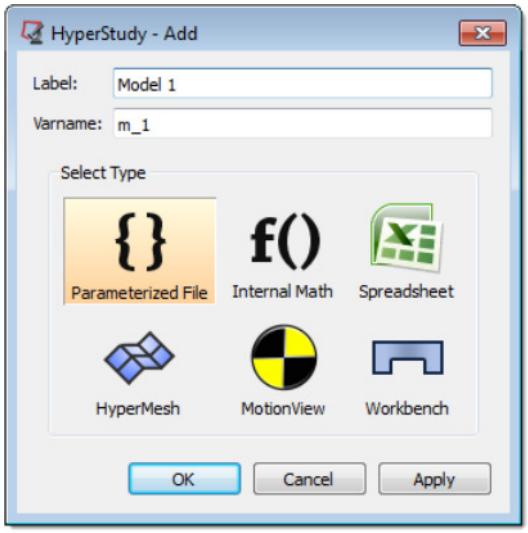
Step 4: Perform the Study Setup

1. To start a new study, click ***File*** > ***New*** from the menu bar, or click on the toolbar.
2. Optional: In the **HyperStudy - Add** dialog, enter a label for the study in the **Label** field.
3. In the **Location** area, navigate to your working directory.

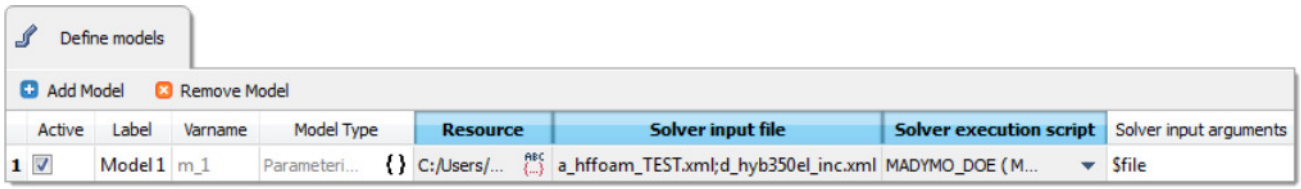
4. Optional. If you would like to create a new study specific folder, select the ***Create study directory in subfolder, based on Varname*** check box.
5. Click ***OK***. The study opens in the **Explorer**.



6. To continue on to the **Define models** step, click ***Next*** twice, or click ***Define models*** in the **Explorer**.
7. To add a model, click ***Add Model***.
8. In the **HyperStudy - Add** dialog, add one **Parameterized File** model.



9. In the **Resource** column of **Model_1**, click {...}.
10. In the **Open File** dialog, navigate to your working directory and open the `a_hffoam_TEST.tpl` file.
11. In the **Parameter Editor**, review the `a_hffoam_TEST.tpl` file and then click ***OK***.
12. In the **Solver input file** column, enter `a_hffoam_TEST.xml;d_hyb350el_inc.xml`. This is the name of the solver input file HyperStudy writes during any evaluation.
13. In the **Solver execution script** column, select ***MADYMO_DOE (MADYMO_DOE)***.

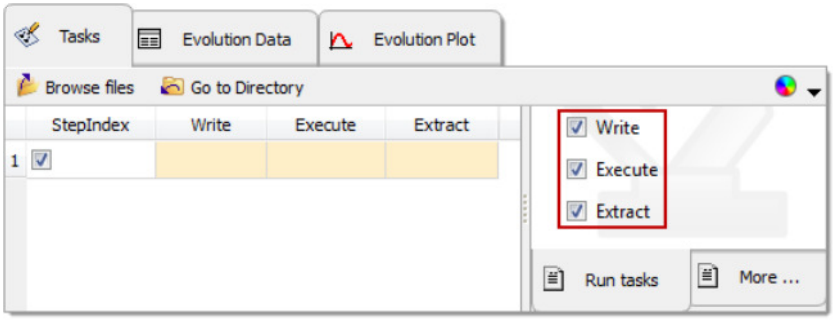


14. Click ***Import Variables***. HyperStudy imports three design variables from the `a_hffoam_TEST.tpl` resource file.
15. To continue on to the **Define design variables** step, click ***Next***.
16. Review the design variable's lower and upper bound ranges.
17. To continue on to the **Specifications** step, click ***Next***.

Step 5: Perform the Nominal Run

1. In the work area, set the **Mode** to ***Nominal Run***.
2. Click ***Apply***.
3. To continue on to the **Evaluate** step, click ***Next***.

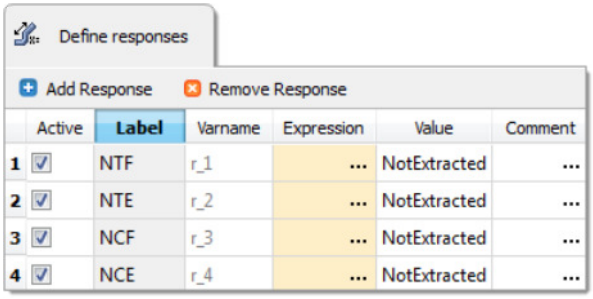
4. In the **Settings** tab, select the ***Write***, ***Execute***, and ***Extract*** check boxes.



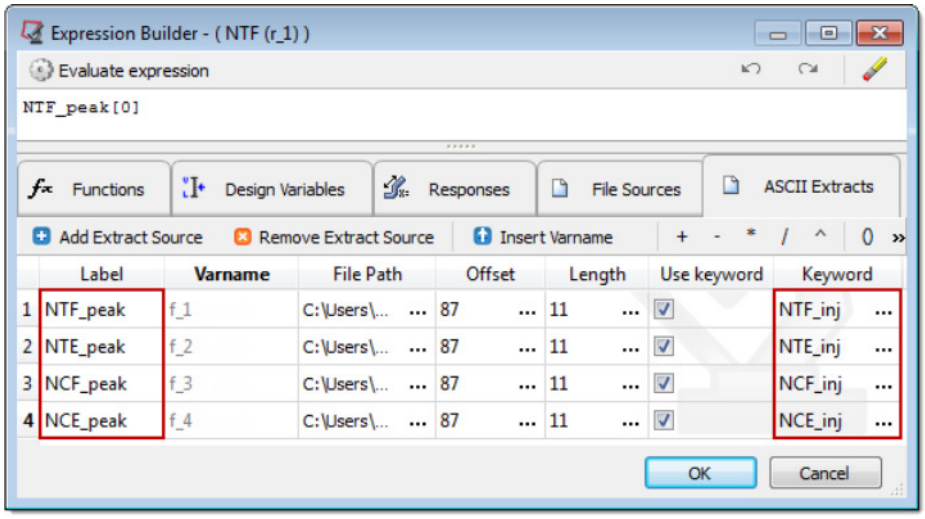
5. Click ***Evaluate Tasks***. HyperStudy creates an `approach/nom_1/` directory inside the study directory.
6. To continue on to the **Define responses** step, click ***Next***.

Step 6: Create and Define Responses

1. To add a response, click ***Add Response***.
2. In the **HyperStudy - Add** dialog, add four responses labeled: NTF, NTE, NCF, and NCE.

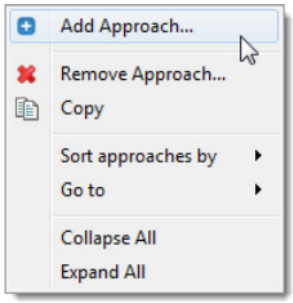


3. In the **Expression** column of the response **NTF**, click ...
4. In the **Expression Builder**, click the ***ASCII Extracts*** tab.
5. To add an extract source, click ***Add Extract Source***.
6. In the **HyperStudy - Add** dialog, add one extract source labeled `NTF_peak`.
7. In the **File Path** column of **NTF_peak**, click ...
8. In the **Extract File** dialog, navigate to the `approaches/nom_1/run__00001/m_1` directory and open the `a_hffoam_TEST.peak` file.
9. Select the ***Keyword*** check box and enter `NTF_ing`.
10. Click ***Next***. HyperStudy locates **NTF_inj** in the file.
11. In the **Offset** field, enter `87`.
12. In the **Length** field, enter `11`.
13. Click ***OK***.
14. Click ***Insert Varname***. The expression `NTF_peak[0]` appears in the **Evaluate expression** field.
15. Click ***Evaluate expression*** The expression `NTF_peak[0]` changes to `0.0220855`.
16. Click ***OK***.
17. To create and define extract sources for the responses NTE, NCF, and NCE, repeat steps 6.3 through 6.16, except change the labels and keywords as indicated in the image below.

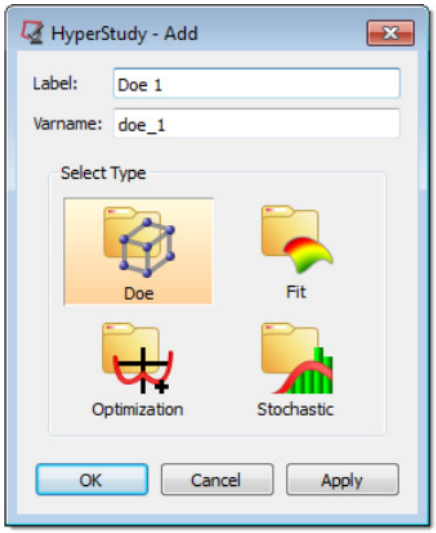


Step 7: Run a DOE Study

1. To add an approach to the study, right-click in the **Explorer** and select ***Add Approach*** from the context sensitive menu.



2. In the **HyperStudy - Add** dialog, add one **Doe** approach.



3. To continue on to the **Specifications** step, click ***Next***.
4. In the work area, set the **Mode** to ***Full Factorial***.
5. Click the ***Levels*** tab.
6. Change the number of **Levels** from 2 to 3 for all variables.
7. Click ***Apply***.
8. To continue on to the **Evaluate** step, click ***Next***.
9. Click ***Evaluate Tasks***. HyperStudy extracts all 27 simulations.
18. After the results are extracted, click ***Next*** to continue on to the **Post processing** step.

See Also:

HyperStudy Tutorials