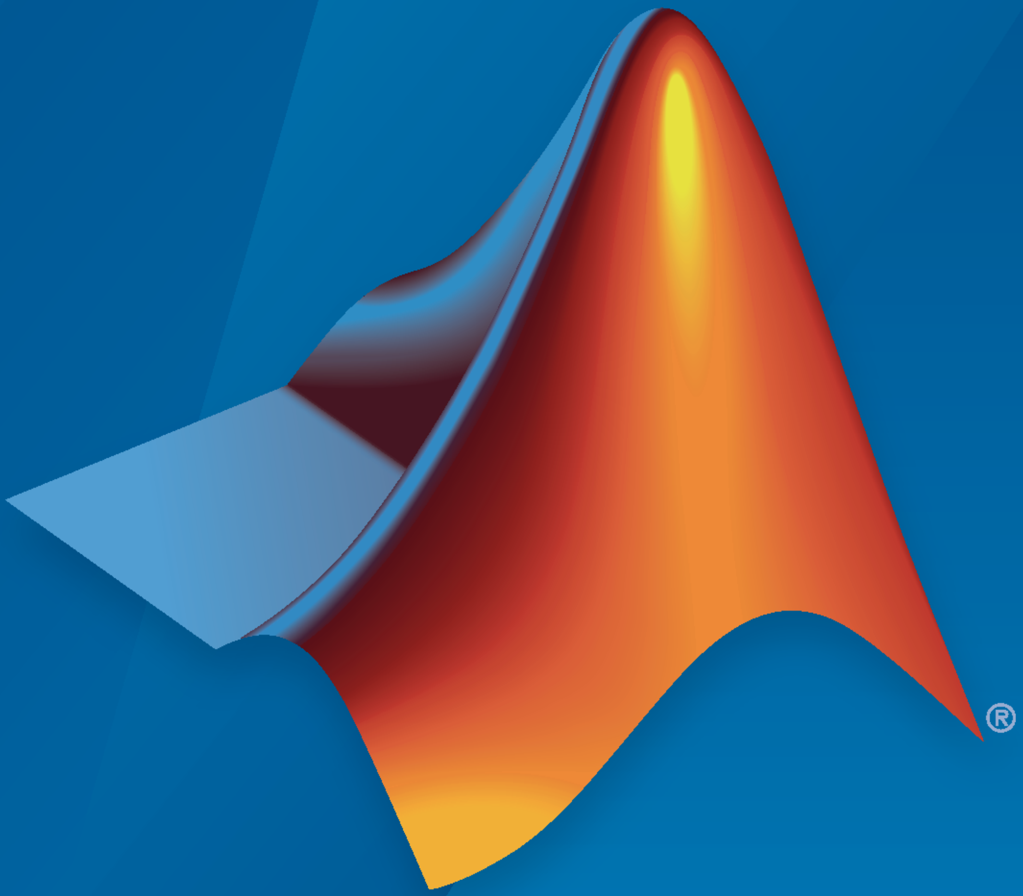
Simulink® Compiler™

Getting Started Guide



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Simulink® Compiler™ Getting Started

Revision History

March 2020a	Online only	New for Version 1.0 (Release 2020a)

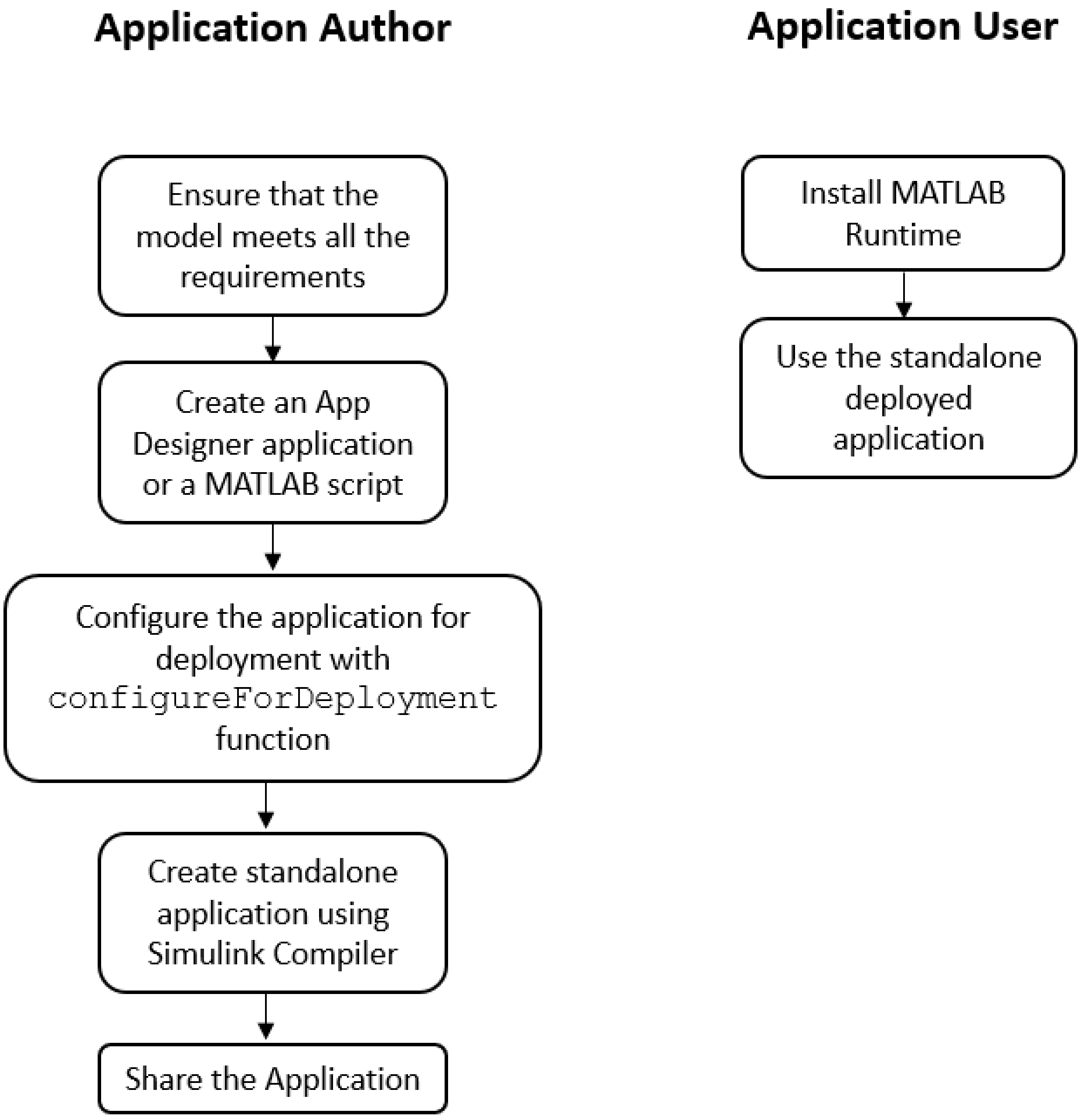
Contents

Simulink Compiler Getting Started

Simulink Compiler Workflow Overview

Simulink Compiler lets you share simulations as standalone applications. Simulink Compiler extends the capabilities of MATLAB® Compiler to allow Simulink `sim` command and associated Simulink functions in the deployed script or application. For more information about MATLAB Compiler, see MATLAB Compiler documentation.

The application users who use these deployed applications are not expected to interact with the Simulink model directly. The Simulink user provides the application user with a tool that allows them to explore task-specific scenarios without looking at the underlying model that represents the dynamic system. The application users can change model parameters and simulation inputs, and record and analyze simulation outputs.


Application Author
Ensure that the model meets all the requirements
Create an App Designer application or a MATLAB script
Configure the application for deployment with configureForDeployment function
Create standalone application using Simulink Compiler
Share the Application
Application User
Install MATLAB Runtime
Use the standalone deployed application

To develop an application, the Simulink user:

1. Prepares the Simulink model to be compatible with Simulink Compiler, such as checking that the model simulates correctly in rapid accelerator mode.
2. Creates an application that simulate the model using the sim command, in a script or an App designer app.
3. Configures the script or the app for deployment by using `simulink.compiler.configureForDeployment` function. The

`simulink.compiler.configureForDeployment` function adapts the model to run in Rapid Accelerator mode.

4. Creates a standalone application using the `mcc` command or the `deploytool` app.
5. Shares the standalone application.

To use the application, the application user:

1. Installs MATLAB Runtime environment for the deployed application.
2. Uses the deployed application.

See Also

`Simulink.SimulationInput` | `configureForDeployment` | `deploytool` | `mcc` | `sim`

Related Examples

- "Create and Deploy a Script with Simulink Compiler" on page 1-7
- "Deploy an App Designer Simulation with Simulink Compiler" on page 2-2
- "Deploy Simulations with Tunable Parameters" on page 2-10

Toolboxes Supported by Simulink Compiler

The following toolboxes are supported by Simulink Compiler:

- AUTOSAR Blockset
- Aerospace Blockset™
- Audio Toolbox™
- Automated Driving Toolbox™
- Communications Toolbox™
- Computer Vision Toolbox™
- Control System Toolbox™
- DSP System Toolbox™
- Data Acquisition Toolbox™
- Fixed-Point Designer™
- Fuzzy Logic Toolbox™
- Image Acquisition Toolbox™
- Model Predictive Control Toolbox™
- Phased Array System Toolbox™
- Powertrain Blockset™
- Robotics System Toolbox™
- Simscape™
- Simscape Driveline™
- Simscape Electrical™
- Simscape Fluids™
- Simscape Multibody™
- Simulink
- Simulink Control Design™
- Simulink Design Optimization™
- Stateflow®
- Statistics and Machine Learning Toolbox™
- System Composer™
- System Identification Toolbox™
- Vehicle Dynamics Blockset™
- Vision HDL Toolbox™

See Also

Related Examples

- “Create and Deploy a Script with Simulink Compiler” on page 1-7
- “Deploy an App Designer Simulation with Simulink Compiler” on page 2-2

- “Deploy Simulations with Tunable Parameters” on page 2-10

Create and Deploy a Script with Simulink Compiler

In this section...

In this example, you prepare a model to work with Simulink Compiler, develop and compile the script, and then deploy it as a standalone application.

Prepare the Model

Simulink Compiler uses rapid accelerator simulation targets to generate an executable to submit a Simulink model. Simulink Compiler only supports models which can run in rapid accelerator mode. To set the simulation mode of the model to rapid accelerator, use the model parameter `'SimulationMode'` with `SimulationInput` object. To enable simulation deployment of the model, your model must be supported by the Rapid Accelerator mode correctly.

Simulink Compiler only supports `sim` function syntax that takes `Simulink.SimulationInput` object and returns `Simulink.SimulationOutput` object.

If callbacks are present in the model, they are called during the build time of the application. However, once the application or the script is deployed, these callbacks are not invoked.

Write the Script to Deploy

After preparing the model, write the script that you would like to deploy. In this example, we use a model and change one of the tunable parameters in the script.

In the MATLAB Editor, create a function `deployedScript`. In this function, create a `Simulink.SimulationInput` object for the model, `sldemo_suspn_3dof` and change the value of `Mb` with the `setVariable` method of the `Simulink.SimulationInput` object. To ensure that the model runs in rapid accelerator mode, set the `SimulationMode` to `Rapid` through the `setModelParameter` method of the `Simulink.SimulationInput` object or use the `simulink.compiler.configureForDeployment` function as shown below.

The variables modified in the simulations can be in the base workspace or in the top model workspace.

```
function deployedScript()
    in = Simulink.SimulationInput('sldemo_suspn_3dof');
    in = in.setVariable('Mb', 1000);
    in = simulink.simulatio.configureForDeployment(in);
    out = sim(in);
end
```

Save the function as a `deployedScript.m`.

Compile Script for Deployment

Before compiling the script that you want to deploy, ensure that the files for the model and script, in this case `sldemo_suspn_3dof` and the `deployedScript.m`, are included on the MATLAB search path. To compile the script, use the `mcc` command with the script name. To learn more about the `mcc` command, see `mcc`.

```
mcc -m deployedScript.m
```

Troubleshooting Tips

Simulink Compiler automatically packages the dependencies in the model and the deployed scripts. If the command `mcc` cannot find a dependency, you might see errors.

- If you see the error "Unable to resolve the name `Simulink.SimulationInput`", check that the model is on the path.
- If the dependent files are located in another directory, attach them by using the flag `-a`. For example, `mcc -m scriptName.m -a myDataFile.dat`.

Run the Deployed Script

Install MATLAB Runtime

To run the deployed executable, you need an appropriate runtime environment. To install the MATLAB Runtime, see https://www.mathworks.com/products/compiler/matlab-runtime.html.

Run the Deployed Application

You can run the deployed application only on the platform that the deployed application was developed on.

Run the deployed application from the Windows command prompt. Running the deployed application from the command prompt enables the application to print diagnostic messages in the command prompt when it encounters errors. These messages can be a helpful tool in troubleshooting the problem.

See Also

`Simulink.SimulationInput` | `configureForDeployment` | `deploytool` | `mcc` | `sim`

Related Examples

- “Deploy an App Designer Simulation with Simulink Compiler” on page 2-2
- “Deploy Simulations with Tunable Parameters” on page 2-10

Export Simulink Models to Functional Mock-up Units

Export Models

Export Simulink models to Functional Mock-up Unit (FMU) that supports Co-Simulation in FMI version 2.0. To check that the exported block is still a valid Simulink model, you can also direct the software to import the FMU back to a Simulink model as part of the export process.

Requirements include:

- Simulink Compiler
- Microsoft® Windows® 64-bit
- A writable folder into which to place the exported FMU.

Exported models can have:

- Input and output data types: double, int32, boolean
- Matrices
- Bus Signals
- Tunable Parameters. Parameter must refer to a global workspace variable.

Standalone FMU

Simulink models can be exported to Standalone Co-Simulation FMU in version 2.0. The generated FMU package contains following files:

- `modelDescription.xml`
- `model.png (optional)`
- `binaries\win64\modelname.dll`, or `binaries\linux64\modelname.so`, or `binaries\darwin64\modelname.dylib`

FMU Variables

FMU modelDescription.xml file contains interfacing variables converted from Simulink model:

- Variables with causality=’input’: converted from root Inport block
- Variables with causality=’output’: converted from root Outport block
- Variables with causality=’parameter’: converted from referenced Runtime Tunable Parameters
- Independent variable ‘time’

To generate FMU input and output, define root Inport and Outport block in Simulink model. Name of the generated variable is converted from root Inport/Outport block name, by removing special and blank characters and avoiding duplicates.

The following input/output data types are supported:

- double (Real in FMI)
- int32 (Integer in FMI)
- boolean (Boolean in FMI)

- string (String in FMI)

If model root Inport or Outport block is a non-virtual bus, individual bus elements will be expanded to variables using structured naming convention (‘.’). If model root Inport or Outport block, individual scalar elements will be expanded to variables using array naming convention (‘[]’).

To export referenced variables as FMU parameter, you can

- define a variable. Use the variable in a Simulink block with tunable parameter, and make sure **Code Generation** > **Optimization** > **Default** parameter behavior is set to ‘**Tunable**’ (or model parameter ‘**InlineParams**’ is set to `off`)
- define a Simulink Parameter object. Use the object in a Simulink block with tunable parameter, and make sure the Storage Class of the object is ‘`ExportedGlobal`’.

Name of the generated variable is converted from parameter name, by removing special characters and avoiding duplicates.

The following parameter data types are supported:

- double (Real in FMI)
- int32 (Integer in FMI)
- boolean or logical (Boolean in FMI)

If referenced parameter is a struct, individual struct members will be expanded to variables using structured naming convention (‘.’). If referenced parameter is array or matrix, individual scalar elements will be expanded to variables using array naming convention (‘[]’).

FMU Solver

Fixed-step solvers are supported for standalone FMU export. It is recommended to set a fixed fundamental sample time (**Solver** > **Solver details** > **Fixed-step size**) before exporting the model. When simulating the Standalone FMU in other environment, communication step-size must be an integral multiple of the fundamental sample time.

FMU Dynamic Library

Generated FMU contains dynamic library build for the current platform. Default fmi2TypesPlatform value is used.

All required and optional fmi2 functions defined by FMI standard can be invoked. However, the following functions have no operation and return fmi2OK immediately:

- Model-Exchange functions
- Functions accessing or serializing FMUstate
- Functions setting or getting input or output derivatives
- Functions querying fmi2DoStep status, or cancelling fmi2DoStep
- Function computing directional derivative of variables

Limitations

You cannot generate FMU from Simulink model, due to these limitations:

- Variable-step solvers are not supported
- Non-zero simulation start time are not supported
- Simulink model that references external resources (data files, mex or m files) are not supported

Export a Simulink Model

Use the Export Dialog Box

Export the `vdp` example using Simulink toolstrip: **Simulation** > **Save** > **Standalone FMU**

1. Open the model, `vdp`
2. In Simulink editor,Simulink toolstrip: **Simulation** > **Save** > **Standalone FMU**.
3. In Simulink editor, select **Save**> **Export Model to**> **FMU Co-Simulation**.
4. In the export dialog box:
5. Click Create

   Simulink creates the FMU file, `modelName.fmu` and optionally the Simulink model,`modelName_fmu.slx`.

Use the Programmatic Interface

- Export the vdp example to an FMU using the default `exportToFMU2CS` function. This command creates the FMU file, *modelName.fmu*. By default, it also creates a Simulink model, *modelName_fmu.slx*, that contains an FMU Co-Simulation block with the original model. Create this model if you want to check the integrity of the exported FMU.

  ```
  load_system('vdp')
  set_param('vdp', 'SolverType', 'Fixed-step')
  exportToFMU2CS('vdp')
  ```
- Export the vdp example to an FMU using the exportToFMU2CS function, but do not create a Simulink model. This command creates the FMU file, *modelName.fmu*.

  ```
  load_system('vdp')
  set_param('vdp', 'SolverType', 'Fixed-step')
  exportToFMU2CS('vdp','CreateModelAfterGeneratingFMU','off')
  ```
- Export the vdp example to an FMU using the `exportToFMU2CS` function. Create a model for the FMU and use an image of the original model as the block icon. This command creates the FMU file, *modelName.fmu*, and a Simulink model with an FMU Co-Simulation block whose block icon is the original model.

  ```
  exportToFMU2CS('vdp','AddIcon','snapshot')
  ```

See Also
`Simulink.SimulationInput` | `configureForDeployment` | `deploytool` | `mcc` | `sim`

Related Examples

- “Deploy an App Designer Simulation with Simulink Compiler” on page 2-2
- “Deploy Simulations with Tunable Parameters” on page 2-10

Simulink Compiler

Deploy an App Designer Simulation with Simulink Compiler

In this section...

This example walks you through the workflow of creating a simulation app in App Designer and using Simulink Compiler to deploy it. The example explains the code that is used to build the app.

Deploying A Simulation App with Simulink Compiler

In this example, we use an app that is prepared in the App Designer and deploy it with Simulink Compiler.

Open and Explore Model

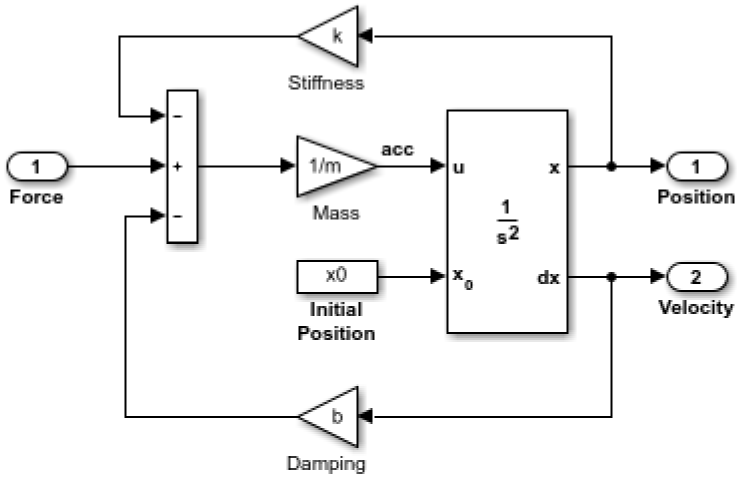
In this example, we use the model of a mass springer damper system. The mass-spring-damper model consists of discrete mass nodes distributed throughout an object and interconnected via a network of springs and dampers. This model is well-suited for modelling object with complex material properties such as non-linearity and elasticity. In this example we use the mass spring damper system. The system is parametrized by mass (m), spring stiffness (k), damping (b) and the initial position (x0). The input to the system is the applied force.

To explore this model with different values of the tunable parameters, create the following model workspace variables:

- Mass - m.
- Spring stiffness - k.
- Damping - b.
- Initial position - xo.

To create the model workspace variables, go to the **Modelling** tab and select **Model Workspace** in the **Data Repositories** in the **Design** section. Use the **Add MATLAB Variables** icon to add the above four variables. Add the appropriate initial values, for example, 3, 128, 2 and 0.5 respectively.

```
open_system('MassSpringDamperModel');
```



Create the App in App Designer

Use the MATLAB APP Designer to create an app to simulate the model with different parameter values and input signals. To learn more about how to create an app using the App Designer, see “Create and Run a Simple App Using App Designer” (MATLAB) Use the `MassSpringDamperApp.mlapp` file to use the app.

```
MassSpringDamperApp
```

App Details

The main part for the app is the simulate button callback function. It has the following salient parts: setup the `SimulationInput` object, configure it for deployment, simulate, and plot the simulation results.

The functionality of the application to change and experiment with the tunable parameters is defined in the callback function `SimulateButtonPushed`. This callback function enables you to change,experiment and analyze different simulations by modifying the values in the app designer.

SimulateButtonPushed Callback Function Code

This section explains the code written to create the app, `MassSpringDamperApp`. The callback function `SimulateButtonPushed` is called in the app designed in the App Designer. This callback function defines how the model is simulated. We use the `Simulink.SimulationInput` object to set the variables to the model and use these variables to change the values and analyze the model.

Create the `Simulink.SimulationInput` Object in the `SimulateButtonPushed` Function

In the `SimulateButtonPushed` function, create a `SimulationInput` object, SimInp for the model `MassSpringDamperModel`. Use the `setModelParameters` method on the `SimulationInput` object. In this example, we set the `StopTime` model parameter for the simulation.

```
function SimulateButtonPushed(app, event)
    try
        app.toggleUIC('off', 'Simulating ...')

        simInp = Simulink.SimulationInput('MassSpringDamperModel');

        stopTimeStr = num2str(app.StopTimeSpinner.Value);
        simInp = simInp.setModelParameter('StopTime', stopTimeStr);
```

Set the Values of the Tunable Parameters and the Input Signal

To set the input signal to the model, use the `ExternalInput` property of the `Simulink.SimulationInput` object, `simInp`. Use the `setVariables` method to set the values of the four tunable parameters. Create the force input signal and set it as the `ExternalInput` in the simulation input object.

```
simInp.ExternalInput = app.externalInput();

simInp = simInp.setVariable('k',app.StiffnessSpinner.Value);
        simInp = simInp.setVariable('m',app.MassSpinner.Value);
        simInp = simInp.setVariable('b',app.DampingSpinner.Value);
        simInp = simInp.setVariable('x0',app.InitialPositionEditField.Value);
```

Configure for Deployment

Now that we have assigned all the values to the variables and set the input signal, the `Simulink.SimulationInput` object is required to be configured for deployment. Use the `simulink.compiler.configureForDeployement` function of Simulink Compiler. This funtion handles all the settings required for the script to be compatible for deployment by setting the simulation mode to rapid accelerator, and by setting the parameter `RapidAcceleratorUpToDateCheck` to `off`.

```
simInp = simulink.compiler.configureForDeployment(simInp);
```

Simulate and Plot the Results

Use the configured Simulink.SimulationInput object to run the simulation with the `sim` command. Plot the results from the simulation using the `Simulink.SimulationOutput` object, `simOut`.

```
simOut = sim(simInp);

t = simOut.y.time;
        yp = simOut.y.signals(1).values;
        yv = simOut.y.signals(2).values;
        plot(app.PositionUIAxes, t, yp);
        plot(app.VelocityUIAxes, t, yv);


      catch ME
        errordlg(ME.message);
      end
    app.toggleUIC('on', 'Simulate');
end
```

Test Out the Application in App Designer

Before deploying the application, ensure that the app runs in the App Designer. Click the **Simulate** button on the app to verify that the application works by simulating the model for different values.

Compile Script for Deployment

To compile the app, use the `mcc` command, followed by the script name.

```
mcc -m MassSpringDamperApp.mlapp
```

Running the Deployed Application

Install MATLAB Runtime and Package the Deployable

To run the deployed executable, you need an appropriate runtime environment. For more information, see “MATLAB Runtime” (MATLAB Compiler).

Ensure that the path environment variable is free of other instances of MATLAB Runtime from previous installs. If there are any, remove them.

To install MATLAB Runtime, follow the instructions on “Install and Configure the MATLAB Runtime” (MATLAB Compiler).

Compile the deployable for the first time as follows:

1. Enter `deploytool` command in the MATLAB Command Window and select **Application Compiler**.
2. In the **Main File** section, add the file to be deployed, `MassSpringDamperApp.mlapp`
3. In the **Packaging Options** section on the toolstrip, select **Runtime included in package** and enter the `deployed_installer` in the text box.
4. Click **Package** in the **Package** section of the toolstrip.
5. Once the package is ready, use the `deployed_installer` in the `for_redistribution` folder to install the proper runtime environment for running the deployed application.

Run the Deployed Application

You can run the deployed script only on the platform that the deployed script was developed on.

It is recommended to run the deployed application from the Windows Command Prompt. Running the deployed application from the command prompt also enables the script to print errors when something is wrong in the deployed application. These errors can help troubleshoot the problem.

Note The `MassSpringDamperApp.mlapp` is not compatible to run on Web Apps.

See Also

`Simulink.SimulationInput` | `deploytool` | `mcc` | `simulink.compiler.configureForDeployment`

More About

- "Create and Deploy a Script with Simulink Compiler" on page 1-7
- "Deploy Simulations with Tunable Parameters" on page 2-10

Deploying A Simulation App with Simulink Compiler

In this example, we use an app that is prepared in the App Designer and deploy it with Simulink Compiler.

Open and Explore Model

In this example, we use the model of a mass springer damper system. The mass-spring-damper model consists of discrete mass nodes distributed throughout an object and interconnected via a network of springs and dampers. This model is well-suited for modelling object with complex material properties such as non-linearity and elasticity. In this example we use the mass spring damper system. The system is parametrized by mass (m), spring stiffness (k), damping (b) and the initial position (x0). The input to the system is the applied force.

To explore this model with different values of the tunable parameters, create the following model workspace variables:

- Mass - m.
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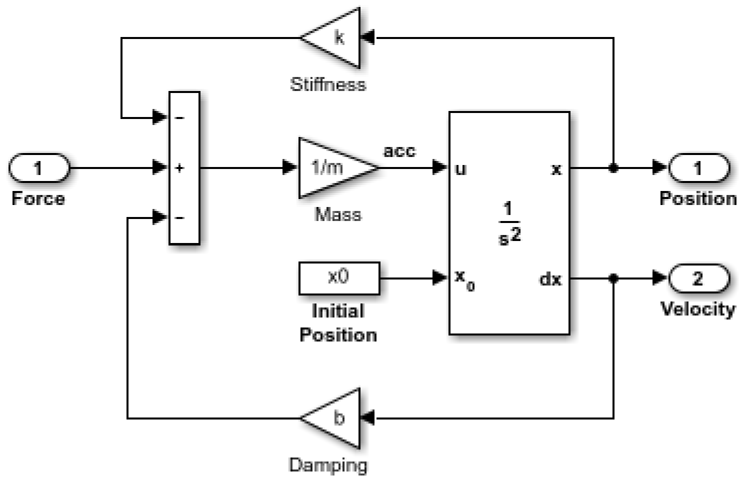
To create the model workspace variables, go to the **Modelling** tab and select **Model Workspace** in the **Data Repositories** in the **Design** section. Use the **Add MATLAB Variables** icon to add the above four variables. Add the appropriate initial values, for example, 3, 128, 2 and 0.5 respectively.

```
open_system('MassSpringDamperModel');
```



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`MassSpringDamperApp`

App Details

The main part for the app is the simulate button callback function. It has the following salient parts: setup the `SimulationInput` object, configure it for deployment, simulate, and plot the simulation results.

The functionality of the application to change and experiment with the tunable parameters is defined in the callback function `SimulateButtonPushed`. This callback function enables you to change,experiment and analyze different simulations by modifying the values in the app designer.

SimulateButtonPushed Callback Function Code

This section explains the code written to create the app, `MassSpringDamperApp`. The callback function `SimulateButtonPushed` is called in the app designed in the App Designer. This callback function defines how the model is simulated. We use the `Simulink.SimulationInput` object to set the variables to the model and use these variables to change the values and analyze the model.

Create the `Simulink.SimulationInput` Object in the `SimulateButtonPushed` Function

In the `SimulateButtonPushed` function, create a `SimulationInput` object, SimInp for the model `MassSpringDamperModel`. Use the `setModelParameters` method on the `SimulationInput` object. In this example, we set the `StopTime` model parameter for the simulation.

```
function SimulateButtonPushed(app, event)
    try
        app.toggleUIC('off', 'Simulating ...')

        simInp = Simulink.SimulationInput('MassSpringDamperModel');

        stopTimeStr = num2str(app.StopTimeSpinner.Value);
        simInp = simInp.setModelParameter('StopTime', stopTimeStr);
```

Set the Values of the Tunable Parameters and the Input Signal

To set the input signal to the model, use the `ExternalInput` property of the `Simulink.SimulationInput` object, `simInp`. Use the `setVariables` method to set the values of the four tunable parameters. Create the force input signal and set it as the `ExternalInput` in the simulation input object.

```
simInp.ExternalInput = app.externalInput();

simInp = simInp.setVariable('k',app.StiffnessSpinner.Value);
        simInp = simInp.setVariable('m',app.MassSpinner.Value);
        simInp = simInp.setVariable('b',app.DampingSpinner.Value);
        simInp = simInp.setVariable('x0',app.InitialPositionEditField.Value);
```

Configure for Deployment

Now that we have assigned all the values to the variables and set the input signal, the `Simulink.SimulationInput` object is required to be configured for deployment. Use the `simulink.compiler.configureForDeployement` function of Simulink Compiler. This funtion handles all the settings required for the script to be compatible for deployment by setting the simulation mode to rapid accelerator, and by setting the parameter `RapidAcceleratorUpToDateCheck` to `off`.

```
simInp = simulink.compiler.configureForDeployment(simInp);
```

Simulate and Plot the Results

Use the configured Simulink.SimulationInput object to run the simulation with the `sim` command. Plot the results from the simulation using the `Simulink.SimulationOutput` object, `simOut`.

```
simOut = sim(simInp);

t = simOut.y.time;
        yp = simOut.y.signals(1).values;
        yv = simOut.y.signals(2).values;
        plot(app.PositionUIAxes, t, yp);
        plot(app.VelocityUIAxes, t, yv);


      catch ME
        errordlg(ME.message);
      end
    app.toggleUIC('on', 'Simulate');
end
```

Test Out the Application in App Designer

Before deploying the application, ensure that the app runs in the App Designer. Click the **Simulate** button on the app to verify that the application works by simulating the model for different values.

Compile Script for Deployment

To compile the app, use the `mcc` command, followed by the script name.

```
mcc -m MassSpringDamperApp.mlapp
```

Deploy Simulations with Tunable Parameters

With Simulink Compiler, you can deploy simulations that use tunable parameters.

As you construct a model, you can experiment with block parameters, such as the coefficients of a Transfer Fcn block, to help you decide which blocks to use. You can simulate the model with different parameter values, and capture and observe the simulation output.

You can change the values of most numeric block parameters during a simulation. This technique allows you to quickly test parameter values while you develop an algorithm. You can:

- Tune and optimize control parameters.
- Calibrate model parameters.
- Test control robustness under different conditions.

The following example shows how to set a tunable parameter in a model, write a standalone application that can be used to tune the parameters, and analyze the simulations. For more information on tunable parameters, see “Tune and Experiment with Block Parameter Values” (Simulink).

Prepare a Script to Deploy Simulations with Parameter Tuning

In this example, create a MATLAB function to simulate the model `sldemo_suspn_3dof_deploy` with the values of `Simulink.SimulationInput`. Save the script as `deployParameterTuning.m` on the MATLAB path.

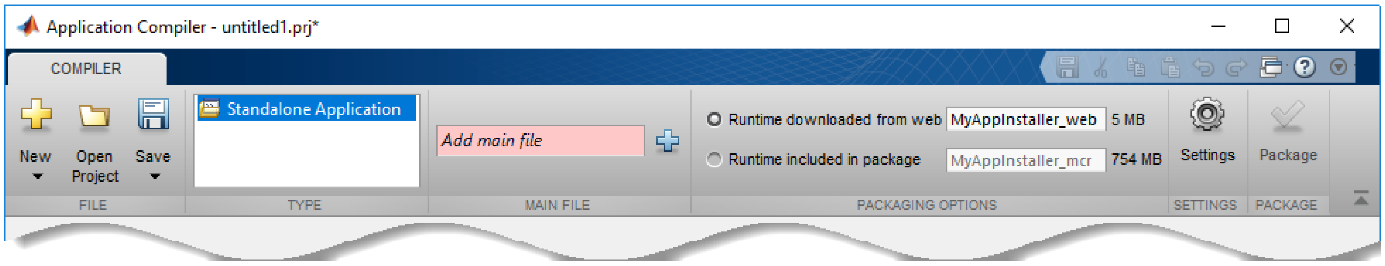
Prepare a Function to Deploy

Create a function called `deployParameterTuning` containing the code shown below. This code creates a `Simulink.SimulationInput` object for the model `sldemo_suspn_3dof_deploy`. `mb` is the value that we pass through the `setVariable` method for the tunable parameter, `Mb`. To configure this script to be deployed, use the function `simulink.compiler.configureForDeployment`. `simulink.compiler.configureForDeployment` configures the `Simulink.SimulationInput` object for by deployment by setting its simulation mode to Rapid Accelerator and by restricting inputs that require rebuilding the deployed app.

```
function deployParameterTuning(oName, mb)

    if ischar(mb) || isstring(mb)
        mb = str2double(mb);
    end

    if isnan(mb) || ~isa(mb, 'double') || ~isscalar(mb)
        disp('The value of mb given to deployedScriptSaveResults must be a double scalar or a str
    end

    in = Simulink.SimulationInput('sldemo_suspn_3dof_deploy');
    in = in.setVariable('Mb', mb);
    in = simulink.compiler.configureForDeployment(in);
    out = sim(in);

    save(oName, 'out');

end
```

Deploy the Prepared Function

1. On the **Apps** tab, in the **Apps** section, click the arrow. In **Application Deployment**, click **Application Compiler**.



   Alternately, you can open the **Application Compiler** app by entering `applicationCompiler` at the MATLAB prompt.
2. In the **Compiler** project window, specify the main file of the MATLAB application that you want to deploy.

   a. In the **Main File** section, click ➕.
   b. In the **Add Files** window, browse to path where you have saved the prepared function, and select `deployParameterTuning.m`. Click **Open**.

      The function `deployParameterTuning.m` is added to the list of main files.
3. Decide whether to include the MATLAB Runtime installer in the generated application by selecting one of the two options in the **Packaging Options** section:

   - **Runtime downloaded from web** — Generates an installer that downloads the MATLAB Runtime and installs it along with the deployed MATLAB application.
   - **Runtime included in package** — Generates an installer that includes the MATLAB Runtime installer.
4. Customize the packaged application and its appearance:

   - **Application information** — This section lists editable information about the deployed application. You can also customize the standalone applications appearance by changing the application icon and splash screen. The generated installer uses this information to populate the installed application metadata. See “Customize the Installer” (MATLAB Compiler).
   - **Command line input type options** — This section lists selection of input data types for the standalone application. For more information, see “Determine Data Type of Command-Line Input (For Packaging Standalone Applications Only)” (MATLAB Compiler).
   - **Additional installer options** — Edit the default installation path for the generated installer and selecting custom logo. See “Change the Installation Path” (MATLAB Compiler) .
   - **Files required for your application to run** —Files required by the generated application to run. These files are included in the generated application installer. See “Manage Required Files in Compiler Project” (MATLAB Compiler).
   - **Files installed for your end user** — This section lists the files that are installed with your application. These files include:

     - A generated `readme.txt` file
     - The generated executable for the target platform

     See “Specify Files to Install with Application” (MATLAB Compiler).

- **Additional runtime settings** —This section lists platform-specific options for controlling the generated executable. See “Additional Runtime Settings” (MATLAB Compiler).

5. To generate the packaged application, click **Package**. In the Save Project dialog box, specify the location to save the project.
6. In the **Package** dialog box, verify that **Open output folder when process completes** is selected.

   When the packaging process is complete, examine the generated output.

   - `PackagingLog.txt` — Log file generated by MATLAB Compiler.
   - Three folders are generated in the target folder location: `for_redistribution`, `for_redistribution_files_only`, and `for_testing`. For more information about the files generated in these folders, see .

See Also
`Simulink.SimulationInput` | `configureForDeployment` | `deploytool` | `mcc` | `sim`

More About
- “Simulink Compiler Workflow Overview” on page 1-2
- “Tune and Experiment with Block Parameter Values” (Simulink)
- “Code Regeneration in Accelerated Models” (Simulink)

Comparing Simulink Coder and Simulink Compiler

Simulink Compiler enables you to share Simulink simulations as standalone executables. You can build the executables by packaging the compiled Simulink model and the MATLAB code to set up, run, and analyze a simulation. Standalone executables can be complete simulation apps that use MATLAB graphics and UIs designed with MATLAB App Designer. To cosimulate with an external simulation environment, you can generate standalone Functional Mockup Unit (FMU) binaries that adhere to the Functional Mockup Interface (FMI) standard.

Simulink Coder generates and executes C and C++ code from Simulink models, Stateflow charts, and MATLAB functions. The generated source code can be used for real-time and non-real-time applications, rapid prototyping, and hardware-in-the-loop testing. You can tune and monitor the generated code using Simulink or run and interact with the code outside MATLAB and Simulink.

Differences

The following table states the major comparisons between Simulink Compiler and Simulink Coder. Use this table to understand the differences between the applications and usage of the two products.

Outputs and Support	**Simulink Compiler**	**Simulink Coder**
Main Use Case	Deploy simulations as standalone executables on desktop or production servers	Generate portable C/C++ code for Simulink model that can be deployed on embedded platforms or desktop
Output	Executable or software component or shared library	Portable and readable C/C++ source code
Simulink Block Support	All the blocks supported in Rapid Accelerator mode in Simulink	A subset of Simulink blocks
Supported Blocksets	All the blocksets supported by Rapid Accelerator mode in Simulink	A subset of Simulink blocks
Production	MATLAB Production Server	Embedded Coder
Simulink Graphics Support	Supports MATLAB Graphics.	None
Library Dependencies	MATLAB Runtime	None

Common Questions about Simulink Compiler and Simulink Coder

The following table answers some of the common questions about using Simulink Compiler and Simulink Coder, such as the memory required, performance, and other questions about support.

Common Questions	**Simulink Compiler**	**Simulink Coder**
What files are produced?	Shared executables or libraries, along with the required MATLAB Runtime components.	Source code (`*.c` & `*.h`) that can be compiled into shared libraries and executables

Common Questions	Simulink Compiler	Simulink Coder
Which platforms can these files be deployed to?	All platforms supported by MATLAB (Windows, Mac, and Linux)	Any platform that supports ANSI/ISO C/C++ code
Does it generate readable code?	No, only non-readable shared libraries	Yes, readable source code
Is it faster than Simulink?	Runs at the same speed as Rapid Accelerator mode in Simulink.	Has the potential to be faster, depending on the algorithm. The generated code is not faster for optimized MATLAB functions (such as FFT, or Image Processing, and Computer Vision functions) Use GPU CoderGPU Coder™ to generate CUDA source code that potentially runs faster on NVIDIA GPUs.
Does it take advantage of hardware accelerators?	Supports the same hardware as MATLAB, including GPUs and AVX. Multicore and clusters are supported via Parallel Computing Toolbox	C code running on local multicore machines can be supported using the OpenMP API. Use GPU Coder to generate CUDA source code that runs on NVIDIA GPUs. Use HDL CoderHDL Coder™ to generate Verilog or VHDL that runs on FPGAs.
What is the difference in memory use on a desktop?	Highly dependent on the executables. MATLAB Runtime itself uses more memory than the Simulink Coder.	Highly dependent on the MATLAB code.
What file I/O formats does each software support?	Supports all formats supported in MATLAB	Limited file support: text files, audio, and video formats. Does not support image formats.

See Also

More About

- “Simulink Compiler Workflow Overview” on page 1-2

Rapid Accelerator Limitations

Rapid Accelerator Mode

The rapid accelerator mode creates a *Rapid Accelerator standalone executable* from your model. This executable includes the solver and model methods, but it resides outside of MATLAB and Simulink. It uses external mode to communicate with Simulink.

MATLAB and Simulink run in one process, and if a second processing core is available, the standalone executable runs there.

Rapid Accelerator Mode Limitations

- Rapid Accelerator mode does not support:
  - Algebraic loops.
  - Targets written in C++.
  - Interpreted MATLAB Function blocks.
  - Noninlined MATLAB language or Fortran S-functions. You must write S-functions in C or inline them using the Target Language Compiler (TLC) or you can also use the MEX file. For more information, see .
  - Debugger or Profiler.
  - Run time objects for Simulink.RunTimeBlock and Simulink.BlockCompOutputPortData blocks.
- Model parameters must be one of these data types:
  - `boolean`
  - `uint8` or `int8`
  - `uint16` or `int16`
  - `uint32` or `int32`
  - `single` or `double`
  - Fixed-point
  - Enumerated
- You cannot pause a simulation in Rapid Accelerator mode.
- If a Rapid Accelerator build includes referenced models (by using Model blocks), set up these models to use fixed-step solvers to generate code for them. The top model, however, can use a variable-step solver as long as the blocks in the referenced models are discrete.
- In certain cases, changing block parameters can result in structural changes to your model that change the model checksum. An example of such a change is changing the number of delays in a DSP simulation. In these cases, you must regenerate the code for the model. See for more information.
- For root inports, Rapid Accelerator mode supports only base as the `Srcworkspace`.
- For root inports, when you specify the minimum and maximum values that the block should output, Rapid Accelerator mode does not recognize these limits during simulation.
- In Rapid Accelerator mode, To File or To Workspace blocks inside function-call subsystems do not generate any logging files if the function-call port is connected to Ground or unconnected.

See Also

More About

- “Simulink Compiler Workflow Overview” on page 1-2
- “Rapid Accelerator Mode” (Simulink)
- “Select Blocks for Rapid Accelerator Mode” (Simulink)
- “Parameter Tuning in Rapid Accelerator Mode” (Simulink)

Debug an Application for Deployment

This topic provides high-level tips on debugging the standalone applications. The following lists highlight the solutions and tips for most frequently encountered errors.

Debug Application in Simulink

Use the following tips while preparing the standalone application to be deployed:

- To ensure that the model runs successfully in rapid accelerator mode correctly, run the rapid accelerator target in a writable directory.
- While writing the script, ensure that the `sim` command uses the `Simulink.SimulationInput` object as the input.
- If you see the error "Unable to resolve the name `Simulink.SimulationInput`", check that the model is on the path.
- If the dependent files are located in another directory, attach them by using the flag `-a`. For example, `mcc -m scriptName.m -a myDataFile.dat`.
- If you are using a function as string, either:

  – Add a function pragma `%#function`.

  ```
  set(gca, 'ButtonDownFcn', 'foo'); % function foo is a string here.
  ```

  ```
  %#function foo
  set(gca, 'ButtonDownFcn', 'foo'); % function foo is a string here.
  ```

  – Write it as an anonymous function

  ```
  set(gca, 'ButtonDownFcn', @foo);
  ```

Debug Application

- Callback functions in the model might include functions that are not deployable. Ensure that the functions in the callbacks of the model are deployable.
- Callback functions are not invoked at runtime. Ensure that the deployed simulation application does not use callback functions that are required to be invoked at runtime.

See Also

More About

- “Simulink Compiler Workflow Overview” on page 1-2

Export Simulink Model to Standalone FMU

This example shows how to export Simulink component to standalone Co-Simulation FMU 2.0 with Simulink Compiler®. For a detailed explanation of the model, see sldemo_fuelsys and fxpdemo_fuelsys.

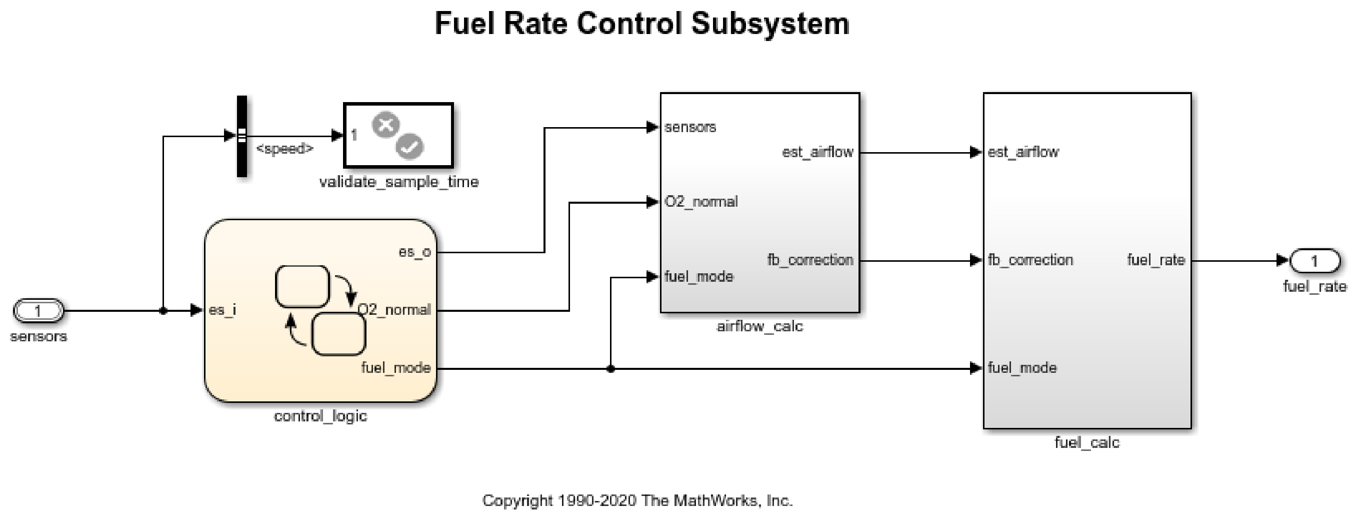
In this example, the air-fuel ratio control system is composed of three Simulink models:

- Fuel Rate Control Component: `fmudemo_export_fuelsys_controller`,
- Engine Gas Dynamics Component: `fmudemo_export_fuelsys_plant`, and
- top-level model `fmudemo_export_fuelsys_top`.

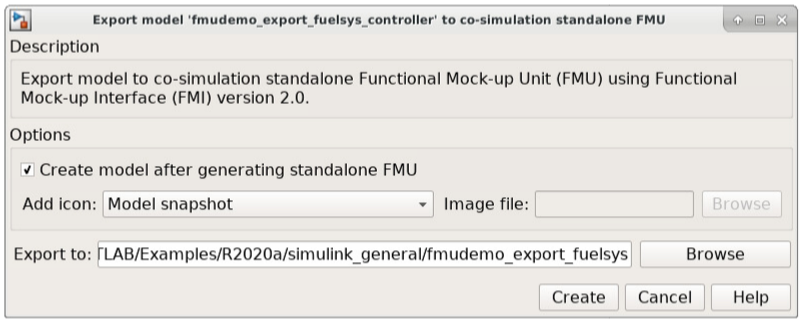
Once the controller and plant components are export to FMU format, they can be integrated using the top-level model. The generated FMUs can also be imported into other simulation tools that support FMI. For a list of Tools that support FMI, see: https://fmi-standard.org/tools/.

Export Fuel Rate Control Component to FMU

Open the `fmudemo_export_fuelsys_controller` example model.



From **Simulation** tab, click drop-down button for **Save**. In **Export Model To** section, click **Standalone FMU...**. In FMU Export dialog, configure wrapper model and icon settings, and specify save location for generated FMU.


Export model 'fmudemo_export_fuelsys_controller' to co-simulation standalone FMU

Description

Export model to co-simulation standalone Functional Mock-up Unit (FMU) using Functional Mock-up Interface (FMI) version 2.0.

Options

[✓] Create model after generating standalone FMU

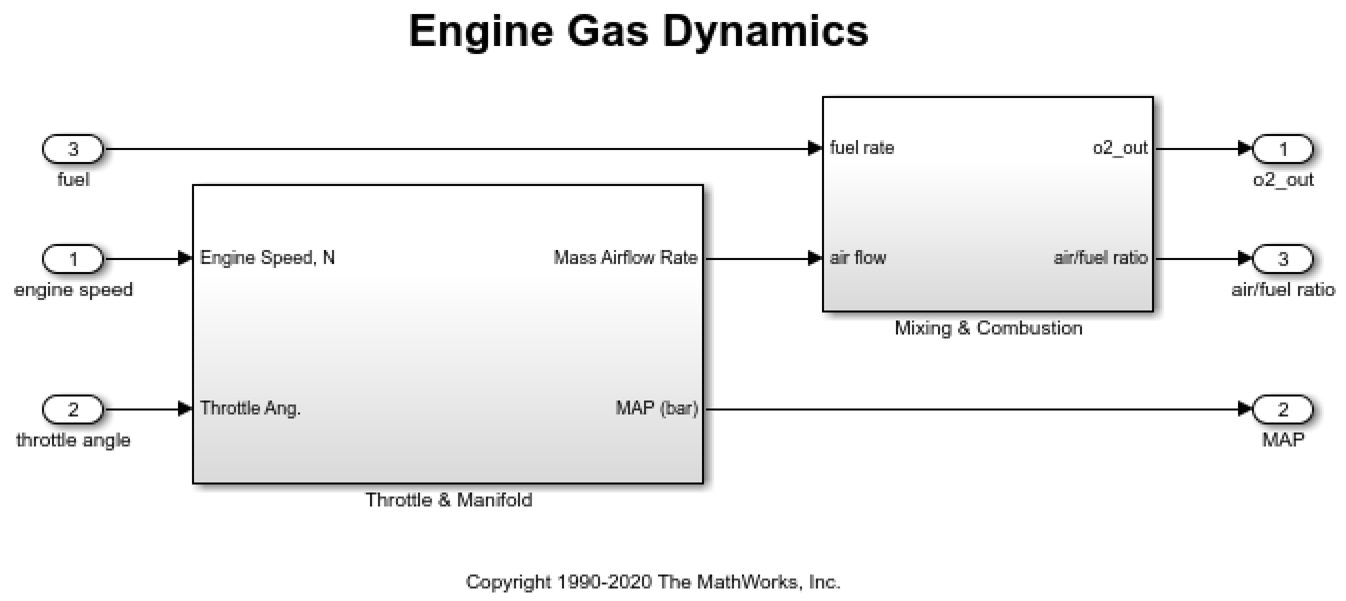
Add icon: Model snapshot   Image file: Browse

Export to: TLAB/Examples/R2020a/simulink_general/fmudemo_export_fuelsys   Browse

Click **Create** to export to FMU. The `fmudemo_export_fuelsys_controller.fmu` file can be found at specified save location.

Export Engine Gas Dynamics Component to FMU

Open the `fmudemo_export_fuelsys_plant` example model.



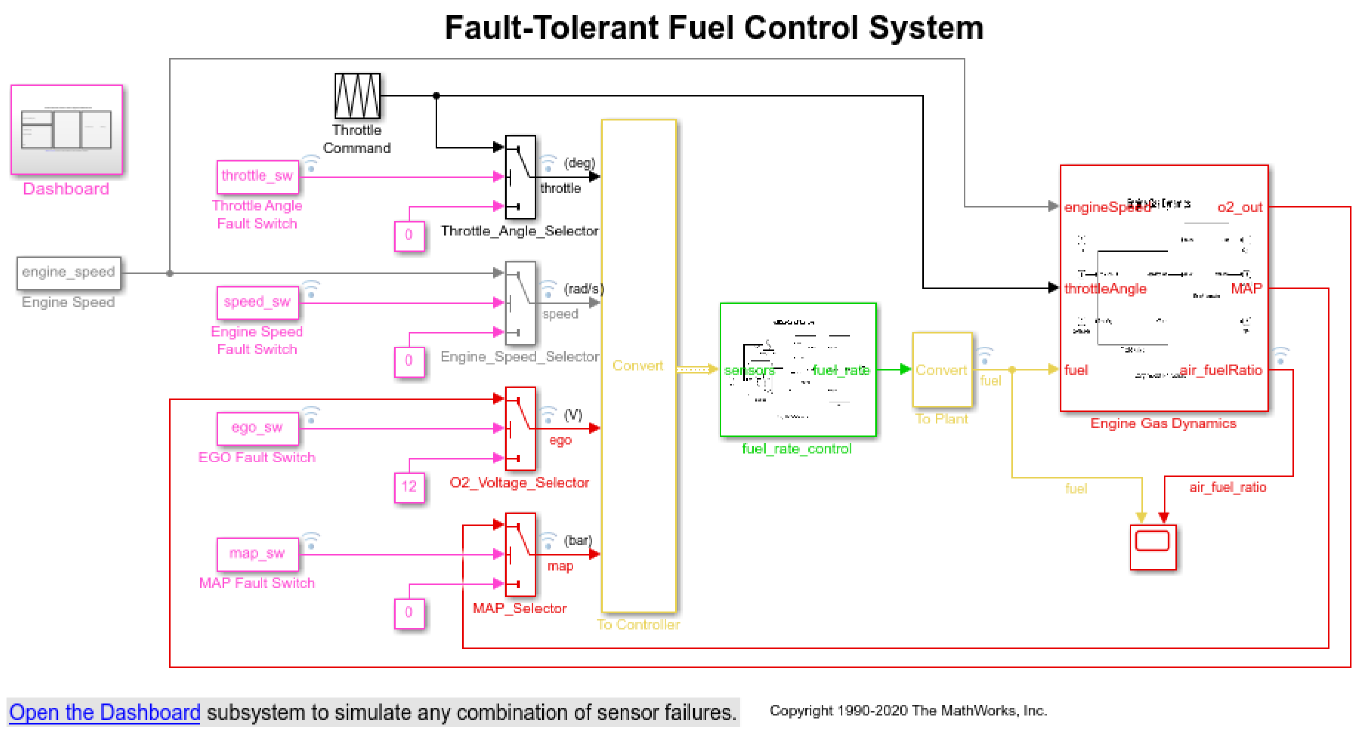
FMU can also be exported using command-line. In MATLAB command line window, use `exportToFMU2CS` command:

```
% Export model to Standalone Co-Simulation FMU 2.0
exportToFMU2CS('fmudemo_export_fuelsys_plant', 'CreateModelAfterGeneratingFMU', 'off', 'AddIcon'
```

You can use optional arguements **CreateModelAfterGeneratingFMU**, **AddIcon**, **SaveDirectory** to configure FMU export settings. For more information, call `help ExportToFMU2CS`.

Integrate FMU components in Simulink

Once both FMUs are successfully exported, you may use the top model `fmudemo_export_fuelsys_top` to fully integrate the system for testing.



Open the Dashboard subsystem to simulate any combination of sensor failures.

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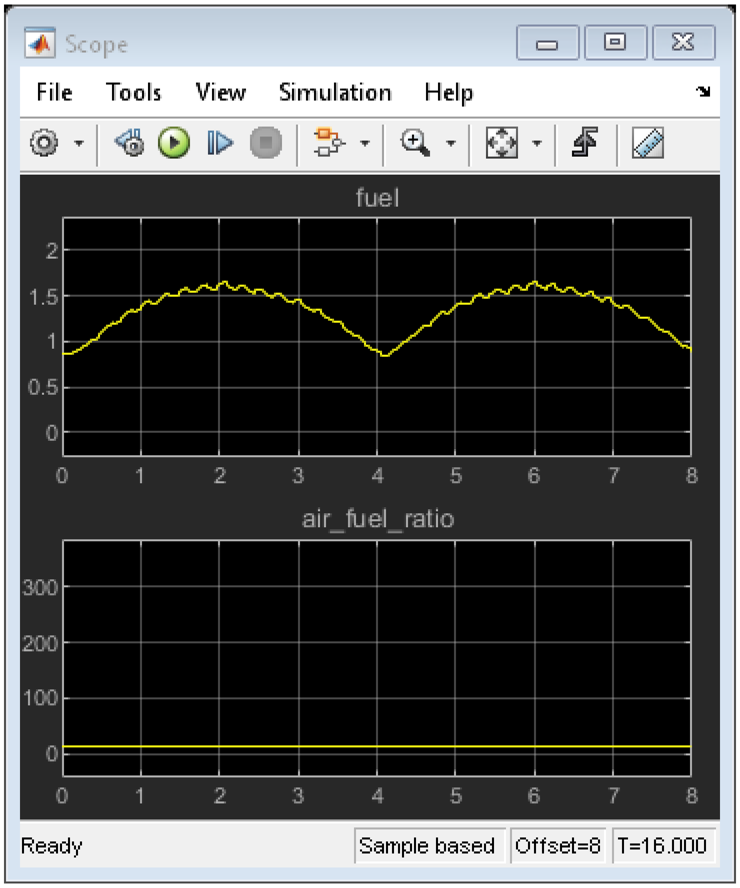
Scope
File
Tools
View
Simulation
Help
fuel
2
1.5
1
0.5
0
0
1
2
3
4
5
6
7
8
air_fuel_ratio
300
200
100
0
0
1
2
3
4
5
6
7
8
Ready
Sample based
Offset=8
T=16.000