

How to Use DESERT

Introduction

This document explores a model of a mass, spring, and damper system in CyPhy. The document explains how to use the Design Space Exploration Tool (DESERT) and the Master Interpreter to run simulations on the MyMassSpringDamper using alternate component configurations.

DESERT and the Master Interpreter make it easy to compare results between designs that have alternate components. For example, if one wanted to see how the MyMassSpringDamper behaves with a tungsten spring rather than the steel spring, just a few steps are necessary to see the difference in behavior between the two using these tools.

The Master Interpreter has an additional purpose. It allows users to simulate a component assembly using multiple different interpreters at the same time. This saves the user's time.

This document is **Part 3** in a series of **three (3) educational documents** explaining how to use GME/CyPhy to make a component assembly, make a test bench on the assembly, and then run simulations using alternate components.

Design Spaces

Conceptually, a design space is defined as the whole realm of design possibilities given a set of constraints. For example, installing a special type of shocks in a car's suspension may limit the number of different A-arms that you can use in the suspension. We would say in this situation that you have placed a constraint on your design space. CyPhy uses the idea of design spaces to help the user develop the best possible design.

Instruction

The user is expected to have the MyMassSpringDamper component assembly and Test Bench containing the MyMassSpringDamper fully built as outlined in **Parts 1 and 2** of this series of documents.

Workflow Definition

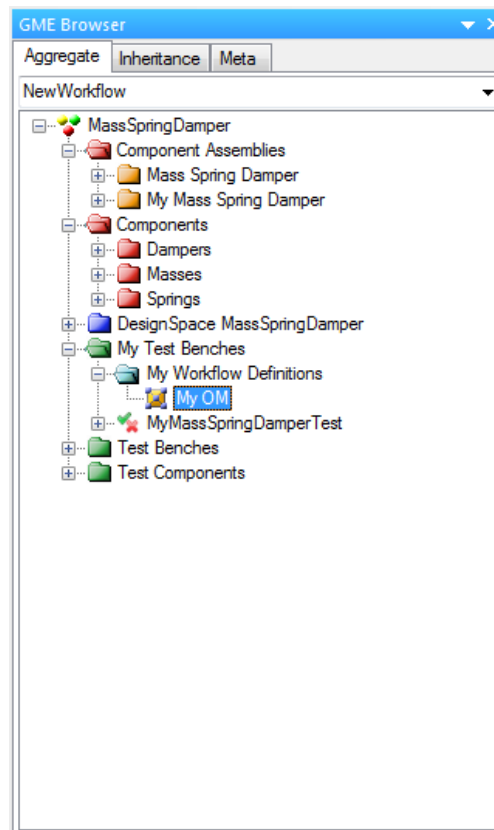
A workflow definition is an object that tells CyPhy's master interpreter which interpreters we want to use. In the MyMassSpringDamper, there are two different models wrapped in the CyPhy for each component; A Modelica model and a CAD model. We need to implement the OM(OpenModelica) workflow definition.

- *Note: At this time, it is not supported to use the DESERT and Master Interpreter tools to assemble CAD models. We will only simulate the Modelica models inside the MyMassSpringDamper in this document (As of 7/11/2012). This is why the workflow definition contains only the OpenModelica aspect. This document is still informative because the steps can be taken to include CAD without much modification. To use the CAD interpreter include the CyPhy2CAD task in the workflow definition.*

Right-click on the Test Bench folder that contains the MyMassSpringDamper test and go to Insert Folder > Workflow Definitions. Right-click on the new folder and select Insert Model > Workflow Definition. Call the new workflow “OM”.

We could call the workflow anything we like, but we will call it “OM” to stand for “OpenModelica”.

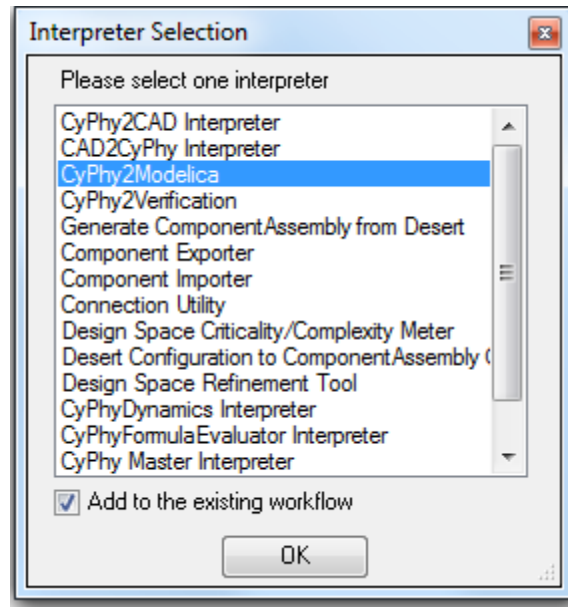
The GME Browser Tree should look like the following:



Double-click on the workflow. Go to the Part Browser and drag the task onto the work space.

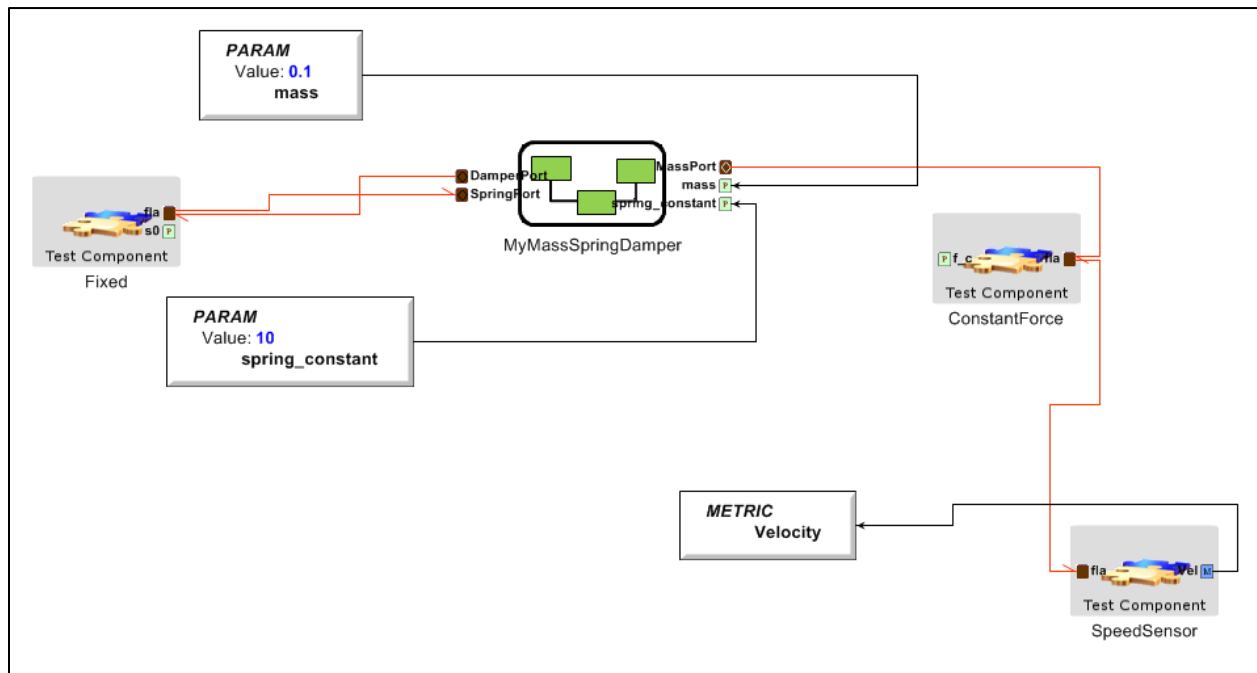
A window will pop up, asking you what kind of interpreter to use. The window looks like the figure below. **Choose “CyPhy2Modelica”.**

In theory, we could add any number of Tasks to the work space and connect them in different ways. However, we only want to use the CyPhy2Modelica interpreter, so that is all we need to include.



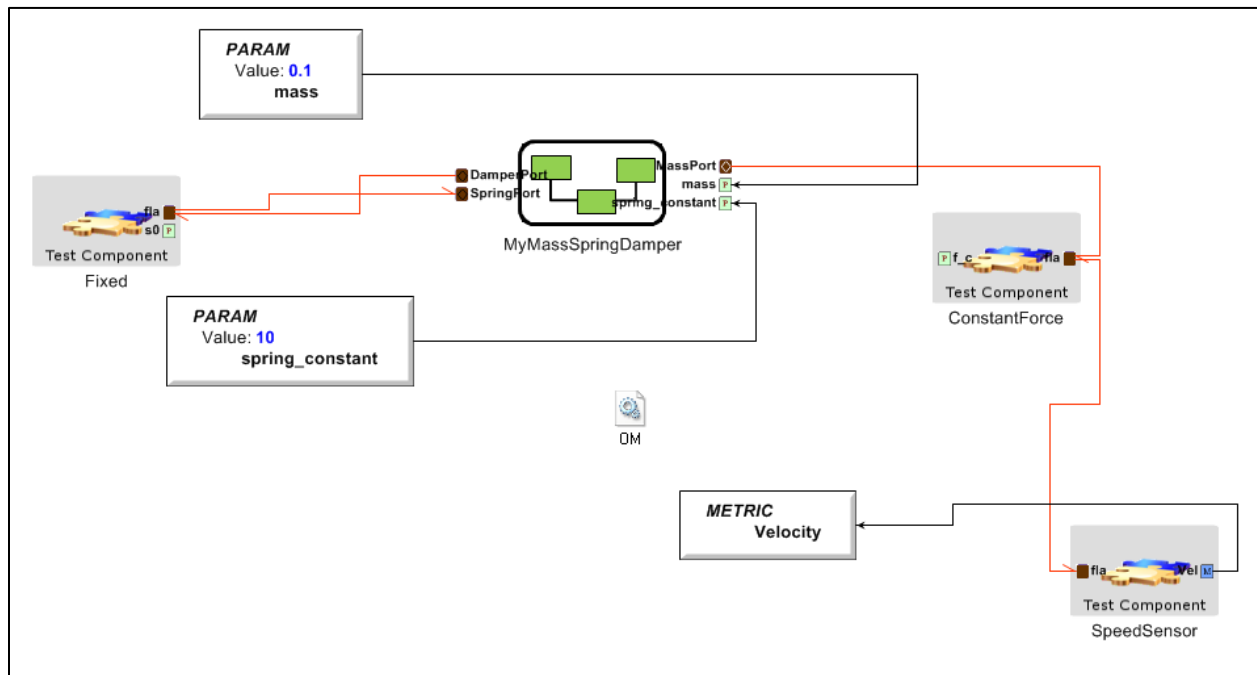
Go back to the Test Bench folder and double-click on the “MyMassSpringDamperTest”.

The work space should look like the following.



Right-click on the Workflow Definition. Select “Copy”. Then go to the Work Space and right-click on any of the white space. Select Paste Special > As Reference.

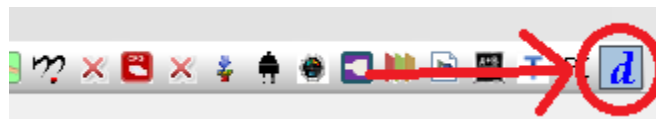
The work space should look like this (Note the OM Workflow Definition near the center):



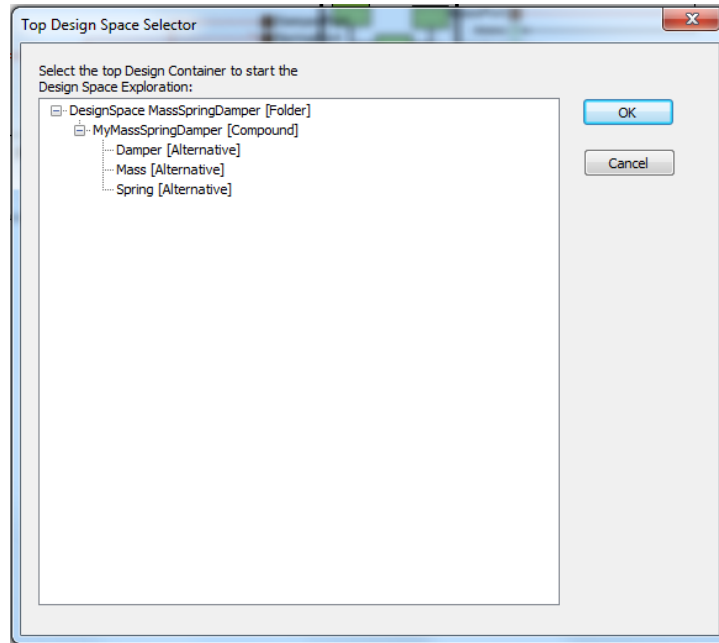
DESERT Simulation

The DESERT simulator is a tool in CyPhy that lets the user analyze multiple configurations of the same component assembly.

The DESERT icon is displayed in the figure below. **Click on the DESERT icon.**



The following window will pop up. **Click on “MyMassSpringDamper [Compound].**



We are telling CyPhy that we want to run DESERT on the full (“compound”) component assembly, not one of its components such as the Mass or the Spring.

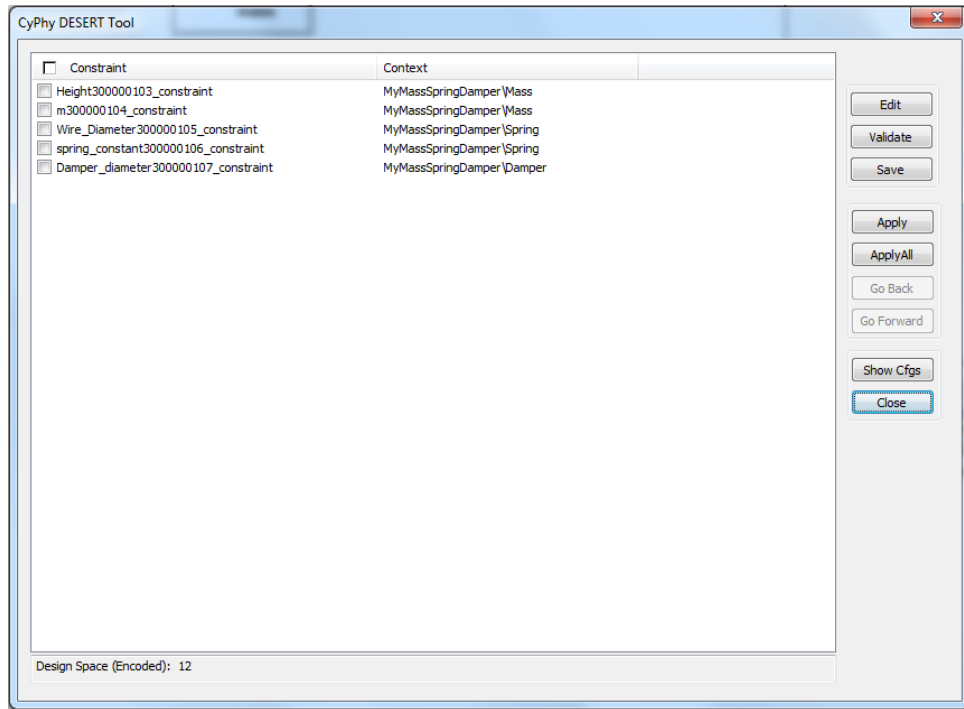
Next, the window in the following figure will pop up. This is a list of constraints on the design space. Constraints are restrictions on the number of designs that can be made.

For example, the lightest gold mass is so light that its height is lower than the minimum for the Mass component. The range of acceptable heights for the Mass component is recorded in the Parameter called “Height” in the Mass component. The stated range is [10, 50]. Since the height of the gold mass is lower than the minimum, all configurations that include the lightest gold mass are omitted when the constraint on the height of the mass is applied.

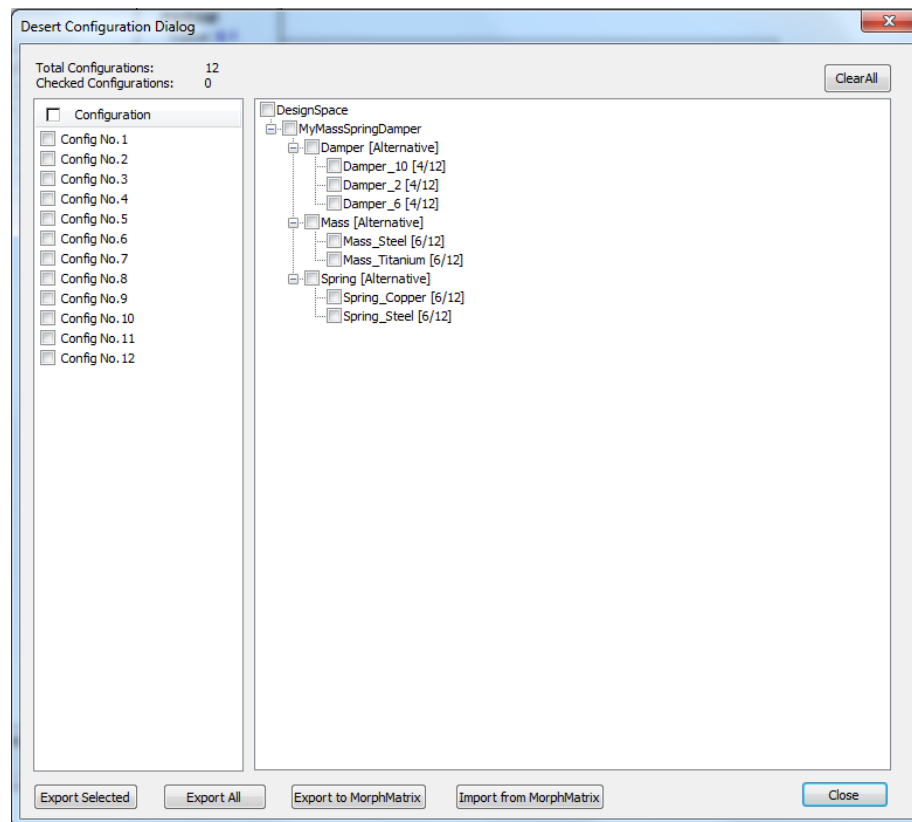
Constraints to the MyMassSpringDamper are determined automatically by CyPhy.

Click “Apply All.” After the computer is finished working, **click “Show Cfgs”.**

“Show Cfgs” stands for “Show Configurations”.



A window called “Desert Configuration Dialog” will pop up. This window is used to select which designs to analyze. The window will look like the following figure:

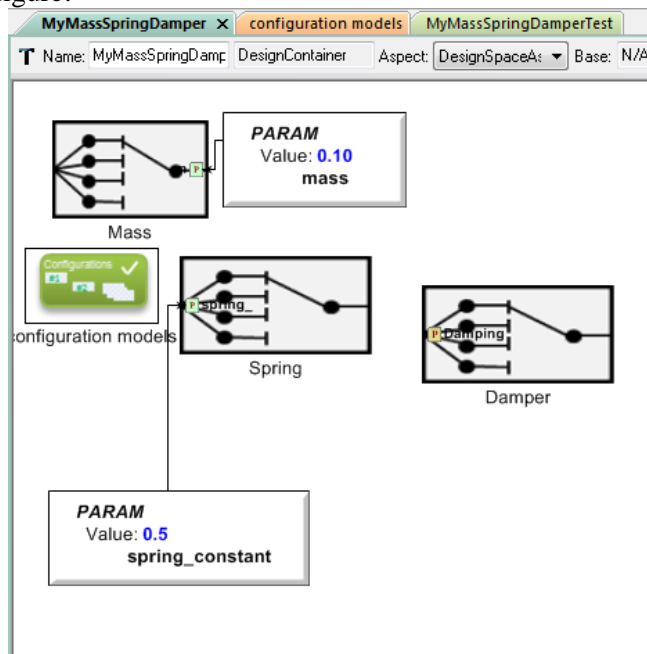


You may select any number of configurations explore, from just one configuration to all of them. For the purposes of this demonstration, we will export all of the configurations to show how convenient the tools can be and to give the user freedom to explore all of the results at the end of the walkthrough.

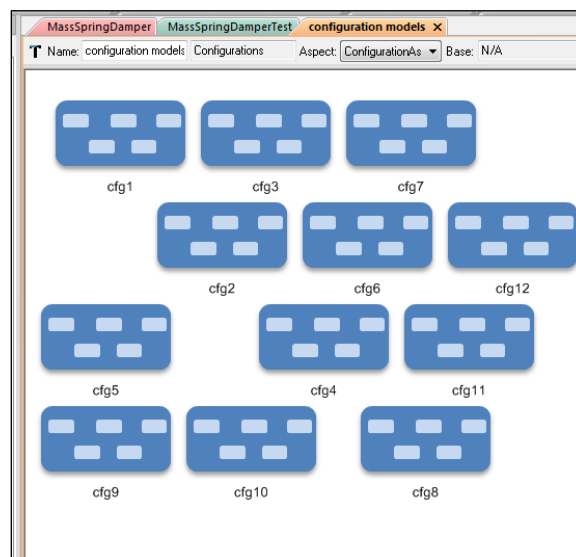
Click “Export All”. After the program has finished exporting, close the windows and click “Save”.

**Navigate to the MyMassSpringDamper design container.
Select the ‘Design Space’ aspect.**

There should be a green rectangle in the Design Space titled “Configurations”. The work space will look similar to the following figure:



Double-click on the Configurations box. The screen should look like the following figure:

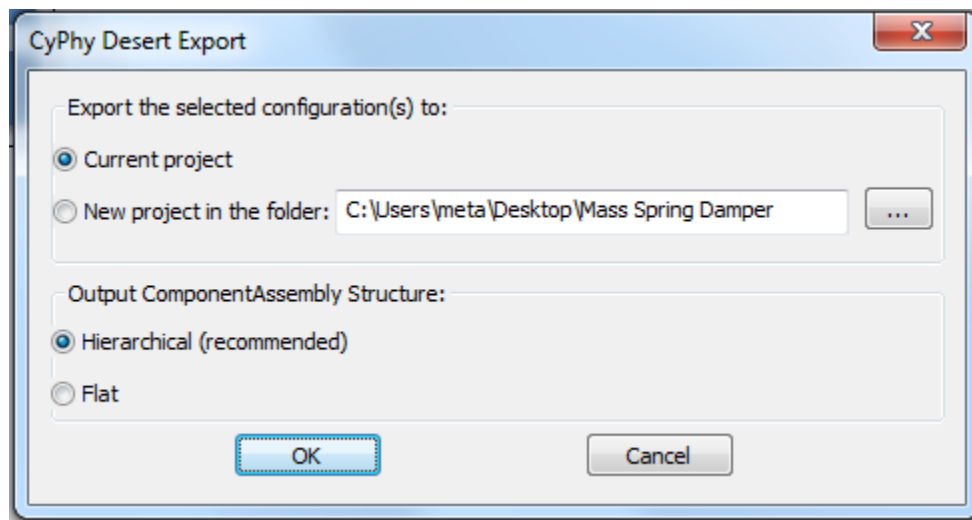


lick and drag from one corner of the work space to another so that all of the boxes in the diagram are selected. Click the red “Generate Component Assembly from Desert” button.

The button looks like the following:

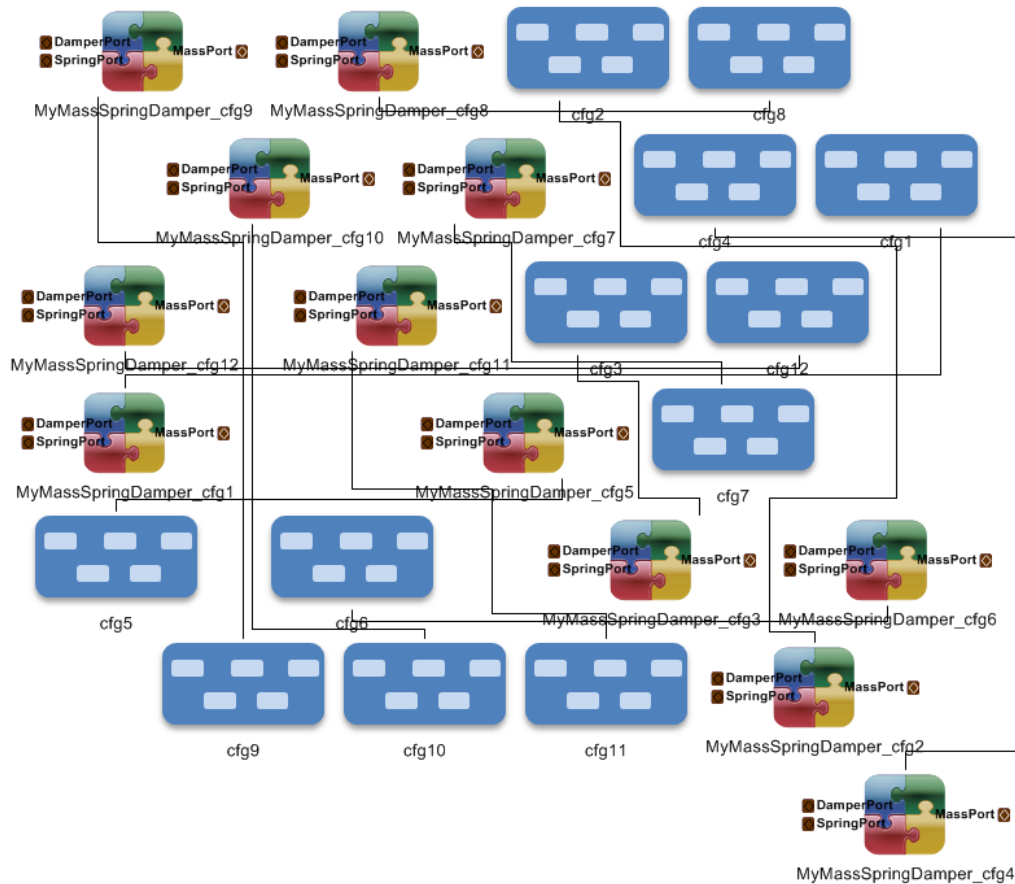


After clicking on that button, a screen will pop up that looks like this:



You can simply click ok in this window.

Wait a few moments for the computer to finish running before continuing. The work space inside the Configurations box will look similar to the following figure.



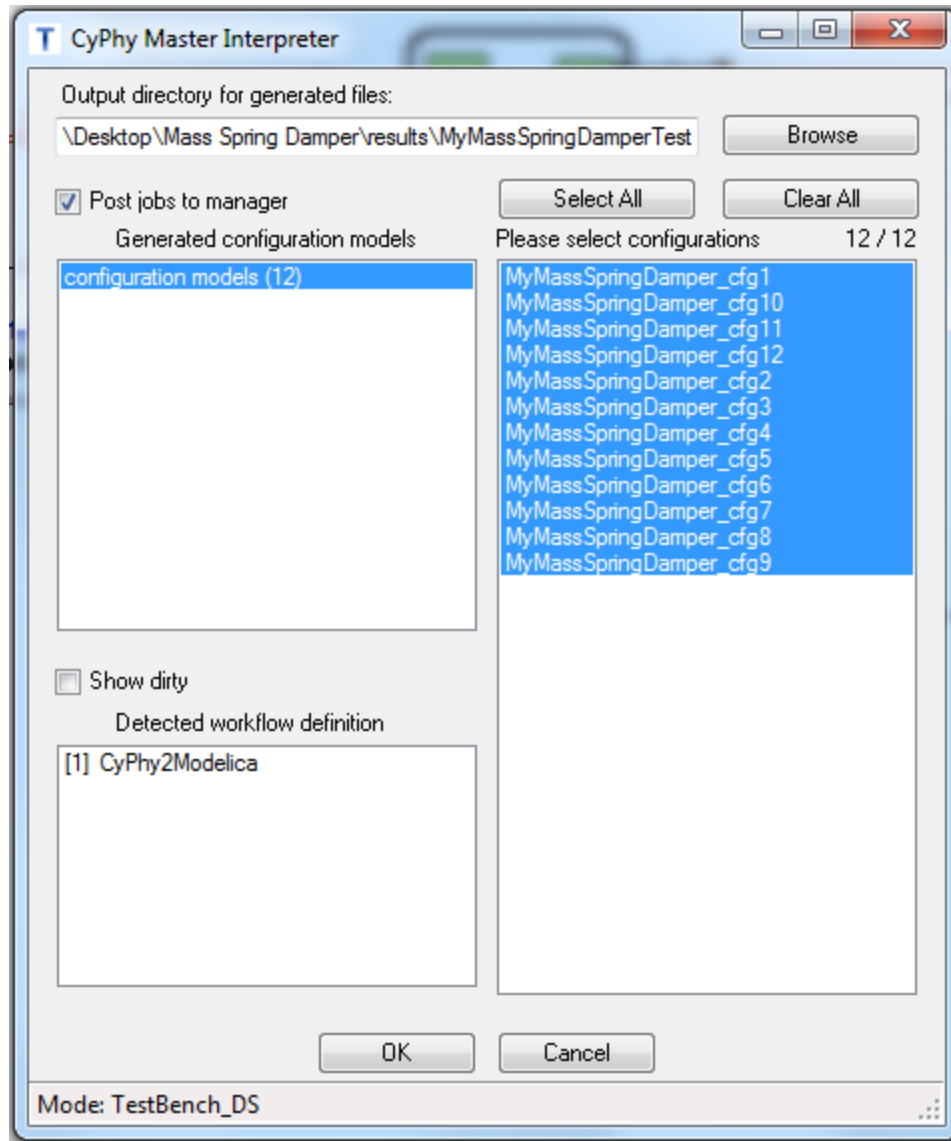
Using the Master Interpreter

The Master Interpreter is a tool in CyPhy that lets the user generate simulation files from multiple interpreters using the workflow definition that was just created. The icon for the Master Interpreter is a white “T” on the top toolbar.

Go back to the MyMassSpringDamper Testbench. Click on the circled icon in GME. This is the Master Interpreter.



A window like the following will pop up.



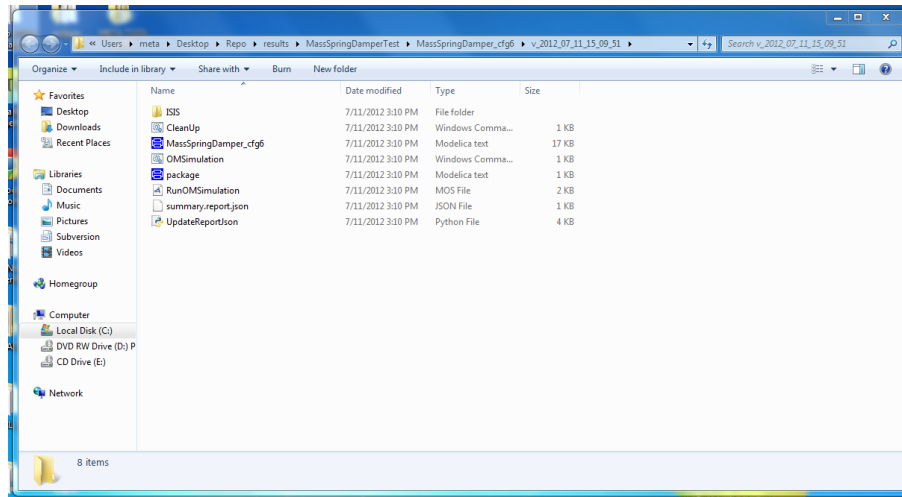
Again, in order to show the user how convenient these tools can be and to give the user more flexibility to inspect results, we will select all of the configurations to be run through the interpreter.

Click “Select All”. Check the box that says “Post jobs to manager”.

Click “OK”. Lines of text will appear in the Console Window. CyPhy will produce links to the simulation data. Those lines will start with: **“Output files are”**. Wait until the program has finished running before continuing.

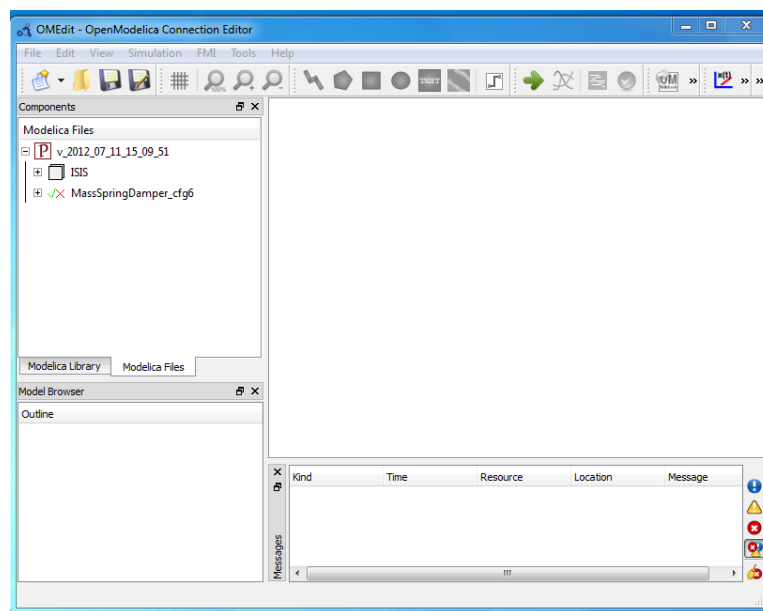
Seeing Results in OpenModelica

When you click on a link in the Console Window of GME, a window will pop up that looks similar to this:



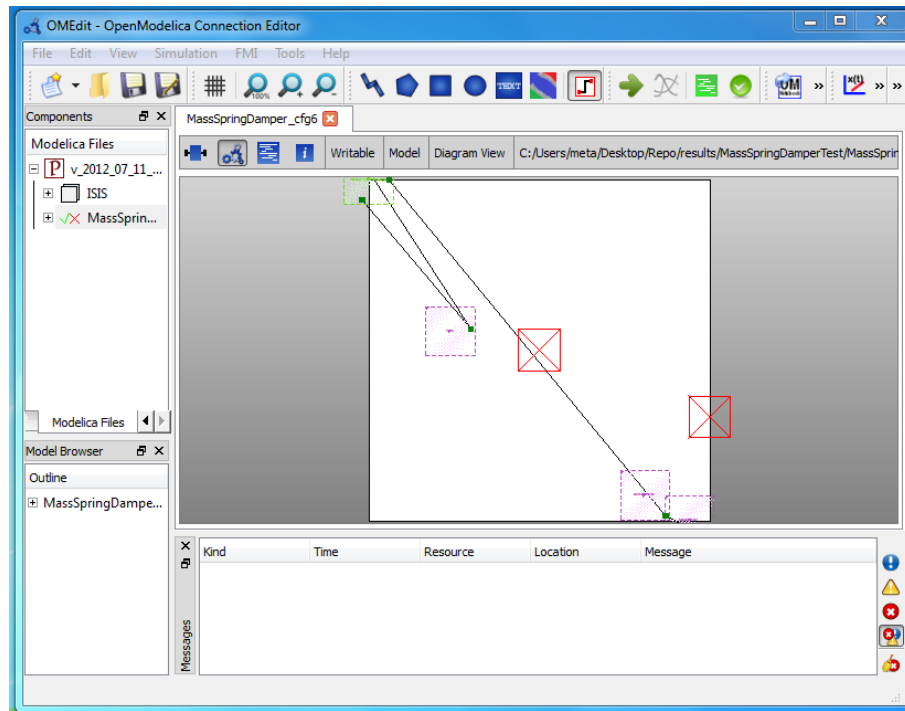
Open the Modelica file named “package” in OpenModelica. The CyPhy2Modelica interpreter will always name the file containing the model “package”. The other output files support the package.

The OpenModelica window should look similar to this:



Double-click on the checkmark-and-x icon. The work space should look similar to the following.

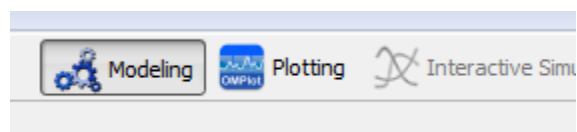
It is not important how the model looks in the work space. Packages generated from the interpreter are designed only for simulation.



Click on the Simulate icon. It is a green arrow.

OpenModelica will begin simulation of the model.

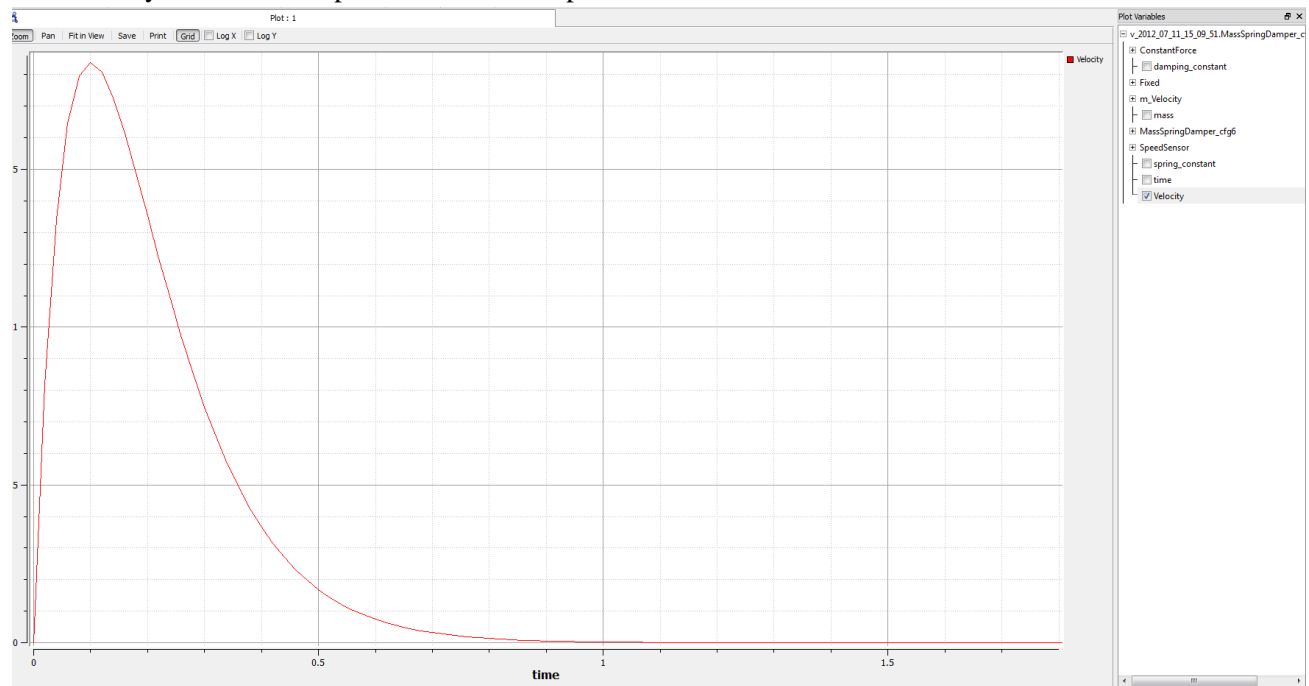
Once OpenModelica has finished the simulation, click on “Plotting”. The icon is located on the toolbar to the right.



A blank graph should appear. Use the tree to the right to find the variables that you want to plot.



The velocity of the mass is plotted in this example.



The user can open OpenModelica multiple times and follow the above procedure. Then the user can compare results by comparing similar curves.

Conclusion

This concludes the third and final part of an educational series of documents that explains how to:

- 1) Make a component assembly,
- 2) How to make a test bench and a design space,
- 3) How to simulate the component assembly along with alternate configurations simultaneously using DESERT and the Master Interpreter.

If the reader would like to know more about CyPhy, GME, DESERT, or other things related to the AVM Project, please consult the Documentation Project on Vehicleforge.net.