Saber®
Simulink Co-simulation Interface
User Guide

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chapter 1

Saber-Simulink Co-simulation Overview

Saber-Simulink Co-simulation is an interface between the Saber simulator and the Mathwork's Simulink that allows designs to be simulated interactively. The Saber-Simulink Co-simulation solution consists of two sets of functionality. The core functionality couples the Saber and Simulink simulation algorithms. The second is a user interface which supports the generation of Saber MAST templates and Saber Sketch symbols automatically from the Simulink model.

Simulation Coupling

The Saber-Simulink Co-simulation interface is currently enabled through a synchronous method of communication between simulation engines. In the synchronous method of co-simulation, each simulation engine progresses independently in time and exchanges data at a predetermined period known as the Co-simulation Step Size (dt). From the viewpoint of each simulator, the information received from the other during co-simulation is effectively sampled by a zero-order hold at a rate of 1/dt.

The synchronous approach to Saber-Simulink Co-simulation has both advantages and disadvantages:

Advantages:

The Simulink user interface is active and accessible during simulation

Works efficiently with periodic sampled systems since it can sample when required on the Simulink side

Disadvantages:

No error control between simulators

For continuous or non-periodic systems the user must specify a co-simulation step size that is sufficiently small enough to capture the behaviors of interest. As a suggested rule-of-thumb, over-sample by 10 times the smallest time constant of the combined Saber-Simulink

system to reduce or minimize distortion and aliasing errors. The user should be aware, however, that a smaller co-simulation step size will increase overall simulation time and may cause numerical noise in Simulink.

User Interface

The user interface can be divided into three categories: creating the design, running a simulation, and analyzing the results. Each of these is briefly discussed below.

Creating the Design

The creation of the schematic diagrams within Saber Sketch and Simulink is performed using the standard techniques for these tools with the added consideration that selected signals each design will be connected to a co-simulation interface block.

A co-simulation interface model, named SaberCosim.mdl, must be inserted into the Simulink diagram. This model has an input, an output, and two properties defining the width (number of signals) at the input and output. The signals are then routed through muxes and demuxes to these inputs and outputs.

Adjacently, a co-simulation interface symbol and MAST template must be available and placed appropriately on the corresponding Saber Sketch schematic. In order to simplify the process of creating the required symbol and template, the Saber-Simulink Co-simulation capability includes a graphical model generation tool.

Running a Simulation

Running the co-simulation is controlled entirely from the Saber interface, either from the Saber command line or from the Saber Guide interface within Saber Sketch. Saber simulation commands can be used according to user preference. There are no changes to Saber simulation commands or Saber Guide to support the Saber-Simulink Co-simulation.

Changes to the Simulink model simulation settings can be made at any time as long as no analyses are being run.

Analyzing the Results

The results of the simulation can be analyzed in both CosmosScope and Simulink during and after the simulation run.

chapter 2

Using the Saber-Simulink Co-simulation Tool

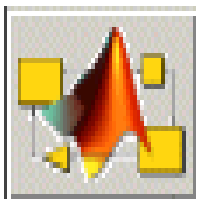
A few steps must first be completed in order to co-simulate a Simulink model with a Saber Sketch design. The first step is installing the required files for co-simulation. Next, the Simulink model and the Saber Sketch design must be modified for use in a co-simulation. Once this has been done, a co-simulation can be performed by running an analysis on the modified Saber Sketch design.

Installing the Co-simulation Files

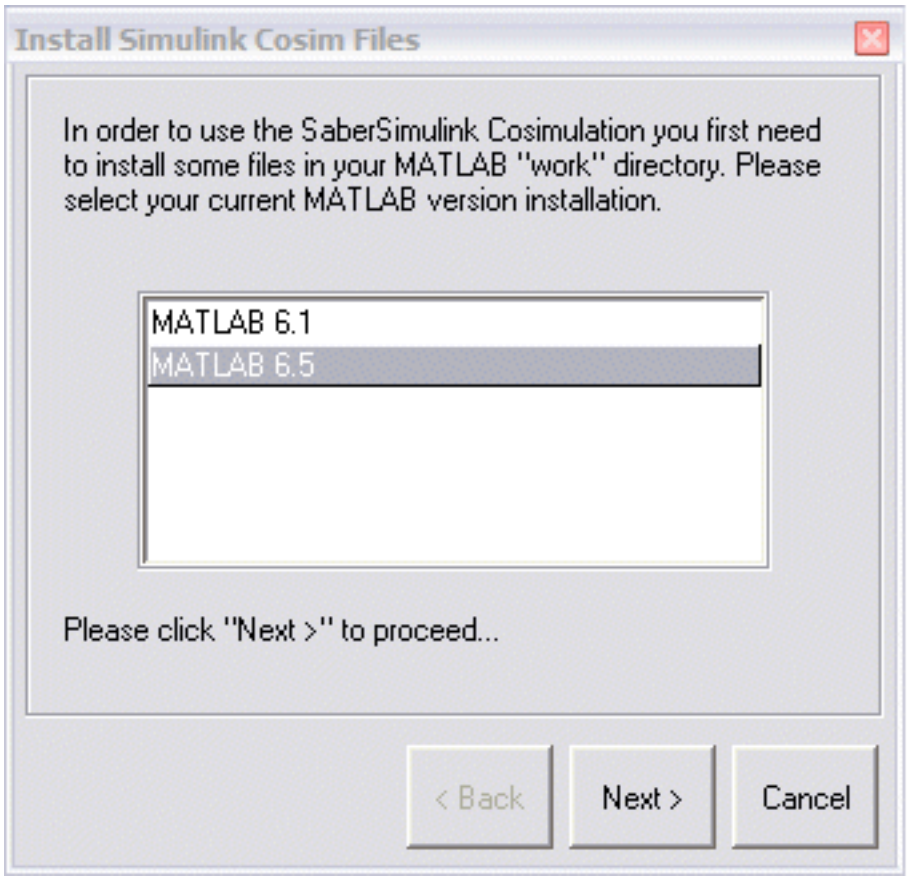
Matlab files must be installed before using the Saber-Simulink Co-simulation interface and any time the user wishes to switch to another version of Matlab supported by the Saber-Simulink Co-simulation interface.

The procedure is:

1. Invoke Saber Sketch and open the Saber-Simulink Co-Simulation Tool with the “open” button.

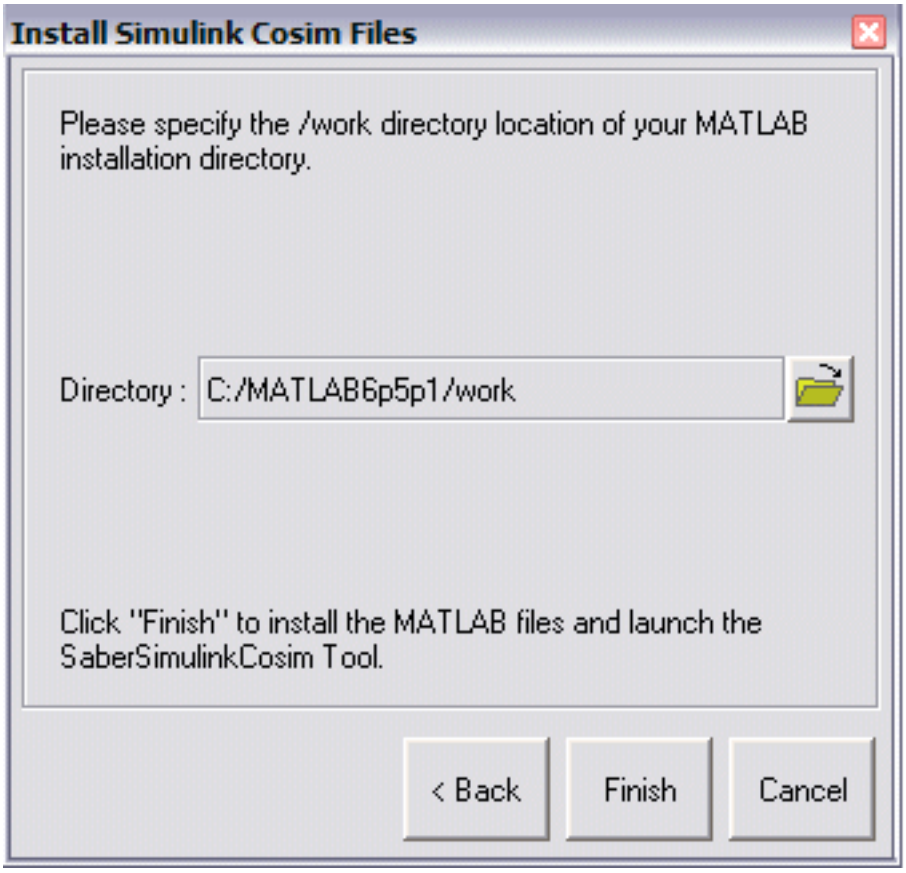


2. Press File > Install Cosim Files
3. Select the version of Matlab being used (6.1 or 6.5) and press Next



4. Select the Matlab work directory. The default location of the work directory in Matlab 6.5 is:

   C:\MATLAB6p5p1\work



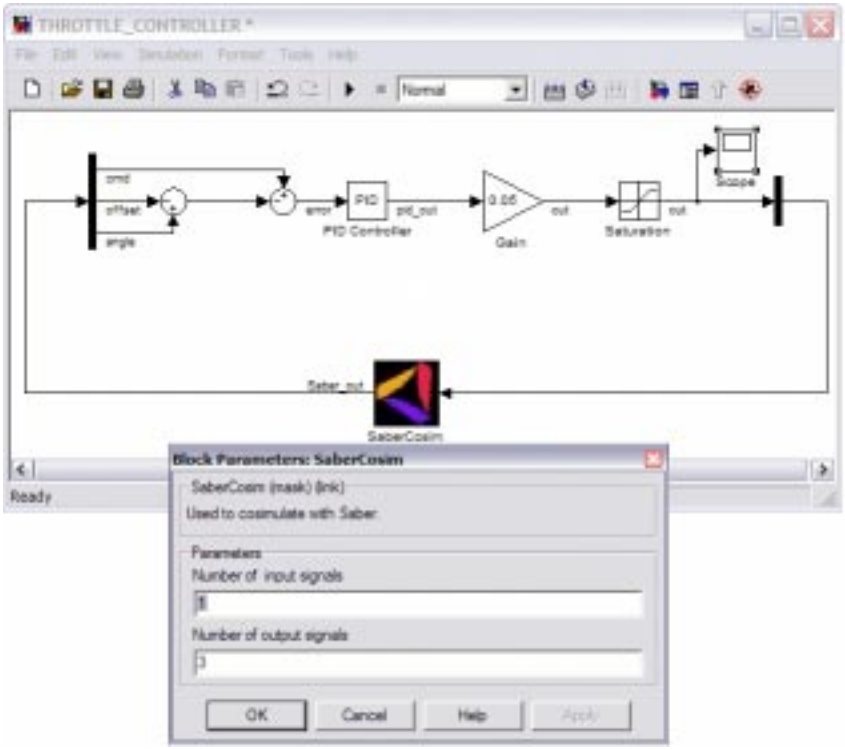
5. Press the Finish button and the required Matlab files will automatically be installed.

Preparing the Simulink model

In order to use a Simulink model in a co-simulation with Saber it must be modified to include a Saber Co-simulation block. This step must be completed for all Simulink models that will be used in a co-simulation with Saber.

1. 1.Open the Simulink model.
2. Associate the inputs of the Simulink model with the output of a demux block.
3. Associate the outputs of the Simulink model with the inputs of a mux block.

4. Place the Saber Co-simulation block in the Simulink model. This block can be found in the Matlab work directory specified during the installation of the Matlab files.
5. Modify the properties of the Saber Co-simulation block to have the correct number of inputs and outputs.
6. Connect the Saber Co-simulation block to the mux and demux blocks described in steps 2 and 3.

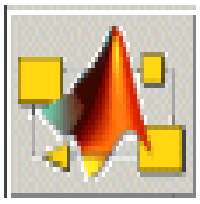


7. Save the Simulink Model and close all Matlab windows.

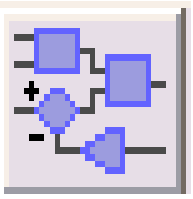
Preparing the Saber Design

Once the Simulink model has been modified, the Saber-Simulink Co-Simulation Tool is used to generate the required co-simulation interface symbol and template for the Saber Sketch design.

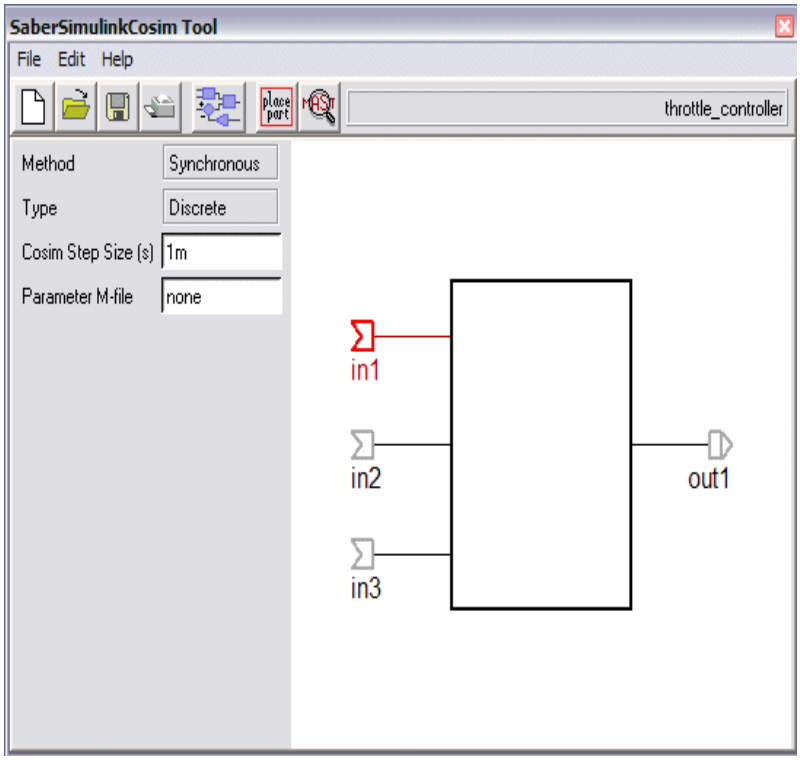
1. Invoke Saber Sketch
2. Invoke the Saber-Simulink Co-simulation Tool with the “open” button.



3. Press the Import Simulink Model button:

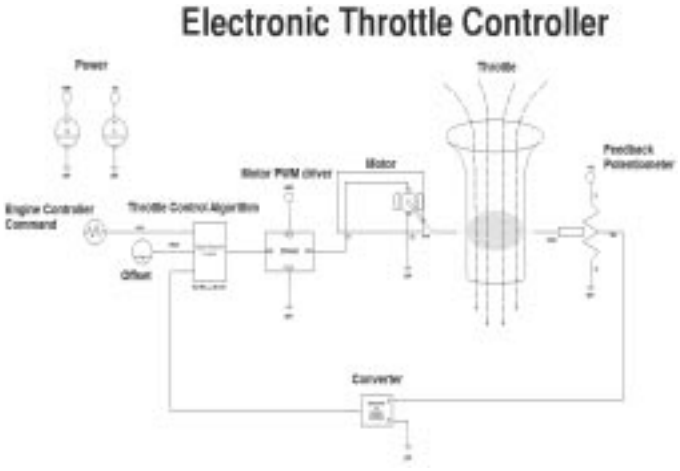


4. Browse to the location of the Simulink model that was previously prepared for co-simulation.
5. Press the Open button and the symbol preview window as well as the values for the co-simulation properties will be updated.
   a. The pin order of the inputs and outputs can be re-ordered by clicking and dragging them with the mouse.
   b. The Cosim Step Size can be modified.
   c. A parameter M-file can be specified. The parameter M-file is an optional Matlab file that can be used for initializing parameters and variables that are used by the Simulink model.



6. Press the Save icon after specifying all of the desired options. The Saber Sketch symbol and the associated MAST template will be saved in the specified directory.

7. Press the Place Part button to place the symbol in the current Saber Sketch design.



8. Connect the Saber-Simulink Co-simulation symbol in the Saber Sketch design.

Running a Saber-Simulink Co-simulation

After the Saber-Simulink Co-simulation symbol has been placed in your design, a co-simulation with Simulink can be performed.

1. Netlist the design.
2. Load the design into the simulator by pressing Design->Simulate

   d. Matlab will be invoked automatically

   e. The Simulink model used in co-simulation will be opened automatically
3. Perform the desired analysis. The communication between Saber and Simulink is automatically set up by the co-simulation blocks placed in the Saber Sketch design and the Simulink model.
4. Signals in the Saber Sketch design can be viewed in CosmosScope and signals found in the Simulink model can be viewed in Simulink. Alternatively, SaberLink can be used to transfer data between Simulink and Saber to view all signals in one viewer.

appendix A

Frequently Asked Questions

Question: How does the Saber-Simulink Co-simulation interface work?

Answer: It works by leveraging Saber's foreign routine interface, and available hooks in the MATLAB engine interface. Communication between Saber and Simulink is made possible through an S-function.

Question: What operating system(s) is the Saber-Simulink Co-simulation interface currently supported on?

Answer: Saber-Simulink Co-simulation is currently supported on PCs running Windows 2000 or XP.

Question: What versions of Saber and MATLAB are required to run the Saber-Simulink Co-simulation interface?

Answer: Saber 2004.03 or higher and Matlab R12.1 or R13

Question: How do I install the files required to run the Saber-Simulink Co-simulation interface?

Answer: From the Saber-Simulink Co-simulation Tool, choose 'File > Install Cosim Files…'. Select the version of MATLAB you are using and click 'Next'. Then, browse to the location of the 'work' directory in your MATLAB installation and press 'Finish'.

Question: How can I initialize variables within my Simulink model?

Answer: The Saber-Simulink Co-simulation Tool provides a property called 'Parameter M-File' for initializing variables in the MATLAB environment. Specify the name of the m-file (without the ".m" extension) that you would like to execute at the start of the co-simulation. The specified m-file should be located in the current working directory of the design.

Question: What is the 'Co-simulation Step Size'?

Answer: The Co-simulation Step Size specifies the period at which Saber and Simulink exchange data during co-simulation.

Question: What are the implications of the synchronous co-simulation method used by the Saber-Simulink Co-simulation interface?

Answer: The synchronous co-simulation method causes Saber and Simulink to exchange data at a fixed period, effectively sampling the data sent between each tool. This is equivalent to communicating through a zero-order hold operating at a period determined by the Co-simulation Step Size.

Question: Do I need to open my Simulink model before co-simulating with Saber?

Answer: No, Saber will automatically load the Simulink model during initialization of a co-simulation.

Question: What types of analyses can I perform with the Saber-Simulink Co-simulation interface?

Answer: The Saber-Simulink Co-simulation interface supports most of Saber's analyses, including DC, Transient, Vary, and Monte Carlo.

BOOKSHELF

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CosmosScope™ MATLAB® Interface User Guide

CosmosScope™ Reference Manual

Saber® and CosmosScope™ AIM User Guide

Saber® and CosmosScope™ Command Line Tool User Guide

Saber® and CosmosScope™ Draw Tool User Guide

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