

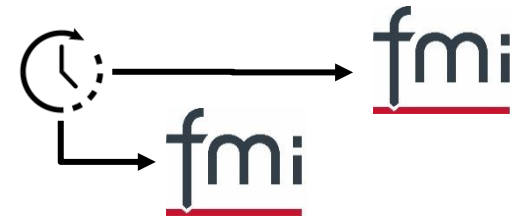


Morgan Fremovici, Application Engineer
mfremovi@mathworks.com

FMI 3.0 overview

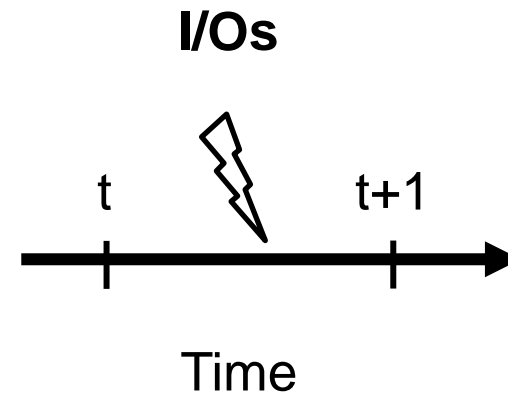
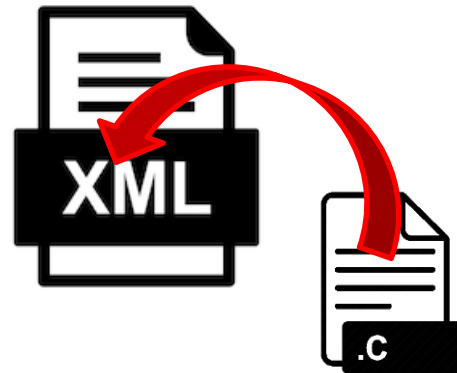
Model Exchange
Co-Simulation
Scheduled Execution
NEW!

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$



**Adjoint
derivatives**

Double
Real
8-bit
16-bit
32-bit
Binary
NEW!



Terminals
Icons

R2023b FMI support overview

**FMI 3.0
Import**

**Code generation from
model with FMU 2.0**

**FMI 2.0
Variable step solver
Export**

Enum support

**FMI 3.0
Fixed step solver
Export**

**External code
conversion to FMI 3.0**

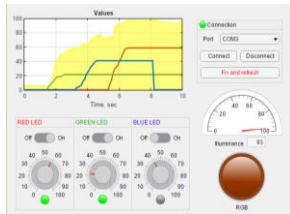
Support Package - FMU Builder for Simulink

Existing Standalone FMU Export Features from Simulink Compiler and New Standalone FMU Export Features Moving into **FMU Builder Support Package**

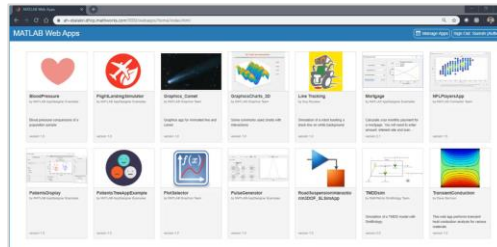
Simulink Compiler (up to 2023a)

Standalone Applications

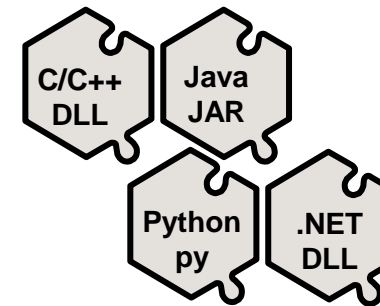
.exe



MATLAB Web Apps



Language-Specific Libraries



Standalone FMUs



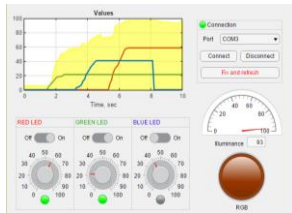
Support Package - FMU Builder for Simulink

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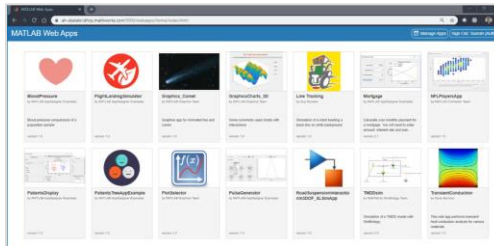
Simulink Compiler

Standalone Applications

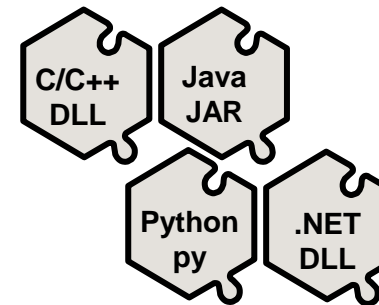
.exe



MATLAB Web Apps



Language-Specific Libraries



FMU Builder for Simulink

Standalone FMUs



* FMU Builder support package has license dependency on Simulink Compiler

[Link to the FMU Builder support package](#)

Support Package - FMU Builder for Simulink

How would you find the support package?

- If the support package is not installed, an error message during FMU export will prompt the users to install FMU Builder Support Package via Add-On Explorer.

The image shows a Simulink model window with a 'Model Browser' on the left. The 'EXPORT MODEL TO' section is expanded, showing options like 'Protected Model...', 'Template...', 'Standalone FMU...', 'Simulation App...', and 'Previous Version...'. The 'Standalone FMU...' option is selected. An orange arrow points from this option to a dialog box that appears over the Simulink window. The dialog box contains the text: 'FMU export requires FMU Builder for Simulink support package. To install this support package, use the [Add-On Explorer](#).' Below this text, it says 'Component: Simulink | Category: Model error'. Another orange arrow points from the 'Add-On Explorer' link in the dialog box to the 'Add-On Explorer' window. The 'Add-On Explorer' window shows the 'FMU Builder for Simulink' support package, which is currently not installed. The package is by MathWorks FMU Builder Team and is a MathWorks Optional Feature. It has 75 Downloads and was updated on 13 Sep 2023. The 'Requires' section lists Simulink, MATLAB Compiler, and Simulink Compiler. The 'MATLAB Release Compatibility' section indicates it was created with R2023b and is compatible with R2023b. The 'Platform Compatibility' section shows it is compatible with Windows, macOS (Apple silicon), macOS (Intel), and Linux. A 'Manage' button is visible next to the package name.

FMU export requires FMU Builder for Simulink support package. To install this support package, use the [Add-On Explorer](#).

Component: Simulink | Category: Model error

Add-On Explorer

FMU Builder for Simulink
by MathWorks FMU Builder Team **STAFF**

Create standalone Functional Mock-up Units (FMUs) from Simulink models and C/C++ source code

MathWorks Optional Feature

Overview | Reviews (0) | Discussions (0)

Create standalone Functional Mock-up Units (FMUs) from your design with FMU Builder for Simulink support package. The generated FMUs can be configured to be compliant with either [FMI 2](#) or [FMI 3](#) specifications.

With FMU Builder, you can:

- Create standalone FMUs from Simulink models or C/C++ source code
- Create nested FMUs
- Use Structured I/O Signals and Runtime Tunable Parameters
- Validate Exported FMUs
- Integrate your Simulink model with third-party simulation environments

For more details on capabilities for this support package, please visit: <https://www.mathworks.com/products/fmubuilder.html>

Requires

- Simulink
- MATLAB Compiler
- Simulink Compiler

MATLAB Release Compatibility

Created with R2023b
Compatible with R2023b

Platform Compatibility

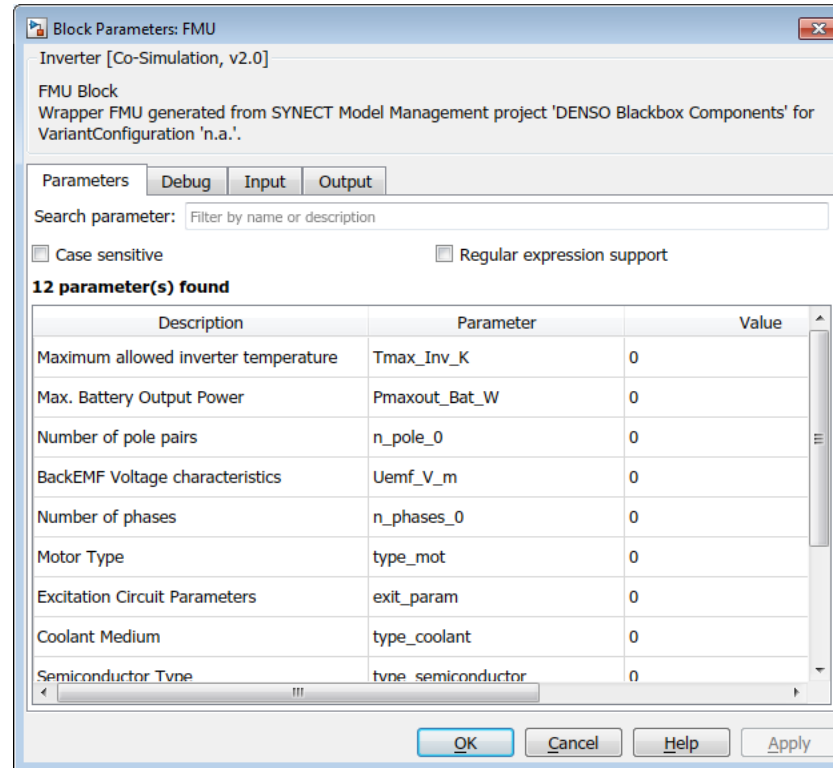
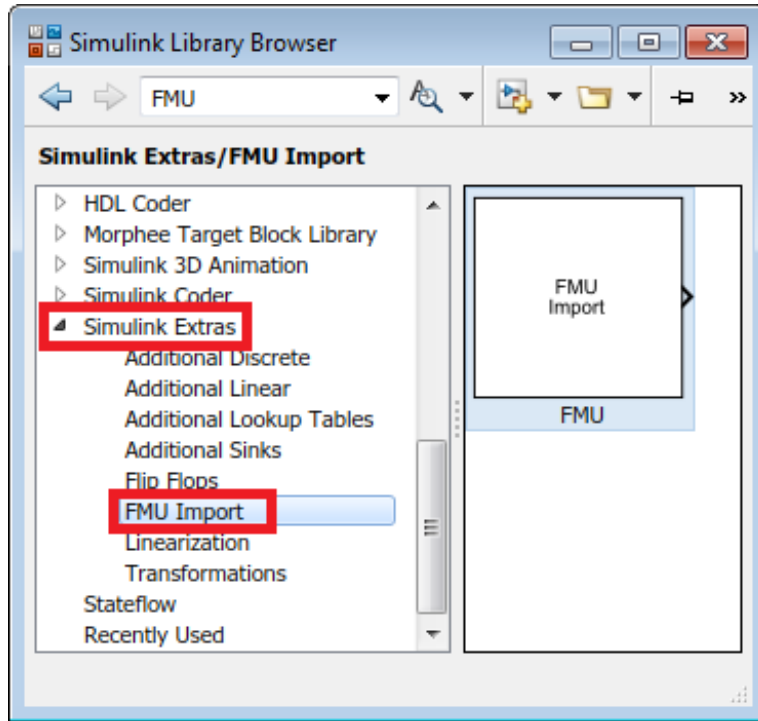
- ☒ Windows ☐ macOS (Apple silicon)
- ☒ macOS (Intel) ☒ Linux

Manage

[Link to FMU Builder support package](https://www.mathworks.com/products/fmubuilder.html)

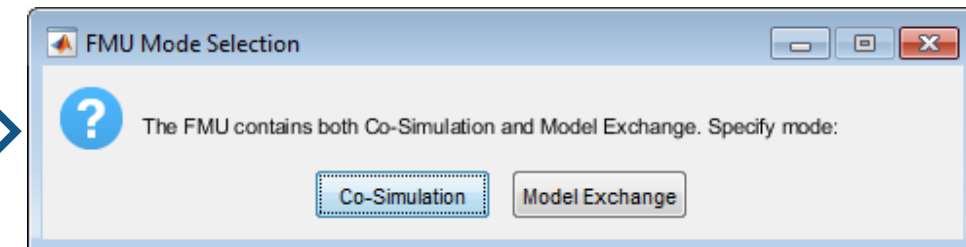
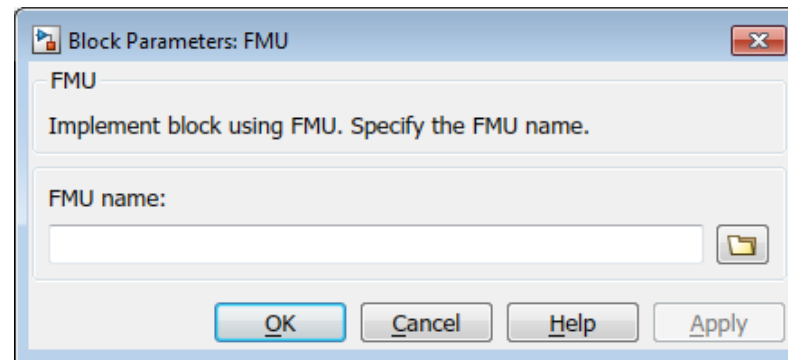
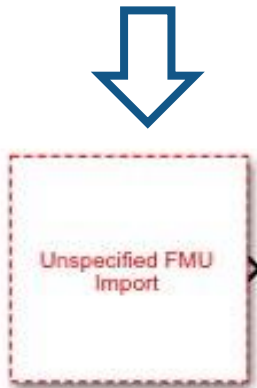
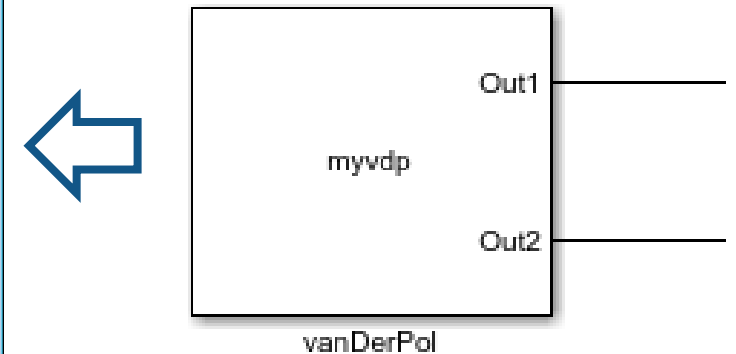
FMU Import

FMU Import Block



Version FMI 1.0 & 2.0

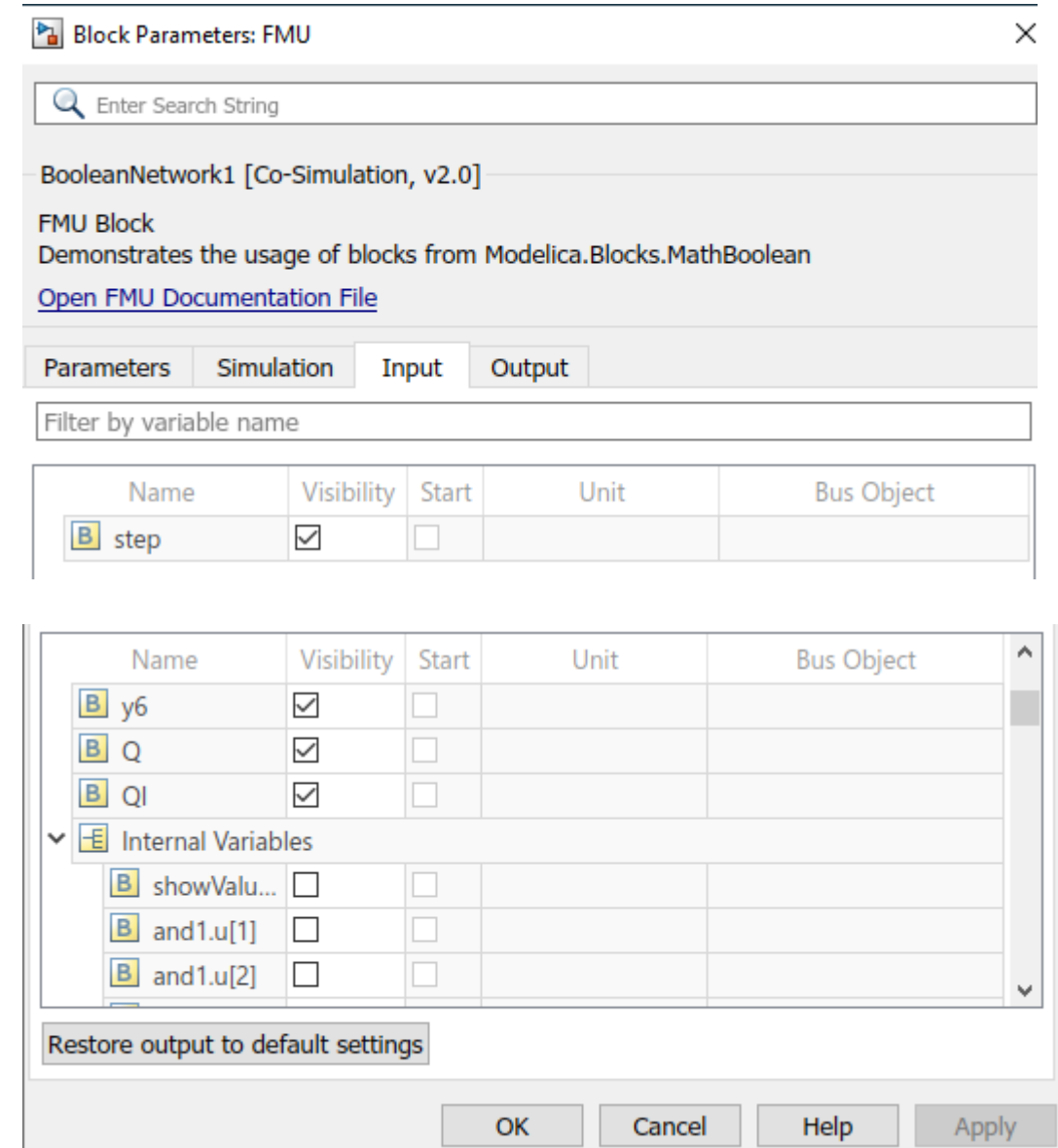
- Supported FMU types:
 - Model exchange
 - Co-Simulation



FMU Import Block

FMU block is now more customizable

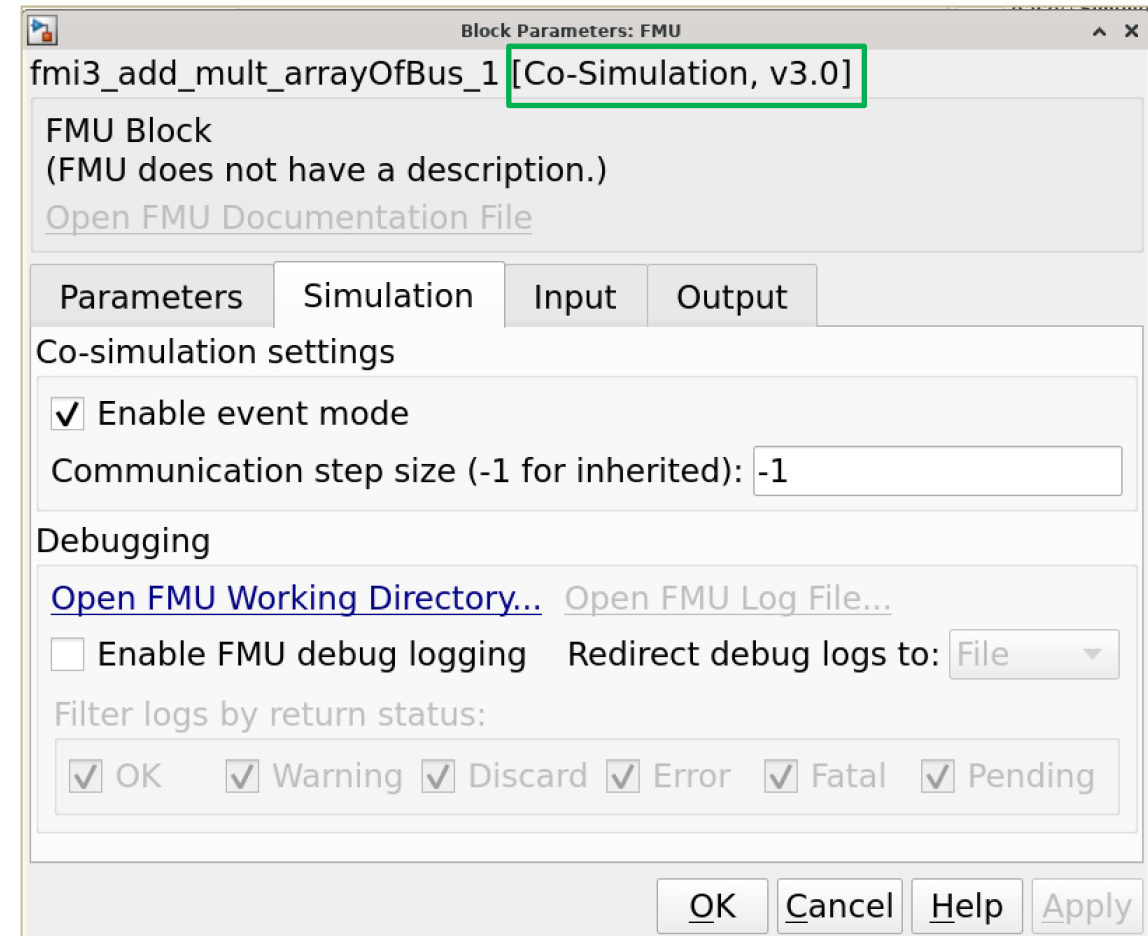
- Enabling you to:
 - Hide or display block input and output ports.
 - Customize the FMU block interface for different model needs.
 - Restore to default block layout.
 - Set the start value for input or local variables.
 - Edit the start values of local variables.
 - Expose local variables as output signals.



FMU Import Block

Import FMUs implemented in FMI 3.0 standard

- Supported FMU types:
 - Model exchange and co-simulation
- Supported Simulink simulation mode :
 - Normal, Accelerator
- Supported FMI v3.0 features:
 - New datatypes: float32, uint8, int8, uint16, int16, uint32, uint64, int64, boolean, string (scalar only)
 - Support for vectors and matrices variables
 - Support for event mode in co-simulation
 - Support for binary type



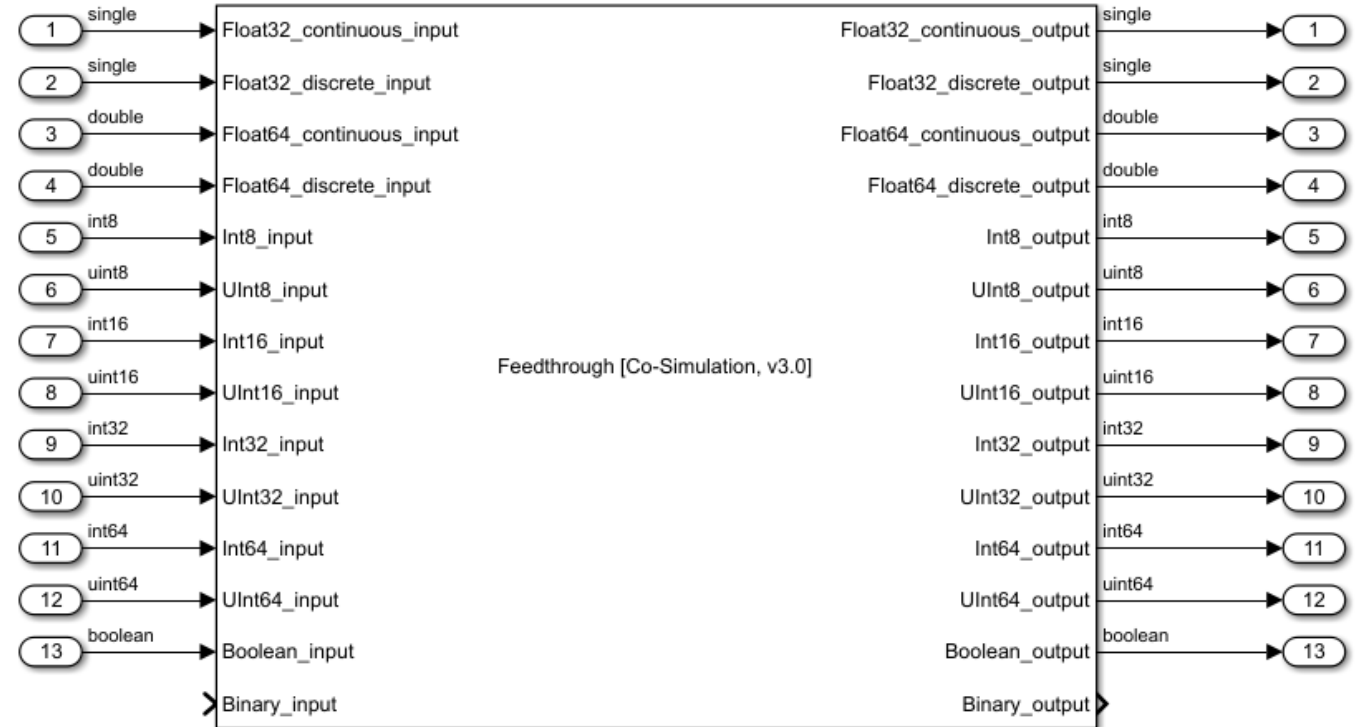
FMU Import

FMI 3.0 Numerical Datatype

FMU Import Block

Import FMUs implemented in FMI 3.0 standard with support for “New Datatypes”

- Float64, float32, uint8, int8, uint16, int16, uint32, int32, uint64, int64, boolean, string (scalar only)



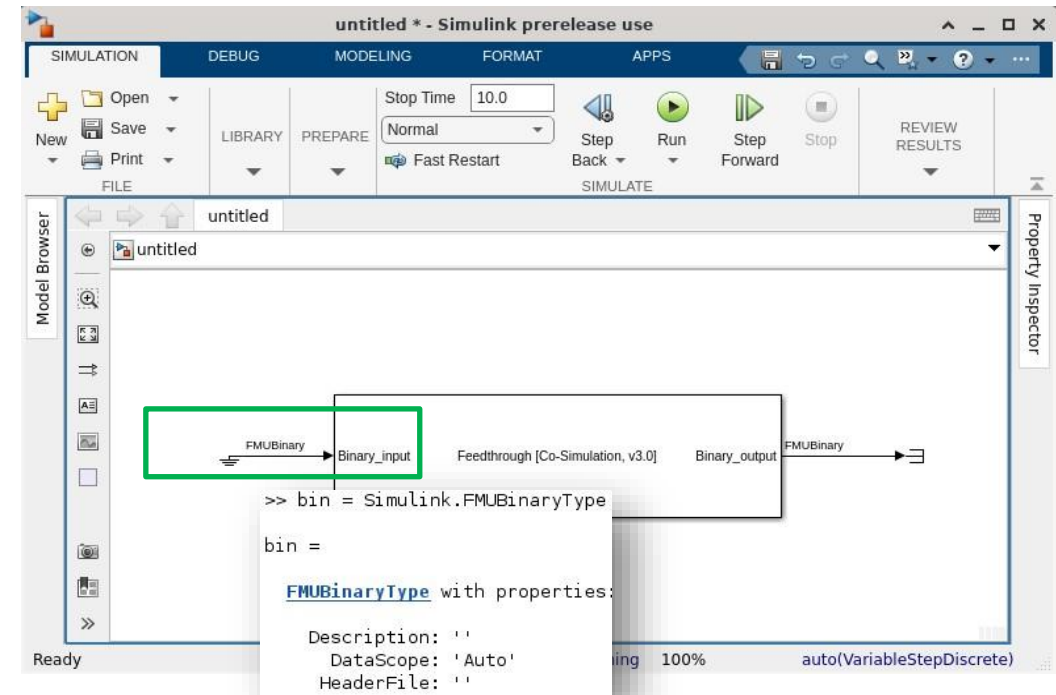
FMU Import

FMI 3.0 Binary Datatype

FMU Import Block

Import FMUs implemented in FMI 3.0 standard with support for binary data type

- The new `Simulink.FMUBinaryType` data type is introduced to Simulink in R2023b
- Used for non-numeric data handling, such as complex sensor data interfaces
- The FMUBinary data type is supported for FMU block, ground, terminator, inport, outport (no logging), From, Goto blocks



FMUBinary data type

FMU Import

FMI 3.0 Vector & Array

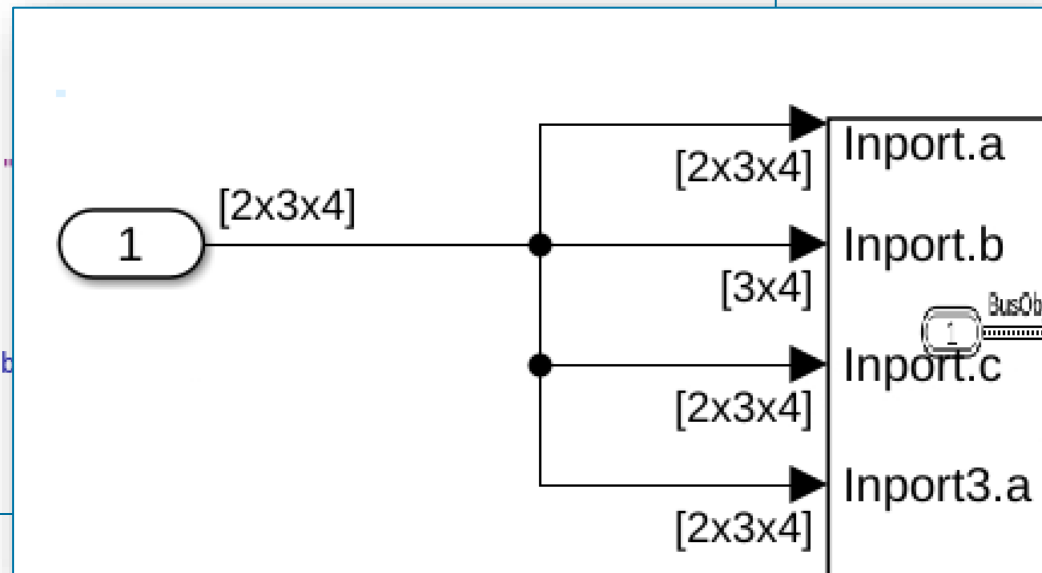
FMU Import Block

Import FMUs implemented in FMI 3.0 standard with Vectors and Arrays support

```

▼<UInt32 causality="input" description="Inport.b" initial="exact" name="Inport.b" start="0 0 0
  variability="discrete">
  <Dimension start="3"/>
  <Dimension start="4"/>
</UInt32>
▼<Float64 causality="input" description="Inport.c" initial="exact" name="Inport.c" start="0 0
  valueReference="0" variability="continuous">
  <Dimension start="2"/>
  <Dimension start="3"/>
  <Dimension start="4"/>
</Float64>
▼<Int16 causality="input" description="Inport3.a"
  valueReference="10" variability="discrete">
  <Dimension start="2"/>
  <Dimension start="3"/>
  <Dimension start="4"/>
</Int16>
▼<UInt32 causality="input" description="Inport3.b"
  variability="discrete">
  <Dimension start="3"/>
  <Dimension start="4"/>
</UInt32>

```



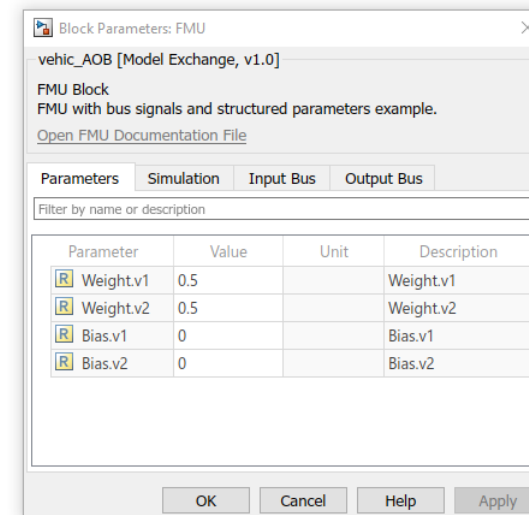
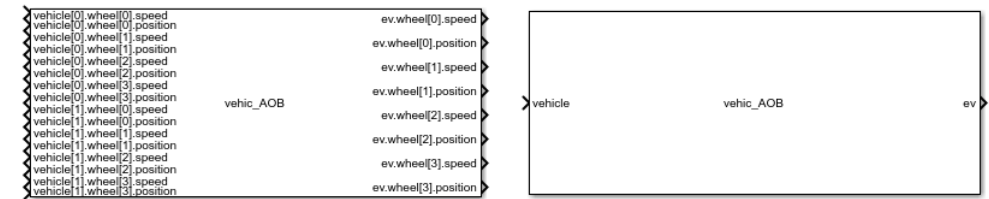
“Flattening” FMU 1.0 & 2.0

Change Block Input, Output, and Parameter Structures

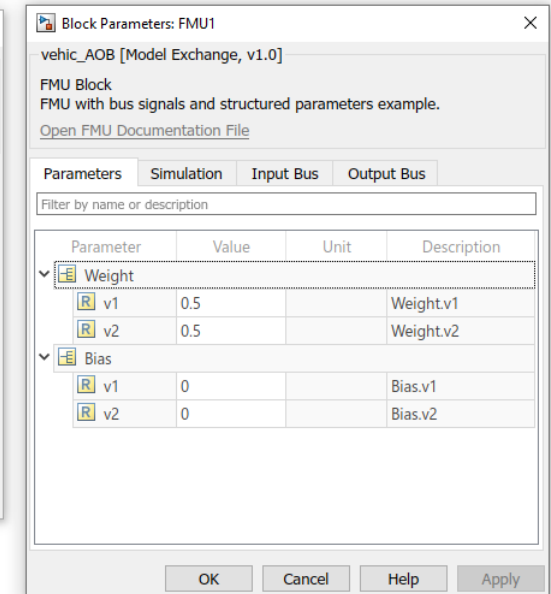
You can change the layout of FMU block input ports, output ports, and parameters with these parameters:

Parameter	Action	Settings
FMUInputMapping	Change hierarchy of input ports.	<p>'Flat' – Separates input into individual signals.</p> <p>'Structured' – Combines input into a structure of signals (bus).</p>
FMUOutputMapping	Change hierarchy of output ports.	<p>'Flat' – Separates output into individual signals.</p> <p>'Structured' – Combines output into a structure of signals (bus).</p>
FMUParamMapping	Change hierarchy of parameters.	<p>'Flat' – Separates parameters into individual parameters, listed by the parameter name and value.</p> <p>'Structured' – Combines parameters into a structure of parameter values (struct).</p>

```
>> set_param(gcf,'FMUInputMapping','flat')
>> set_param(gcf,'FMUOutputMapping','flat')
>> set_param(gcf,'FMUParamMapping','flat')
```



Flat



Structured

FMU Import

FMI 3.0 Event mode

FMU Import Block

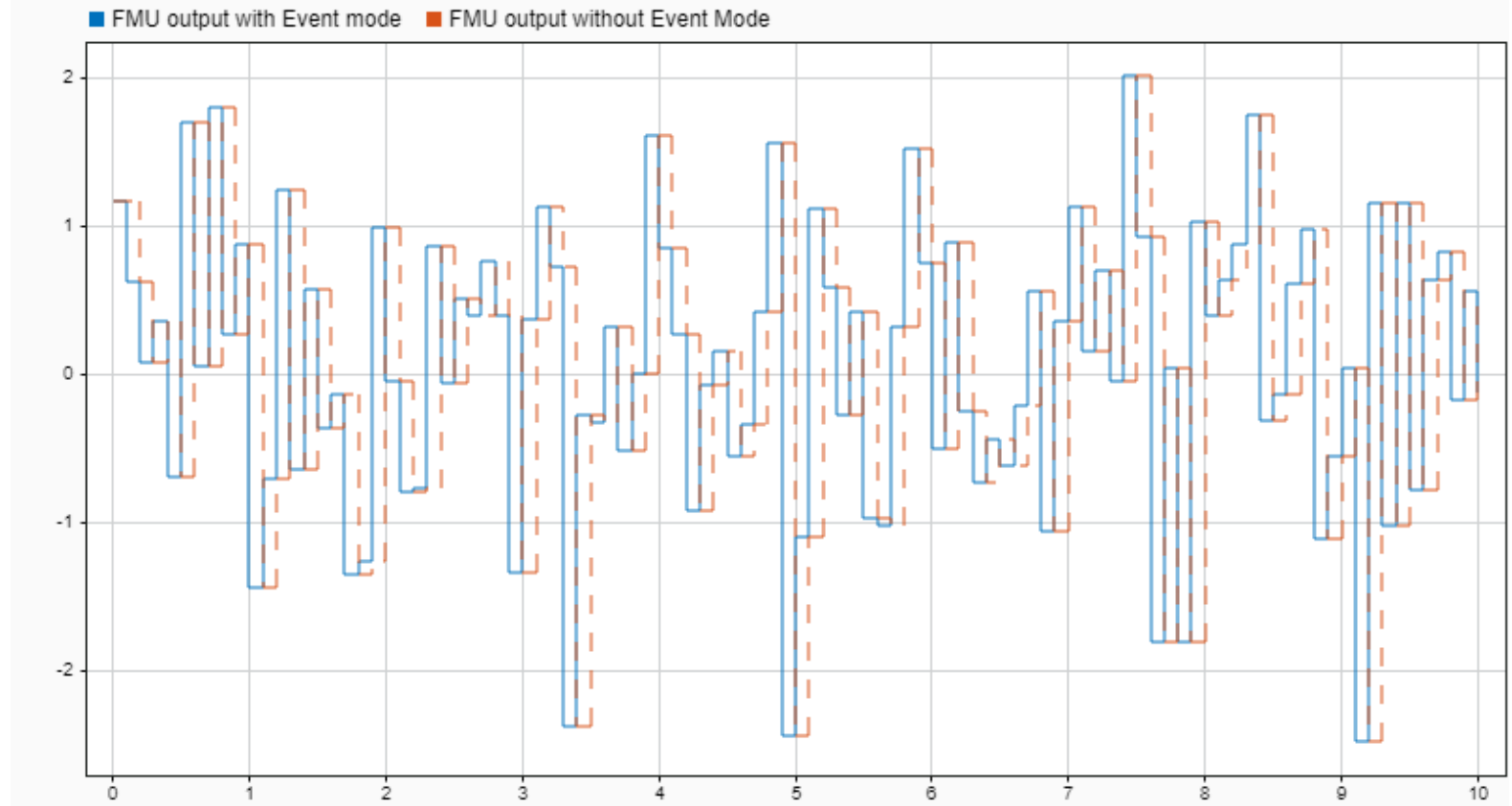
Import FMUs implemented in FMI 3.0 standard with Event mode in co-simulation

Co-simulation settings

☒ Enable event mode

Communication step size

- Could remove the delay time step observed with FMU 2.0

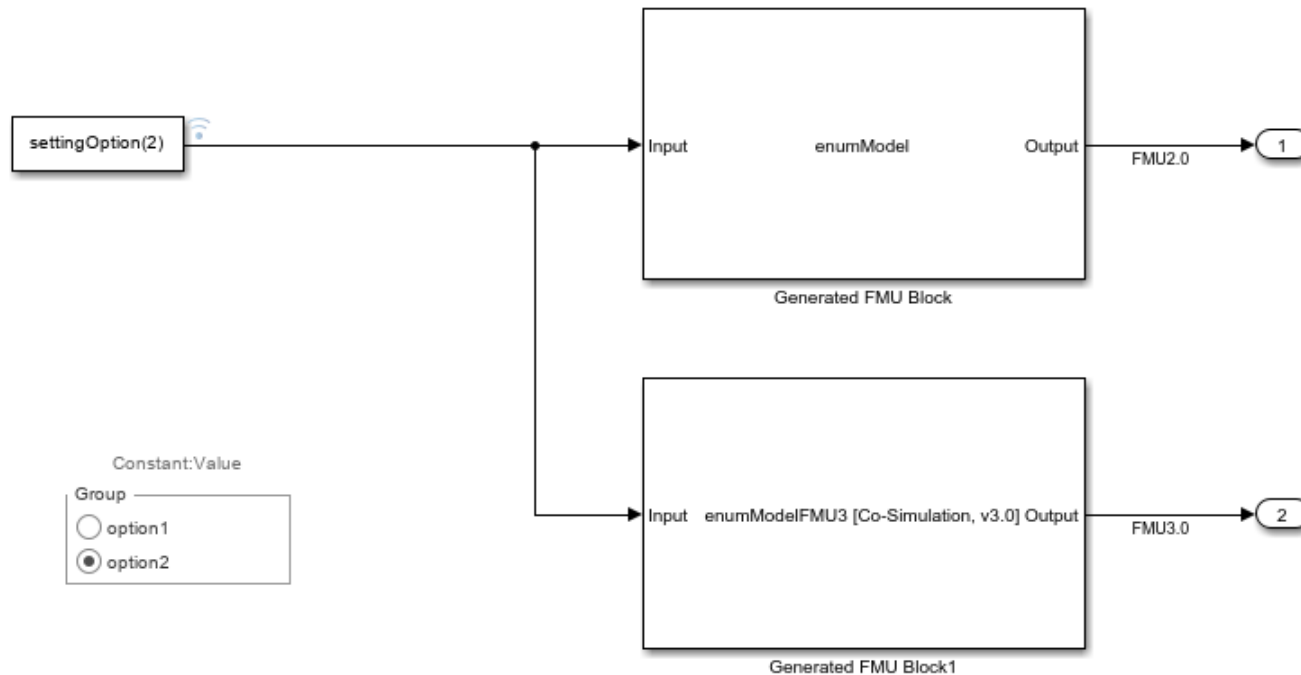


FMU Import

Enumeration support enhancement

Generate FMU object definitions

Native Enum support removing previous mandatory cast in integer



Generate FMU object definitions

For automatic Enum definition generation

- `fmudialog.createEnumType(gcf, "CreateClassDefinitionTo", "File")`
- Create automatically the classdef file to enum contained inside the FMU



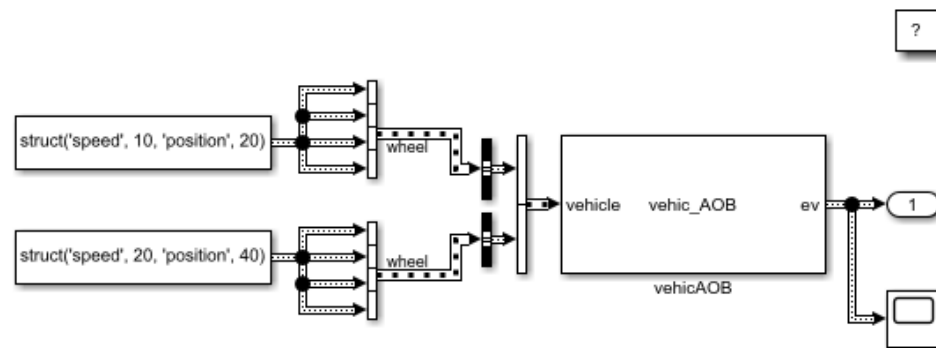
```
settingOption.m  x  +
1  classdef settingOption < int32
2      enumeration
3          option1(1)
4          option2(2)
5      end
6      methods (Static)
7          function retVal = getDefaultValue()
8              retVal = settingOption.option1;
9          end
10     end
11 end
12
```

Generate FMU object definitions

For Bus definition

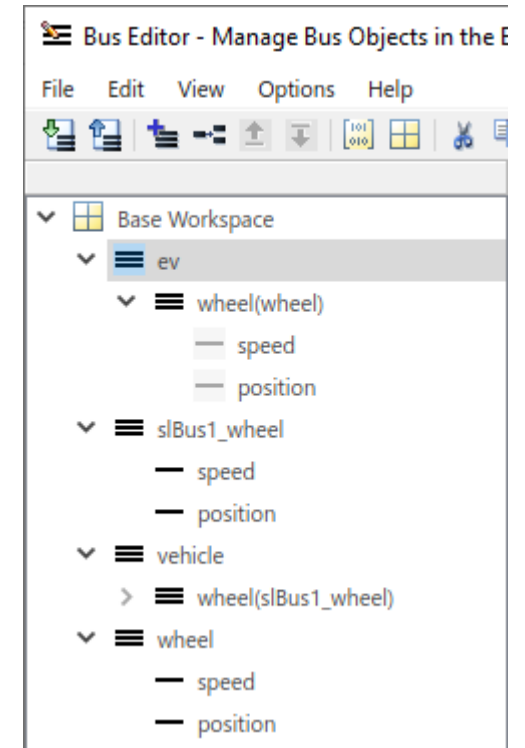
- `fmudialog.createBusType(gcb)`
- Create automatically the Simulink Bus object that FMU has at its interface

Using Bus Signals and Structure Parameters in the FMU Import Block



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`fmudialog.createBusType(gcb)`



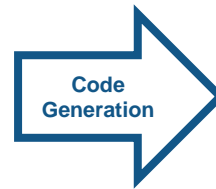
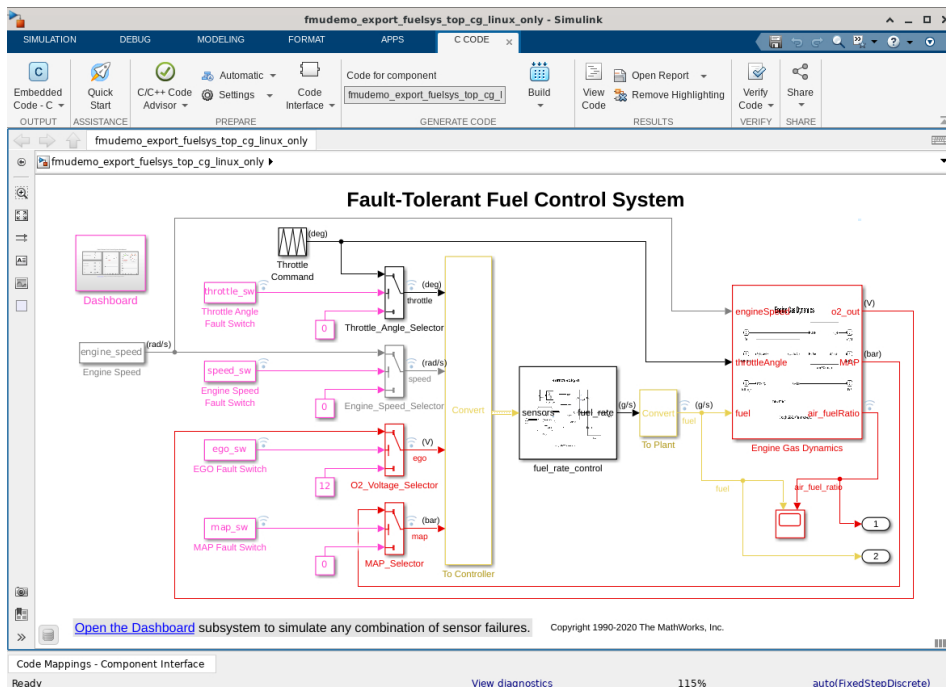
FMU Import

FMI 1.0/2.0 Code Generation support

FMU Block Code Generation

Enable code generation for FMU 1.0 & 2.0 import block

- You are now able to generate code for GRT & ERT
 - Generate portable code (in-process mode only)
 - Work with protected model, packNGo



The screenshot shows the 'Code Generation Report' window for the 'fmudemo_export_fuelsys_top_cg_linux_only' model. The report is titled 'Content' and includes sections for 'Summary', 'Subsystem Report', 'Code Interface Report', 'Traceability Report', 'Static Code Metrics Report', 'Code Replacements Report', and 'Code Assumptions'. The 'Code' section is expanded, showing the generated C code for the 'fuel_rate_control' block. The code includes initialization logic and a real-time execution loop. The 'fuel_rate_control' block is highlighted in the report.

```

241
242 /* DataTypeConversion: '<S3>/DTC1' incorporates:
243  * Switch: '<Root>/Throttle_Angle_Selector'
244  */
245 rtB.BusCreator.throttle = rtB.LookupTable1;
246 if (rtM->Timing.TaskCounters.TID[2] == 0) {
247   /* FMU: '<Root>/fuel_rate_control' */
248   if (rtDWork.fuel_rate_control_FmuIsInitiali == 0) {
249     rtDWork.fuel_rate_control_FmuPrevTime = ((rtM->Timing.clockTick2) * 0.01);
250     rtDWork.fuel_rate_control_slPrevTime =
251       rtDWork.fuel_rate_control_FmuPrevTime;
252     FMU2_enterInitializationMode(&rtDWork.fuel_rate_control_FmuStruct);
253     realValue_8 = rtB.BusCreator.throttle;
254     FMU2_setReal(&rtDWork.fuel_rate_control_FmuStruct, 0, 1, &realValue_8);
255     realValue_9 = rtB.BusCreator.speed;
256     FMU2_setReal(&rtDWork.fuel_rate_control_FmuStruct, 1, 1, &realValue_9);
257     realValue_a = rtB.BusCreator.ego;
258     FMU2_setReal(&rtDWork.fuel_rate_control_FmuStruct, 2, 1, &realValue_a);
259     realValue_b = rtB.BusCreator.map;
260     FMU2_setReal(&rtDWork.fuel_rate_control_FmuStruct, 3, 1, &realValue_b);
261     FMU2_exitInitializationMode(&rtDWork.fuel_rate_control_FmuStruct);
262     rtDWork.fuel_rate_control_FmuIsInitiali = 1;
263     FMU2_getReal(&rtDWork.fuel_rate_control_FmuStruct, 4, 1, &realValue_d);
264
265     /* FMU: '<Root>/fuel_rate_control' */
266     rtb_fuel_rate_control = realValue_d;
267   } else {
268     currentTime = ((rtM->Timing.clockTick2) * 0.01);
269     stepsize = currentTime - rtDWork.fuel_rate_control_slPrevTime;
270     if (stepsize > 0.0) {

```

FMU Export

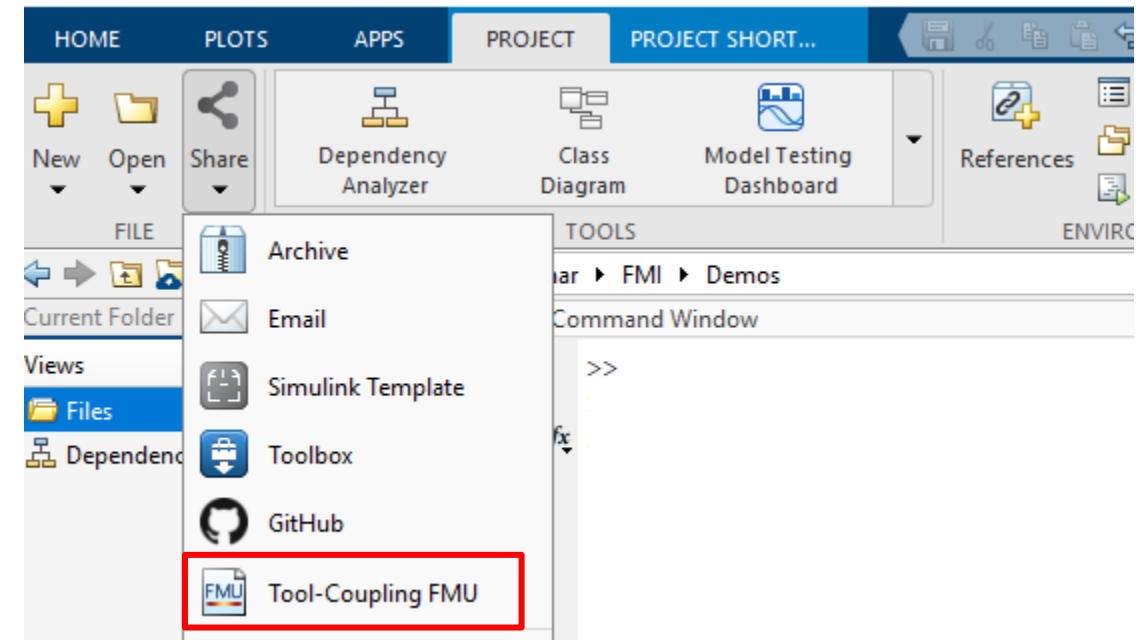
FMU 2.0 Export

Tool Coupling from Project

FMU Export from Project

Export a Simulink model as a FMU 2.0 Co-Simulation from Project

- Tool Coupling FMU
 - All toolboxes used by model needed at execution
 - All toolboxes used by model need to be installed
- Variable and Fixed step solver supported
- No Code Generation under the hood
- IP protection not guaranteed unless protected model used



FMU Export from Project

Export a Simulink model as a FMU 2.0 Co-Simulation from Project

- Dedicated Matlab Session need to be started to used it
 - Matlab command:
 - “shareMATLABForFMUCoSim”
 - From the Operating system :

- On Windows:

```
<matlabroot>\toolbox\shared\fmu_share\script\fmu-matlab-setup.cmd
```

- On Linux and Mac OS:

```
<matlabroot>/toolbox/shared/fmu_share/script/fmu-matlab-setup
```

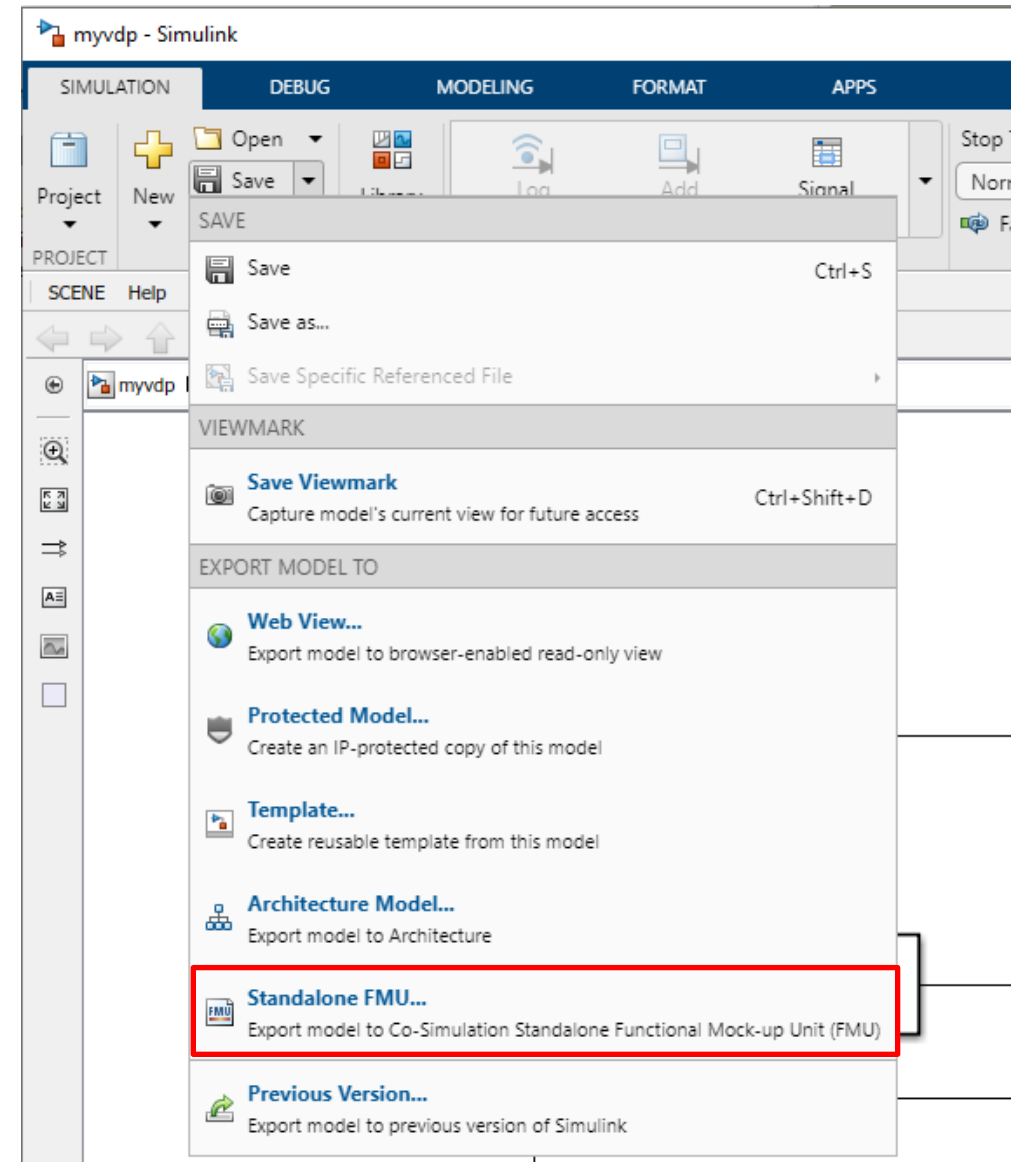
FMU 2.0 / 3.0 Export

Standalone Fixed Step Solver

FMU Export with Fixed step solver support

Export a Simulink model as a FMU 2.0 Co-Simulation with Simulink Compiler

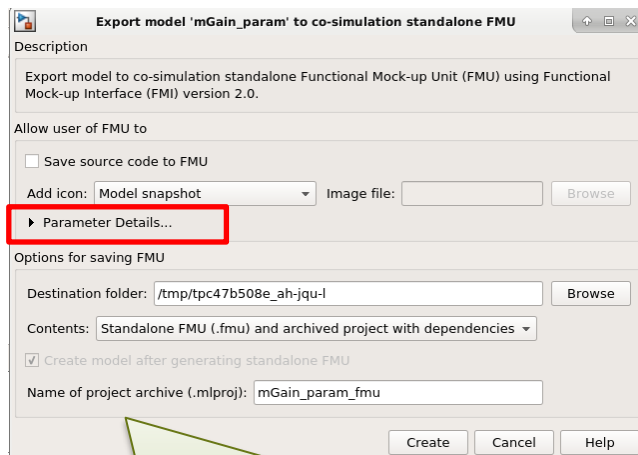
- Standalone FMU
 - No license check at execution
 - No additional installation needed
- Limited to fixed step solver only
- Model need to be Code Generation compatible
- Command line: [exportToFMU2CS](#)



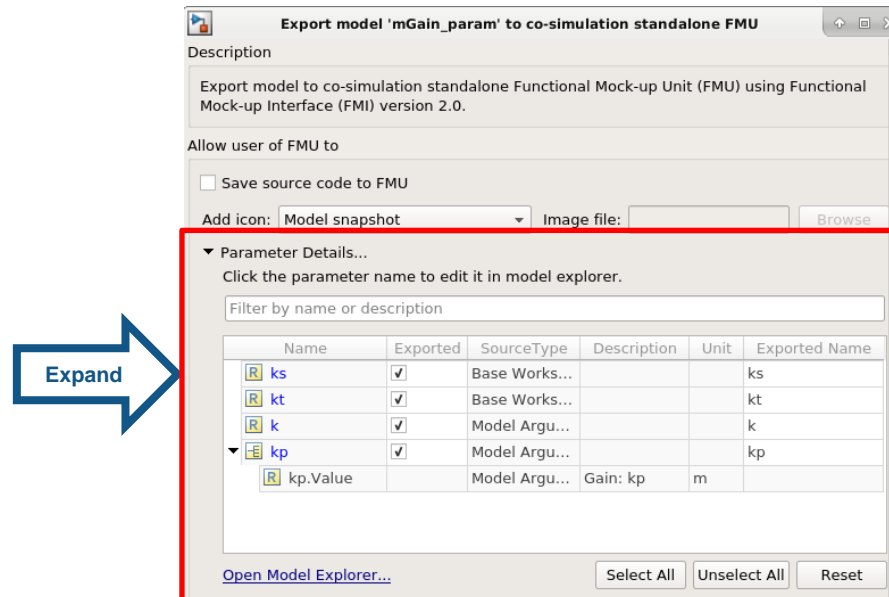
FMU export: parameter configuration

Export improvements with FMU parameter selection and configuration from the FMU export dialog

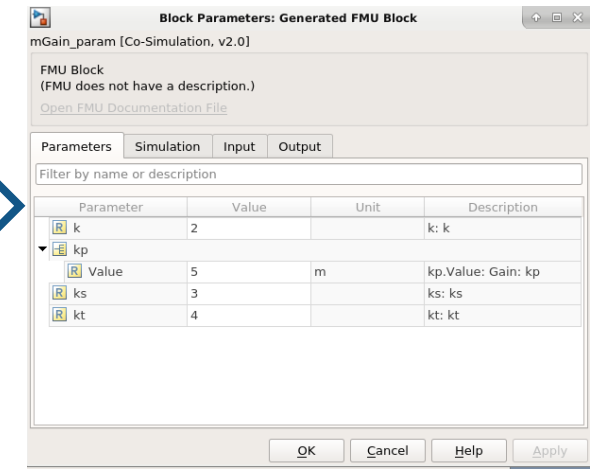
- Select parameters for export from FMU export dialog
- Export model arguments as FMU parameters



Expand to customize the FMU parameters to be exposed



Export/import



Select FMU parameters from model arguments and global WS variables

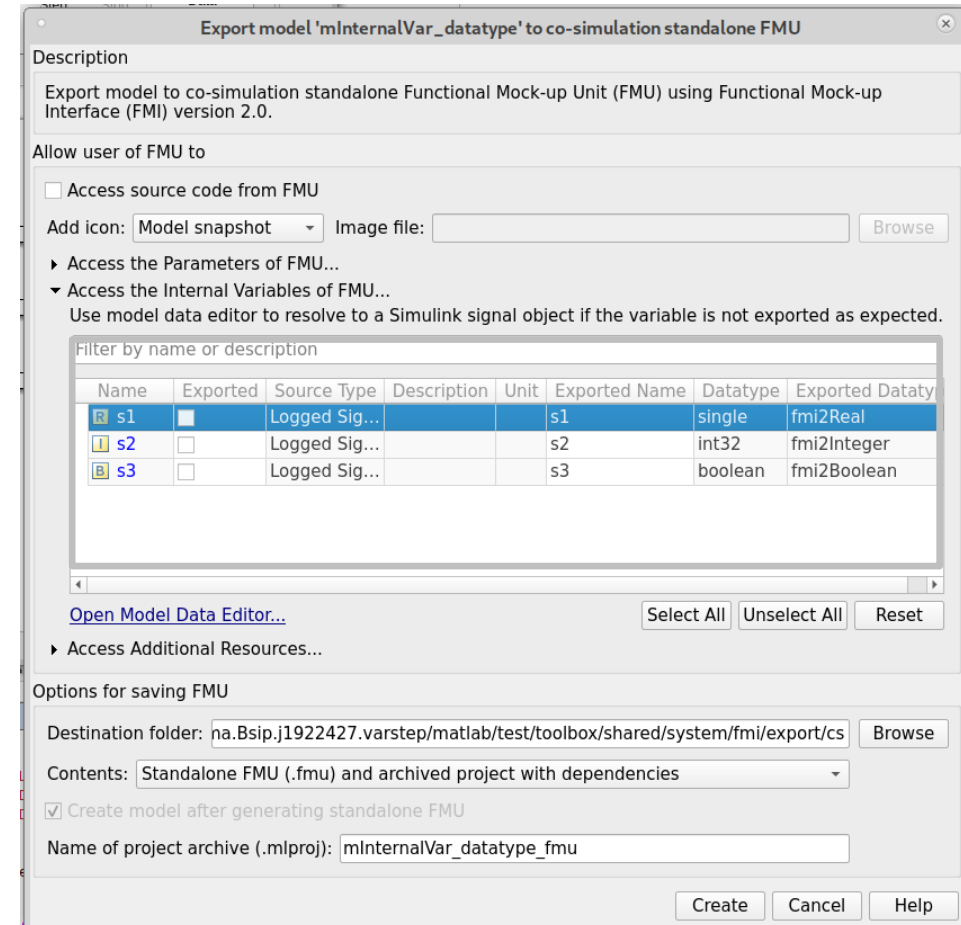


FMU file

FMU Export: Configure Internal Variables

A new toggle panel in the Standalone FMU Export dialog to export internal variables

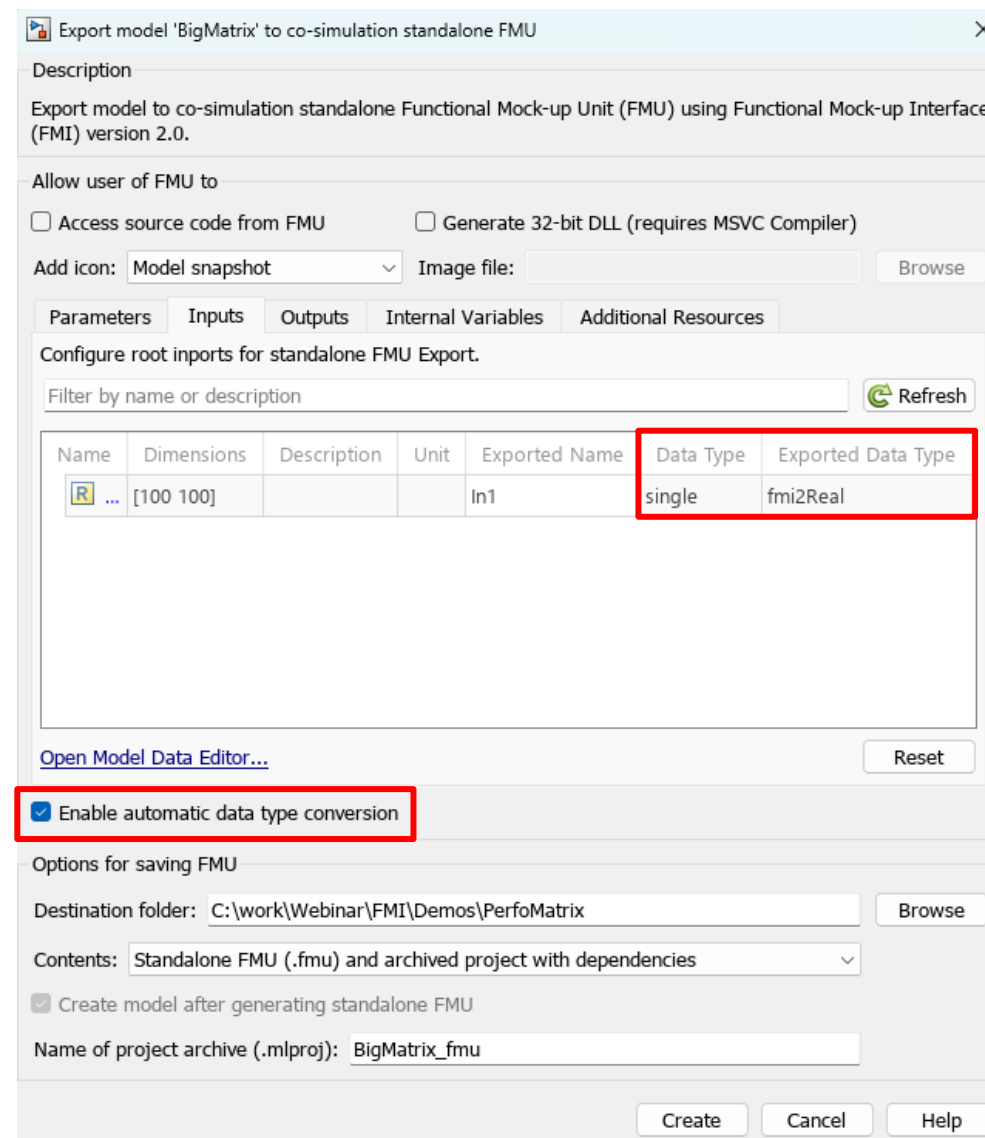
- Enables the user to export logged signals as internal variables from the FMU Standalone Export dialog
- Automatic datatype conversion for datatype unsupported by the FMI standard
- Command line workflow is also supported
- *Logged signals must be resolved to Simulink.Signal for export*



FMU Export: Datatype conversion

FMU Export dialog Enhancement and automatic datatype conversion options

- You can now change the names of the root input ports, root output ports, and parameters before export
- You can also enable automatic datatype conversion to FMI-supported datatypes for root input ports, root output ports, and parameters.



Export model 'BigMatrix' 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.

Allow user of FMU to


☐ Access source code from FMU ☐ Generate 32-bit DLL (requires MSVC Compiler)

Add icon: Image file:

Parameters Inputs Outputs Internal Variables Additional Resources

Configure root inputs for standalone FMU Export.

Filter by name or description

Name	Dimensions	Description	Unit	Exported Name	Data Type	Exported Data Type
 ...	[100 100]			In1	single	fmi2Real

[Open Model Data Editor...](#)

☒ Enable automatic data type conversion

Options for saving FMU

Destination folder:

Contents:

☒ Create model after generating standalone FMU

Name of project archive (.mlproj):

FMU Export with Fixed step solver support

Export a Simulink model as a FMU 3.0 Co-Simulation with Simulink Compiler

- Standalone FMU
 - No license check at execution
 - No additional installation needed
- Limited to fixed step solver only
- Model need to be Code Generation compatible
- New command line: [exportToFMU](#)

Export model 'mFMU3MixDataTypesUI' to co-simulation standalone FMU

Description

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

FMU Settings

FMI Version: 3.0 Solver: [FixedStepAuto](#) Refresh

Parameters Inputs Outputs Internal Variables Additional Resources Schema

Configure root inputs for standalone FMU Export.

Filter by name or description

Name	Dimensions	Description	Unit	Imported Nan	Data Type
Inport				Inport	int32
Inport1	[1 4]			Inport1	uint32
Inport2				Inport2	uint16
Inport3	[4]			Inport3	int16
Inport4				Inport4	uint64
Inport5	[2 4]			Inport5	int64
Inport6	[2 2 2]			Inport6	uint8

[Open Model Data Editor...](#) Reset

Options for saving FMU

Destination folder: /taocheng.Bsip.j2291239/matlab/test/toolbox/shared/system/fmi/export/cs/FMU3CS Browse

Contents: Standalone FMU (.fmu) and archived project with dependencies

☒ Create model after generating standalone FMU

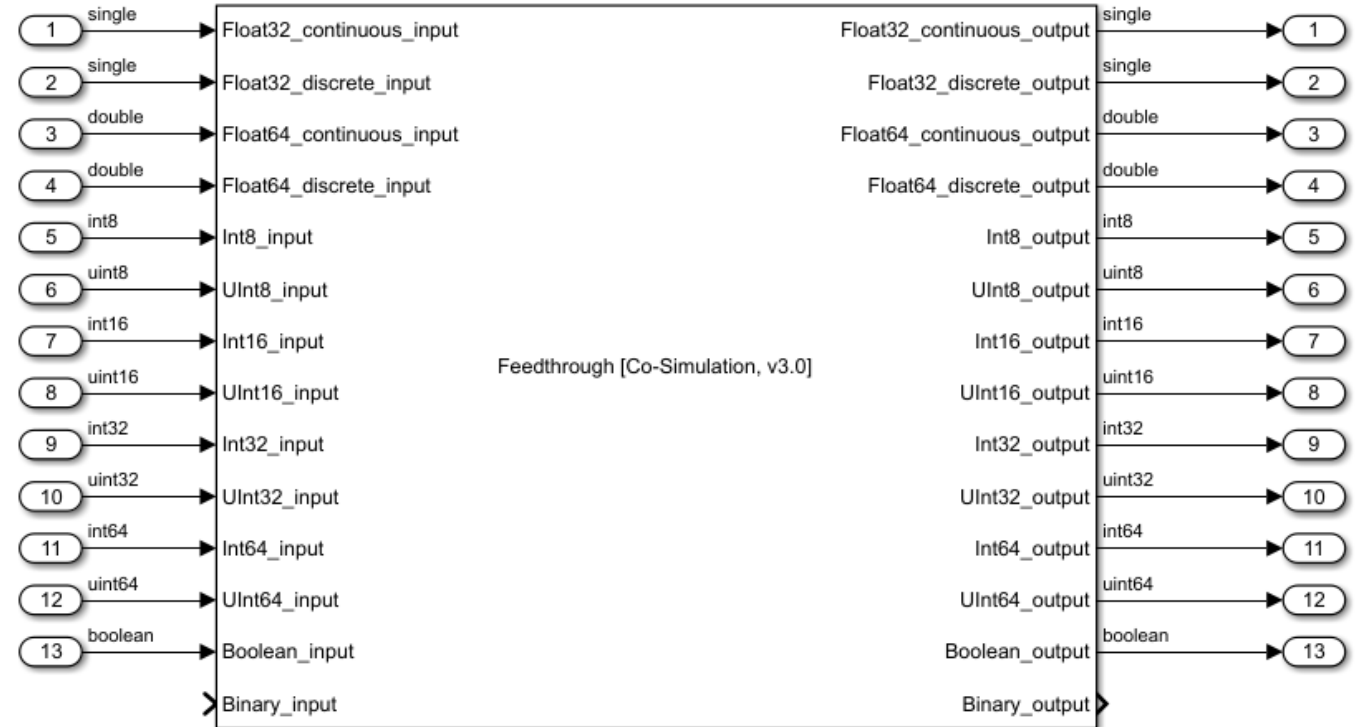
Name of project archive (.mlproj): mFMU3MixDataTypesUI_fmu

Create Cancel Help

FMU Export with Fixed step solver support

Export a Simulink model as a FMU 3.0 Co-Simulation with Simulink Compiler

- Float64, float32, uint8, int8, uint16, int16, uint32, int32, uint64, int64, boolean, string (scalar only)



FMU Export with Fixed step solver support

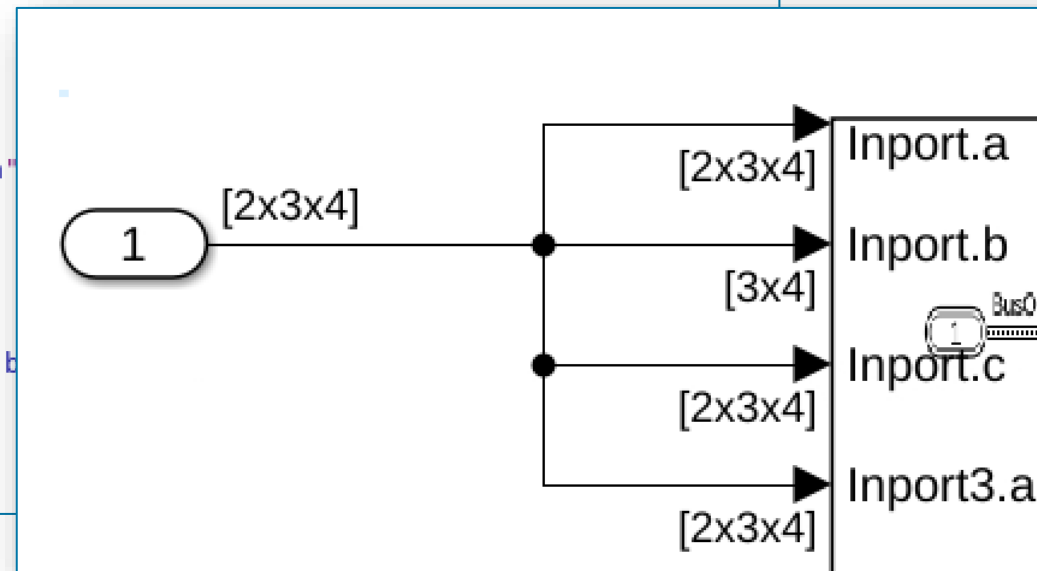
Export a Simulink model as a FMU 3.0 Co-Simulation with Simulink Compiler

- Support array & vector variables

```

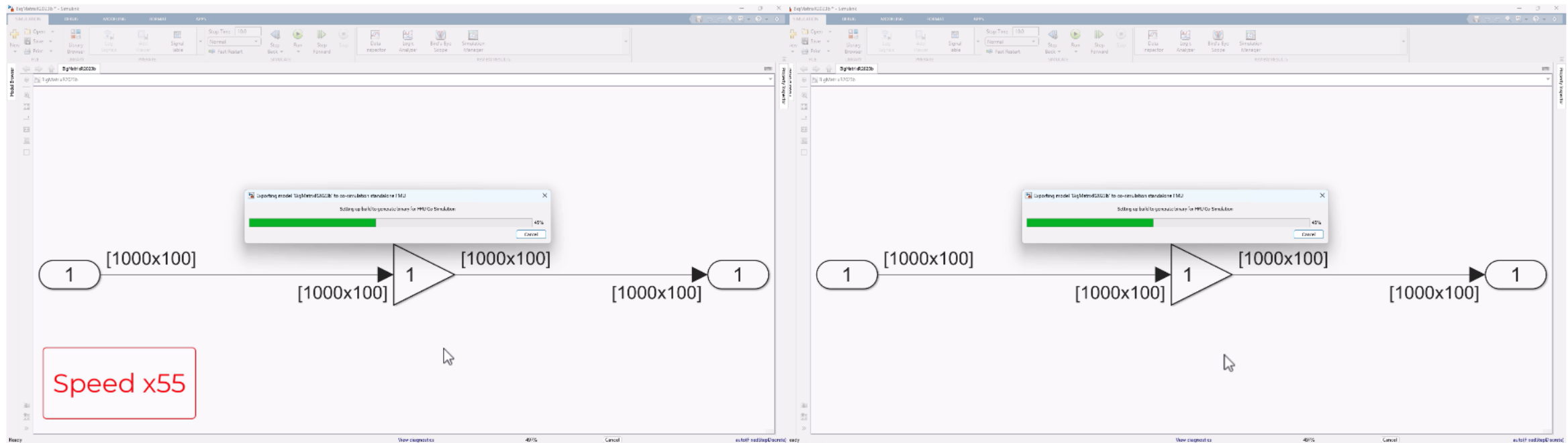
▼<UInt32 causality="input" description="Inport.b" initial="exact" name="Inport.b" start="0 0 0
  variability="discrete">
  <Dimension start="3"/>
  <Dimension start="4"/>
</UInt32>
▼<Float64 causality="input" description="Inport.c" initial="exact" name="Inport.c" start="0 0
  valueReference="0" variability="continuous">
  <Dimension start="2"/>
  <Dimension start="3"/>
  <Dimension start="4"/>
</Float64>
▼<Int16 causality="input" description="Inport3.a"
  valueReference="10" variability="discrete">
  <Dimension start="2"/>
  <Dimension start="3"/>
  <Dimension start="4"/>
</Int16>
▼<UInt32 causality="input" description="Inport3.b"
  variability="discrete">
  <Dimension start="3"/>
  <Dimension start="4"/>
</UInt32>

```



FMU Export with Fixed step solver support

Export a Simulink model as a FMU 3.0 Co-Simulation with Simulink Compiler



- FMU 2.0 creation: 10 min 15 sec
- FMU 2.0 Size: 6.79 MB

- FMU 3.0 creation: **15 sec**
- FMU 3.0 Size: 77 KB

FMU Export with Fixed step solver support

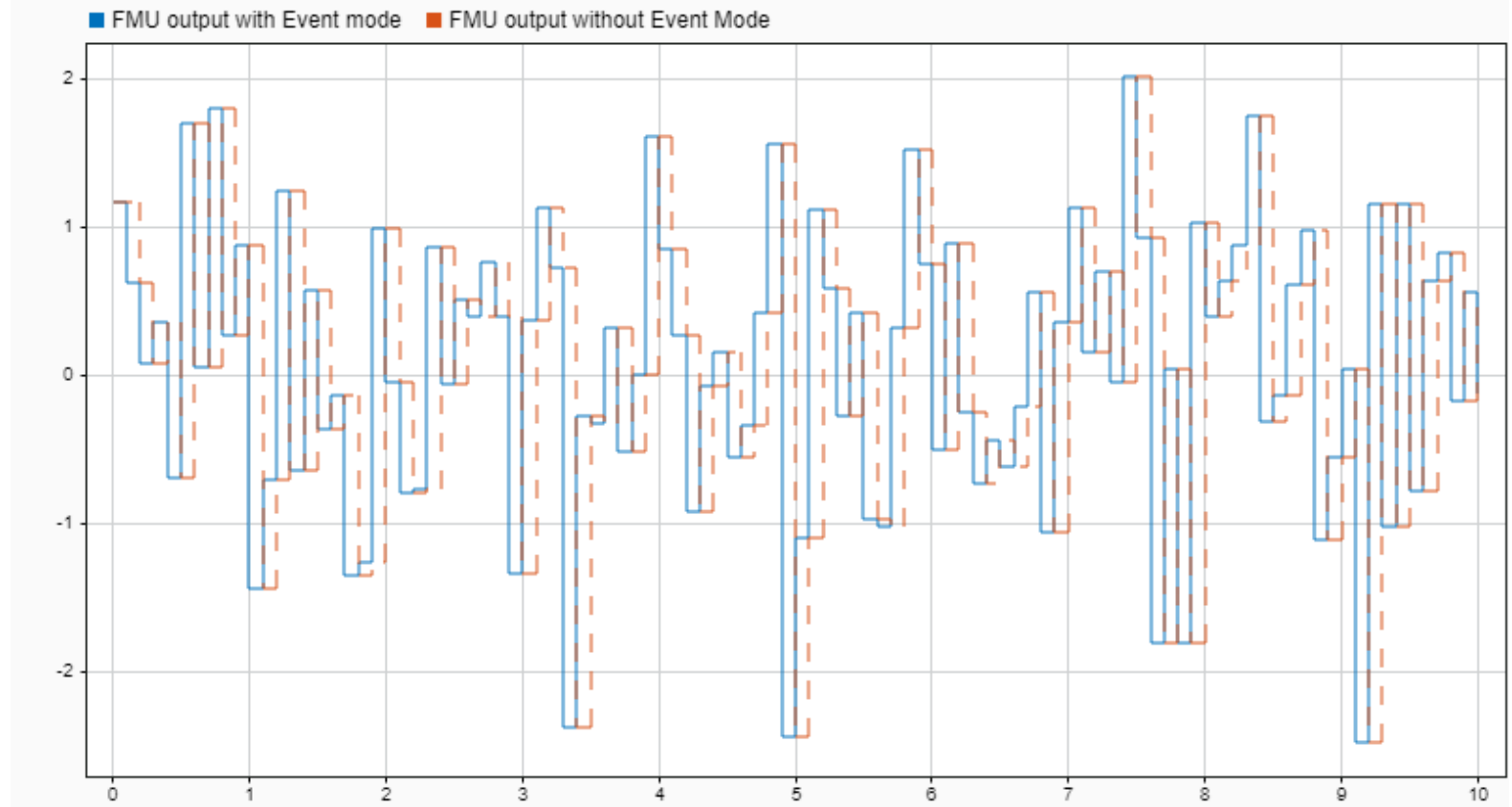
Export a Simulink model as a FMU 3.0 Co-Simulation with Simulink Compiler

- Event mode include in generated FMU

Co-simulation settings

☒ Enable event mode

Communication step size



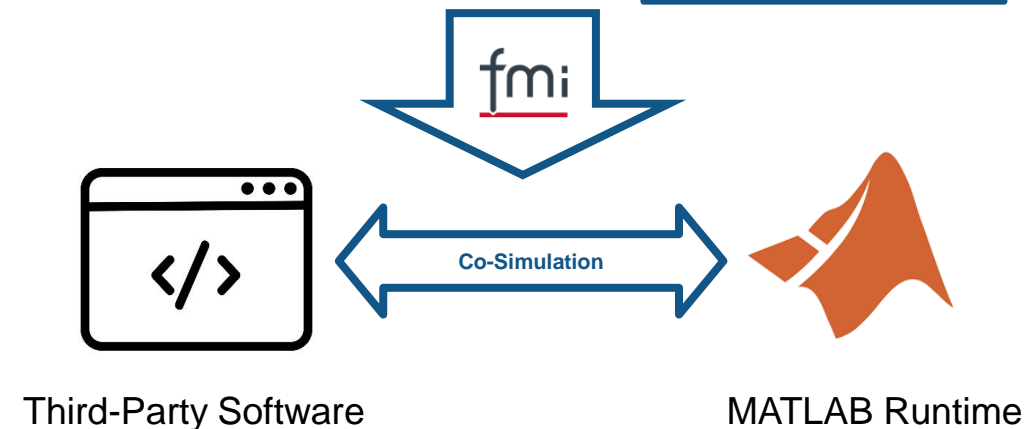
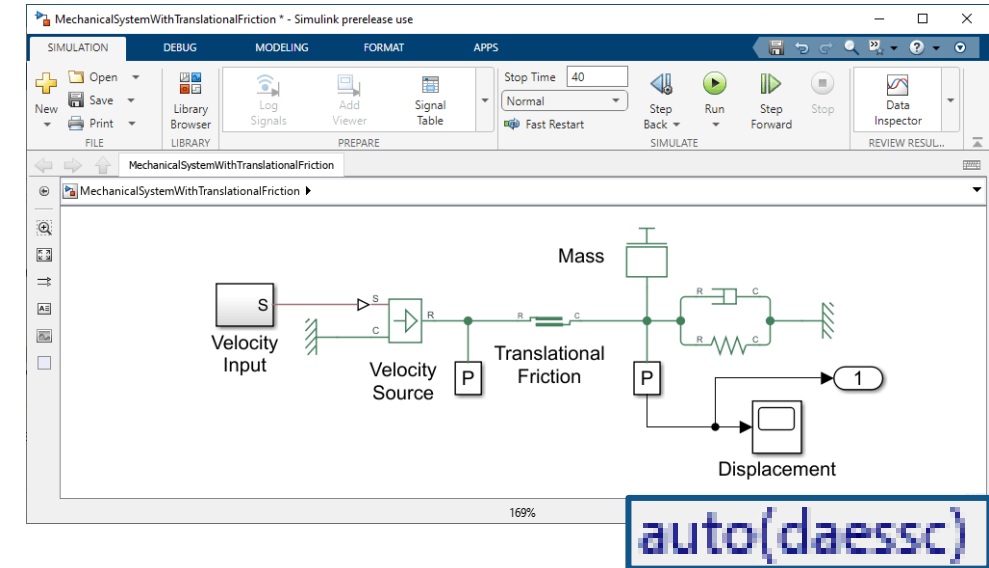
FMU 2.0 Export

Tool Coupling Variable Step Solver

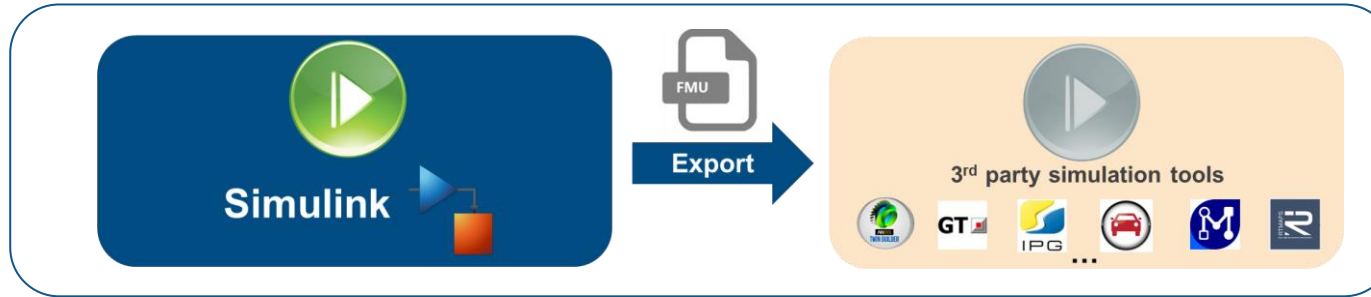
FMU Export with variable step solver support

Export a Simulink model as a FMU 2.0 Co-Simulation with Simulink Compiler

- Tool Coupling FMU
 - No license check at execution
 - MATLAB Runtime need to be installed separately
- Variable step solver support
- Model need to be compatible with Rapid Accelerator mode



Export from Simulink to 3rd party tools with FMI Standard



Release	Product	FMU Export Support	Comments
R2018b	Simulink	Tool coupling co-simulation FMU 2.0	<ul style="list-style-type: none"> - Need Simulink installation - Check out licenses - Variable step & fixed step solver support
R2020a	Simulink Compiler	<i>Standalone</i> co-simulation FMU 2.0	<ul style="list-style-type: none"> - No license checkout - No Simulink installation needed - Fixed step solver support
R2023b	Simulink Compiler	<i>Tool coupling</i> co-simulation FMU 2.0	<ul style="list-style-type: none"> - No license checkout - MATLAB Runtime installation required - Variable step solver support
R2023b	Simulink Compiler	<i>Standalone</i> co-simulation FMU 3.0	<ul style="list-style-type: none"> - No license checkout - No Simulink installation needed - Fixed step solver support



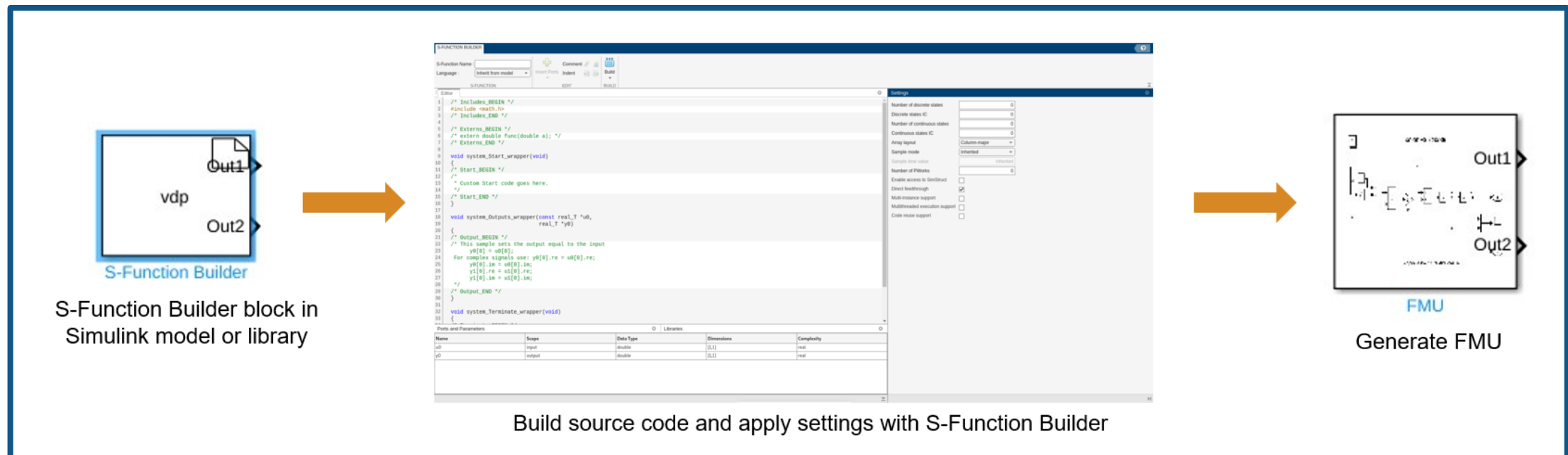
FMU 3.0 Export

From Source Code

FMU Export from external source code

Build an FMI 3.0 FMU from the source code using the S-Function Builder

- Users can write their own implementation of the source code from the S-Function Builder editor
- A command line API is provided to generate FMU from the S-Function Builder block
 - [Simulink.SFunctionBuilder.generateFMU\(blkHdl\);](#)

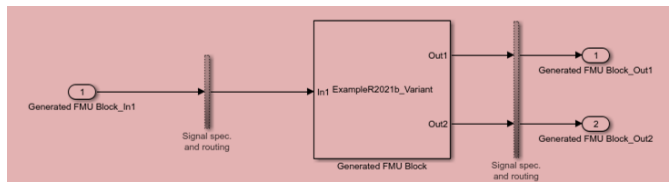


Nested FMUs & Protected Models

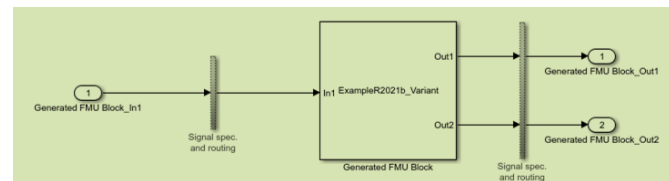
Simulink Compiler: Nested FMU

- Export Simulink model with a FMU Import blocks as nested standalone FMU.
 - Simulink packs all dependent inner FMUs into the resources/ folder of the nested FMU.
 - All inner FMUs will share the same callback functions provided by the environment, for example, logger and memory allocation functions.

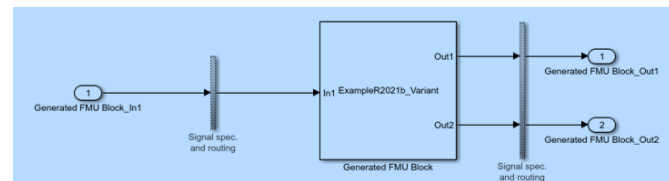
FMU 1



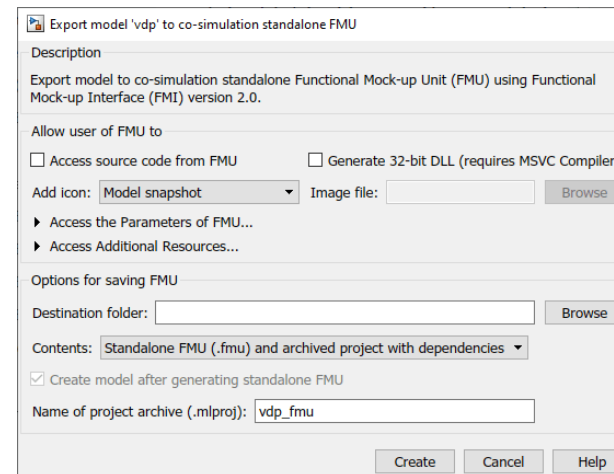
FMU 2



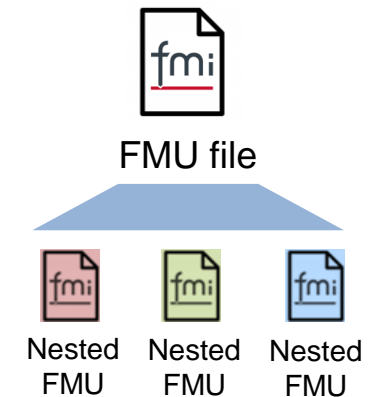
FMU 3



FMU Export



New FMU

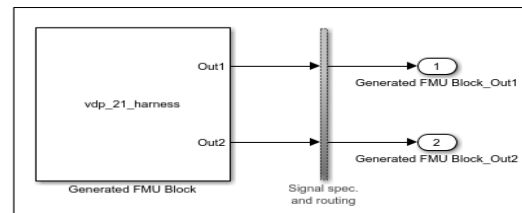
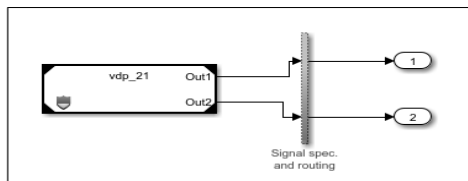
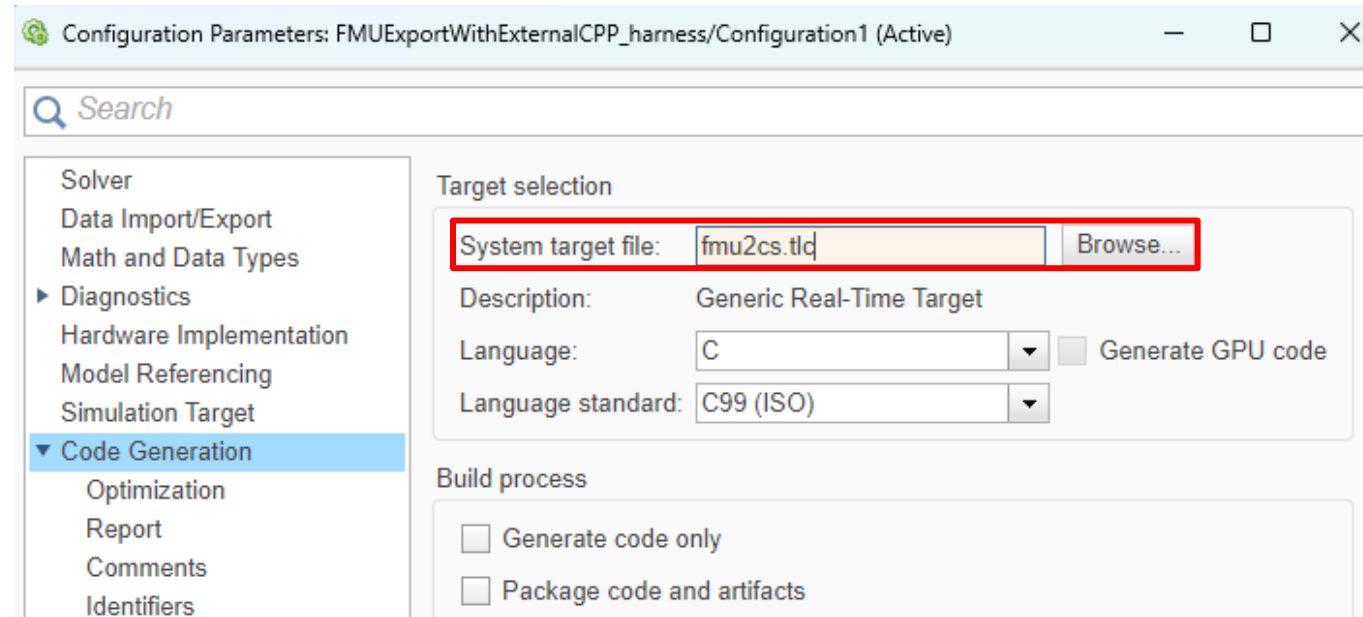


Protected Model Support for Standalone FMU Export

R2022a

Simulink Model with protected model now can be exported as standalone FMUs

- Complete customer workflow involving protected models \leftrightarrow standalone FMUs
- The protected model should be generated with fmu2cs target (including source code)
- Support both GUI and command-line workflow



Model with protected model

Standalone FMU

NEW!**R2023b**

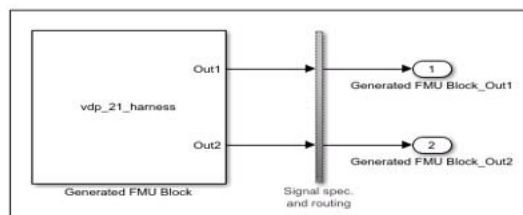
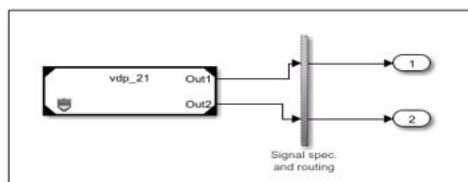
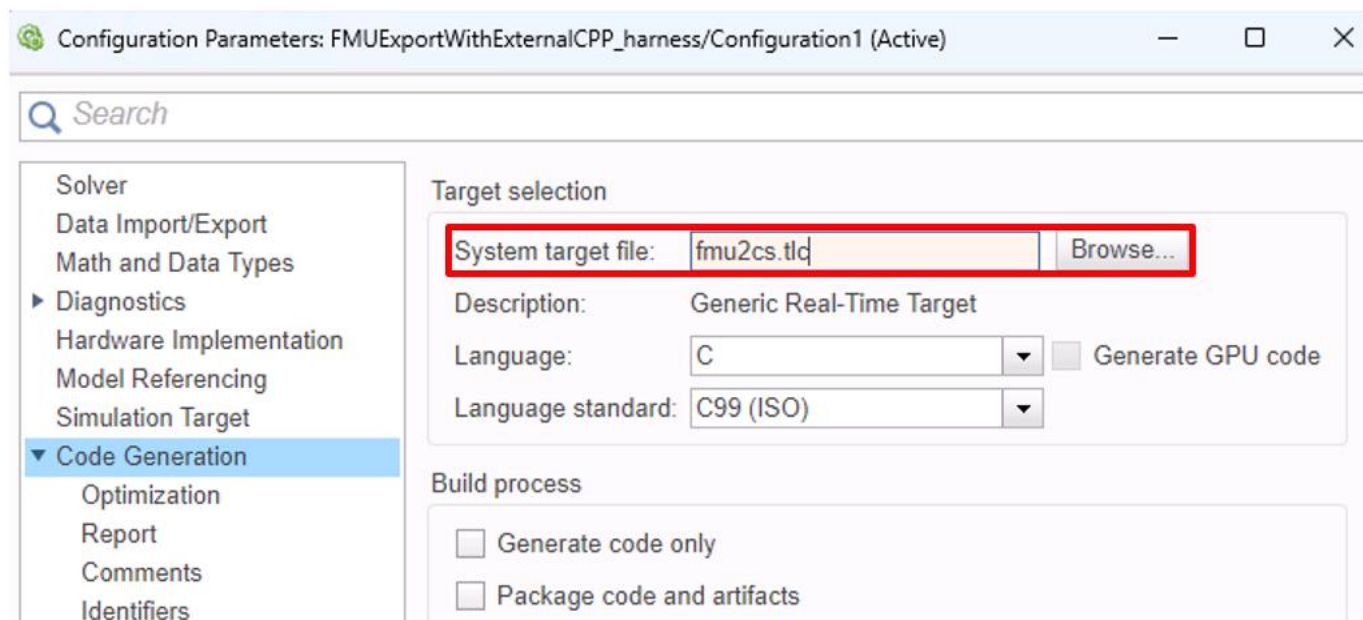
- Support for protected model generated with **grt.tlc** in combination of fmu2cs.tlc

Protected Model Support for Standalone FMU Export

R2022a

Simulink Model with protected model now can be exported as standalone FMUs

- Complete customer workflow involving protected models \leftrightarrow standalone FMUs
- The protected model should be generated with fmu2cs target (including source code)
- Support both GUI and command-line workflow



Model with protected model

Standalone FMU

NEW!**R2023b**

- Support for protected model generated with **grt.tlc** in combination of fmu2cs.tlc

HOME PLOTS APPS Search Documentation Morgan

New Script New Live Script New Open Find Files Compare Import Data Clean Data Variable Save Workspace Clear Workspace Favorites Run and Time Clear Commands Simulink ENVIRONMENT RESOURCES

FILE VARIABLE CODE SIMULINK

C:\work\Webinar\FMI\Demos\3_NestedProtectedModels\VariableStepSolver

Current Folder

Live Script

ExportSimulinkModelWithPMAndFMUToStandalone...

Simulink Model

mechanical_system_local.slx

mechanical_system_local_ProtectedModel.slx

mechanical_system_local_ProtectedModel_harness.slx

Command Window

>>

Workspace

ans

handle

M

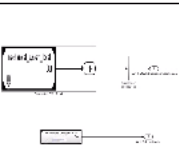
model

out

mechanical_system_local_ProtectedModel_harness.slx (S...

Model version:
1.7
Saved in Simulink version:
R2023b Update 3
Last modified by:
mfremovi
(no description available)

Preview:



Live Editor - C:\work\Webinar\FMI\Demos\3_NestedProtectedModels\VariableStepSolver\ExportSimulinkModelWithPMAndFMUToStandaloneFMUE...

LIVE EDITOR INSERT VIEW

New Open Save Compare Print Export NAVIGATE Text B I U M Code Control Task Refactor SECTION Run Stop

FILE CODE RUN

ExportSimulinkModelWithPMAndFMUToStandaloneFMUExample.mlx

the model `mechanical_system_local` demonstrates exporting protected model and FMU Import block to a Standalone FMU.

Simulink Compiler™ license is required for standalone FMU Export and Simulink Coder™ license is required to create protected models.

The example consists of two steps:

- Export Simulink Model to Protected Model
- Export Simulink Model with Protected Model to Variable Step Solver FMU

Export Simulink Model to Protected Model

```
1 % Open example model mechanical_system_local
2 model = "mechanical_system_local";
3 open_system(model);
4
5 % generate protected model
6 Simulink.ModelReference.protect(model);
7
```

Creating protected model for 'mechanical_system_local'.
Starting serial model reference simulation build.
Generating code for Physical Networks associated with solver block 'mechanical_system_local/Velocit...
done.
Successfully updated the model reference simulation target for: mechanical_system_local
Finished creating protected model 'C:\work\Webinar\FMI\Demos\3_NestedProtectedModels\VariableStepSolver\mech...

Export Simulink Model with Protected Model to Variable Step Solver FMU

```
8 % Open top model that reference the protected model
9 model = "mechanical_system_local_ProtectedModel";
10 open_system(model);
11
12 % Export model to Standalone Co-Simulation FMU 2.0
13 exportToFMU(model, 'FMIVersion', '2.0', 'FMUType', 'CS', 'CreateModelAfterGeneratingFMU', 'off');
14 close_system(model);
15
16 model = "mechanical_system_local_ProtectedModel_harness";
```

A standalone FMU is generated in the **Destination** folder specified from the export dialog.

Zoom: 110% UTF-8 LF script Ln 6 Col 40

Compatibility table for Nested FMUs & Protected models **R2023b**

	Final Export as		
	FMU 2.0 FSS	FMU 3.0 FSS	FMU 2.0 VSS
Nested FMU 2.0 FSS	✓	✗	✓
Nested FMU 3.0 FSS	✗	✗	✗
Nested FMU 2.0 VSS	✗	✗	✗
Protected model Simulation Only	✗	✗	✓
Protected model simulation + Code Generation*	✓	✓	✓

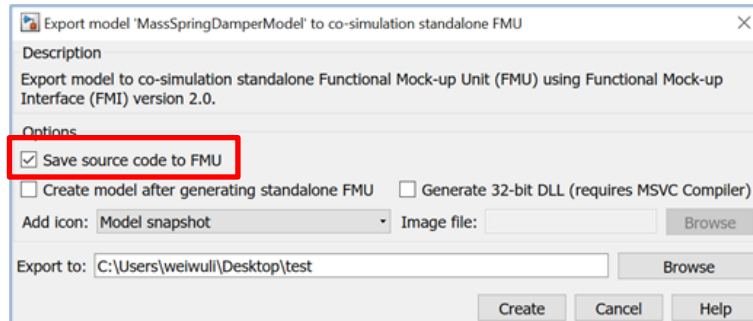
FSS = Fixed Step Solver
VSS = Variable Step Solver

*System Target file need to be fmu2cs.tlc before protecting model before R2023b. And grt.tlc since R2023b

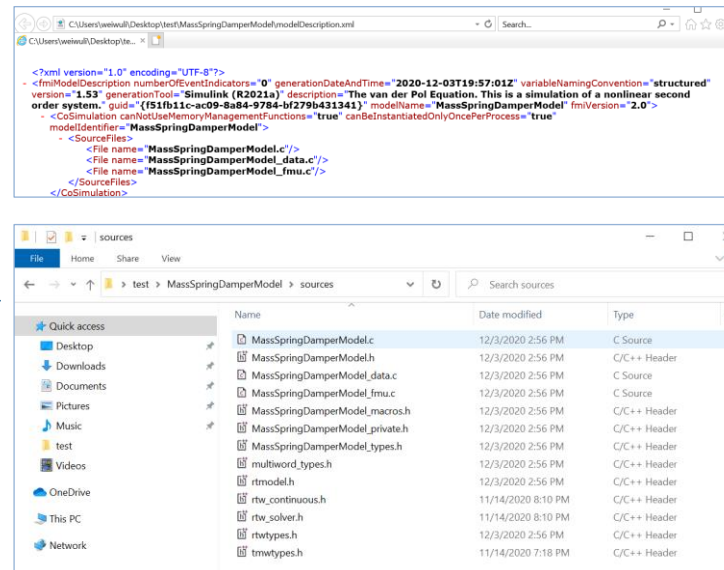
Cross Compilation

Simulink Compiler: Source Code FMU 2.0 Export

- Export Simulink Model as Standalone co-simulation FMU with C Code
- Generated source code can be used for Cross-Platform workflows
- Rebuild instructions in the documentation folder via the index file



FMU Export



Recompilation



Real-time Simulation

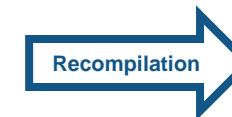
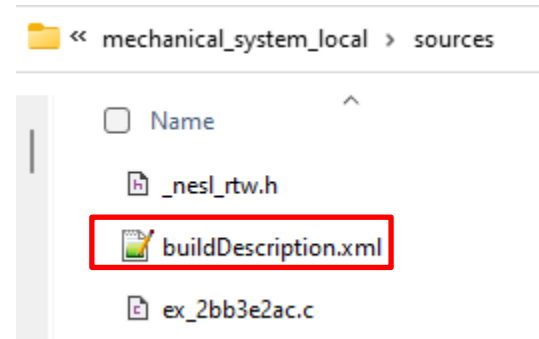
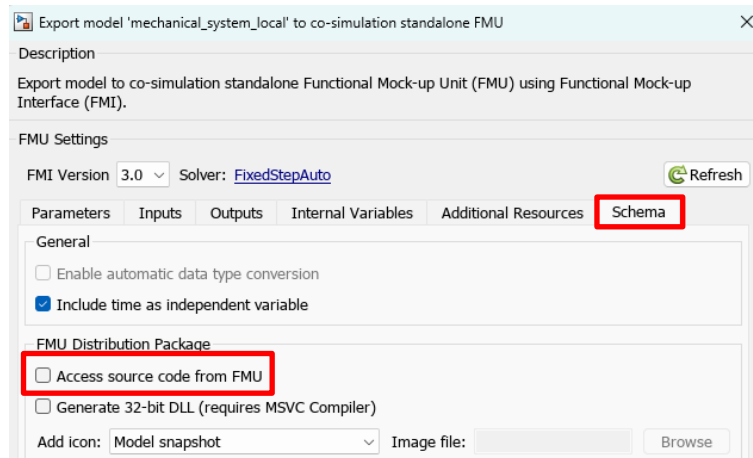


Deploy desktop simulation
on different OS

Requires both **Simulink Compiler** and **Simulink Coder** licenses

Simulink Compiler: Source Code FMU 3.0 Export

- Export Simulink Model as Standalone co-simulation FMU with C Code
- Generated source code can be used for Cross-Platform workflows
- Rebuild through **buildDescription.xml** file



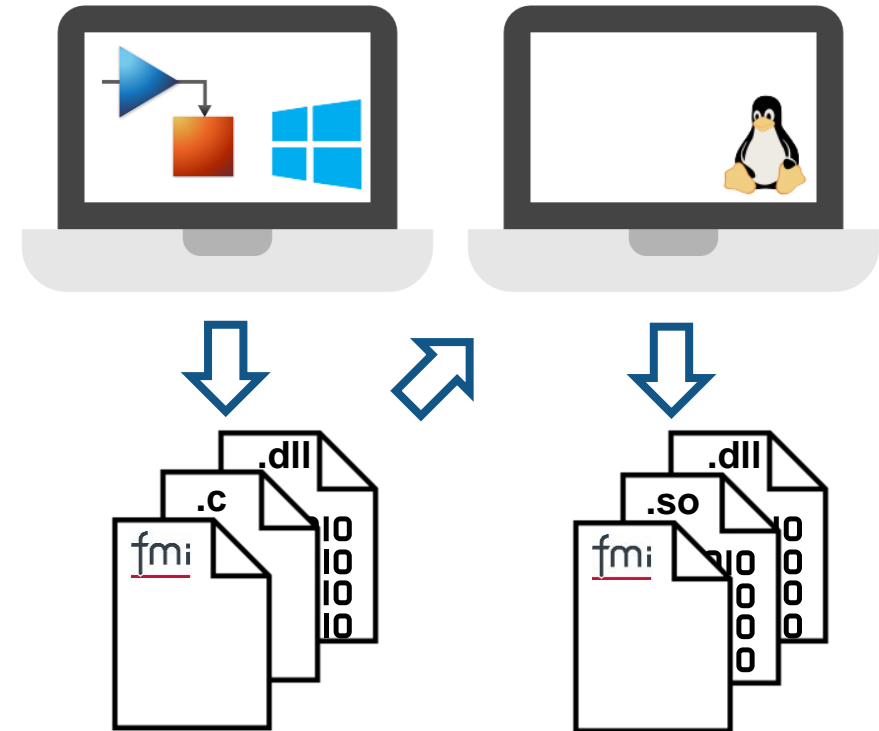
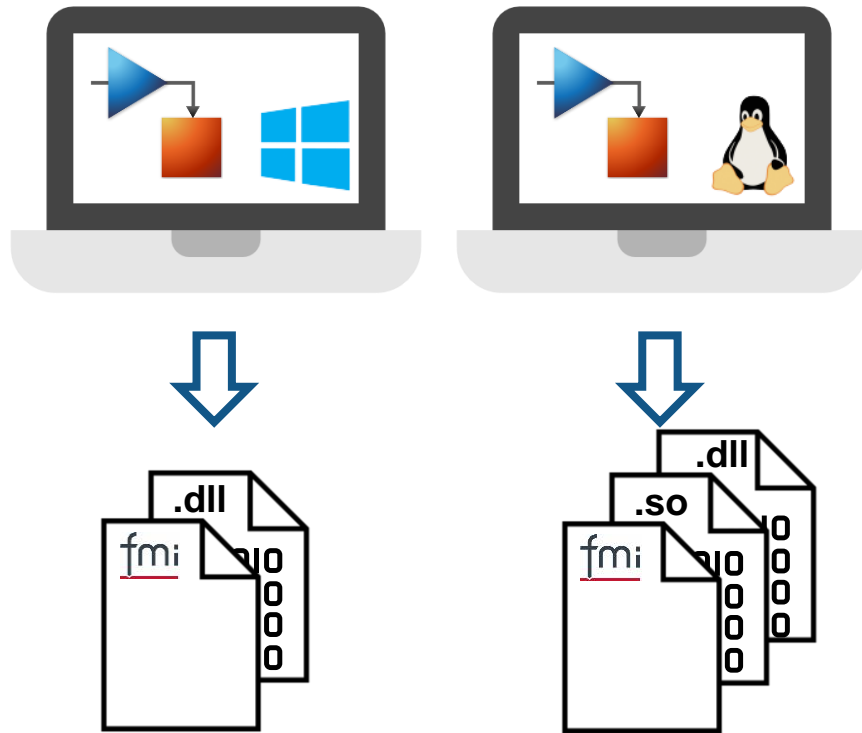
Real-time Simulation



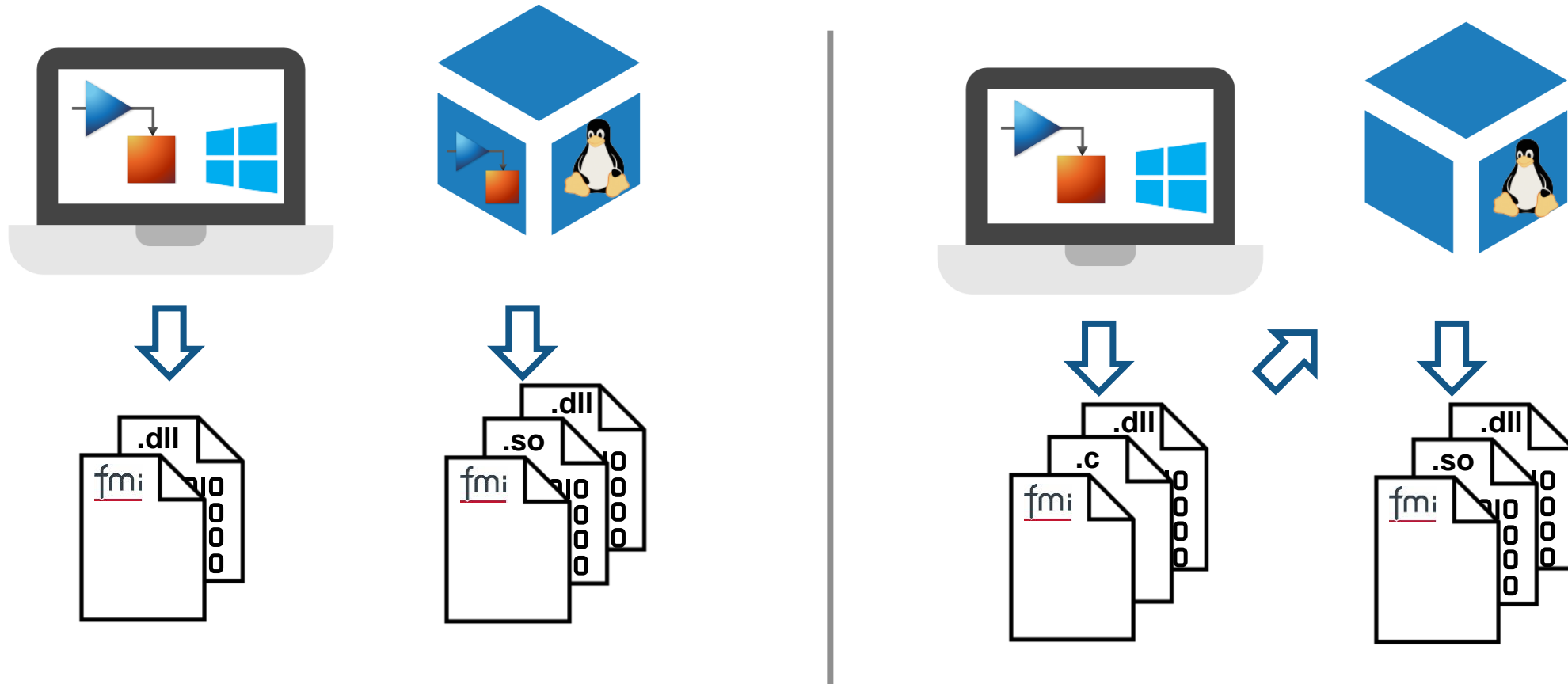
Deploy desktop simulation
on different OS

Requires both **Simulink Compiler** and **Simulink Coder** licenses

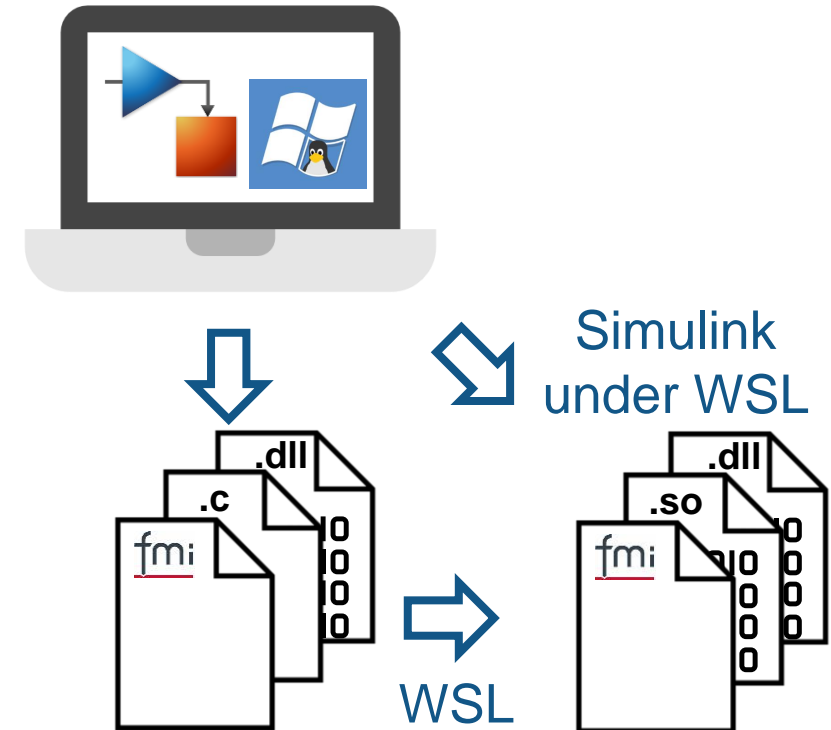
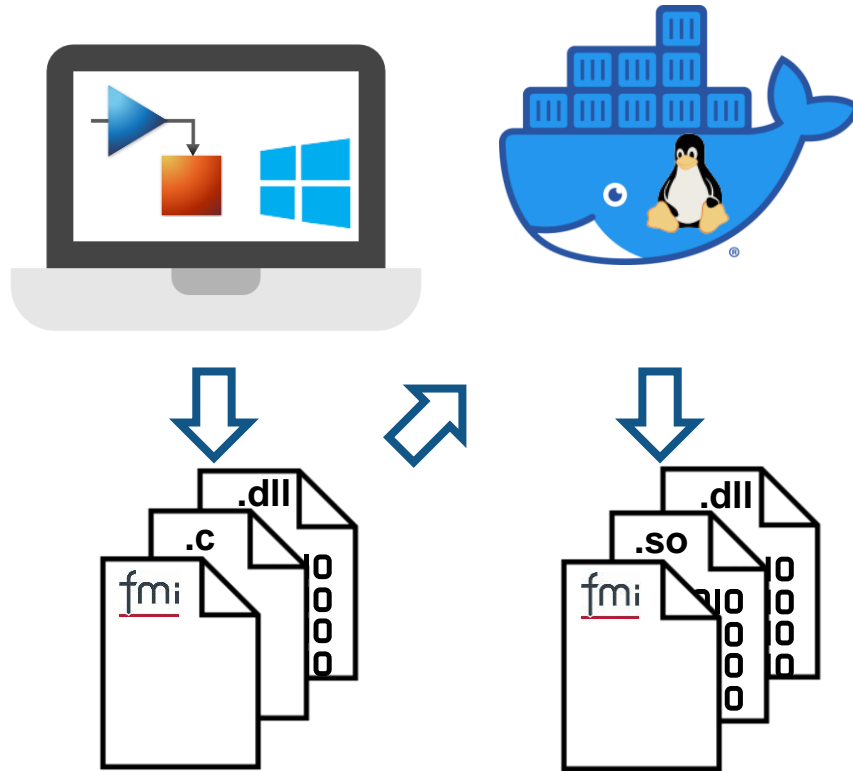
Cross Compilation



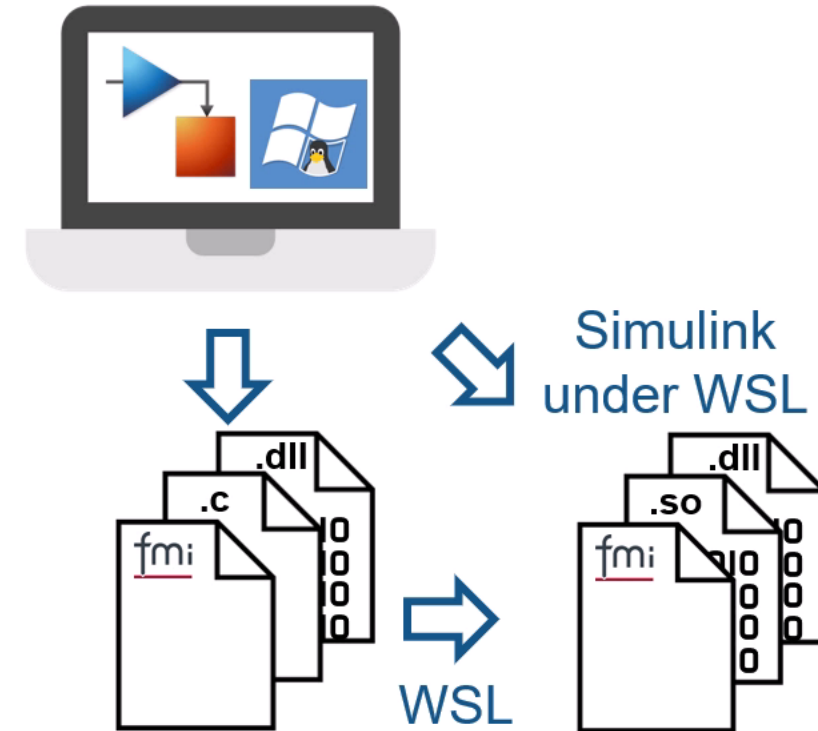
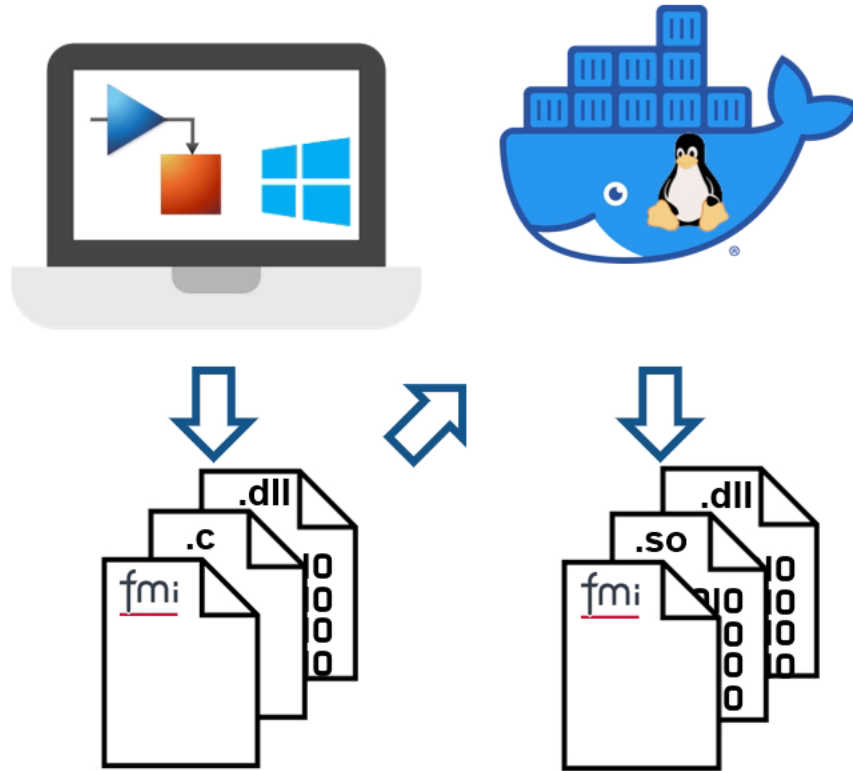
Cross Compilation



Cross Compilation



Cross Compilation

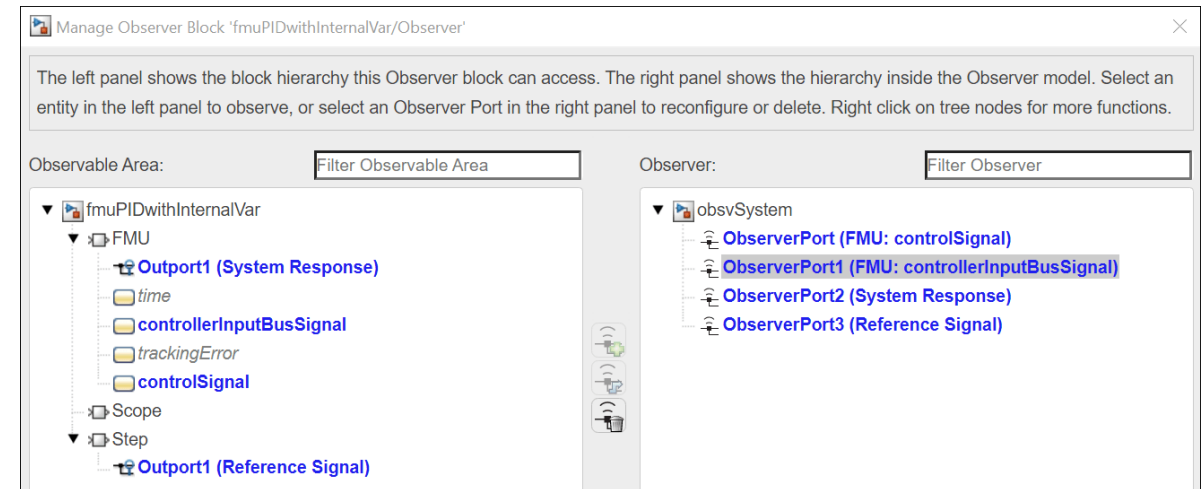


Around Simulink / Simulink Compiler support?

FMI standard support increase in many other toolboxes like:

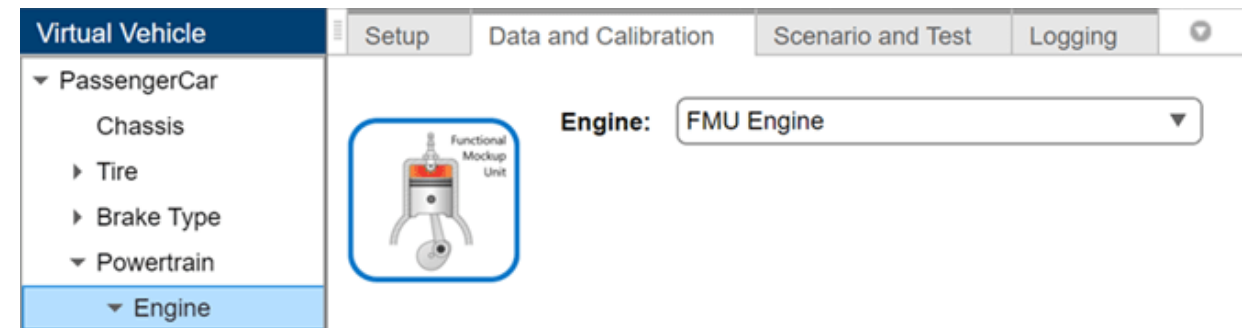
- Simulink Test: FMU interval variable support for Observer block
 - [openExample\('simulinktest/ObservePIDInsideAnFMUUsingAndObserverExample'\)](#)

R2022b



- Virtual Composer App: use FMU to replace Engine model of your vehicle

R2023a



Around Simulink / Simulink Compiler support?

FMI standard support increase in many other toolboxes like:

- Simulink Real-Time: Execute in Real-Time your FMU
 - Apply FMU for Simulink Real-Time:
[openExample\('slrealtime/SlrtApplyFunctionalMockupUnitsByUsingSimulinkRealTimeExample'\)](#)
 - Recompile FMU source code for Simulink Real-Time:
[openExample\('slrealtime/SlrtCompileSourceCodeForFunctionalMockupUnitsExample'\)](#)



FMU 1.0 Co-Simulation

R2018a

FMU 2.0 Co-Simulation

R2022a

- Deep Learning: [many different examples](#) involving FMUs **R2023b**

Q & A