# Getting Started with the MapleSim Connector

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# Contents

# Introduction

The MapleSim™ Connector provides all of the tools you need to prepare and export your dynamic systems models to Simulink® as S-function blocks. You can create a model in MapleSim, simplify it in Maple™ by using an extensive range of analytical tools, and then generate an S-function block that you can incorporate into your Simulink toolchain.

You can also use these tools for exporting mathematical models that you have created from first principles in Maple as S-functions.

Furthermore, various options allow you to use the C code generation feature in Maple to create code libraries of your MapleSim models for implementation in other applications.

Features of this toolbox include:

- Maple templates, which provide an intuitive user interface for optimizing your MapleSim model, and then generate an S-function in Simulink.
- A range of examples illustrating how to prepare and export your models.
- A direct interface between Maple and Simulink allows you to generate and test an S-function block as you develop the model.
- Commands for developing S-functions of mathematical models from first principles in the Maple environment and examples to illustrate how to do it.
- Access to commands in the **MapleSimConnector** and **DynamicSystems** packages in Maple for developing automated applications to generate S-functions.

## Scope of Model Support

MapleSim is a very comprehensive modeling tool where it is possible to create models that could go beyond the scope of this MapleSim Connector release. In general, the MapleSim Connector supports systems of any complexity, including systems of DAEs of any index, in any mix of domains, as long as they exhibit continuous behavior. Systems that contain any type of discontinuity, including discrete transforms, switches, logic gates, relational and Boolean operations are not supported by the current release of this product.

Apart from all of the engineering and signal components that are continuous, this product also supports lookup tables, and custom components that do not use discontinuous operations such as piecewise functions.

## System Requirements

For installation instructions and a complete list of system requirements, see the **Install.html** file on the product disc.

# 1 Getting Started

## 1.1 Setting Up the MapleSim Connector

To generate an S-function block and have Maple communicate with MATLAB you have to establish a connection with MATLAB.

Start Maple and enter the following command to establish a connection with MATLAB.

> *Matlab*[*evalM*]("simulink")

A MATLAB command window opens and the connection is established. If the window does not open, follow the instructions in the **Matlab/setup** help page in the Maple help system to configure the connection.

Next, set up the MATLAB mex compiler. Go to the MATLAB command window and enter the setup command.

```
>> mex -setup
Please choose your compiler for building external interface (MEX) files:

Would you like mex to locate installed compilers [y]/n?
```

Follow the instructions to choose a local C compiler that supports ANSI (American National Standards Institute) C code.

See the **MapleSimConnector,setup** help page for more information.

You are now ready to use the MapleSim Connector.

## 1.2 Getting Help

In Maple, enter **?MapleSimConnector** at a prompt in a worksheet.

## 1.3 Using the Simulink Component Block Generation Template

The MapleSim Connector provides a **Simulink Component Block Generation** template in the form of a Maple worksheet for manipulating and exporting MapleSim subsystems. This template contains pre-built embedded components that allow you to generate S-function or C code from a MapleSim subsystem, export the subsystem as a Simulink block, and save the source code.

Using this template, you can define inputs and outputs for the system, set the level of code optimization, chose the format of the resulting S-function, and generate the source code, library code, block script, or Simulink block. You can use any Maple commands to perform task analysis, assign model equations to a variable, group inputs and outputs to a single vector and define additional input and output ports for variables.

**Note**: Code generation now handles all systems modeled in MapleSim, including hybrid systems with defined signal input (RealInput) and signal output (RealOutput) ports.

The S-Function Block Generation consists of the following steps:

- Subsystem Preparation
- Subsystem Selection
- Port and Parameter Management
- S-Function Options
- Generate S-Function

- View S-Function

## Subsystem Preparation

**Convert your model or part of your model into a subsystem. This identifies the set of modeling components that you want to export as a block component. Since Simulink only supports data signals, properties on acausal connectors such as mechanical flanges and electrical pins, must be converted to signals using the appropriate ports.**

To connect a subsystem to modeling components outside of its boundary, you add subsystem ports. A subsystem port is an extension of a component port in your subsystem. The resulting signals can then be directed as inputs and outputs for MapleSim™ Connector Template.

**Note**: For connectors you must use signal components, since acausal connectors can not be converted to a signal.

By creating a subsystem you not only improve the visual layout of a system in model workspace and but also prepare the model for export. The following examples in this section, show you how to group all of the components into a subsystem.

## Subsystem Selection

**You can select which subsystems from your model you want to export to a Simulink block. Once a subsystem is selected, click Load Selected Subsystem. All defined input and output ports are loaded.**

**Input Ports:**

| | Input Variables | Port Grouping Name | Change Row |
|---|---|---|---|
| 1 | \`Main.'Differentiator::InputSignal'\`(t) | "InputSignal" | |

**Output Ports:**

| | Output Variables | Port Grouping Name | Change Row |
|---|---|---|---|
| 1 | \`Main.'Differentiator::VInput'\`(t) | "VInput" | |
| 2 | \`Main.'Differentiator::VOutput'\`(t) | "VOutput" | |

## Port and Parameter Management

Port and Parameter Management lets you customize, define and assign parameter values to specific ports. Subsystem components to which you assign the parameter, inherit a parameter value defined at the subsystem level. Once the subsystem is loaded you can group individual input and output variable elements into a vector array, and add additional input and output ports for customized parameter values. Input ports can include variable derivatives, and output ports can include subsystem state variables.

### Note: If the parameters are not marked for export they will be numerically substituted.

The following selections specify the input ports, output ports, and states for generating Simulink blocks.

**Input Ports:**

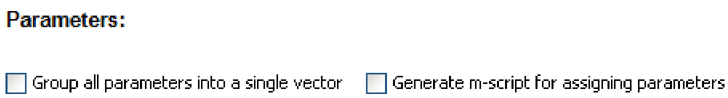
☐ Group all inputs into a single vector ☐ Add additional inputs for required input variable derivatives

Select **Group all inputs into a single vector** to create a single 'vector' input port for all of the input signals instead of individual ports. The order of the inputs are the same as given in the S-function mask window.

Select **Add additional inputs for required input variable derivatives** to specify calculated derivative values instead of numerical approximations.


Select **Group all outputs into a single vector** to define outputs as an S-Function 'mask'.

Select **Add an additional output port for subsystem state variables** to add extra output ports for the state variables.




Select **Group all parameters into a single vector** to  to create a single parameter 'vector' for all of the parameters in the S-function. If not selected, the S-function mask will contain one parameter input box for each of the S-function parameters.

Select **Generate m-script for assigning parameters** to generate an initialization m-file with the system parameters.

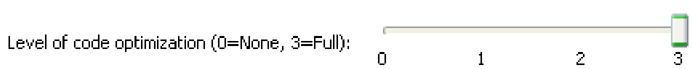

Press Toggle Export Column to toggle selected/unselected parameters for export.

## S-Function Options

### These settings specify the advanced options for the code generation process.

### Optimization Options

Set the level of code optimization to specify whether equations are left in their implicit form or converted to an ordinary differential equation (ODE) system during the code generation process. This option specifies the degree of simplification applied to the model equations during the code generation process and eliminates redundant variables and equations in the system.




Select one of the following options:

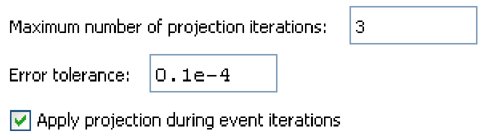
**None** (0): no optimization is performed; the default equations will be used in the generated code.

**Partial** (1, 2): removes redundant equations from the system.

**Full** (3): performs index reduction to reduce the system to an ODE system or a differential algebraic equation (DAE) system of index 1, and removes redundant equations.

### Constraint Handling Options

The **Constraint Handling Options** specifies whether the constraints are satisfied in a DAE system by using constraint projection in the generated Simulink block. Use this option to improve the accuracy of a DAE system that has constraints. If the constraint is not satisfied, the system result may deviate from the actual solution and could lead to an increase in error at an exponential rate.




Set the **Maximum number of projection iterations** to specify the maximum number of times that a projection is permitted to iterate to obtain a more accurate solution.

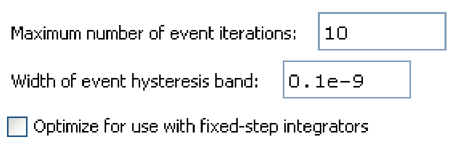
Set the **Error tolerance to** specify the desirable error tolerance to achieve after the projection.

Select **Apply projection during event iterations** to interpolate iterations to obtain a more accurate solution.

Constraint projection is performed using the **constraint projection** routine in the External Model Interface as described on The MathWorks™ web site to control the drift in the result of the DAE system.

### Event Handling Options

The **Event Handling Options** specifies whether the events are satisfied in a DAE system by using event projection in the generated Simulink block. Use this option to improve the accuracy of a DAE system with events. If the constraint is not satisfied, the system result may deviate from the actual solution and could lead to an increase in error at an exponential rate.



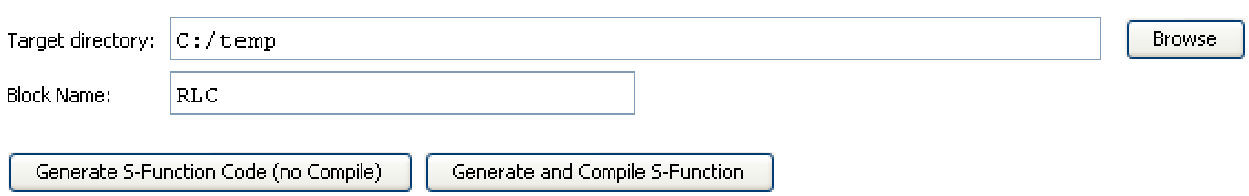

Set the **Maximum number of event iterations** to specify the maximum number of times that a projection is permitted to iterate to obtain a more accurate solution.

Set the **Width of event hysterias band** to specify the desirable error tolerance to achieve after the projection.

Select **Optimize for use with fixed-step integrators** to optimize the event iterations as a function of hysterias bandwidth.

Event projection is performed using the **event projection** routine in the External Model Interface as described on The MathWorks™ web site to control the drift in the result of the DAE system.

## Generate S-Function




Provide a name and specify the location for the generated file.

To generate an S-Function block without a Simulink connection, click **Generate S-Function (no Compile)**.

To generate an S-Function block, click **Generate and Compile S-Function**.

## View S-Function

Once you generate the S-Function code and create the block a MATLAB command window opens and the block with any of the following specified parameters is generated in Simulink:

- Block Generation Script

- C Code
- Parameter Script

## 1.4 Viewing MapleSim Connector Examples

Toolbox examples are available in the **MapleSim Connector Examples** palette in MapleSim.

Each example includes a code generation template in its **Attachments** palette.

**To view an example:**

1. In the **MapleSim Connector Examples** palette on the left side of the MapleSim window, expand one of the palettes, and then click the entry for the model that you want to view.

2. In the **Project** tab, expand the **Attachments** palette and then expand **Documents**.

3. Right-click (**Control**-click for Macintosh) **Simulink Component Block Generation** and select **View**. The template opens in Maple.

Some models include additional documents, such as templates that display model equations or define custom components. You can open any of these documents by right-clicking its entry and selecting **View**.

## 1.5 Example: RLC Circuit Model

In this example, you will generate a Simulink block from an RLC circuit model that was created in MapleSim.

**Note**: Before starting this tutorial, you must set up MATLAB and the mex compiler in order to have the template appear in the list. For more information, see the **MapleSimConnector,setup** help page for more information.

**To generate an S-function block:**

1. In the **MapleSim Connector Examples** palette, select the **RLC Parallel Circuit** example.

2. Click the templates button () in the main toolbar.

3. From the list, select **Simulink Component Block Generation**.

4. In the **Attachment** field, enter **RLC Circuit** as the worksheet name and click **Create Attachment**. Your MapleSim model opens in the **Simulink Component Block Template** in Maple.

5. Using the navigation controls above the model, select **Main > RLC**. The RLC subsystem appears in the workspace.

6. Click **Load Selected Subsystem**. All of the template fields are populated with information specific to the RLC subsystem.

**Note:** By default, all parameters in the model are kept as configurable parameters.

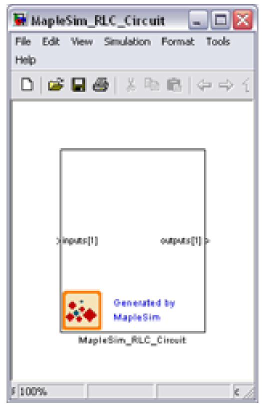
7. In the **S-Function Option** section, set the **Level of code optimization** option to **Full (3)**.

8. In the **Generate F-Function** section, specify the location of generated files.

9. Click **Generate and Compile S-Function** to generate the S-function code and create the block.

**Note:** Generating a block may require a few minutes.

A MATLAB command window opens and the block with the specified parameters is generated in Simulink.




Double-clicking the block opens the mask that contains the symbolic parameters from the original model. This block can now be connected with any compatible Simulink blocks.

## 1.6 Preparing a Model for Export

In this example, you will perform the steps required to prepare a slider-crank mechanism model and export it as an S-function block:

1. Convert the slider-crank mechanism model to a subsystem.

2. Define subsystem inputs and outputs.

3. Define and assign subsystem parameters.

4. Export the model using the Simulink Component Block Generation template.

5. Implement the S-function block in Simulink.

**Note**: The following tutorial will take you through these steps in detail. Before starting this tutorial, you must set up MATLAB and the mex compiler. For more information, see the **MapleSimConnector,setup** help page for more information.

**To open the slider-crank mechanism example:**

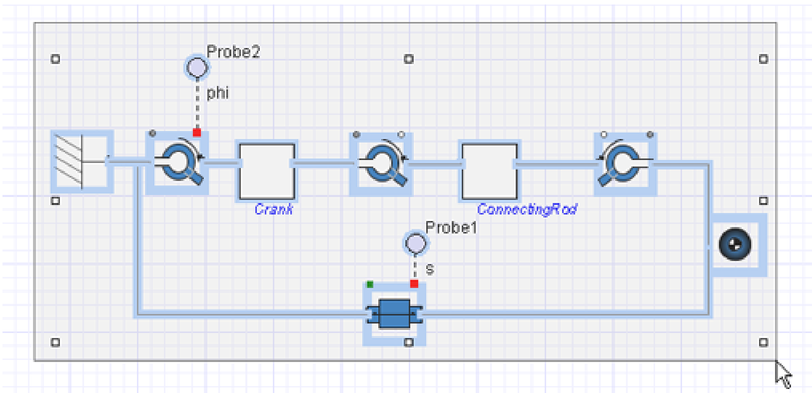
1. In MapleSim, expand the **Examples** palette and then expand the **Tutorial** submenu.

2. Select the **Slider Crank** example. The example appears in the workspace.

### Converting the Model to a Subsystem

By converting your entire model or part of your model into a subsystem, you identify which parts of the model that you want to export. In this example, you will prepare the system for export by grouping all of the components into a subsystem.

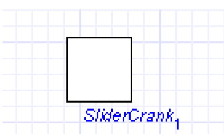
1. Using the selection tool ( ) located above the model workspace, draw a box around all of the components in the model.




2. From the **Edit** menu, select **Create Subsystem**. The **Create Subsystem** dialog box appears.

3. Enter **SliderCrank** as the subsystem name.

4. Click **OK**. A **SliderCrank** subsystem block appears in the model workspace.




## Defining Subsystem Inputs and Outputs

MapleSim uses a topological representation to connect interrelated components without having to consider how signals flow between them, whereas traditional signal-flow modeling tools require explicitly defined system inputs and outputs. Since Simulink only supports data signals, properties on acausal ports, such as mechanical flanges and electrical pins, must be converted to signals using the appropriate components. The resulting signals are directed as inputs and outputs for the subsystem in MapleSim and for the S-function block.

**Note:** Currently, code generation is limited to subsystems with defined signal input (*RealInput*) and signal output (*RealOutput*) ports.

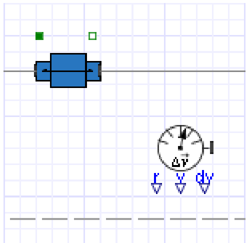
In this example, you will convert the displacements of the slider and the joint between the crank and connecting rod to output signals. The input signal needs to be converted to a torque that is applied to the revolute joint that represents the crank shaft.

1. Double-click the subsystem block to view its contents. The broken line surrounding the components indicates the subsystem boundary, which can be resized by clicking and dragging its sizing handles.

2. Delete the probes that are attached to the model.

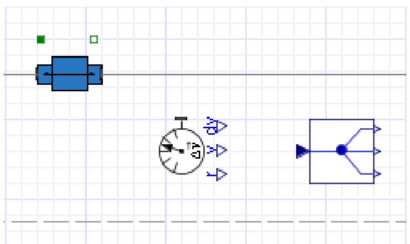
3. On the left side of the MapleSim window, expand the **Multibody** palette and then expand the **Sensors** submenu.

4. Drag the **Absolute Translation** component to the model workspace and place it below the **Prismatic Joint** component.

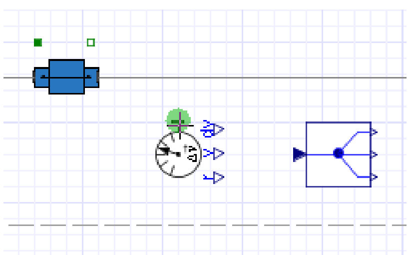



5. Right-click (**Control**-click for Macintosh®) the **Absolute Translation** component and select **Rotate Counterclockwise**.

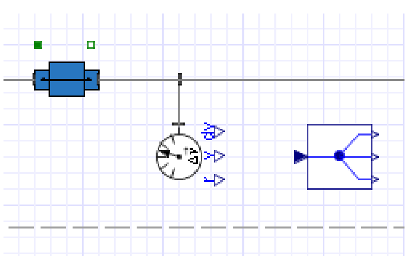
6. From the **Signal Blocks** → **Routing** → **Demultiplexers** menu, drag a **3-port Demultiplexer** component to the model workspace and place it to the right of the **Absolute Translation** component.



7. To connect the **Absolute Translation** component to the model, click the frame_b connector. The frame is highlighted in green when you hover your pointer over it.

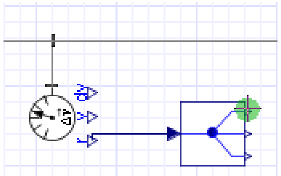


8. Draw a vertical line and click the connection line directly above the component. The sensor is connected to the rest of the diagram.

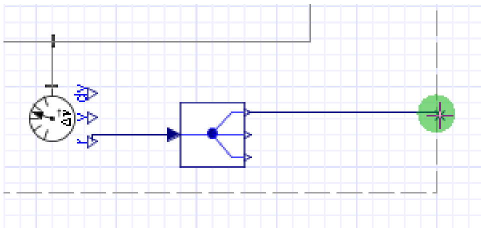


9. In the same way, connect the **r** output port ( *TMOutputP* ) of the **Absolute Translation** component to the demultiplexer Real input signal (u) port. This is the displacement signal from the sensor in x, y, and z coordinates. Since the slider only moves along the x axis, the first coordinate needs to be an output signal.

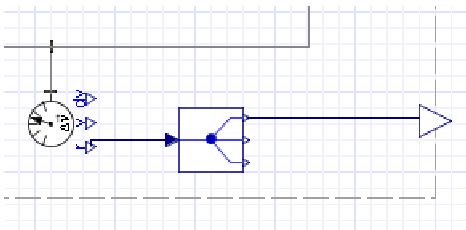
10. Hover your pointer over the first demultiplexer port and click your mouse button once.



11. Drag your pointer to the subsystem boundary.



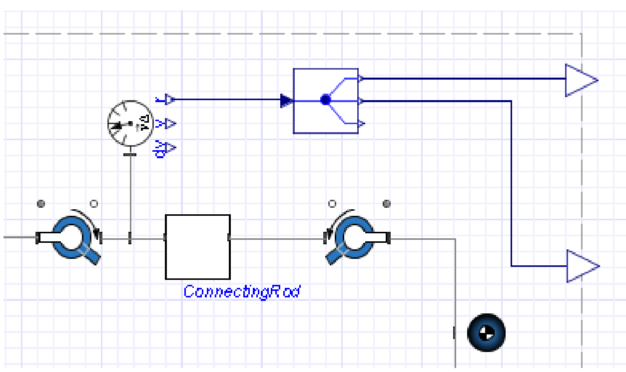
12. Click the boundary once. A real output port is added to your subsystem.



13. Add another **Absolute Translation** component above the **Connecting Rod** subsystem.

14. Right-click (**Control**-click for Macintosh) the **Absolute Translation** component and select **Flip Vertically**.

15. Add a **3-port Demultiplexer** component to the right of the sensor and connect the components as shown below.

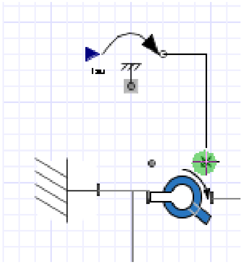



Since the crank is moving in the x, y plane, only the first two signals need to be outputs.

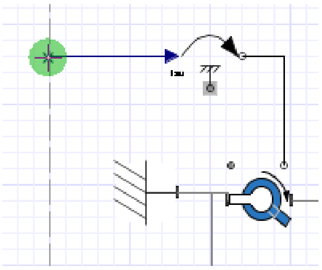
You will now add a real input port to your subsystem to control the torque on the crank shaft.

16. From the **1-D Mechanical → Rotational → Torque Drivers** menu, add a **Torque** component to the model workspace and place it above the **Fixed Frame** component.

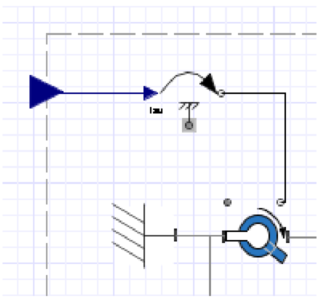
17. Connect the white flange of the **Torque** component to the white flange of the leftmost **Revolute Joint**.



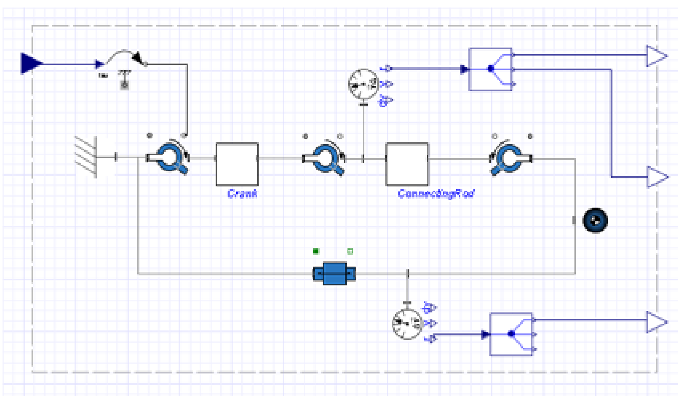
18. Click the input port of the **Torque** component and drag your pointer to the subsystem boundary.



19. Click the boundary once. A real input port is added to your subsystem.



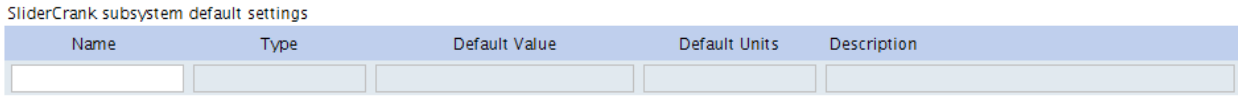
The complete subsystem appears below.




## Define and Assign Subsystem Parameters

You can define custom parameters that can be used in expressions in your model to edit values more easily. To do so, you define a parameter with a numeric value in the parameter editor. You can then assign that parameter as a variable to the parameters of other components; those individual components will then inherit the numeric value of the parameter defined in the parameter editor. By using this approach, you only need to change the value in the parameter editor to change the parameter values for multiple components.

1. While in the detailed view of the **SliderCrank** subsystem, click the Parameters button ( ) above the model workspace. The parameter editor appears.

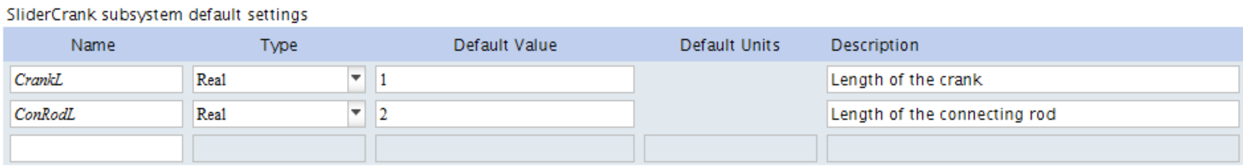



2. In the **New Parameter** field, define a parameter called **CrankL** and press **Enter**.

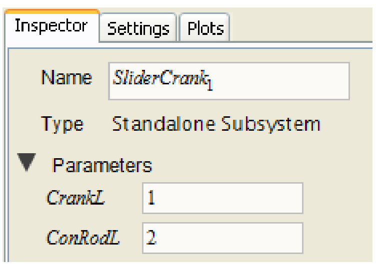
3. Specify a default value of **1** and enter **Length of the crank** as the description.

4. In the second row of the table, define a parameter called **ConRodL** and press **Enter**.

5. Specify a default value of **2** and enter **Length of the connecting rod** as the description.

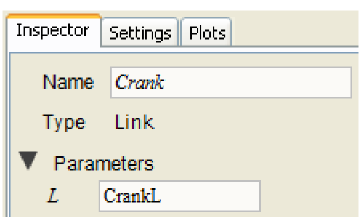



6. Click the Diagram button ( ) to switch to the diagram view. The parameters are defined in the **Inspector** tab.



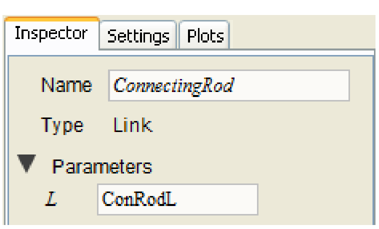

7. In the model workspace, select the **Crank** subsystem.

8. In the **Inspector** tab, change the length value (**L**) to **CrankL**.




The **Crank** subsystem now inherits the numeric value of **CrankL** that you defined.

9. Select the **ConnectingRod** subsystem and change its length value to **ConRodL**.



10. Click the **Main** button above the model workspace to navigate to the top level of the model.


You will include these parameter values in the model that you export. You are now ready to convert your model to an S-function block.

## Exporting Your Model Using the Simulink Component Block Generation Template

After preparing the model, you can use the **Simulink Component Block Generation** template to set export options and convert the model to an S-function block.

1. Click the templates button ( ) in the main toolbar.

2. From the list, select **Simulink Component Block Generation**.

3. In the **Attachments** field, enter **Slider Crank S-Function** as the worksheet name and click **Create Attachment**. The slider-crank subsystem opens in the **Simulink Component Block Generation Template** in Maple.

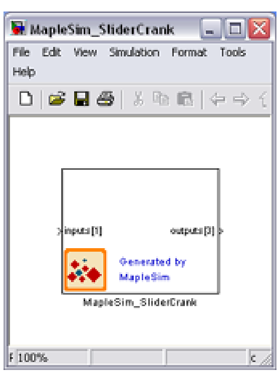
4. From the drop-down menu above the model, select **SliderCrank**.

5. In **Step 1: Subsystem Selection** of the template, click **Load Selected Subsystem**. All of the template fields are populated with information specific to the subsystem.

6. In the **Setting Parameters** section, in the **Parameter Name** list, select the **ConRodL** parameter that you defined in the previous section.

**Note:** The **Keep as Block Parameter** box is selected by default. Also, by default, all input an output ports, and parameters in the model are kept as configurable parameters.

7. Click the **Generate and Compile S-Function** button to generate the S-function code and create the block. A MATLAB command window opens and the block with the specified parameters is generated in Simulink.

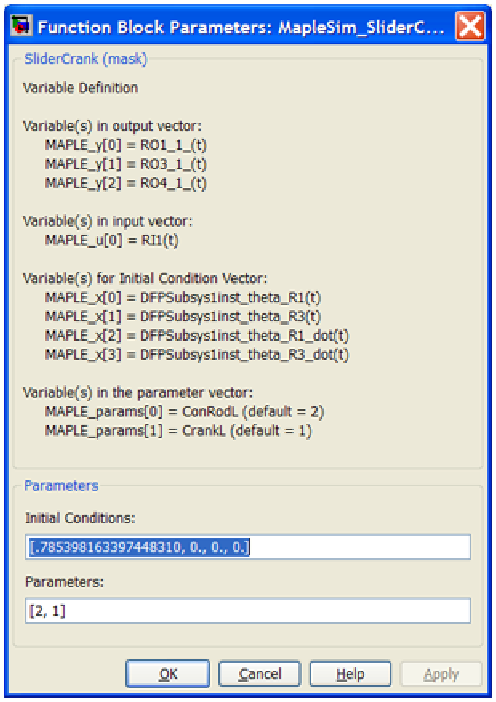



**Note:** Generating a block may require a few minutes.

## Implement the S-Function Block in Simulink

In Simulink, you can connect your block to other compatible blocks, specify initial conditions, and edit the component parameter values.

1. In Simulink, double-click the block. The **Parameter Mask** dialog box appears.




This dialog box displays the **ConRodL** and **CrankL** parameters that you defined in MapleSim as a vector. The text in the dialog describes each parameter in the order they appear in the vector. Initial conditions can also be changed in this dialog box.

2. Click the **Help** button. This window provides a model description and information about the inputs, outputs, parameters, and initial conditions.

3. All inputs and outputs are implemented as vector signals. To access individual signals in Simulink, use a **Mux** block for inputs and a **Demux** block for outputs.

# 2 Creating and Exporting Mathematical Models in Maple

In Maple, you can use commands from the **DynamicSystems** package to create a system from first principles. Maple contains a data structure called a *system object* that encapsulates the properties of a dynamic system. This data structure contains information, for example, the description of the system, and the description of the inputs. Five different types of systems can be created.

- Differential equation or difference equation
- Transfer function as an expression
- Transfer function as a list of numerator and denominator coefficients
- State-space
- Zero, pole, gain

You can use the **Simulink Block Generation for DynamicSystems** template, which provides embedded components for generating source code and exporting a **DynamicSystems** object to Simulink. To open this template, enter **?DynamicSystemsBlockGeneration** at a prompt in a Maple worksheet.

Alternatively, you can create a **DynamicSystems** object in a new worksheet and use commands from the **MapleSimConnector** package to generate source code and save it as a MATLAB .m file.

## 2.1 Using a Template to Generate an S-Function Block

In this tutorial, you will use the **Simulink Block Generation for DynamicSystems** template to generate a Simulink block from a dynamic system defined in Maple.

Before starting this tutorial, you must set up MATLAB and the mex compiler. For more information, see Establishing a Connection with MATLAB.

**To generate an S-function block from a dynamic system:**

1. In a Maple worksheet, enter **?DynamicSystemsBlockGeneration**. The template is opened.

2. If prompted to execute the entire worksheet, click **Yes**.

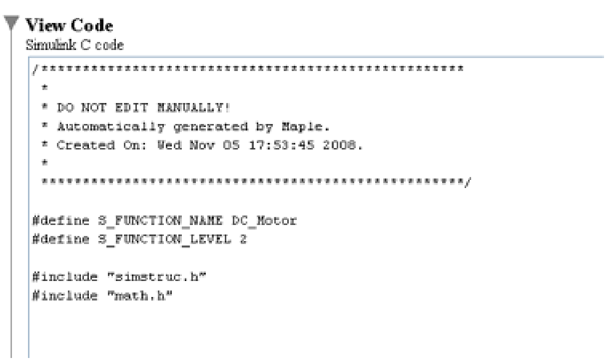
In the **Component Equations** section, you would normally define variables to store component equations and parameters.

| | | |
|---|---|---|
| System variable: | sys | variable name used for storing component equations |
| Parameter variable: | params | variable name used for storing component parameters |

These variables are referenced in the equations that define the system object. For demonstration purposes, the equations and parameters of a DC Motor have been defined for you.

3. In the **Generate Simulink Block** section, select the **Model** radio button. This option places the S-function into a new Simulink model instead of a Simulink block library.

4. Click **Code Generation**. The generated C code is displayed in the **View Code** section.




5. Click **Generate to Simulink**.

6. In the **Select File** dialog box, specify the path and name of the .m and .c files to which to save the generated code.

7. Click **Save**. Maple generates the Simulink block.

**Note:** Generating a block may require a few minutes.

A MATLAB command window is opened and the block with the specified parameters is generated in Simulink. Double-clicking the block opens the mask that contains the symbolic parameters from the original model. This block can now be connected with any compatible Simulink blocks.

## 2.2 Creating and Exporting a DynamicSystems Object Programmatically

First, load the **DynamicSystems** and **MapleSimConnector** packages in the Maple worksheet.

> $with(DynamicSystems):$

> $with(MapleSimConnector):$

To create a system object from the transfer function $\frac{1}{s^2 + a \cdot s + b}$, use the following command:

> $sys := TransferFunction\left(\frac{1}{s^2 + a \cdot s + b}\right)$

$$sys := \left|\begin{array}{c} \textbf{Transfer Function} \\ \text{continuous} \\ \text{1 output(s); 1 input(s)} \\ \text{inputvariable} = [u1(s)] \\ \text{outputvariable} = [y1(s)] \end{array}\right. \tag{2.1}$$

To view the details of the system, use the **PrintSystem** command.

> $PrintSystem(sys)$

$$\left[\begin{array}{c}\textbf{Transfer Function}\\ \text{continuous}\\ \text{1 output(s); 1 input(s)}\\ \text{inputvariable} = [u1(s)]\\ \text{outputvariable} = [y1(s)]\\ tf_{1,1} = \frac{1}{s^2 + a\,s + b}\end{array}\right. \quad (2.2)$$

The default values for the input names ( $u1$) and output names $(y1)$ have been used. Alternatively, during creation of the system, different input and output names can be specified.

To define parameters values, use the following command:

> $par := [a = 1, b = 1]$

$$par := [a = 1, b = 1] \quad (2.3)$$

Finally, use the **SBlock** command to generate the source code and the **SaveCode** command to save the code as a .c file and MATLAB .m file.

> *script* := *SBlock*(*sys*, *sys*:-*inputvariable*, *sys*:-*outputvariable*, "MyTransferFunction", *parameters* = *par*) :

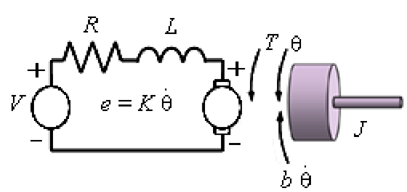
> *SaveCode*("MyTransferFunction", *extension* = "c", *script*[1], *interactive* = *true*) :

> *SaveCode*("MyTransferFunction", *extension* = "m", *script*[2], *interactive* = *true*) :

## 2.3 Example: DC Motor

Consider the classic example of the simplified DC motor. Using the built-in functionality of the **DynamicSystems** package in Maple, you can define the system model, and then visualize and simulate it before saving the code.

This example demonstrates how to define, analyze, and export a system programmatically.




1. In a new Maple worksheet, define the system model.

**Differential Equation Model:**

> $eq1 := L\left(\frac{d}{dt}\, i(t)\right) + R\, i(t) = v(t) - K\left(\frac{d}{dt}\, \theta(t)\right):$

> $eq2 := J\left(\frac{d^2}{dt^2}\, \theta(t)\right) + b\left(\frac{d}{dt}\, \theta(t)\right) + Ks\, \theta(t) = K\, i(t):$

**Transfer Function Model:**

> $sys\_de := DiffEquation(\,[eq1, eq2], [v(t)], [\theta(t), i(t)]\,):$
$sys\_tf := TransferFunction(sys\_de):$
$sys\_tf\text{:-}tf[1, 1];\ sys\_tf\text{:-}tf[2, 1];$

$$\frac{K}{J\,L\,s^3 + (b\,L + J\,R)\,s^2 + \left(Ks\,L + K^2 + b\,R\right)\,s + Ks\,R}$$

$$\frac{J\,s^2 + b\,s + Ks}{J\,L\,s^3 + (b\,L + J\,R)\,s^2 + \left(Ks\,L + K^2 + b\,R\right)\,s + Ks\,R} \tag{2.4}$$

In place of the above commands, you could use the **PrintSystem** command to display each part of the model.

2. Specify the parameters in the model.

| **Description** | **(Initial) Value** | **Units** |
|---|---|---|
| **Input Variables** | | |
| Applied voltage | $v = 0$ | $[\![V]\!]$ |
| **Output Variables** | | |
| Motor shaft angular position | $\theta = 0$ | $[\![rad]\!]$ |
| Motor current | $i = 0$ | $[\![A]\!]$ |
| **Parameters** | | |
| Moment of inertia of the motor | $J = 0.1$ | $[\![kg \cdot m^2]\!]$ |
| Damping of the mechanical system | $b = 0.1$ | $[\![N \cdot m \cdot s]\!]$ |
| Electromotive force constant | $K = 0.1$ | $\left[\!\left[\frac{N \cdot m}{A}\right]\!\right]$ |
| Motor coil resistance | $R = 1$ | $[\![\Omega]\!]$ |
| Motor coil inductance | $L = 0.5$ | $[\![H]\!]$ |
| External Spring Load Constant | $Ks = 0$ | $[\![N \cdot m]\!]$ |

> $params := [J = 0.1, b = 0.1, K = 0.1, R = 1, L = 0.5, Ks = 0]:$

> $ics := [i(0) = 0, \theta(0) = 0, D(\theta)(0) = 0]:$

3. Generate and save the source code as a .c file and MATLAB .m file.

```
> (cSFcn, MBlock) := SBlock(sys, sys:-inputvariable, sys:-
    outputvariable, "MyTransferFunction", parameters = params,
    initialconditions = ics) :
```

```
> MapleSimConnector:-SaveCode("MyTransferFunction", cSFcn,
    extension = "c", interactive = true) :
```

```
> MapleSimConnector:-SaveCode("MyTransferFunction", MBlock,
    extension = "m", interactive = true) :
```

With the basic tools shown in this guide, you are now ready to use the MapleSim Connector to solve many system design problems. Enter **?DynamicSystems** and **?MapleSimConnector** at a prompt in a Maple worksheet for more information about the commands used in this guide.

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