WORKSHOP 1.3

Component design

Contents

Introduction

In this workshop, we will learn how to interface a component or subsystem. By adding connector and parameter interfaces to a component we will be able to use it in other models. We will create a test rig, to verify the components behavior. And optionally add an icon and some documentation.

Loading TrainingPack

In this workshop, we will utilize a training package prepared in advance. It is called **TrainingPack.zip** and should have been provided to you by your course leader. Follow the instructions below to upload it.

- Start the import by clicking the upload button in the *Library Browser*:

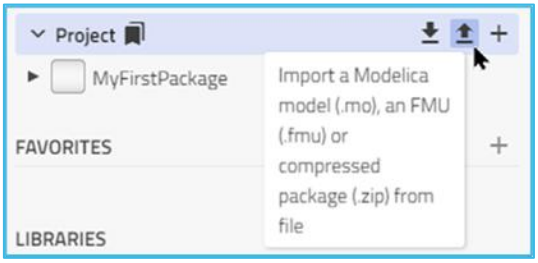


Figure 1 Import modelica package

- Select the supplied **TrainingPack.zip** file.

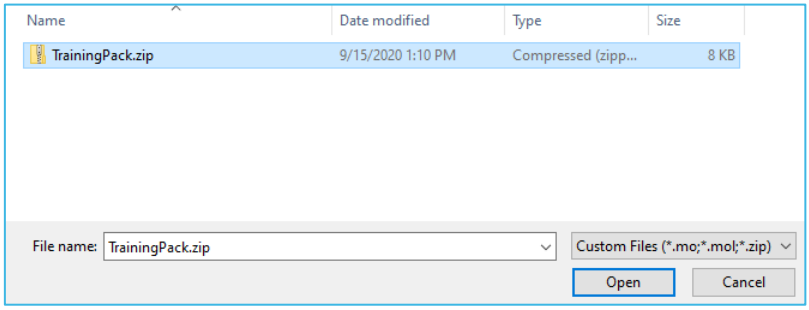


Figure 2 Load TrainingPack

- The package should now be ready to use.

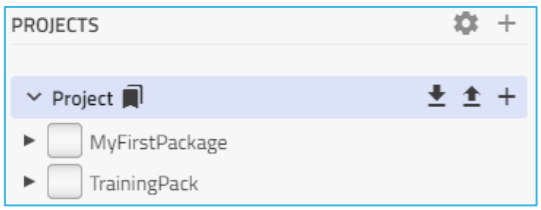


Figure 3 TrainingPack successfully loaded

Designing a component interface

To properly reuse subsystem components, you must consider the following:

- Parameter interface, choosing what data to expose and how to present it.
- Connector Interface, how the component can interact with other components.

In the following part of the workshop, you will create a simple wall segment with components from the **Modelica.Thermal.HeatTransfer.Components** package. You will propagate the necessary parameters and create a connector interface, so you can use the simple wall segment

1. Create a new sub-package called **Components** in **TrainingPack.W3.ComponentDesign** (you can right-click the ComponentDesign package, and choose "New package").
2. Create a new sub-package called **Experiments** in **TrainingPack.W3.ComponentDesign**
3. Create a new model called **LumpedIsolation** in **TrainingPack.W3.ComponentDesign.Components**
4. Drag and connect the following components from the **Modelica.Thermal.HeatTransfer.Components** package:

Class name	Instance name
ThermalConductor	outerLayer
ThermalConductor	innerLayer
HeatCapacitor	isolationHeatCapacity

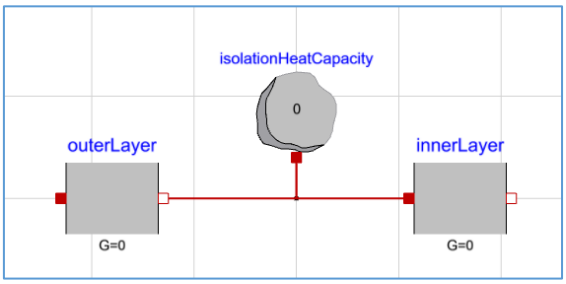
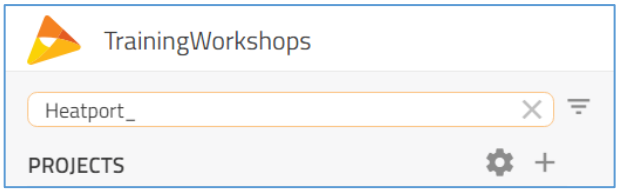
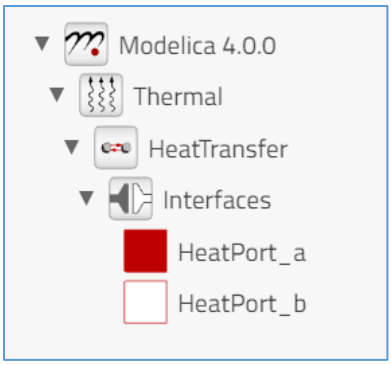


Figure 4 Connected components

5. Now we will create the connector interface. To find the needed connectors you can use the search bar in the top of the left panel:





6. Drag one ***HeatPort_a*** and one ***HeatPort_b*** into the model. Connect them to the inner- and outer-layer, as shown in **Figure** 5 below.

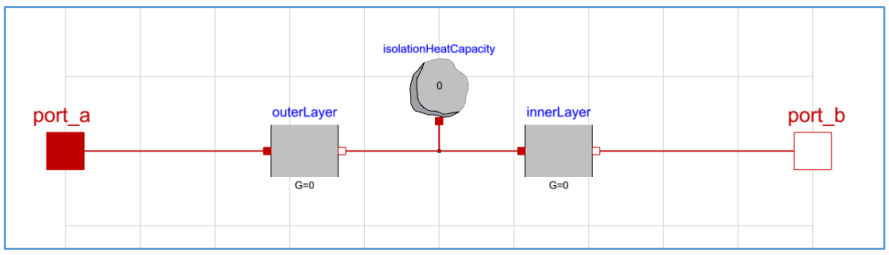


Figure 5 Connected components with connectors

7. Don't forget to remove the search filter before you move on, otherwise you cannot see all the content in the left pane.
8. We need to decide what data needs to be exposed when using the component. In this case, we will expose *G* and *C*. This is done in two steps:
   a. Create a new parameter in the component.
   b. Propagate the new parameter down into the instance as a modifier.
9. Open the **Properties** tab of the *Details Panel*. On the top right, there is a + button.

Figure 6 Finding Add Variable icon

10. Click the button to open the create new parameter dialog. Create the three parameters needed:

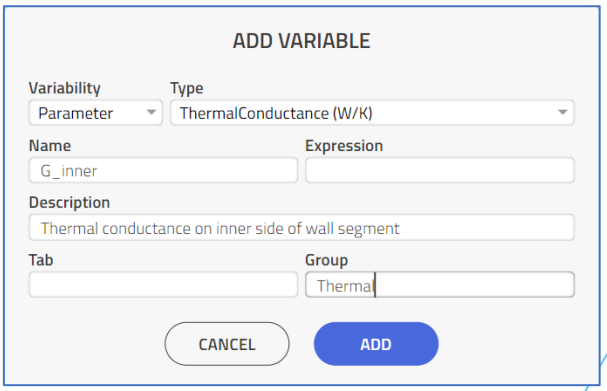
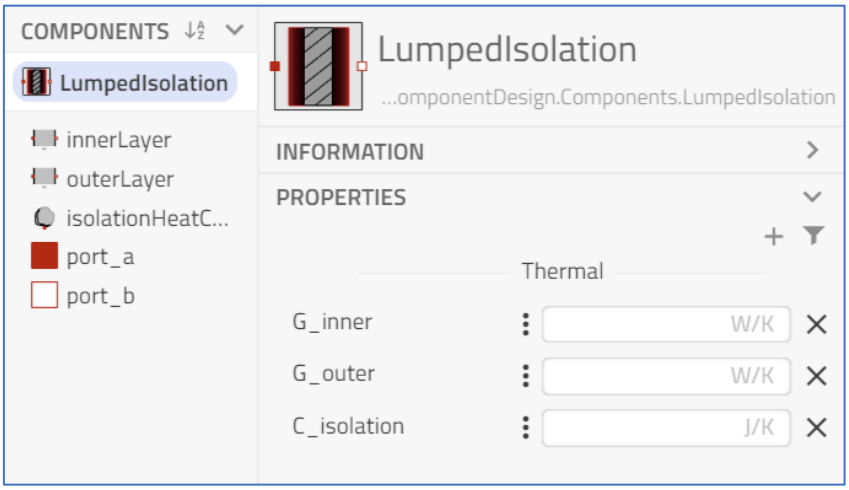


Figure 7 Creating new parameter for G_inner

Types for the coefficients are:

Coefficient	SI Unit Type	Unit	Group
G_inner	ThermalConductance	[W/K]	Thermal
G_outer	ThermalConductance	[W/K]	Thermal
C_isolation	HeatCapacity	[J/K]	Thermal

11. When you are done the "Properties" tab looks like this:



12. Now all parameters are declared in the LumpedIsolation model, the last thing we need to do is to propagate these into the subcomponents, by placing modifiers on the components. Click on *outerLayer*, and go to the parameter *G*.
13. The idea is to modify *G* with the new parameter *G_outer* that we created. If you click the parameter value box, you can autocomplete the content of the instance tree; start typing *G* and choose *G_outer* from the list.
14. Similarly, select *G_inner* for *innerLayer.G*, *C_isolation* for *isolationHeatCapacity.C*.

Figure 8 Modifying J with the new parameter

Test Rig

Next step is to test the behavior of the component. You will create a test rig, mount the component, and simulate it.

15. Create a test experiment for the wall segment component.
    a. Create a new model **TestBench** in **TrainingPack.W3.ComponentDesign.Experiments**.
    b. Drag in the **LumpedIsolation** component.
    c. Drag the following:
        1. ***Modelica.Thermal.HeatTransfer.Sources.FixedTemperature***
        2. ***Modelica.Thermal.HeatTransfer.Sources.PrescribedTemperature***
        3. ***Modelica.Blocks.Sources.Sine***
    d. Connect them according to the schema below in **Figure** 9:

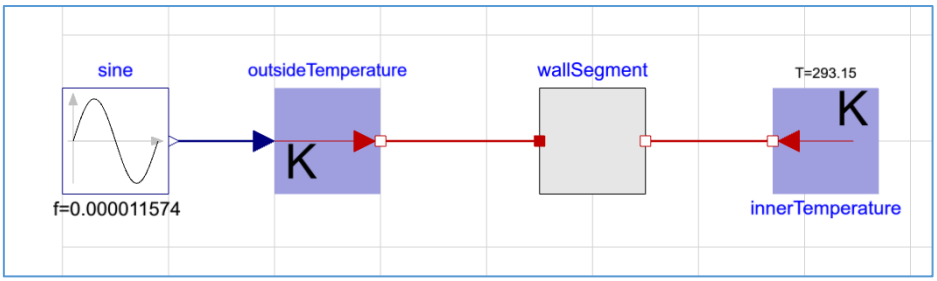


Figure 9 wallSegment mounted in a test bench

e. Parametrize the model according to the data given below:

Parameter:	Value:
sine.amplitude	8
sine.freqHz	1/86400 [Hz]
sine.offset	273.15
wallSegment.C_isolation	0.8*0.3e6
wallSegment.G_inner	0.12*1/(0.15)
wallSegment.G_outer	0.12*1/(0.15)

Here the thickness of the wall is chosen to be 0.3m, lambda=0.12 for wood, and volumetric heat capacity 0.8e6.

f. In Experiment settings, chose "Points=2000", and simulate the model for 86400 seconds. Plot the temperature outside, inside, and in the wall.

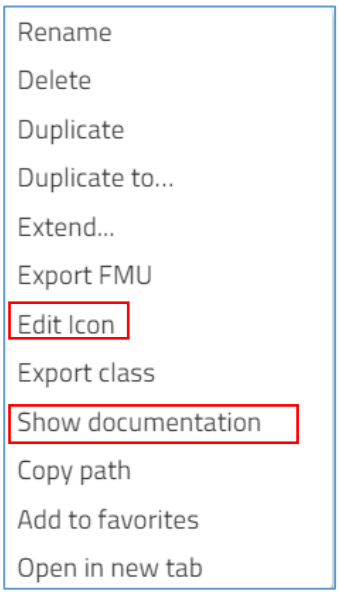
Figure 10 Results of elastic shaft experiment

Create an icon and add documentation

Use the icon editor to create a nice icon for the LumpedIsolation component.

Use the documentation editor to add information about the component.

This can be done by right-clicking on the **LumpedIsolation** class and selecting *Edit Icon* and *Show documentation*, respectively. See figure below.



This concludes workshop 1.3. Well done!