

What's new in MATLAB and Simulink for Model-Based Design

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Application Engineer

What's New?

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Release Notes for Simulink

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- R2014b
- R2014a
- R2013b
- Compatibility Summary

Simulink Release Notes

Bug Reports Bug Fixes

▼ R2016a

New Features, Bug Fixes, Compatibility Considerations

Simulation Analysis and Performance

- › Automatic Solver Option: Set up and simulate your model more quickly with automatically selected solver settings
- › One-Click Display: Click a signal line within the simulation to zoom in on the connection
- › Simulation Metadata Diagnostics: Under the hood, you can now see the simulation metadata
- › Multi-Input Root Inport Mapping: Connect multiple inports to a single root inport
- › Simulation for Mixed Targets: Simulate your model on a range of hardware targets
- › Time Out feature for Performance Advisor: Set a time limit for the Performance Advisor to run
- › Solver Profiler to speed up simulation performance
- › Diagnostic Viewer performance improvements

Component-Based Modeling

- › Variant Source and Sink Blocks with Callouts
- › Scoping Simulink Functions: Call Simulink functions from within a scope
- › Simulink Units: Specify, visualize, and check consistency of units on chart interfaces
- › Mask Dialogs: Create masks with flexible options
- › Mask Images: Quickly add images to mask dialog boxes
- › Tracing Simulink Functions: Display callouts for function calls

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Release Notes for Stateflow

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- R2012b
- R2012a
- R2011b
- R2011a

Stateflow Release Notes

Bug Reports Bug Fixes

▼ R2016a

New Features, Bug Fixes, Compatibility Considerations

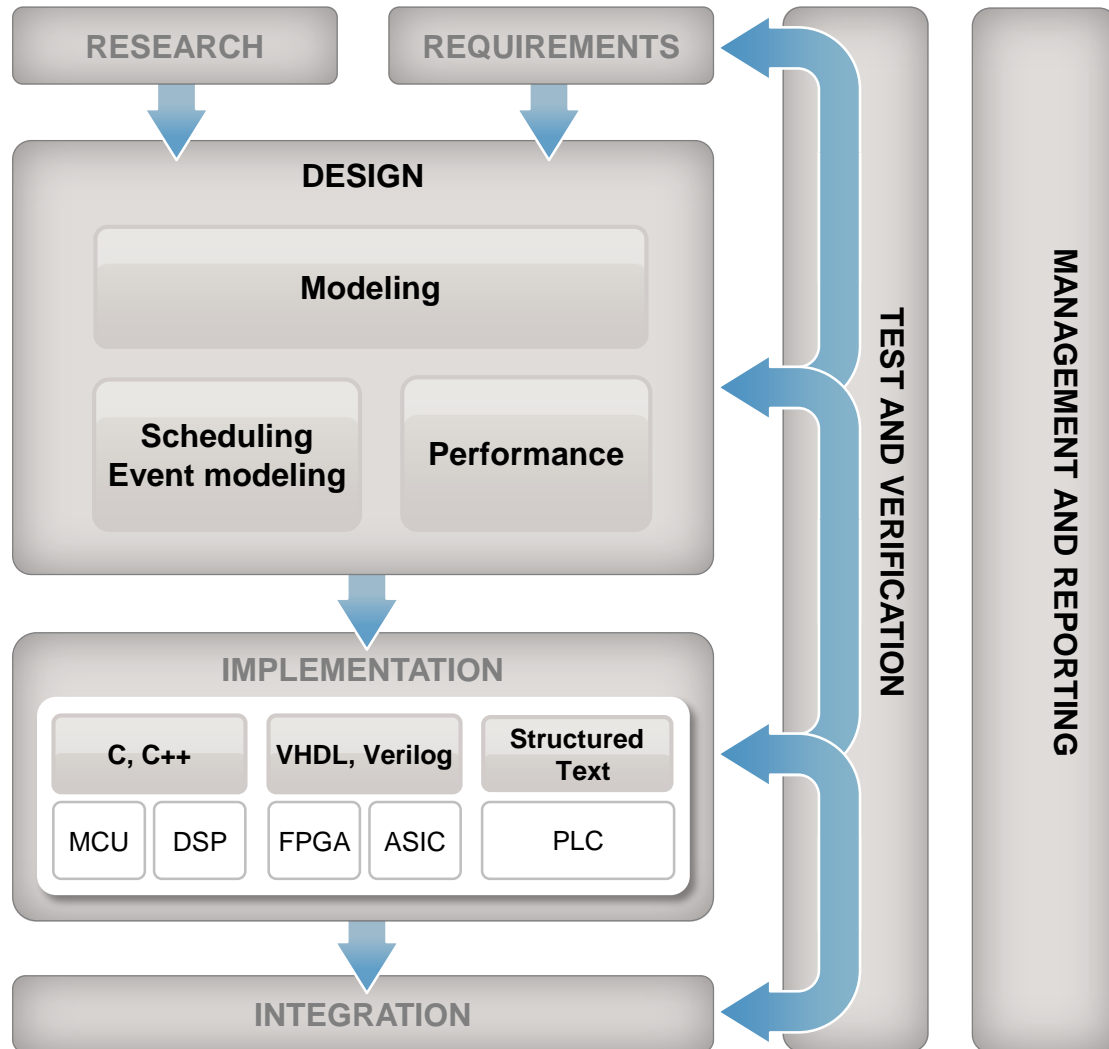
- › Smart Editing Cues: Accelerate common editing tasks with just-in-time contextual prompts
- › Intelligent Chart Completion: Build charts faster with automatic addition of default transitions and creation of complementary state names
- › Simulink Units: Specify, visualize, and check consistency of units on chart interfaces
- › Output Logging: Log output signals for charts
- › JIT for Messages: Reduce model update time for messages with JIT compilation technology
- › API changes for commented objects ⚠
- › Stateflow model templates for common design patterns
- › UserData parameter available for storing values

R2015aSP1

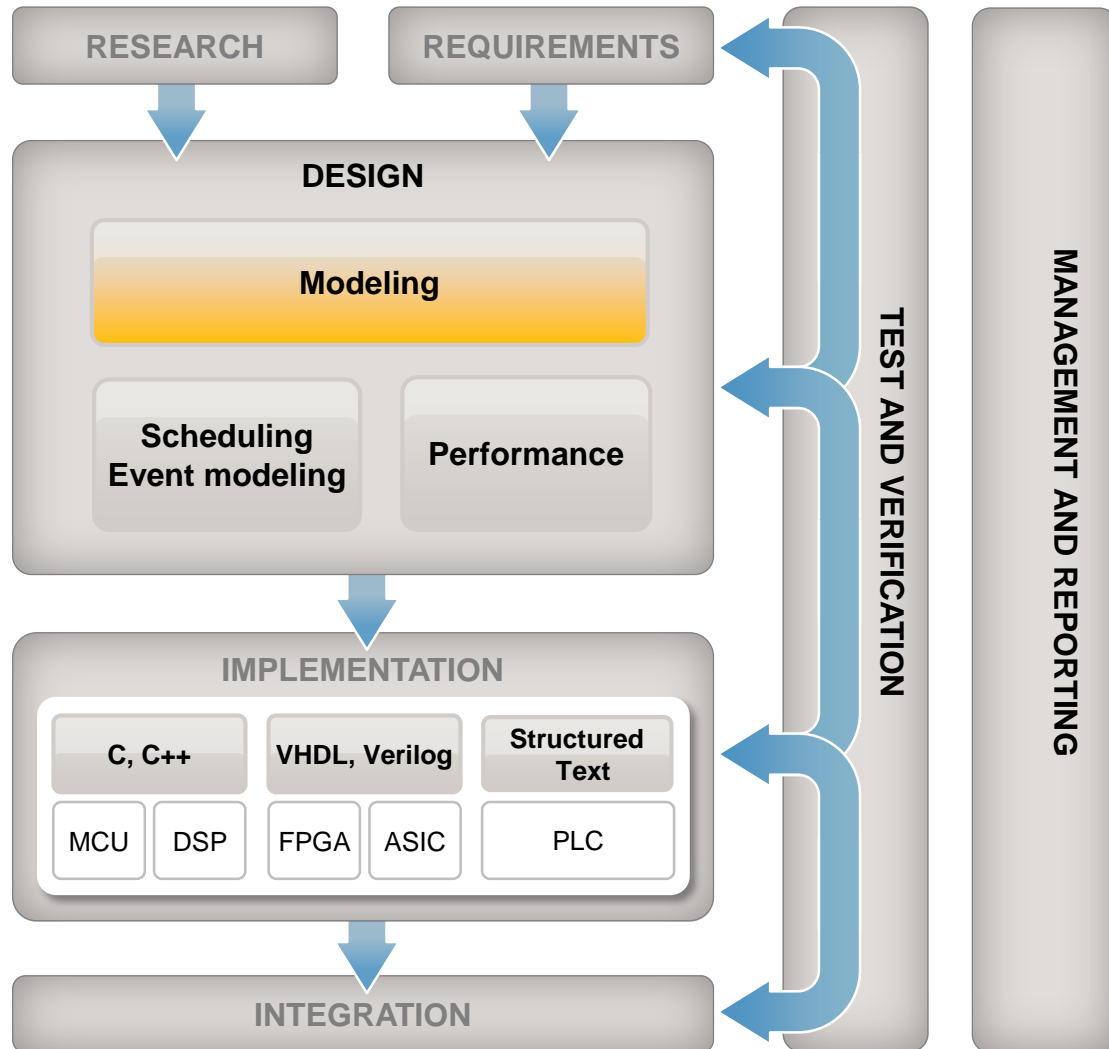
Bug Fixes

› R2015b

Model-Based Design Workflow



Model-Based Design Workflow



HOME PLOTS APPS SHORTCUTS

Expo L M C cl P Search Documentation

New Script New Open Compare Import Data Save Workspace New Variable Open Variable Clear Workspace Analyze Code Run and Time Clear Commands Simulink Layout Parallel Preferences Set Path Add-Ons Help Request Support Community

FILE VARIABLE CODE SIMULINK ENVIRONMENT RESOURCES

C:\Projects\Internal\EXPO2016\WhatsNewInMLandSLforMBD\MATLAB

Current Folder

Name ^

Folder

- drafts
- present
- slprj

Script

- openSE_resource.m

Simulink Model

- modelingExample.slx

WinZip File

- modelingExample_20160418.zip

Command Window

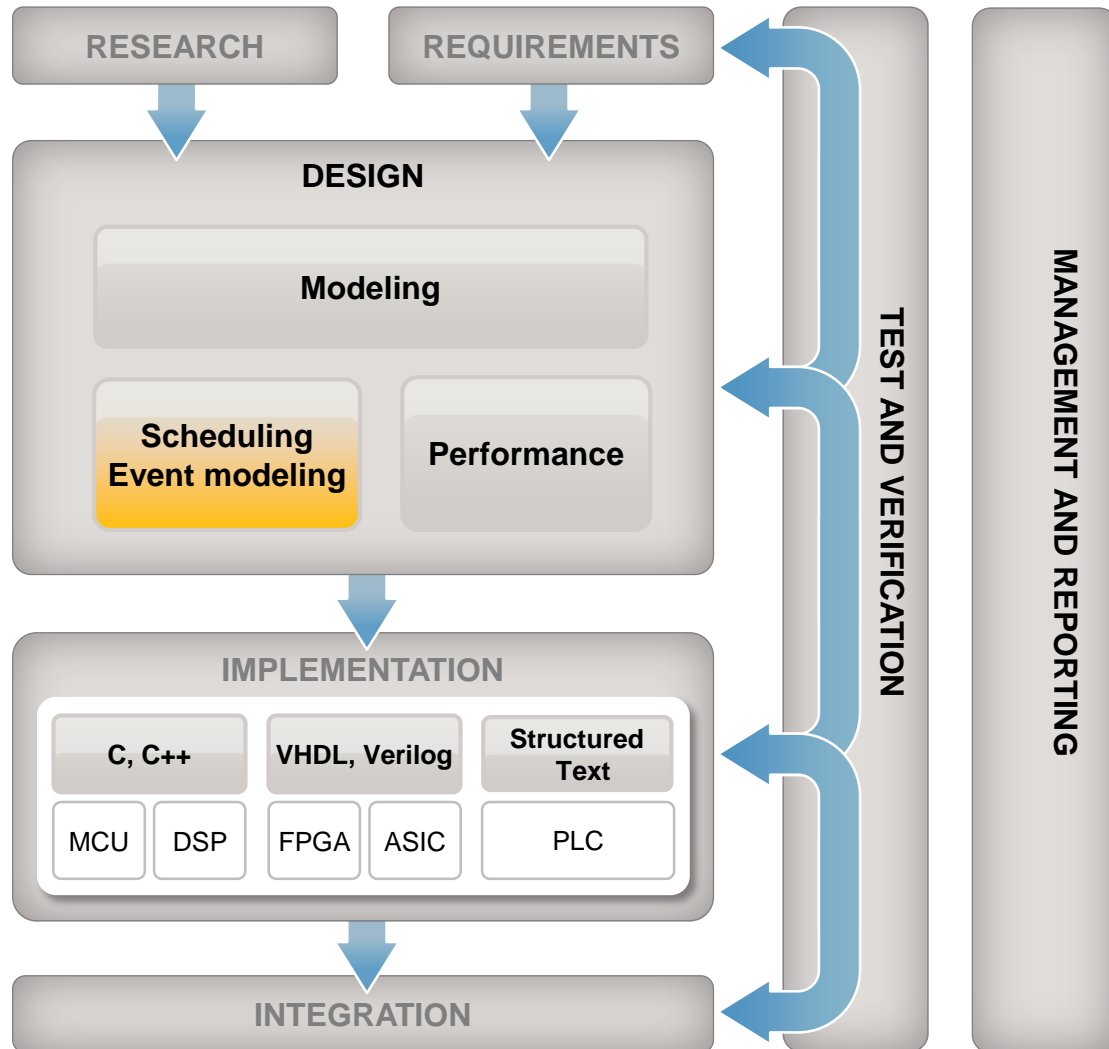
fx >>

modelingExample.slx (Simulink Model)

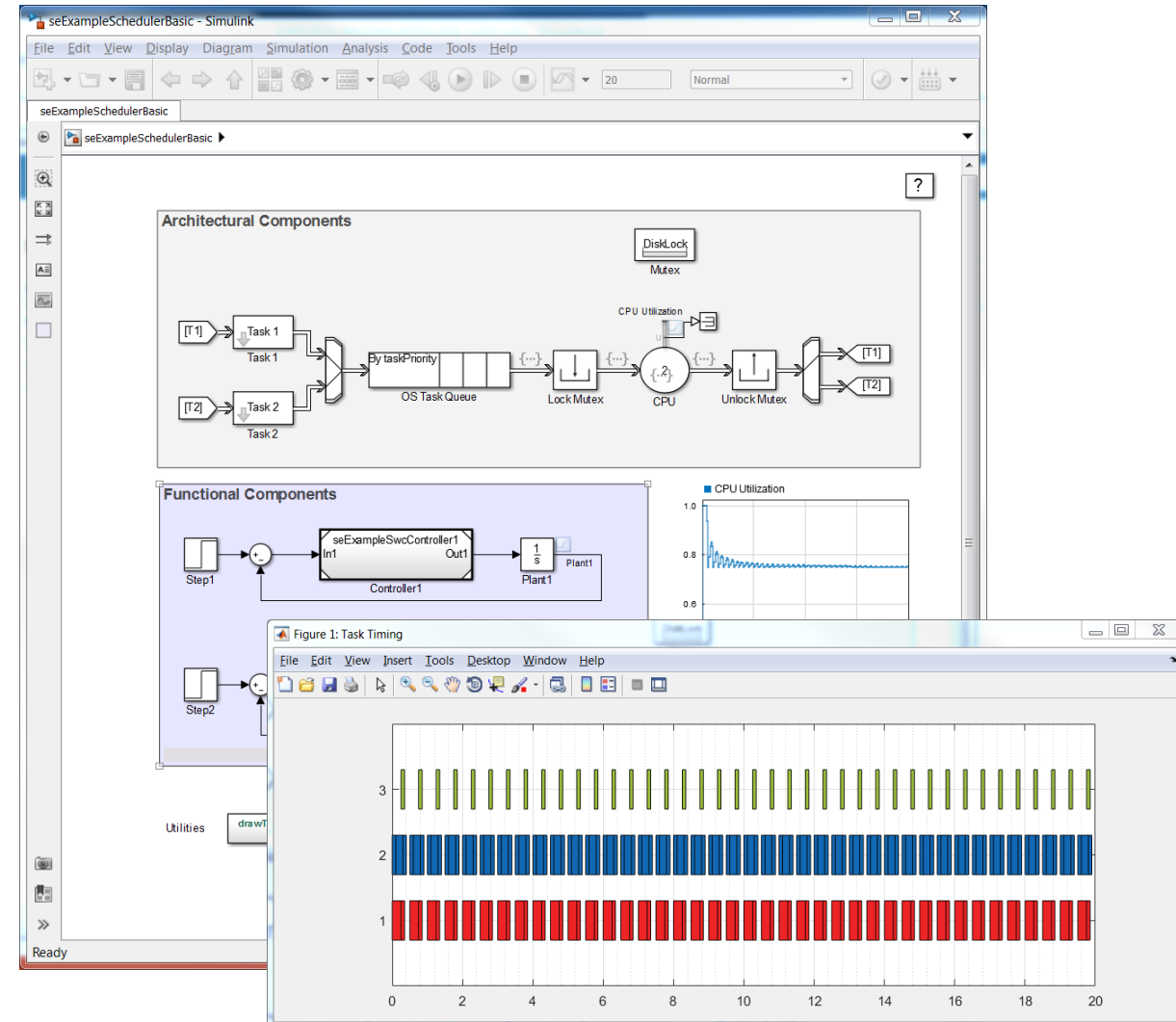
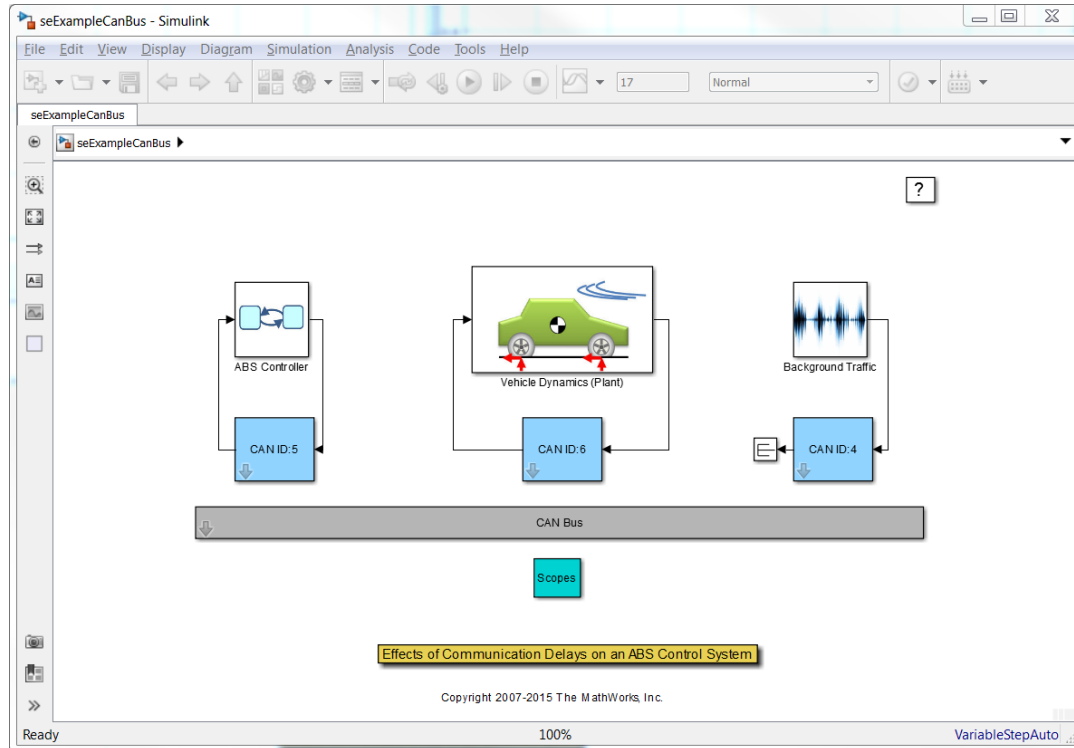
Workspace

Name ^	Value
--------	-------

Model-Based Design Workflow

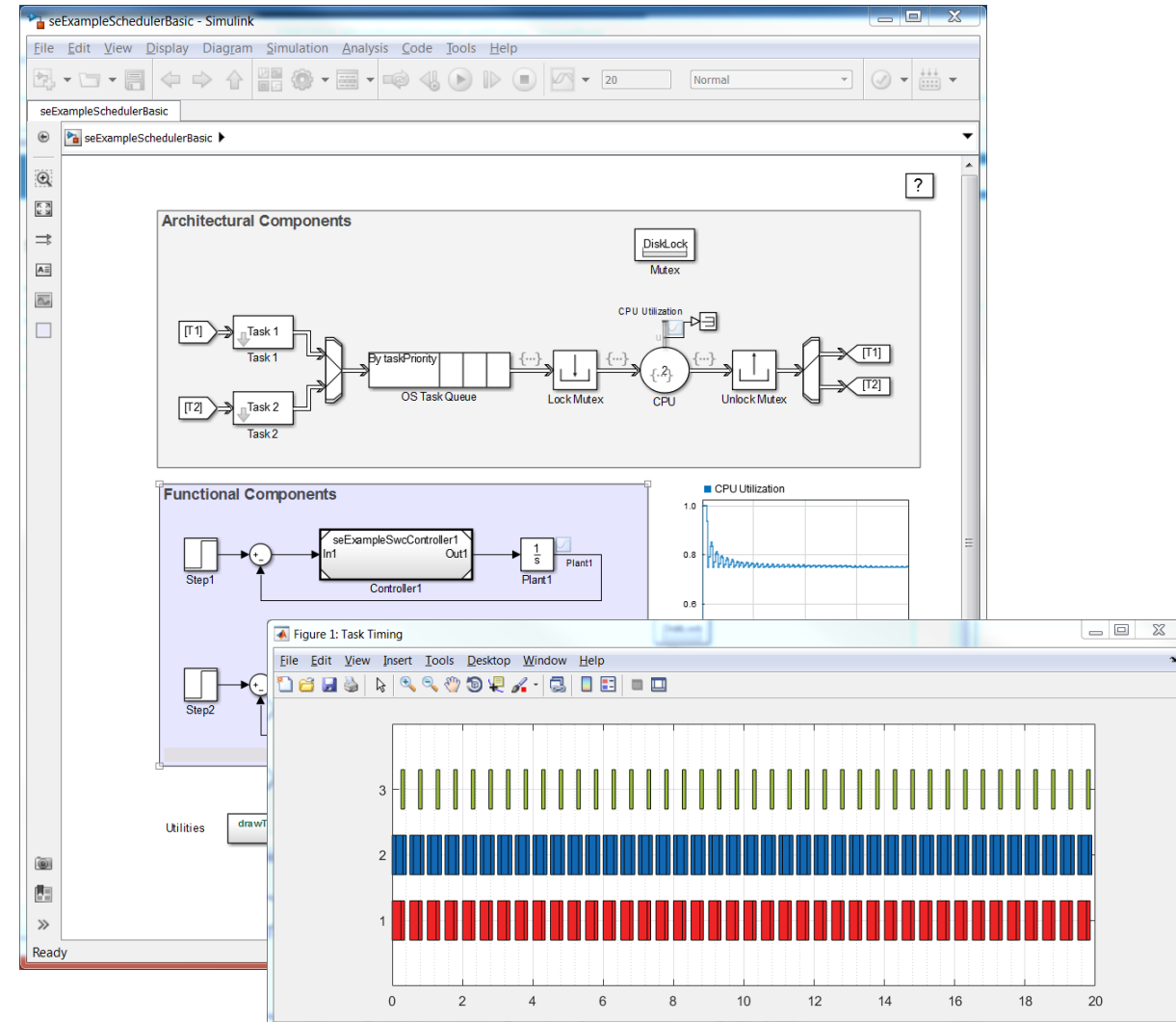
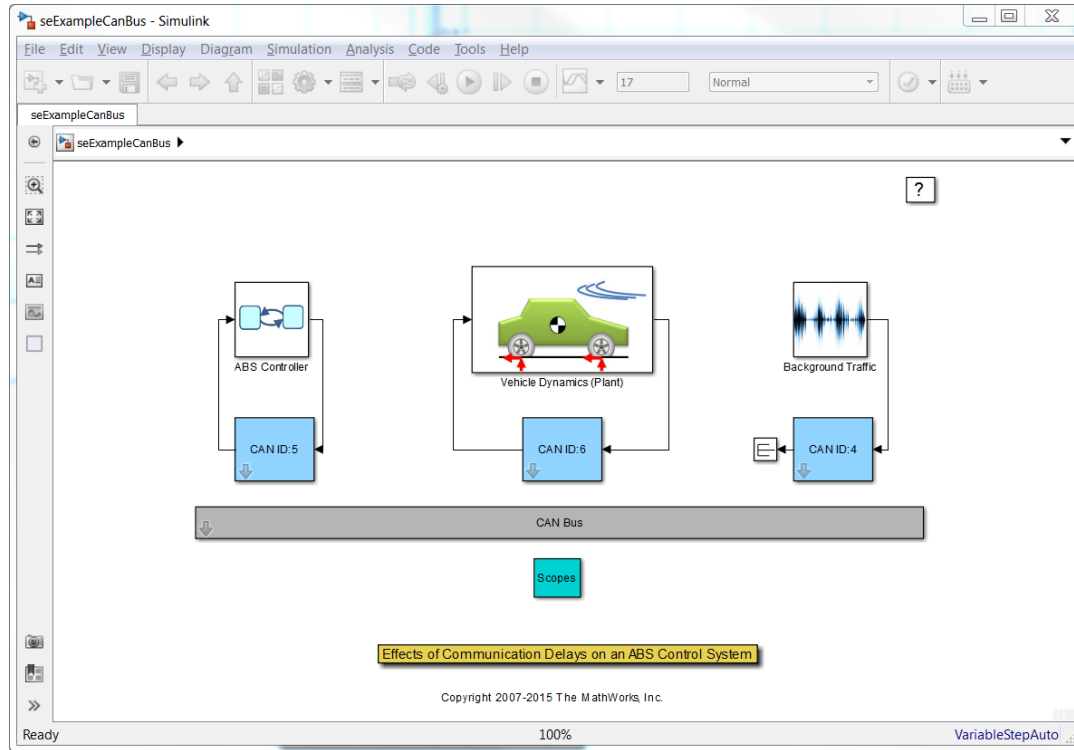


Messages, Functions and Scheduling



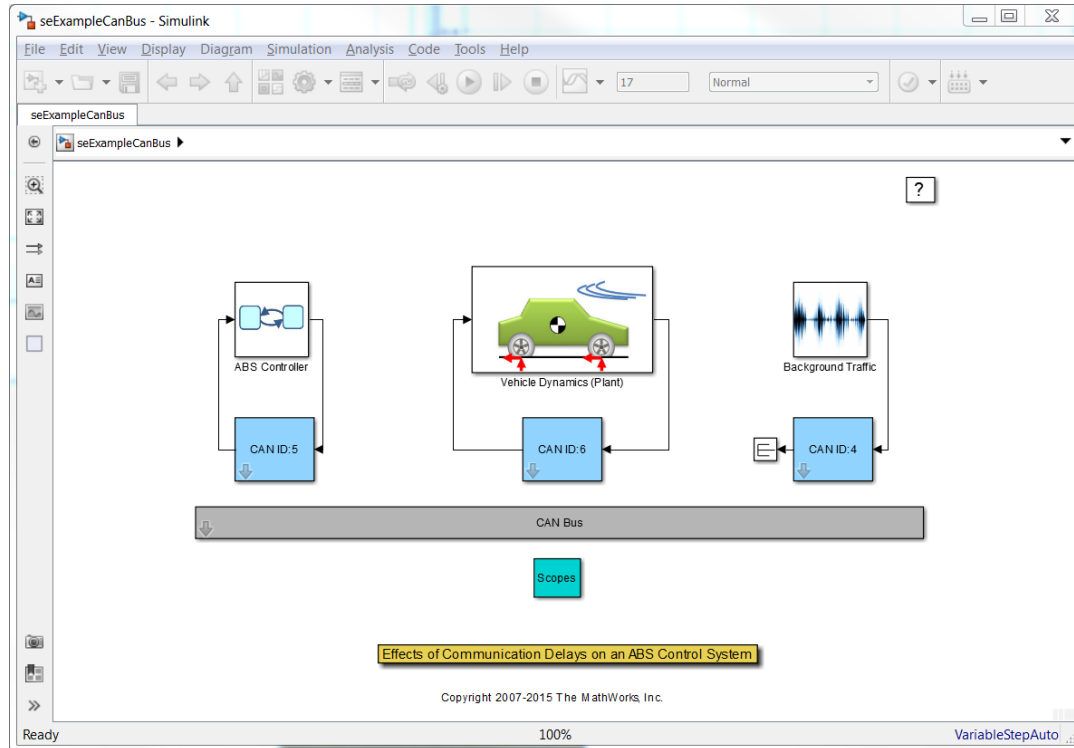
New SimEvents

Discrete-event simulation engine for multidomain system models



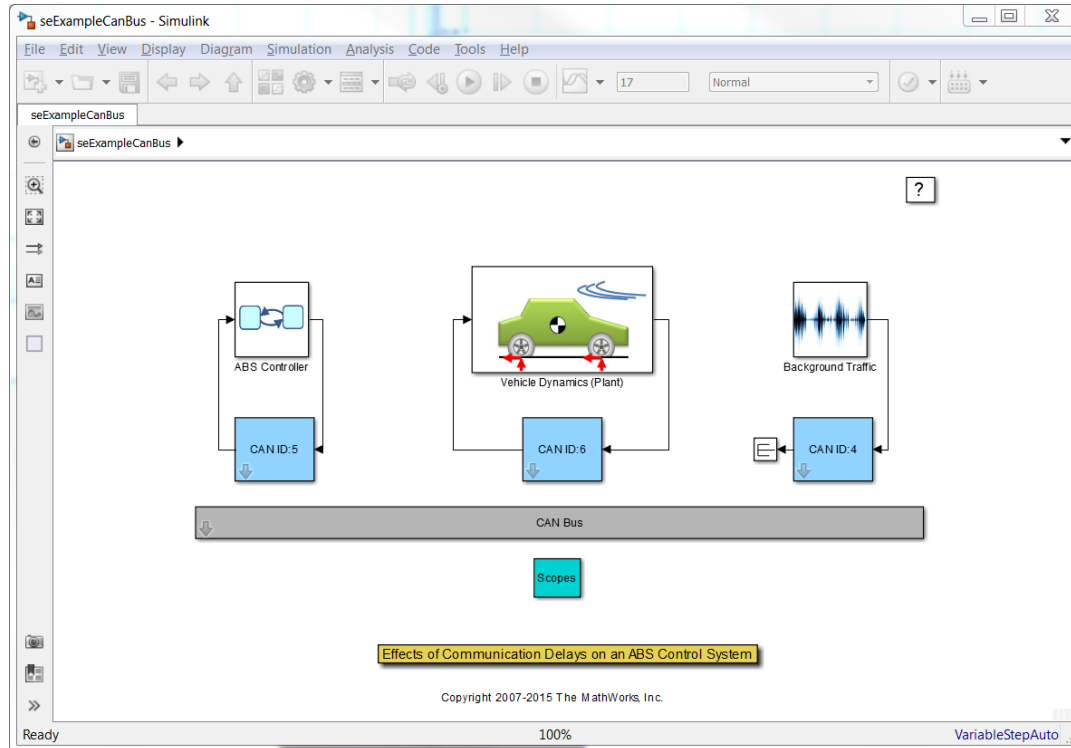
New SimEvents

Discrete-event simulation engine for multidomain system models



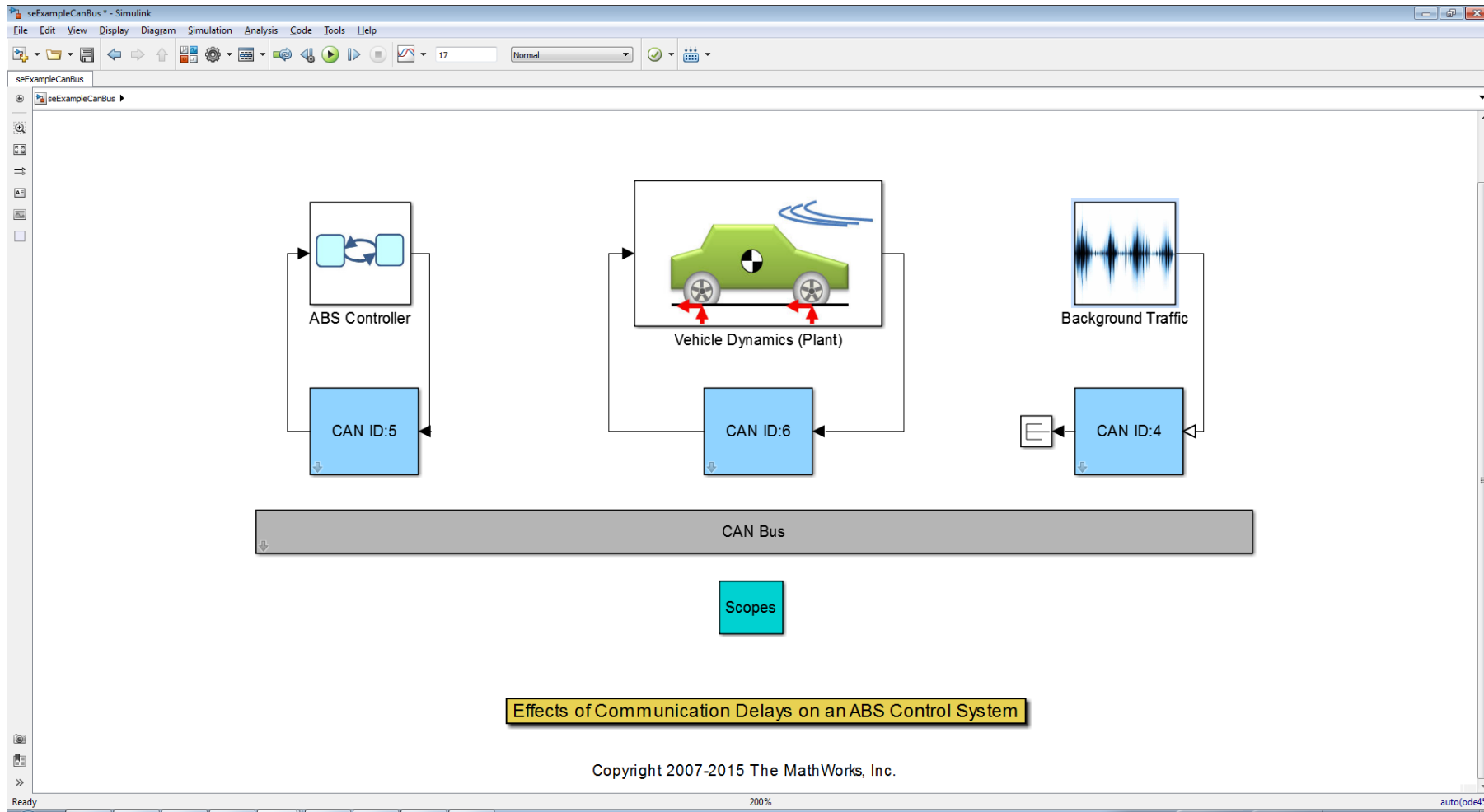
New SimEvents

Discrete-event simulation engine for multidomain system models

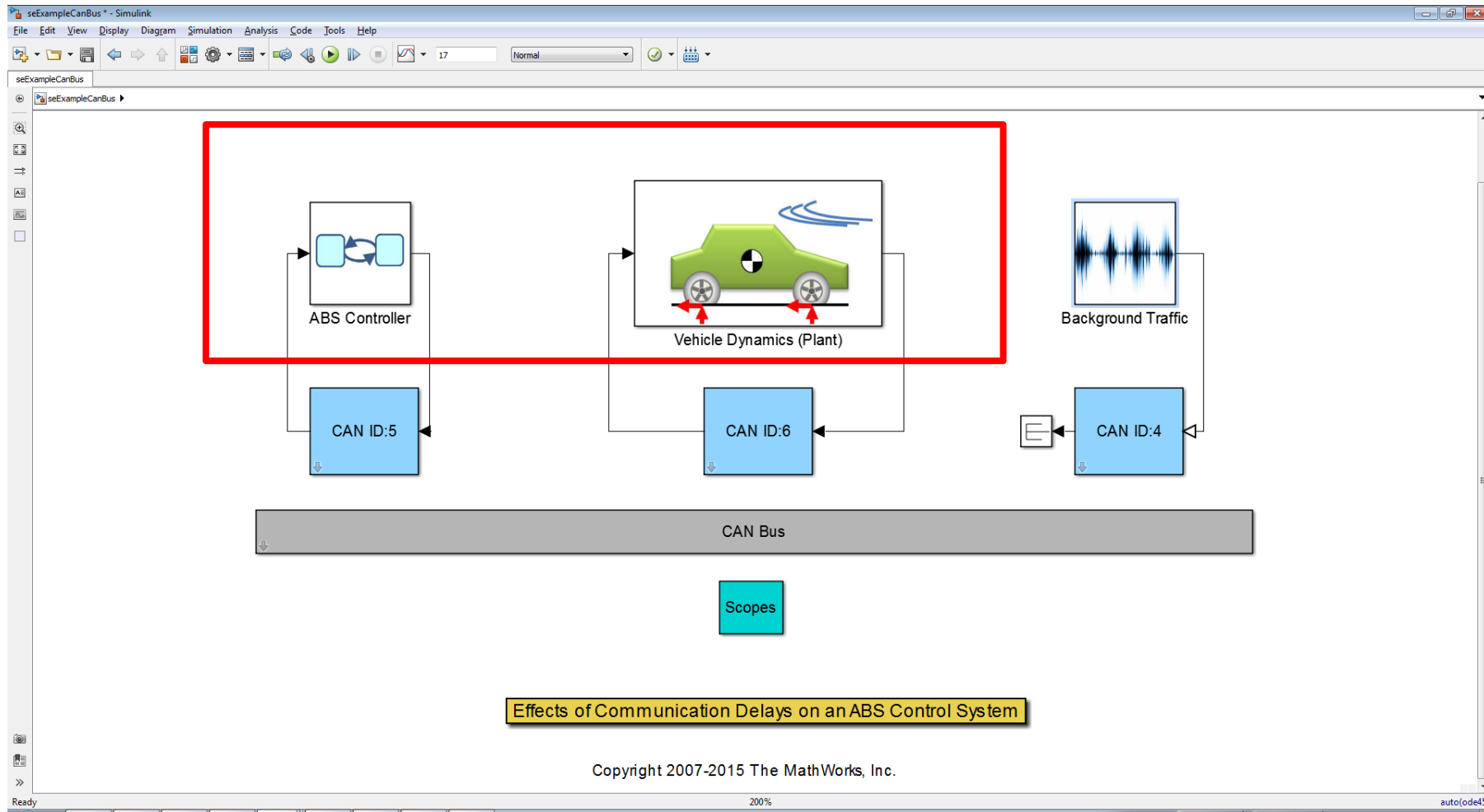


How does communication delays effect your system performance?

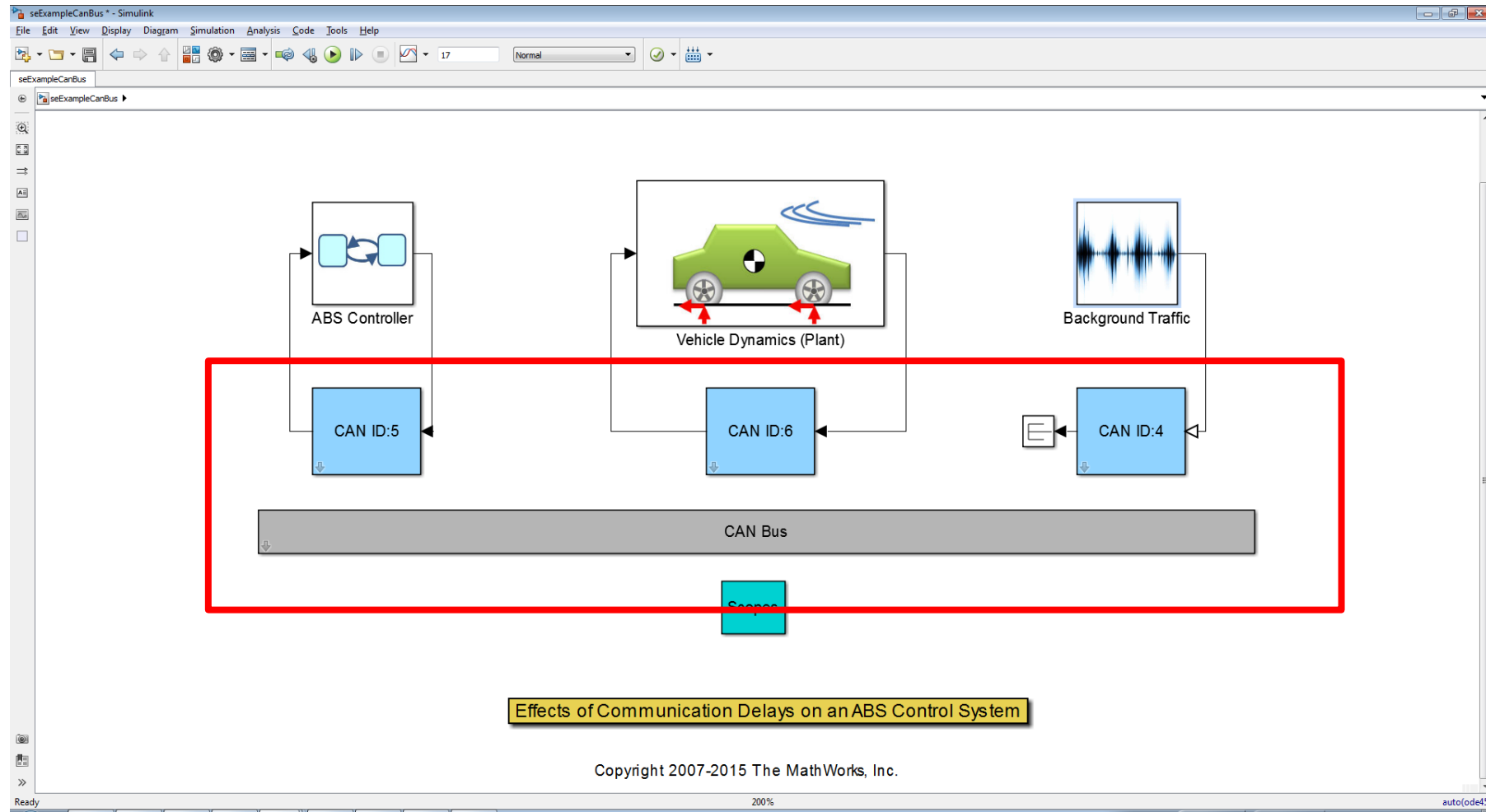
CAN simulation with Simulink and SimEvents



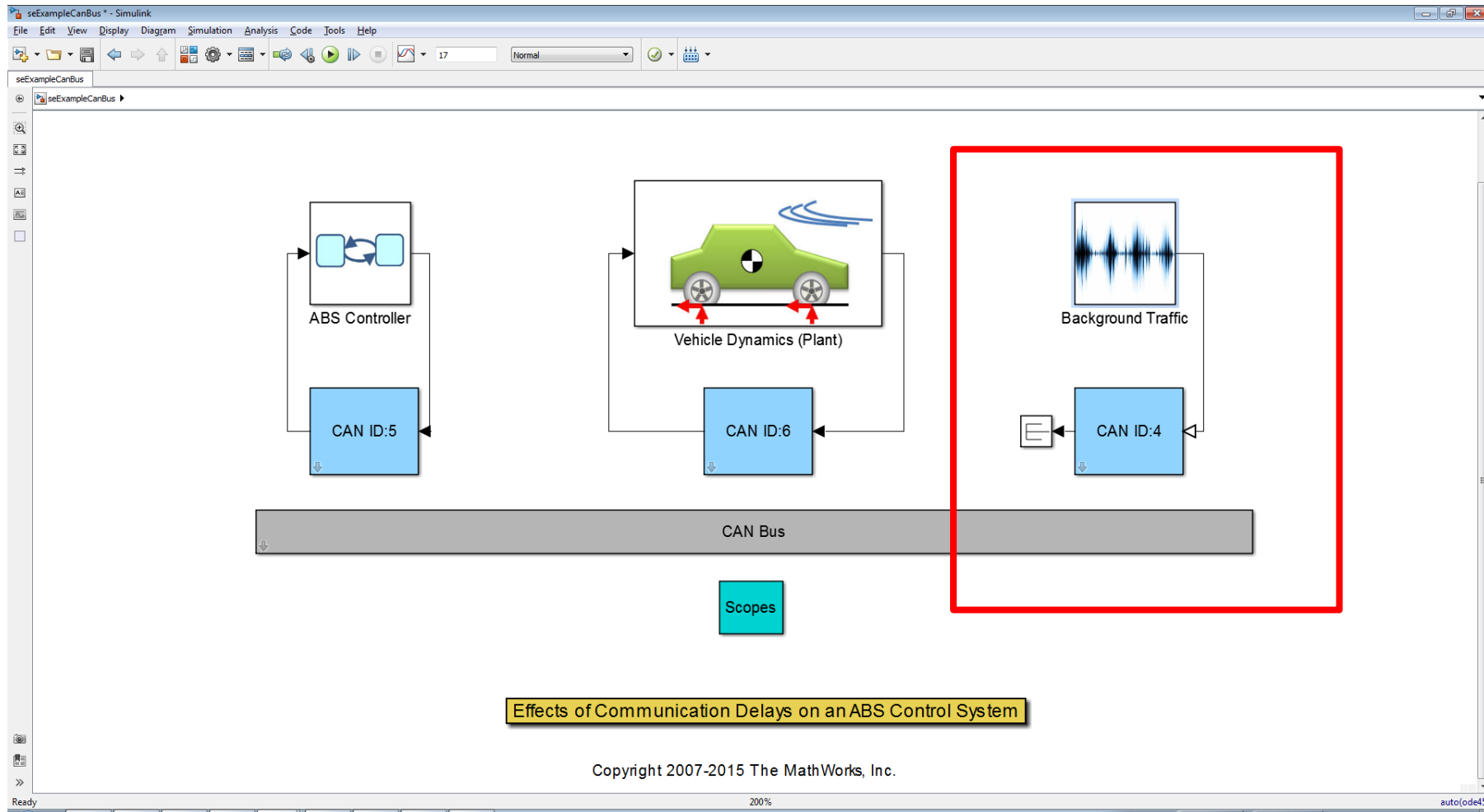
CAN simulation with Simulink and SimEvents



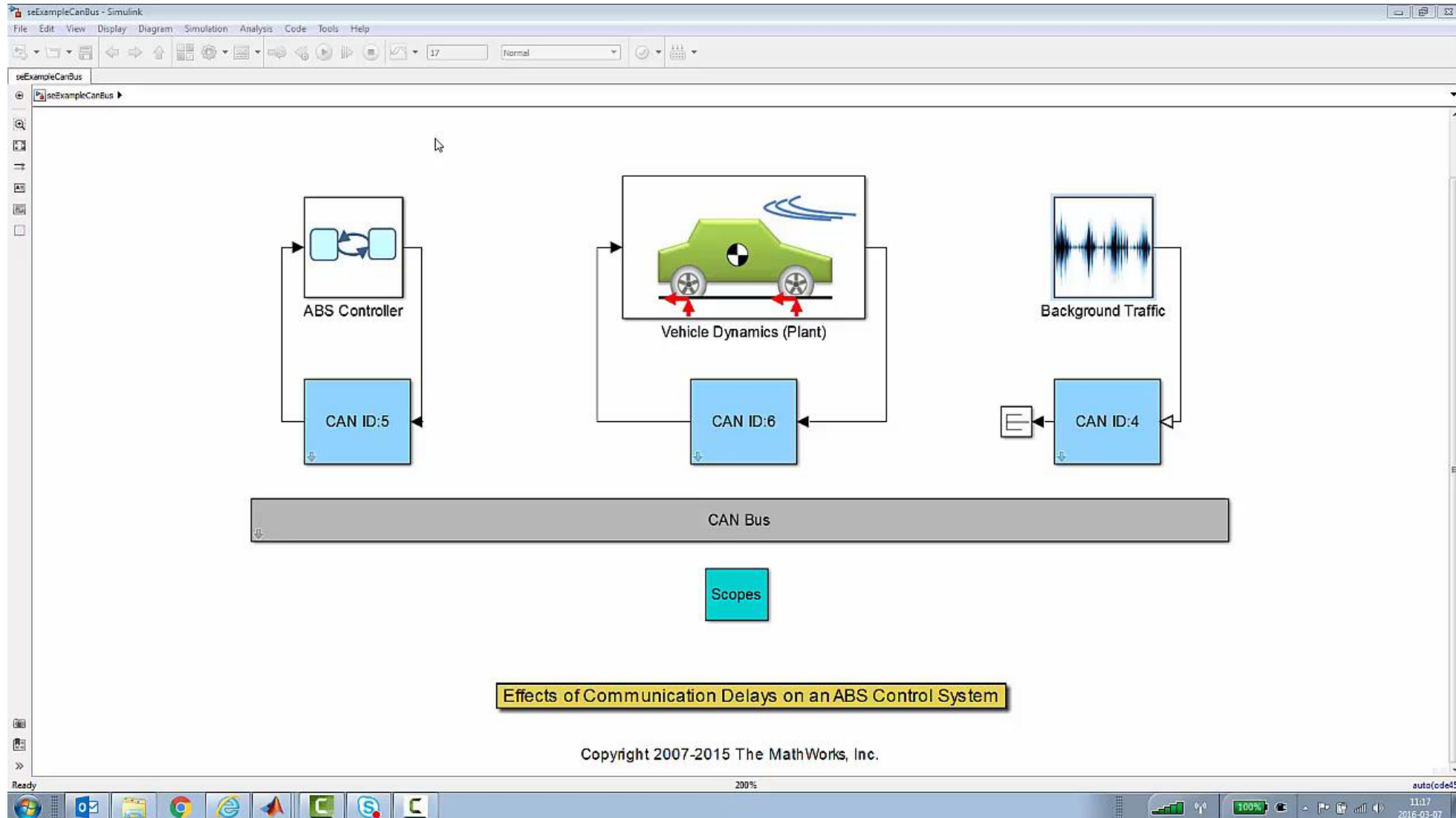
CAN simulation with Simulink and SimEvents



CAN simulation with Simulink and SimEvents

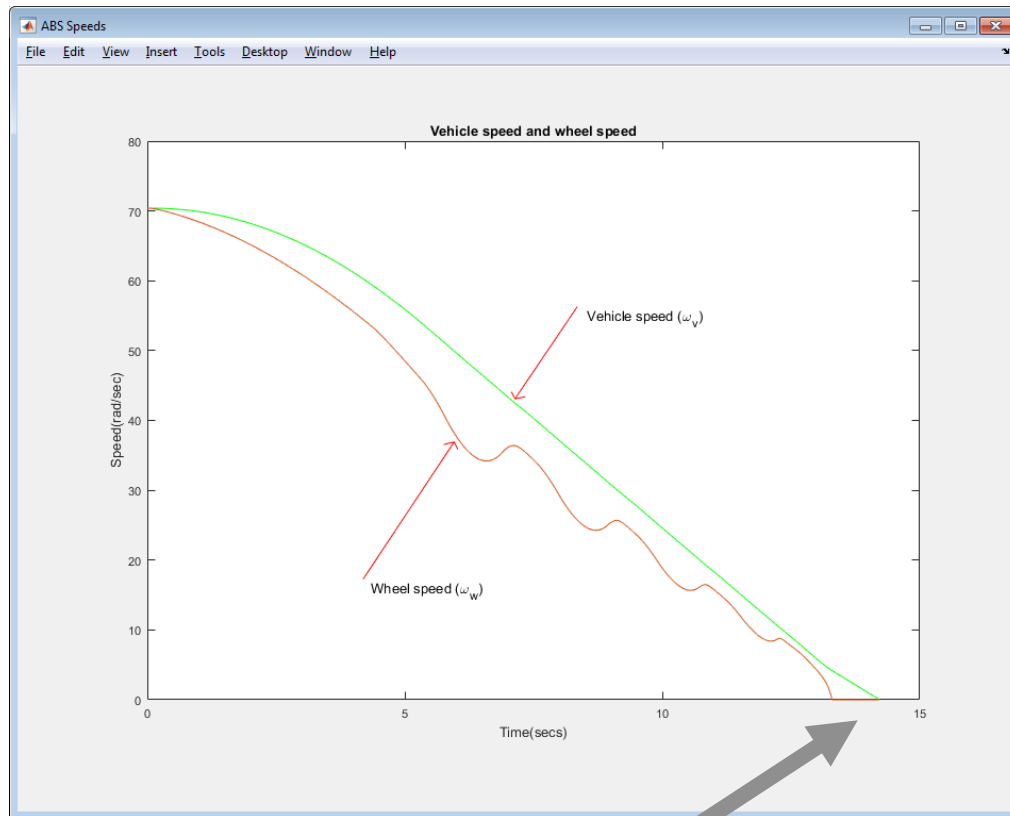


CAN simulation with Simulink and SimEvents



CAN simulation with Simulink and SimEvents

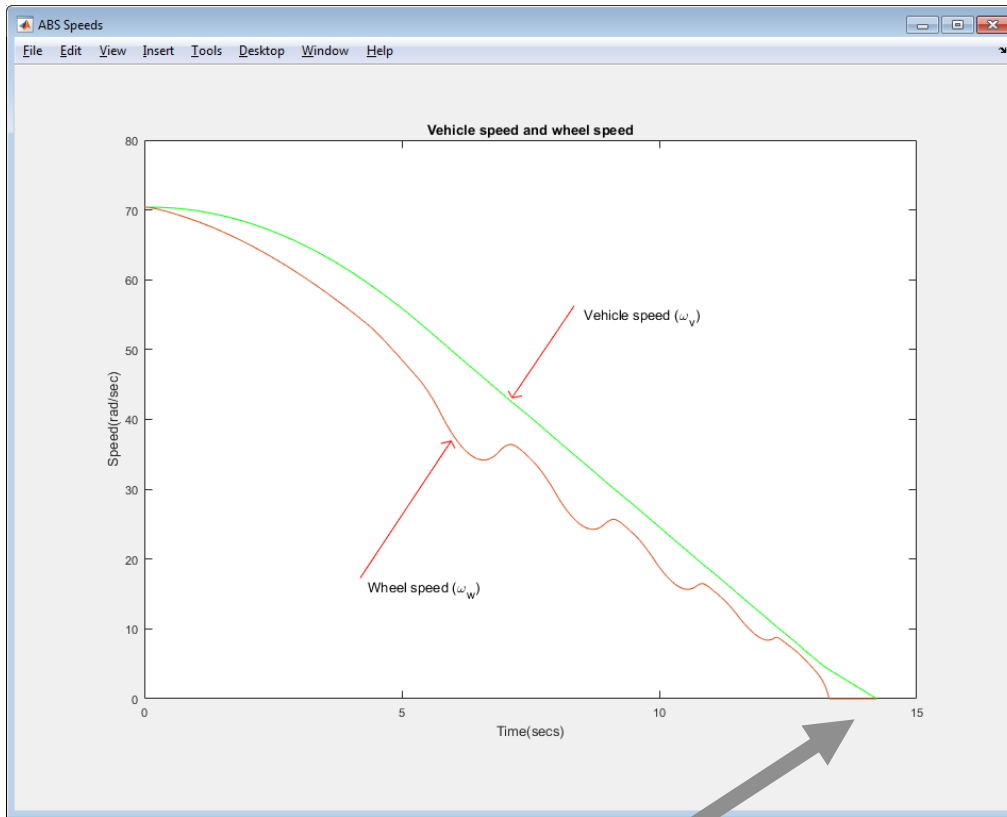
Without background noise



Vehicle stops after 14.2 seconds

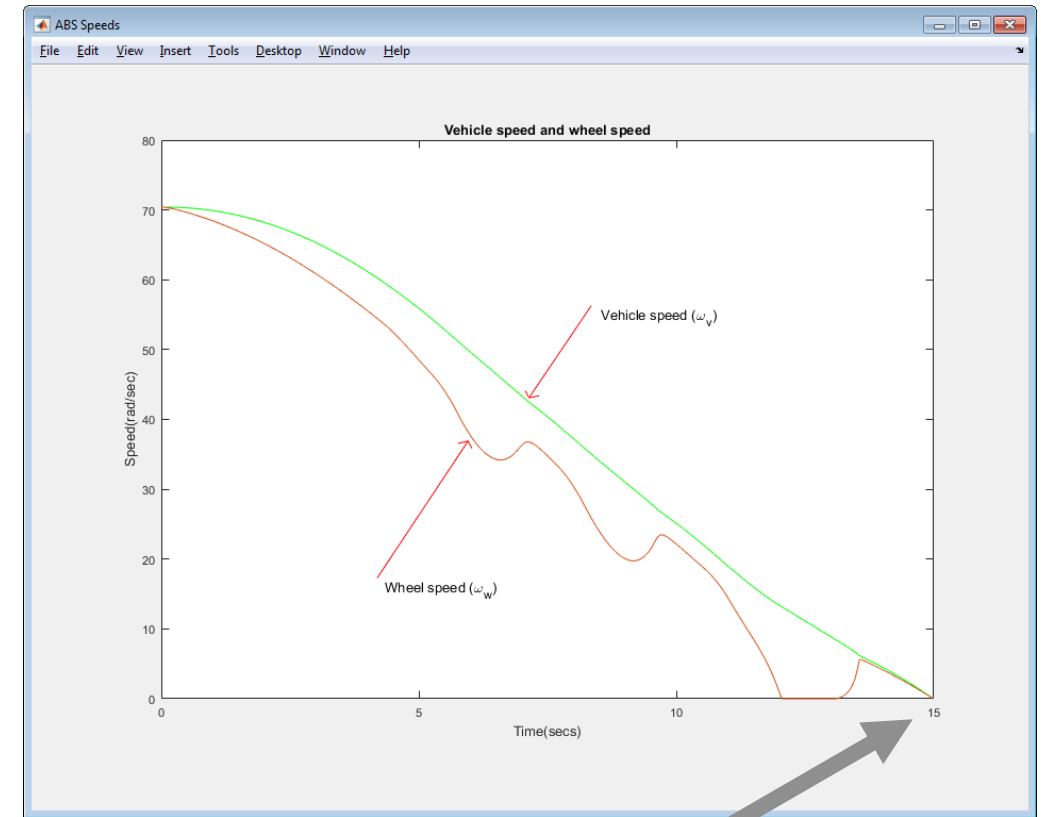
CAN simulation with Simulink and SimEvents

Without background noise



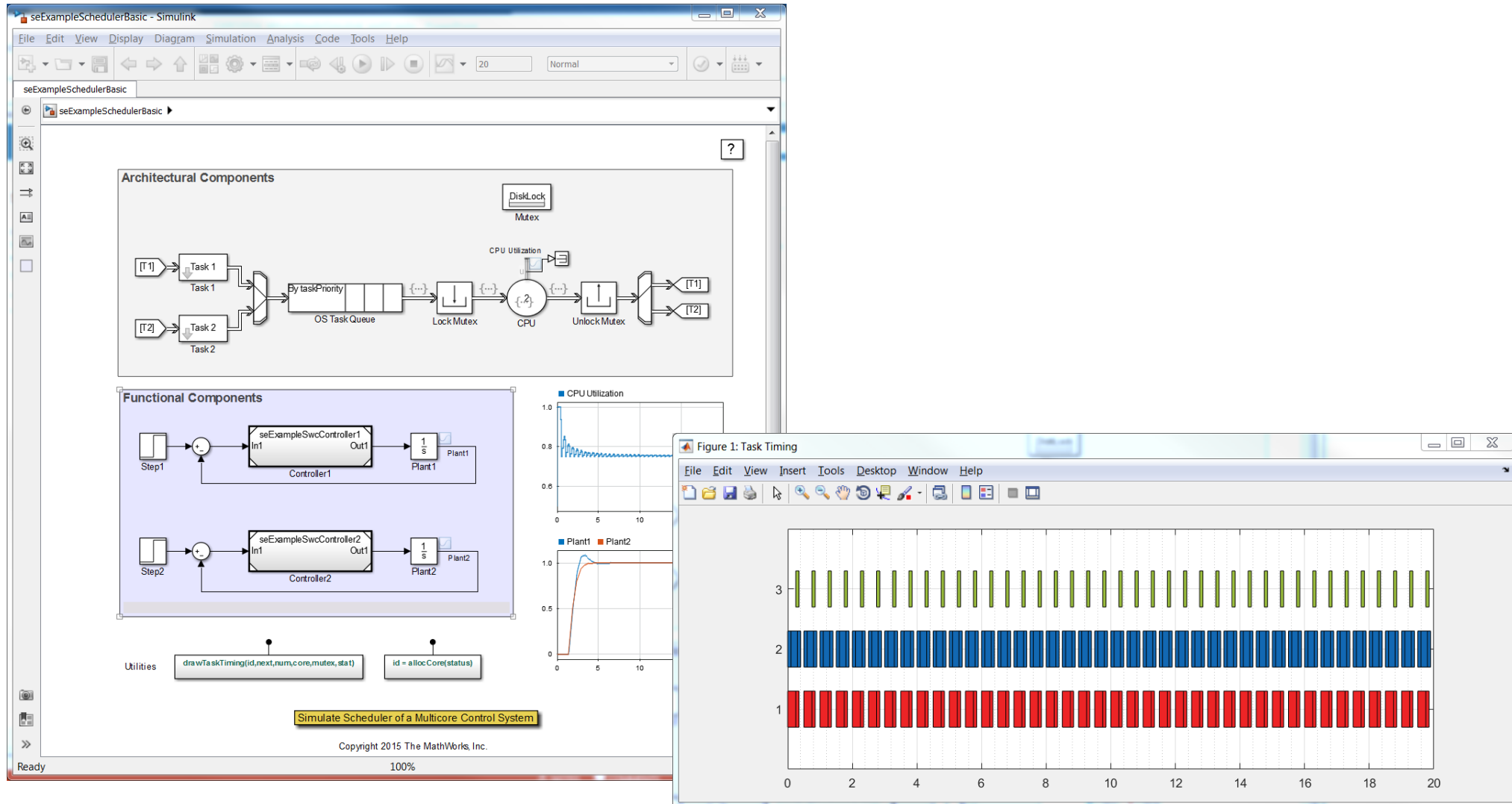
Vehicle stops after 14.2 seconds

With background noise

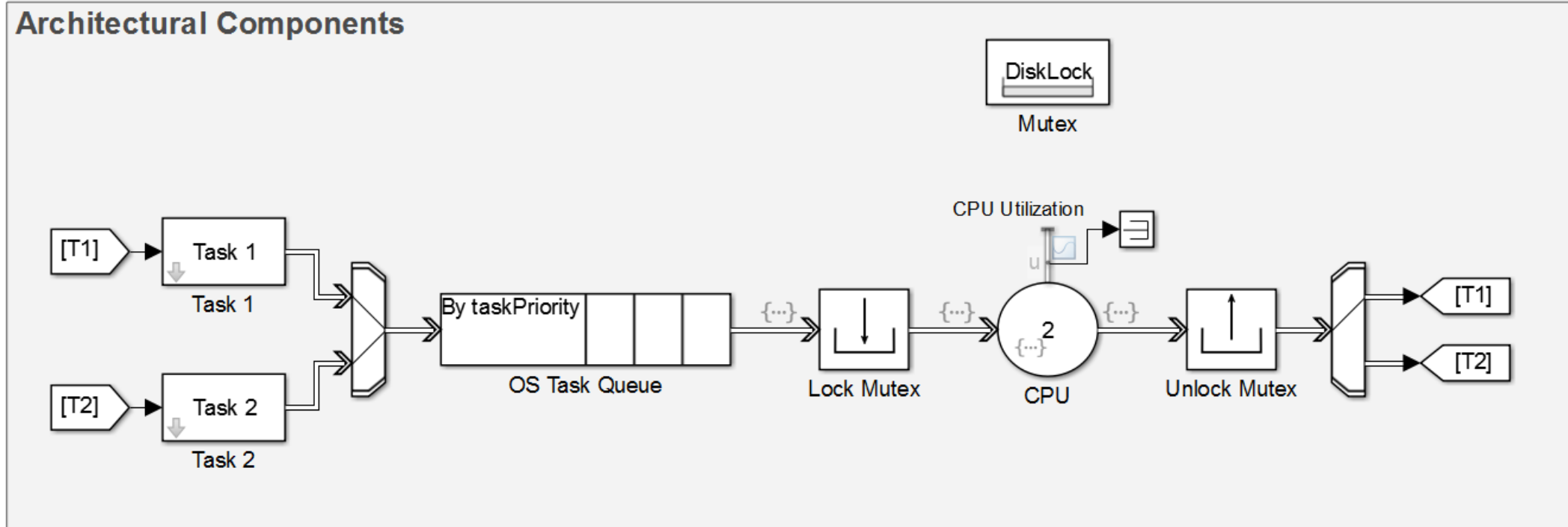


Vehicle stops after 15 seconds

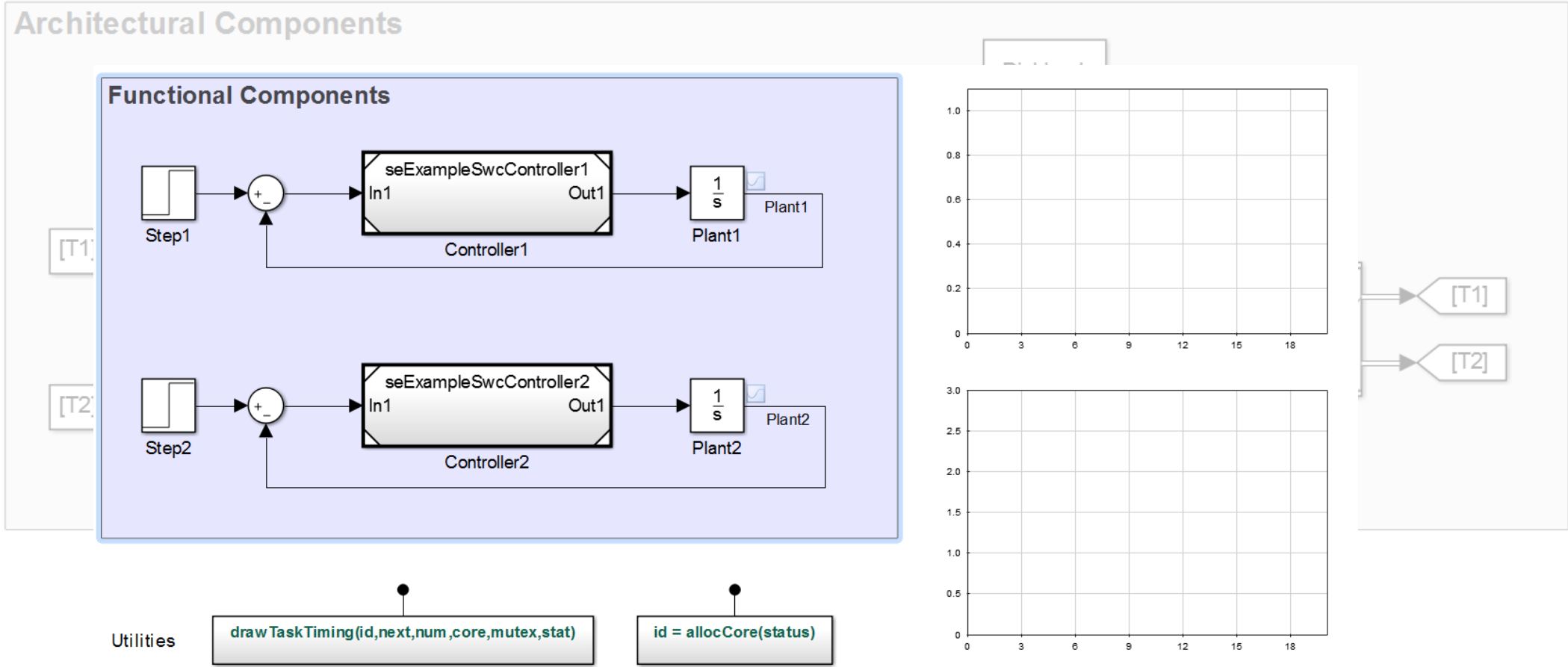
Scheduler Example



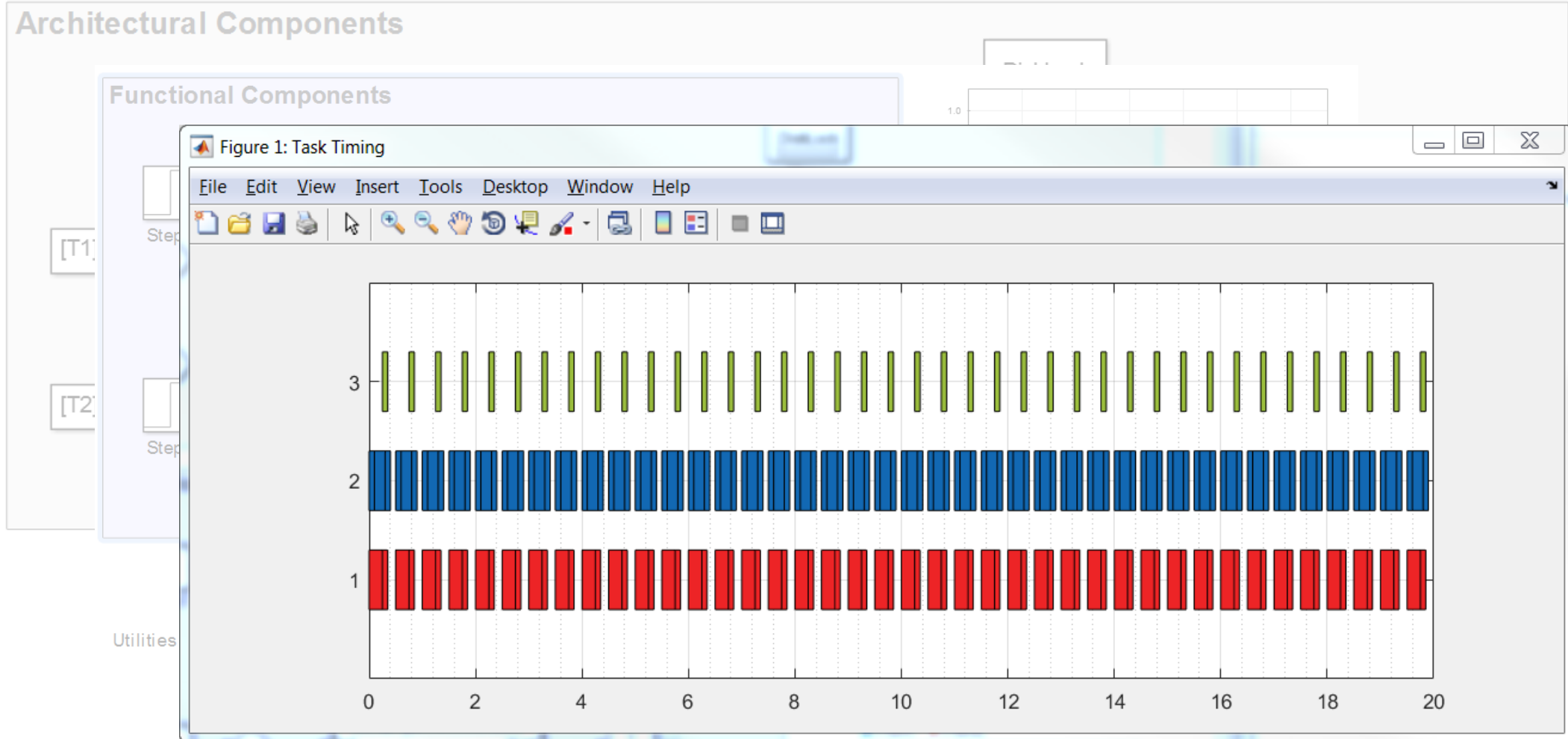
Scheduler Example



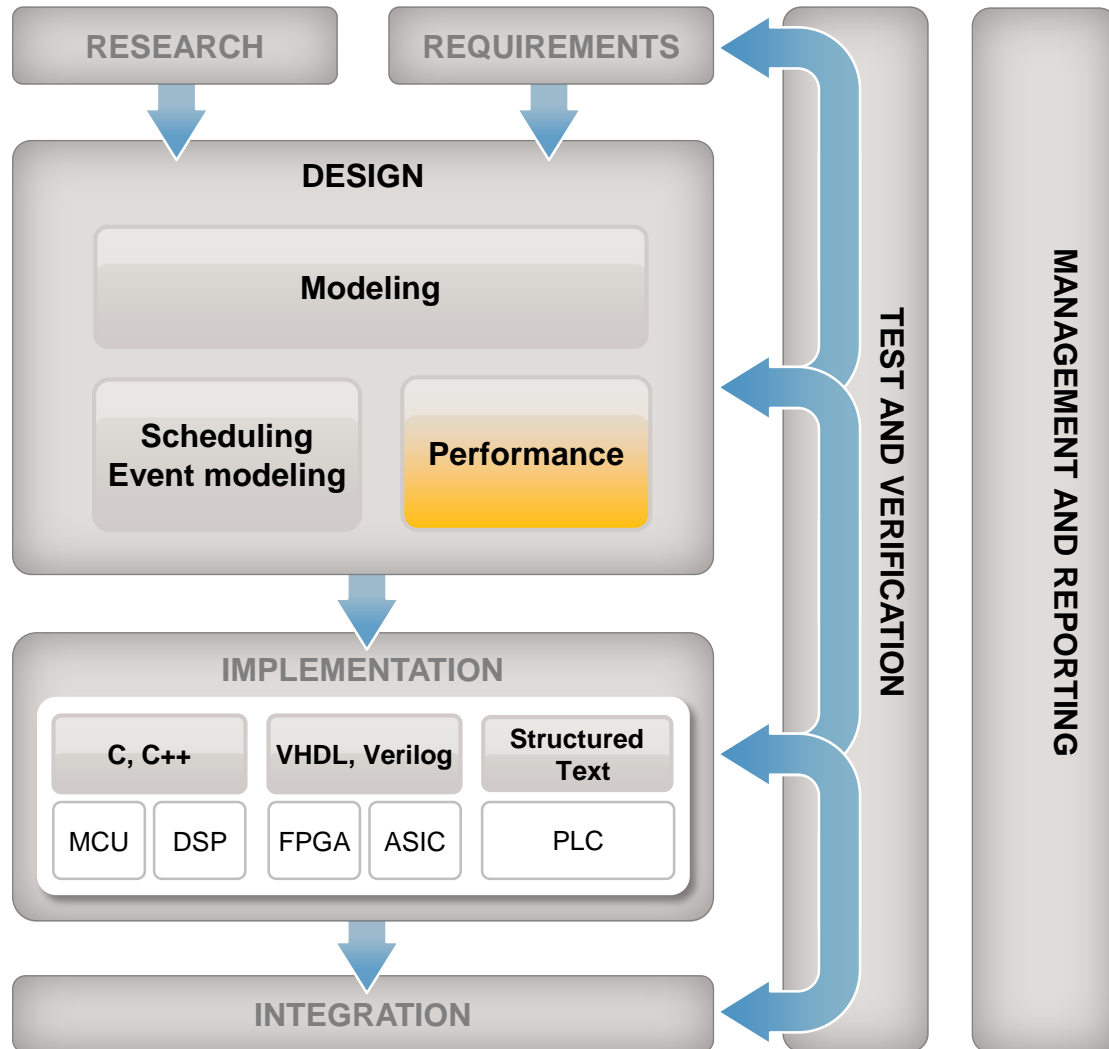
Scheduler Example



Scheduler Example



Model-Based Design Workflow



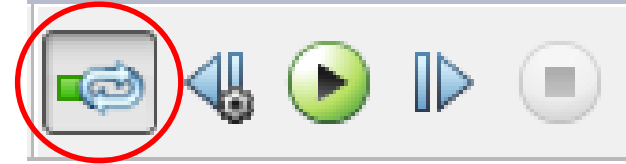
Fast Restart

Run consecutive simulations more quickly



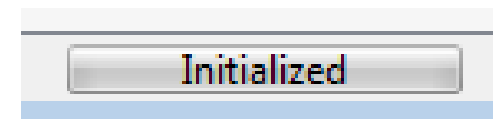
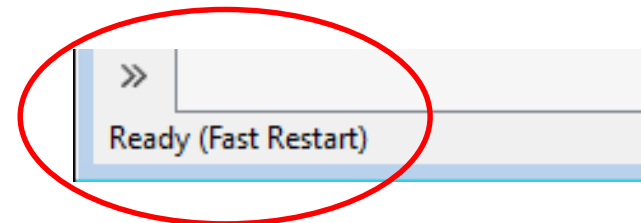
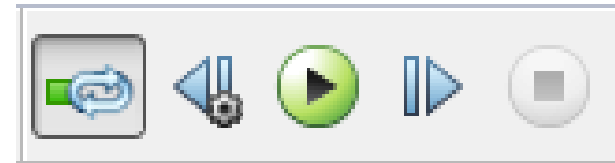
Fast Restart

Run consecutive simulations more quickly



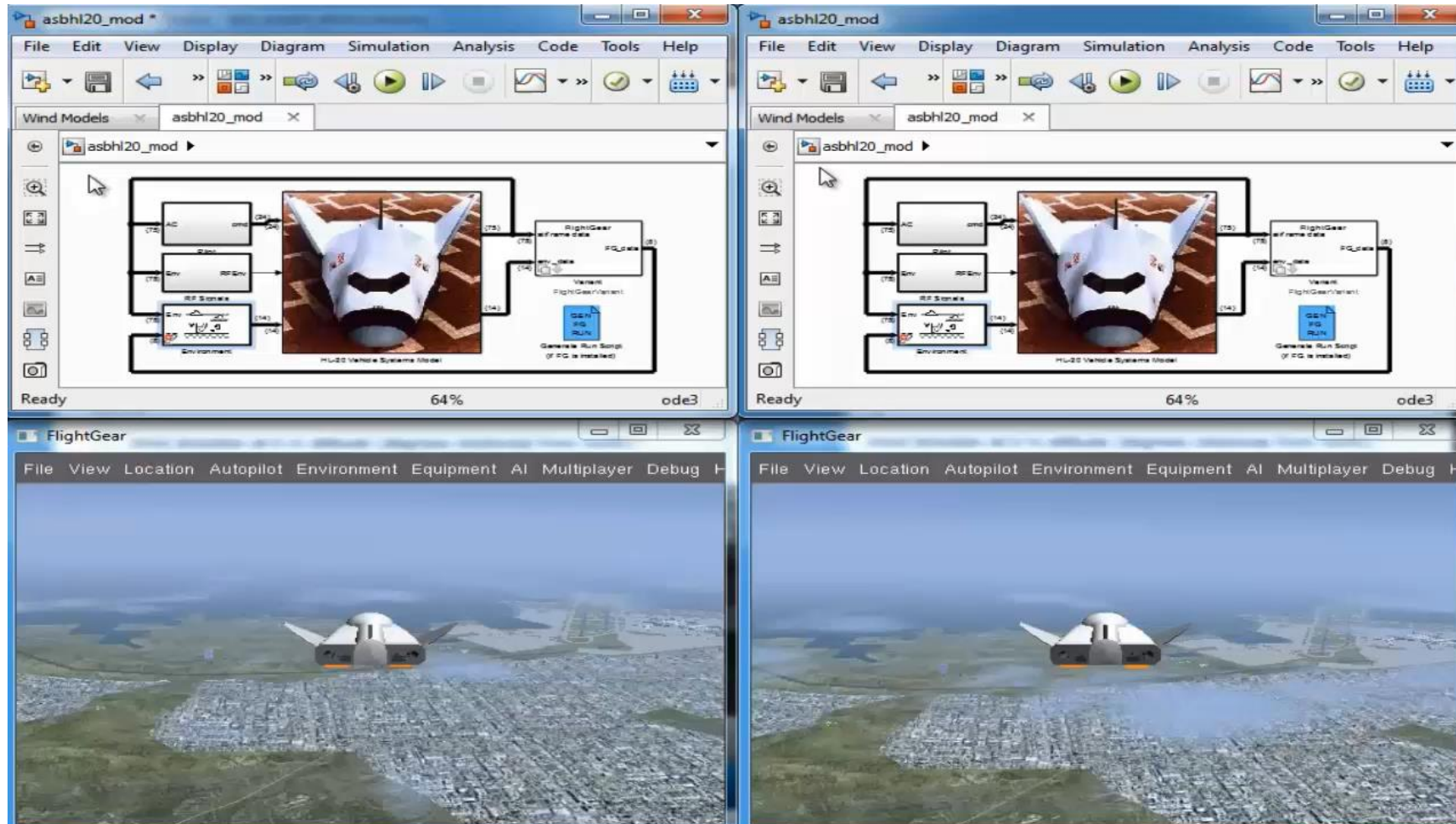
Fast Restart

Run consecutive simulations more quickly

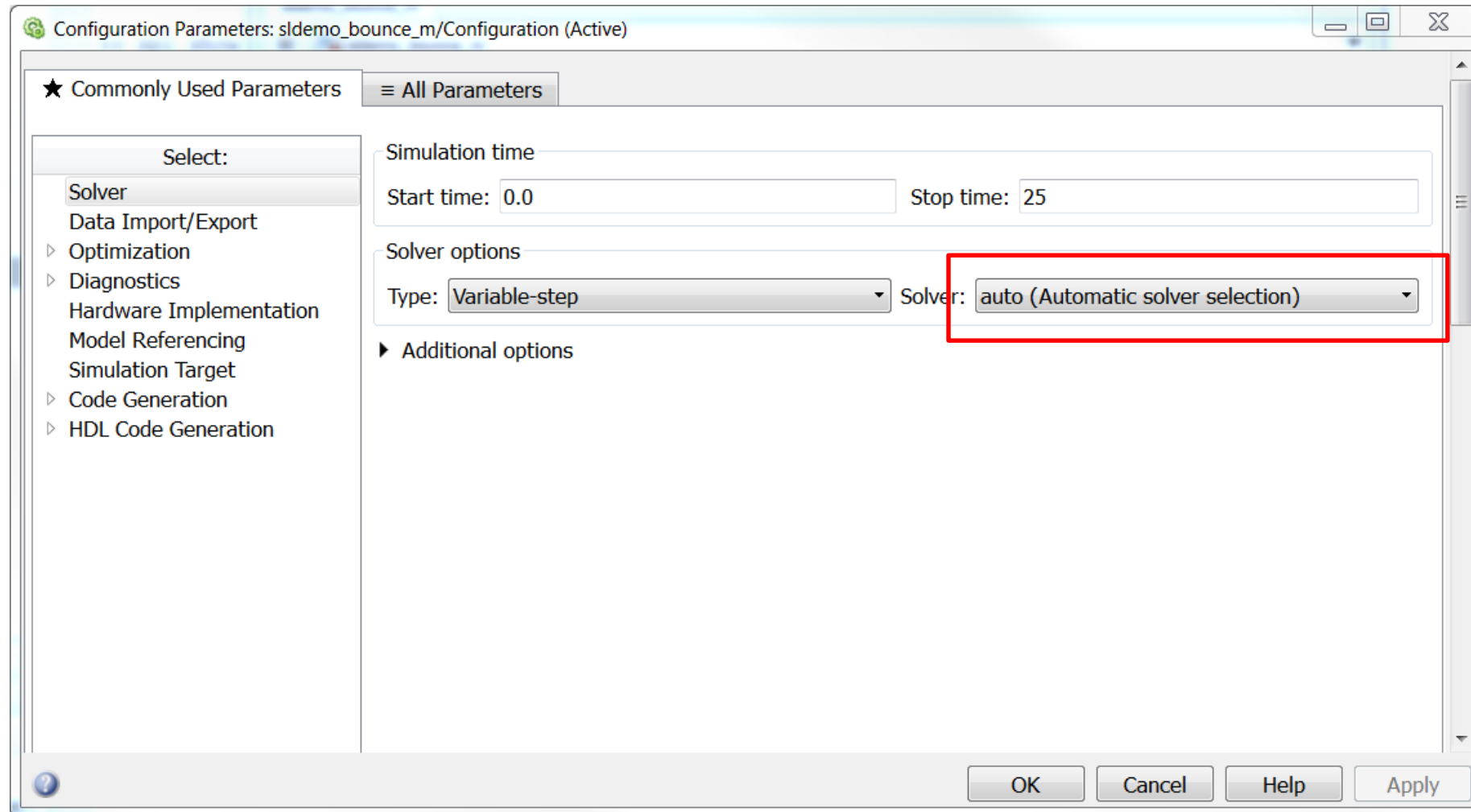


Simulink - Faster consecutive simulations

Fast Restart



Automatic Solver Selection



Understanding the selected solver

The screenshot shows the Simulink environment for a model named "sldemo_bounce_m". The main workspace displays the "Bouncing Ball Model" diagram. The model consists of the following blocks and connections:

- Gravitational acceleration:** A constant block with the value -9.81 .
- Initial Velocity:** A constant block with the value $[15]$.
- Second-Order Integrator:** A block with a transfer function of $\frac{1}{s^2}$. It has two inputs: u (from Gravitational acceleration) and dx_0 (from Initial Velocity). It has two outputs: x (Position) and dx (Velocity).
- Memory:** A block that receives the Velocity output (dx) and outputs it to the Coefficient of Restitution block.
- Coefficient of Restitution:** A gain block with the value -0.8 .
- Terminator1 and Terminator2:** Two blocks that receive the Position and Velocity outputs, respectively, to terminate the simulation.

The Solver information panel, highlighted by a red box, provides the following details:

- Solver:** auto(ode45)
- Max step size:** 0.01

The status bar at the bottom of the window shows "Ready", "88%", and the selected solver "auto(ode45)".

Understanding the selected solver

The screenshot displays the Simulink environment for a model named 'sldemo_bounce_m'. The main workspace shows a block diagram titled 'Bouncing Ball Model'. The diagram includes the following components and connections:

- A constant block for 'Gravitational acceleration' with a value of -9.81 .
- An 'Initial Velocity' block with a value of $[15]$.
- A 'Second-Order Integrator' block with a transfer function of $\frac{1}{s^2}$. It receives inputs 'u' (from gravitational acceleration) and 'dx₀' (from initial velocity).
- The integrator outputs 'x' (Position) and 'dx' (Velocity).
- A 'Coefficient of Restitution' block with a value of -0.8 .
- A 'Memory' block that receives the 'dx' signal and outputs to the 'Initial Velocity' block.
- Two 'Terminator' blocks (Terminator1 and Terminator2) are connected to the 'Position' and 'Velocity' outputs, respectively.

At the bottom right of the workspace, a 'Solver information' panel is visible, which is highlighted with a red box. It contains the following details:

- Solver information**
- Solver: auto(ode45)
- Max step size: 0.01

The status bar at the bottom of the window shows 'Ready', '88%' zoom, and the selected solver 'auto(ode45)'.

Understanding the selected solver - Solver Profiler

Solver Profiler: sldemo_bounce_m - Statistics

SOLVER PROFILER

From: 0 To: 25 Buffer: 50000

Open Save Run Stop

Zoom In Zoom Out Pan

Zero Crossing Solver Exception Solver Reset

Highlight Block Trace to Source Trace to Destination Remove Trace

STATES SHARE

FILE LOG PROFILE VIEW FILTER TRACE

Statistics

MODEL INFORMATION

Blocks with states	2
States	2
Start time	0
Stop time	25
Absolute tolerance	1.00e-06
Relative tolerance	1.00e-03

STEP INFORMATION

Max step size	1.00e-02
Min step size	3.55e-15
Average step size	9.01e-03
Max step size usage(%)	89.37
Total steps	2775

EVENT INFORMATION

Zero crossing source	3
Zero crossing source triggered	1
Total zero crossing	130
Total solver reset	131
Total solver exception	0
Error control exception	0
Newton iteration exception	0

Step Size

Suggestion Zero Crossing Solver Exception

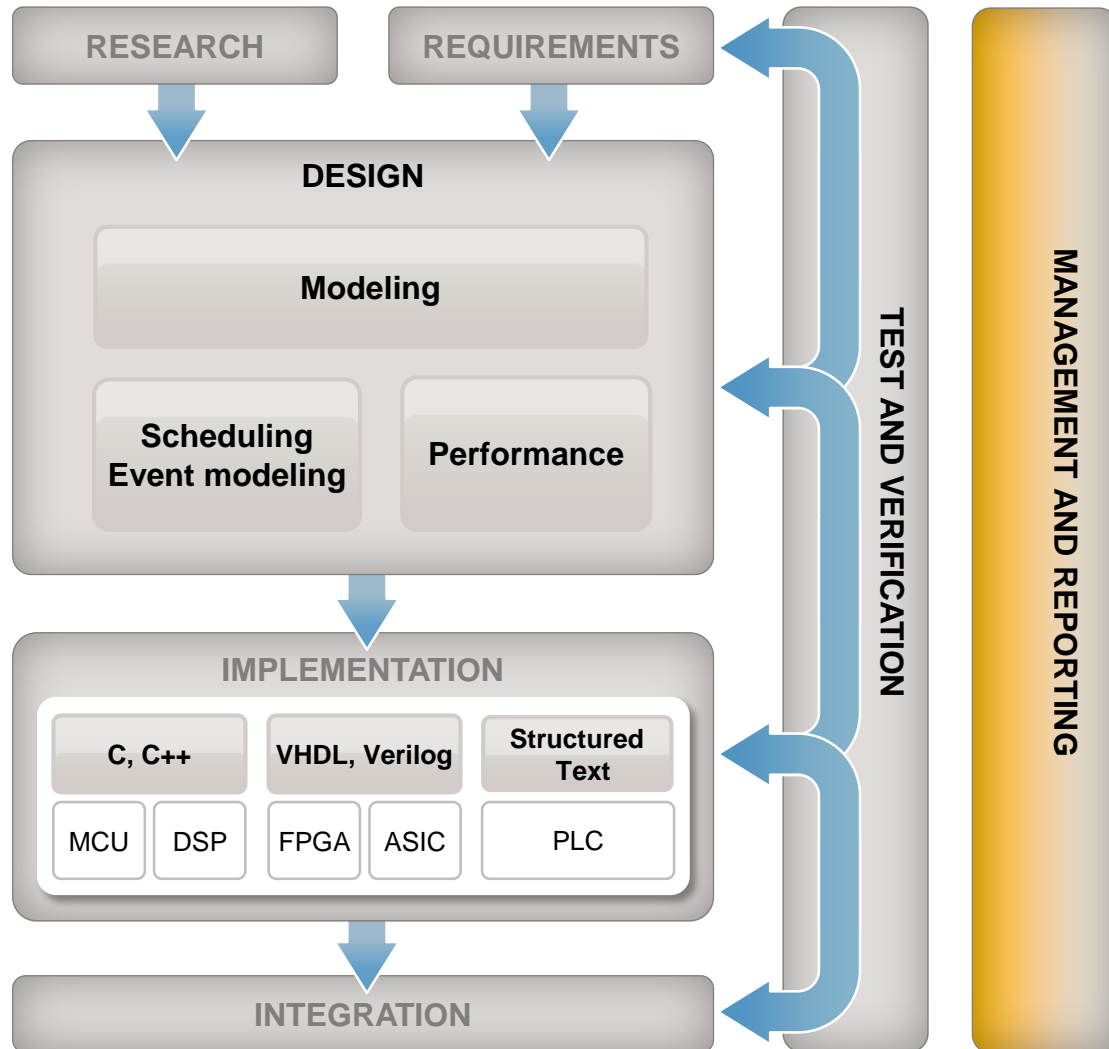
Solver profiler detected dense groups of zero crossings in these regions:
From: 19.36 To: 21.33

1. Identify states that contributed to the majority of zero crossings in these regions.
2. Highlight each block in the model. Explore the zero crossing setting for the block.
3. Examine upstream blocks to identify potential modeling improvements.

During simulation, the solver used the maximum step size 89.37% of total simulation time. You can improve the simulation speed. Increase the maximum step size in the Solver pane of model configuration parameters.

Click and drag to move Zero Crossing or its tab...

Model-Based Design Workflow



Three-Way Model Merge

The screenshot displays the 'Three-Way Merge' interface for a project named 'mine_slproject_f14.slx'. The interface is divided into several sections:

- Navigation and Controls:** Includes 'Next' and 'Previous' buttons, a 'Linked scrolling' checkbox, and buttons for 'Top Model', 'Bottom Model', 'Highlight Now', and 'Always highlight in models'. There are also 'Filter' and 'Accept & Close' options.
- Model Comparison:** Three columns represent different model versions:
 - Theirs:** ID: 34a6598997685c06df4571edf5a31bff2e6c7f
 - Base:** ID: 5268240c99c699aff23ab83fcf4ab5fa4a9eafd4
 - Mine:** (Current model)
- Model Hierarchy:** Each column shows a tree view of model components including 'Model Configuration Sets', 'Configuration', 'Diagnostics', 'Solver', 'Model Hierarchy', 'Simulink', 'Pilot', 'Pilot response amplitude', 'StickCommand_rad', 'Pilot:1 -> Bus Creator:1', 'Pilot:1 -> Branch', and 'EditorSettings'. Red highlights indicate differences between the models.
- Target View:** Located at the bottom, it shows the merged model structure with radio buttons for selecting the source of each element. A red warning icon indicates 'Resolve remaining 5 conflicts'.
- Conflict Resolution Panel:** A pop-up window on the right shows 'Filtered View (3)' and 'All Changes'. It lists conflict types: 'Conflict', 'Conflicted manual merge', and 'Manual merge'. A table below shows counts for 'Automatic' and 'Total'.

Report Generation

Bookmarks

- Table of Contents
- Chapter 1. Model Version
- Chapter 2. Root System
- Chapter 3. Subsystems
- Chapter 4. System Design Variables
- Chapter 5. Requirements Traceability
- Chapter 6. System Model Configuration
- Chapter 7. Glossary
- Chapter 8. About this Report

Chapter 2. Root System

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Description

Blocks

Parameters

Block Execution Order

Figure 2.1. CruiseControl_harness

Description

The cruise controller was designed with Stateflow. To test the controller, we use a harness setup test vectors imported from Excel, and the outputs compared to expected results.

Report Generation

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Chapter 2. Root System

Table of Contents

Description

Blocks

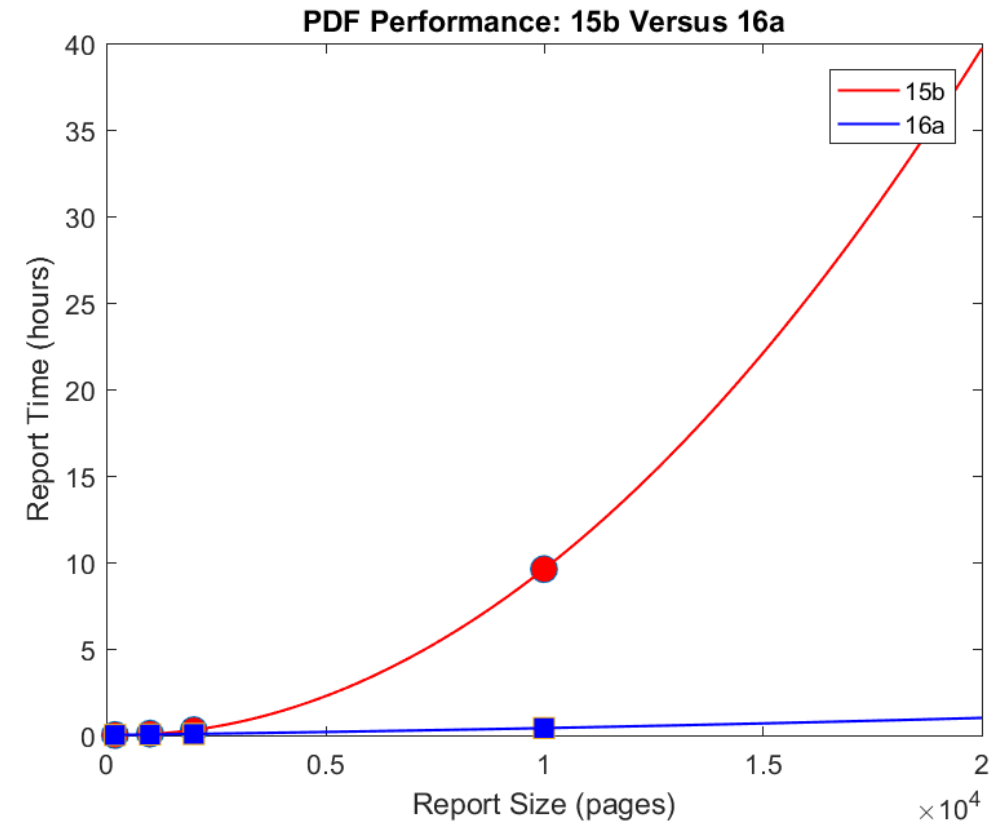
Parameters

Block Execution Order

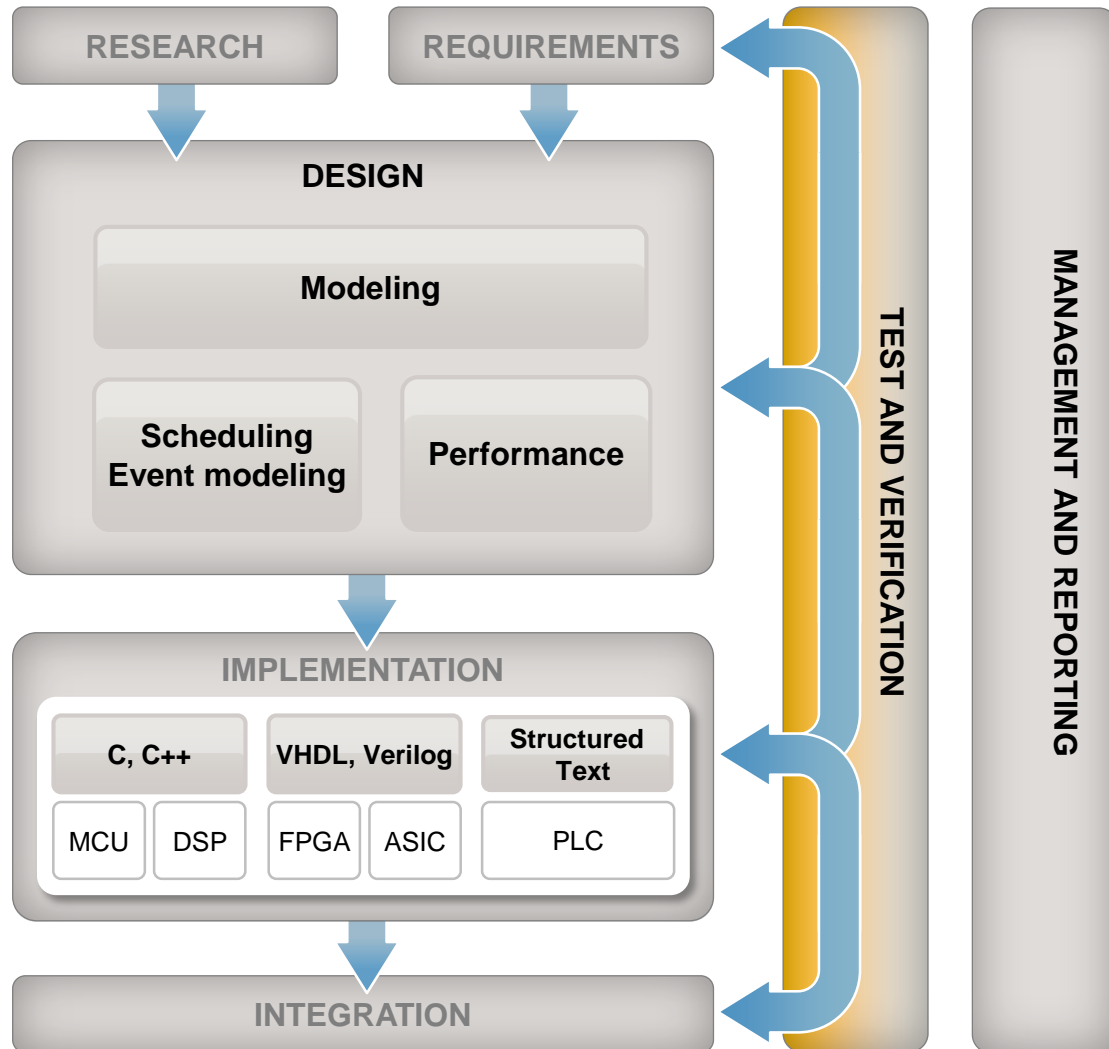
Figure 2.1. CruiseControl_harness

Description

The cruise controller was designed with Stateflow. To test the controller, we use a harness setu test vectors imported from Excel, and the outputs compared to expected results.

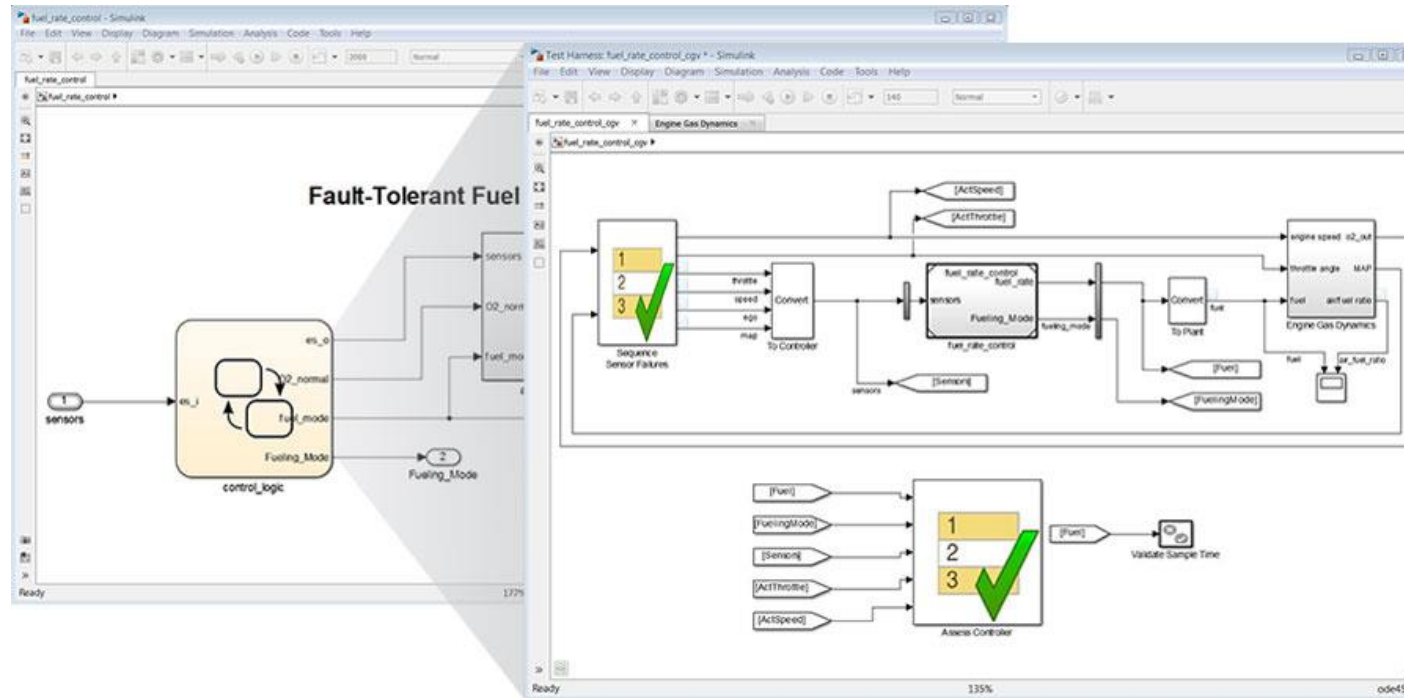


Model-Based Design Workflow



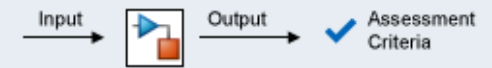
New Product! Simulink Test

Develop, Manage, and execute simulation-based tests

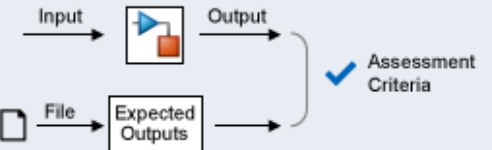


Test Case Templates

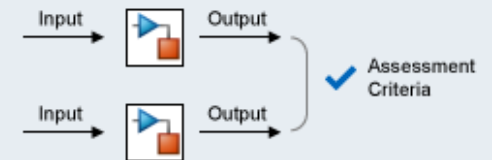
Simulation Test



Baseline Test

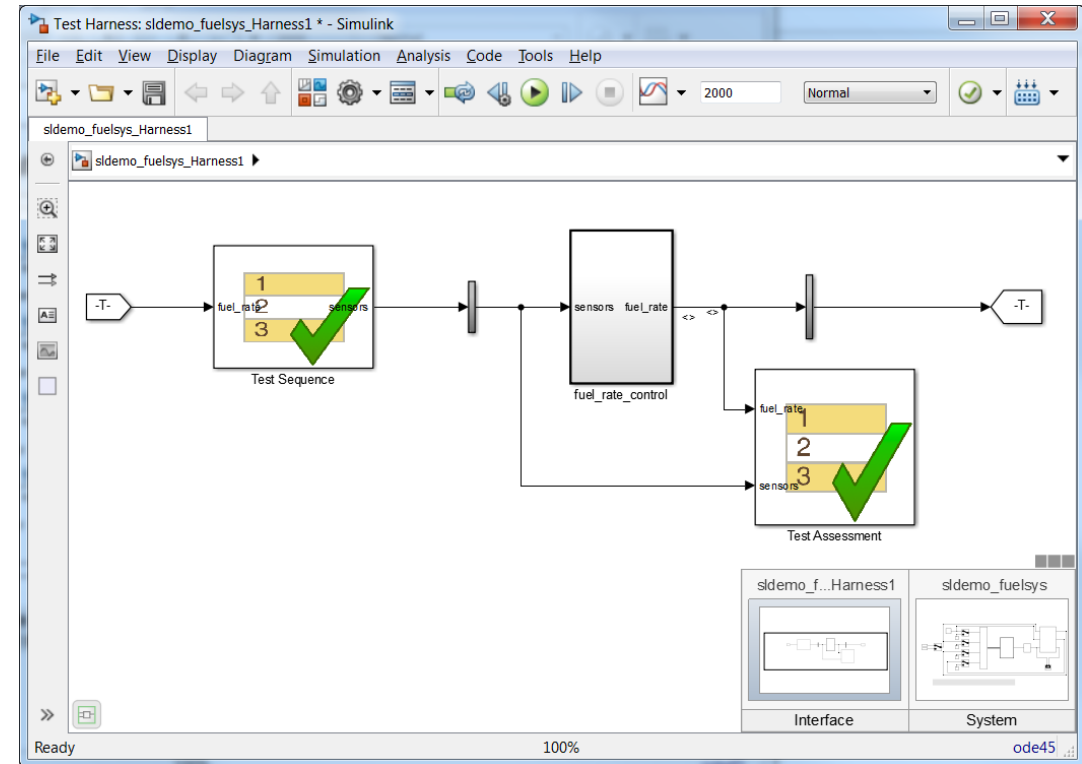


Equivalence Test



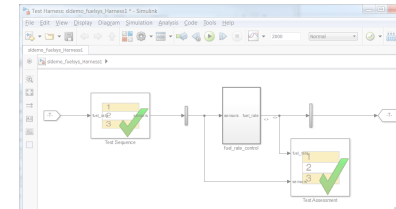
New Product! Simulink Test

- Automatically generate Test Harness

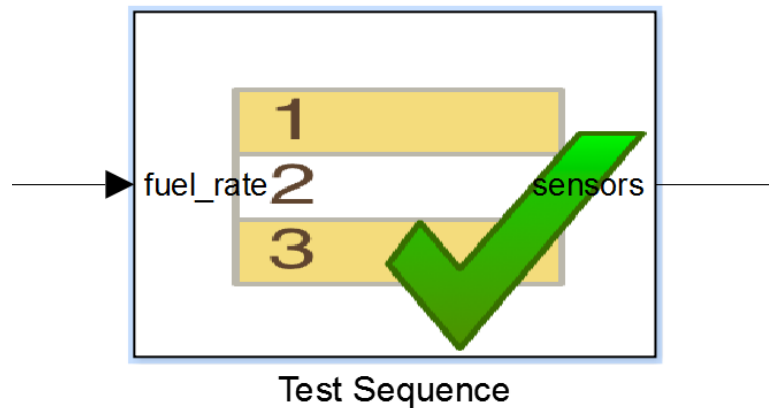


New Product! Simulink Test

- Automatically generate Test Harness



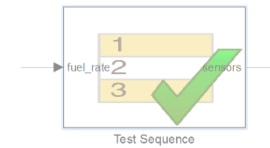
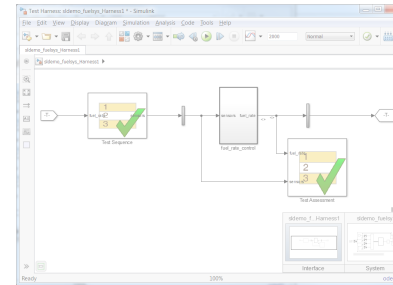
- Test Sequence block



Step	Transition	Next Step
<pre>initialize on_off = false; Tproj = single(0);</pre>	1. true	Normal_on_off ▼
<pre>Normal_on_off end_test = 0;</pre>		
<pre>On on_off = true;</pre>	1. FanOn == true	Wait ▼
<pre>Wait on_off = false; verify(FanOn == true,... 'Simulink:verify_scenario1',... 'Fan should be active');</pre>	1. after(20,sec)	Off ▼
<pre>Off on_off = true;</pre>	1. FanOn == false	End ▼
<pre>End on_off = false; end_test = 1;</pre>		

New Product! Simulink Test

- Automatically generate Test Harness
- Create Test Sequences
- Manage and Reporting

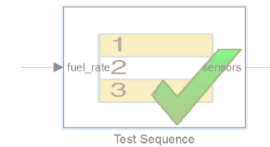
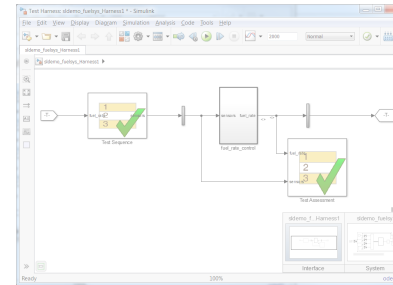


Step	Transition	Next Step
Initialize on_off = false; Tproj = single(0);	1. true	Normal_on_off
Normal_on_off end_test = 0;	1. FanOn == true	Wait
Wait on_off = false; verify(FanOn == true,... "Simulink.verify_scenario1"... "Fan should be active");	1. after(20_sec)	Off
Off on_off = true;	1. FanOn == false	End
End on_off = false; end_test = 1;		

NAME	STATUS
Results : 2014-Dec-10 10:41:08	1 ✓ 1 ✗
Test File	1 ✓ 1 ✗
Test Suite	1 ✓ 1 ✗
Baseline Test Case	✗
Baseline Criteria Result	✗

New Product! Simulink Test

- Automatically generate Test Harness
- Create Test Sequences
- Manage and Reporting



Step	Transition	Next Step
Initialize on_off = false; Tproj = single(0);	1. true	Normal_on_off
Normal_on_off end_test = 0;		
On on_off = true;	1. FanOn == true	Wait
Wait on_off = false; verify(FanOn == true, ... "Simulink.verify_scenario1", ... "Fan should be active");	1. after(20_sec)	Off
Off on_off = true;	1. FanOn == false	End
End on_off = false; end_test = 1;		

NAME	STATUS
Results : 2014-Dec-10 10:41:08	1 1
Test File	1 1
Test Suite	1 1
Baseline Test Case	
Baseline Criteria Result	

Real-Time testing with Simulink Real-Time



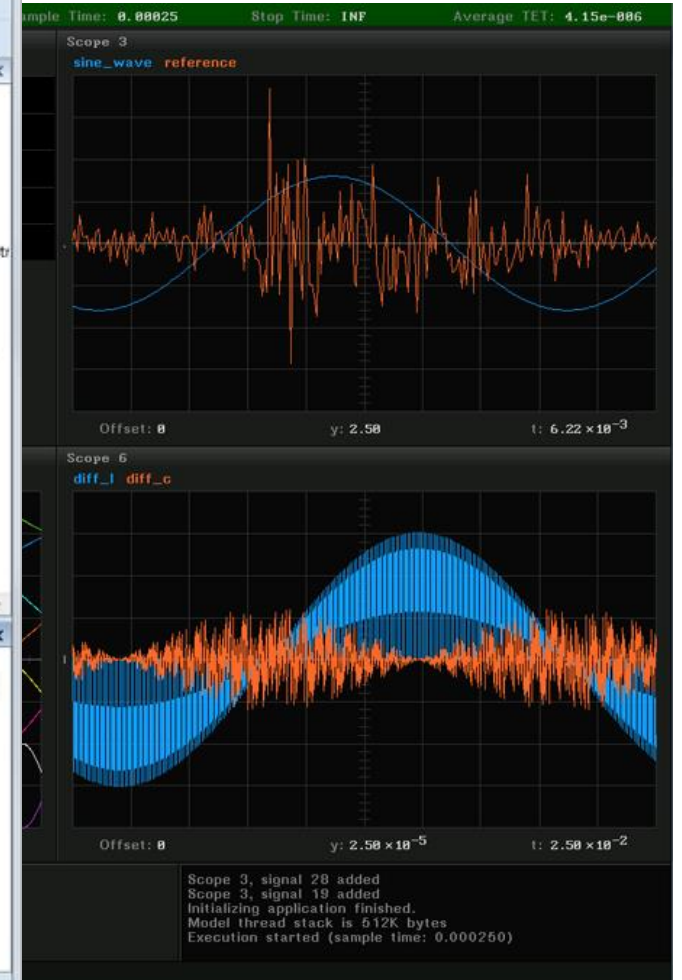
Real-Time testing with Simulink Real-Time

The Simulink Real-Time Explorer interface displays the following components:

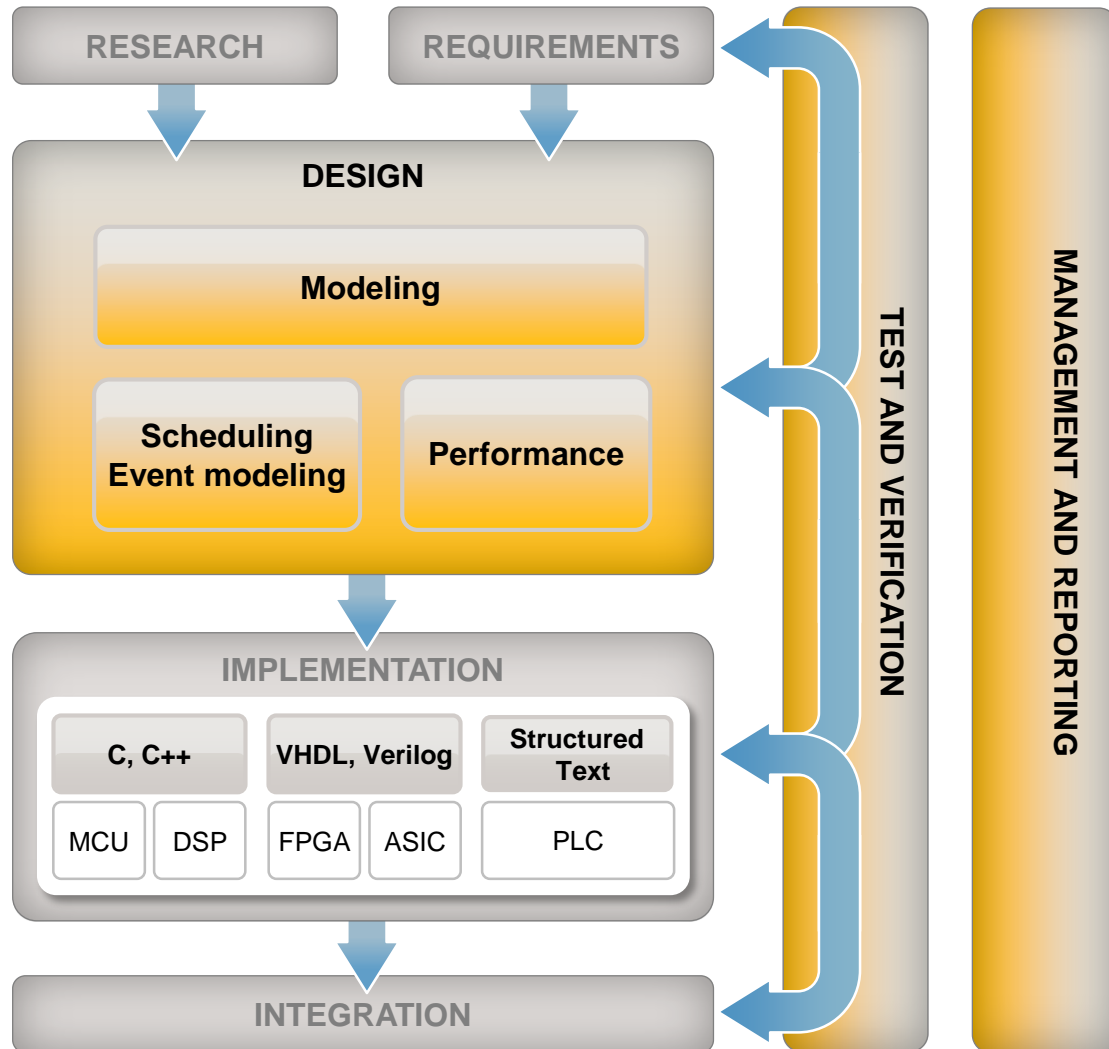
- Control Panel (Control_Panelslrtp):** A gauge labeled "Noise" with a scale from 20 to 32. The needle is positioned at approximately 26. A status indicator shows "ON" with a green bar and a digital display showing "517.9".
- TargetPC1/osc_ip:** Shows the execution mode as "Real-Time Multi Tasking". The execution time is 3405.83. The task execution time (Average) is 7.039E-07.
- osc_ip/Aux (TargetPC1) Monitoring Table:**

Monitor	Signal Name	Monitoring Value	Actions	Index
<input checked="" type="checkbox"/>	Bias	490.99054	[Icons]	
<input checked="" type="checkbox"/>	Gain	-3903286.72489	[Icons]	
<input type="checkbox"/>	Gain2		[Icons]	
- osc_ip (TargetPC1) Block Table:**

Name	Is Edited	Block Name	Actions	Dimensions
Bias	False	Reference	[Icons]	[1, 1]
Amplitude	False	Source	[Icons]	[1, 1]
Bias	False	Source	[Icons]	[1, 1]
Frequency	False	Source	[Icons]	[1, 1]



Model-Based Design Workflow



Questions!

Thanks!