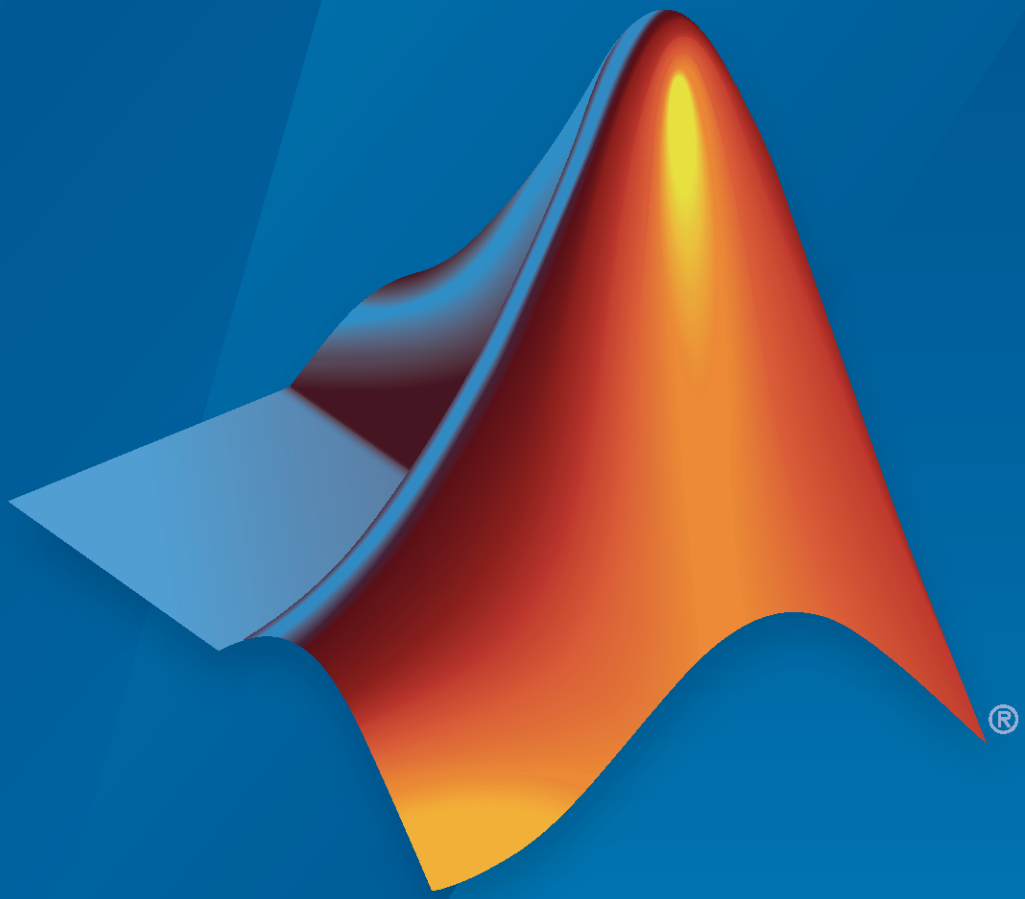
Simulink® Coverage™

Getting Started



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Simulink® Coverage™ Getting Started

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Revision History

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March 2018	Online only	Revised for Version 4.1 (Release 2018a)
September 2018	Online only	Revised for Version 4.2 (Release 2018b)
March 2019	Online only	Revised for Version 4.3 (Release R2019a)
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September 2020	Online only	Revised for Version 5.1 (Release R2020b)

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Simulink Coverage Product Description

Simulink Coverage Product Description

Measure test coverage in models and generated code

Simulink® Coverage™ performs model and code coverage analysis that measures testing completeness in models and generated code. It applies industry-standard metrics such as decision, condition, modified condition/decision coverage (MCDC), and relational boundary coverage to assess the effectiveness of simulation testing in models, software-in-the-loop (SIL), and processor-in-the-loop (PIL). You can use missing coverage data to find gaps in testing, missing requirements, or unintended functionality.

Simulink Coverage produces interactive reports showing how much of your model, C/C++ S-functions, MATLAB® functions, and code generated by Embedded Coder® has been exercised. You can highlight coverage results in blocks and subsystems to visualize gaps in testing. To assess testing completeness, you can accumulate coverage data from multiple test runs, as well as view coverage achieved through unit and system tests. Coverage outcomes can be traced to requirements and tests. You can apply filters to exclude blocks from coverage and justify missing coverage in reports.

Support for industry standards is available through DO Qualification Kit and IEC Certification Kit.

Getting Started with Simulink Coverage

- “Basic Simulink Coverage Workflow” on page 2-2
- “Basic Operation of the Model Coverage Tool” on page 2-4
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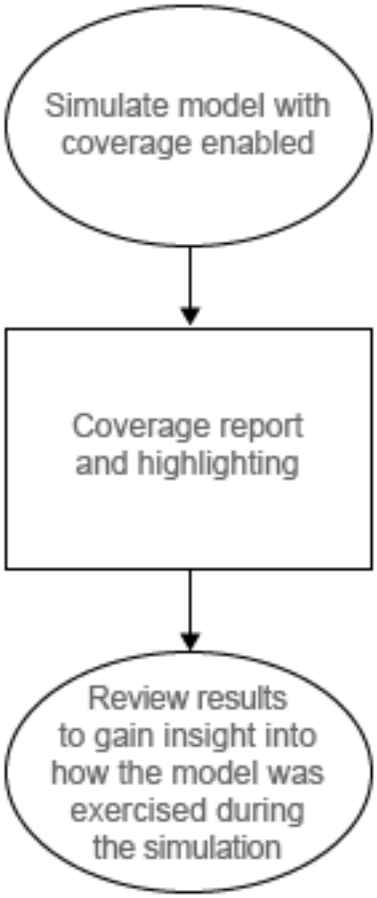
Basic Simulink Coverage Workflow

The simplest use of Simulink Coverage is to gain insight into which parts of your model are exercised during simulation.



After you enable coverage for a model with test cases, Simulink Coverage reports on, and highlights in the model, those objects in your design that were exercised during simulation. You use the coverage reports and model highlighting to learn which parts of your model were active during the specified test cases.

Further steps include “Resolving Missing Coverage” on page 2-11 and, for the most in-depth user workflow, “Simulink Coverage in End-to-End Systematic Verification” on page 2-13.

See Also

More About

- “Create and Run Test Cases”
- “Types of Model Coverage”
- “Types of Code Coverage”

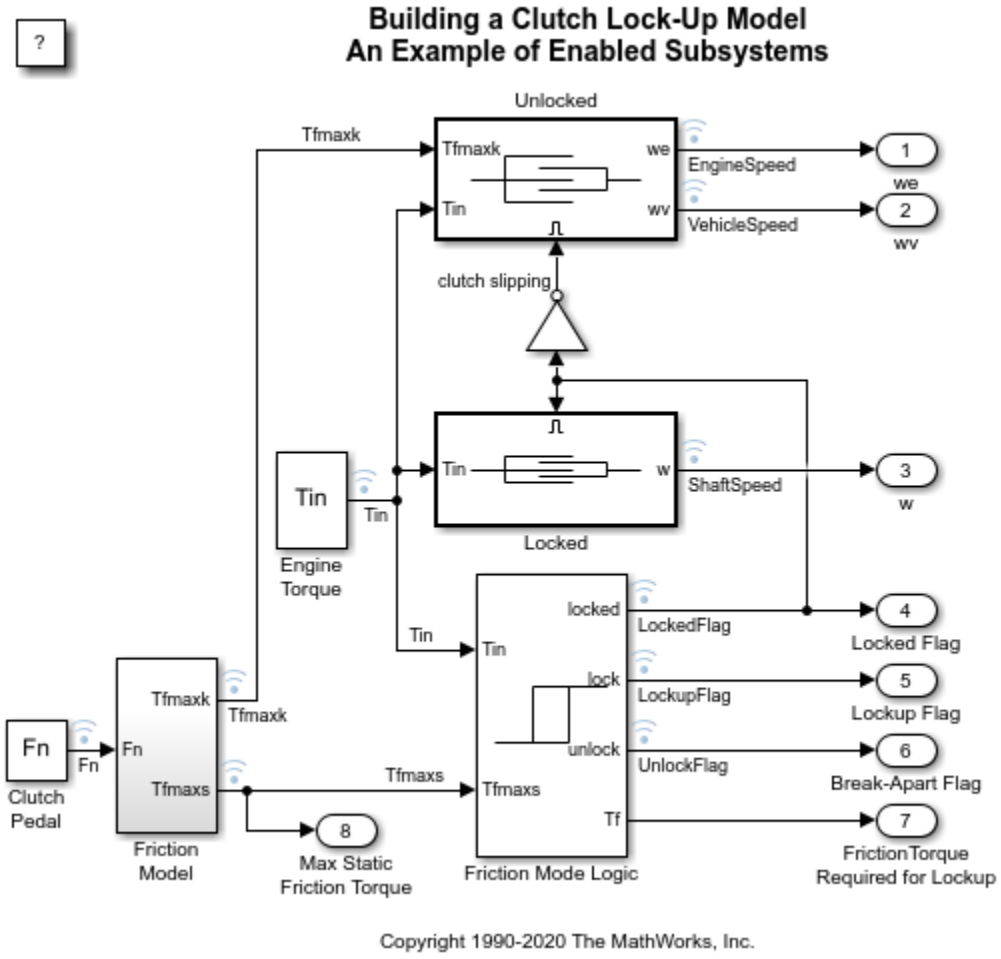
- “View Coverage Results in a Model”

Basic Operation of the Model Coverage Tool

This example shows how to use the Configuration Parameters dialog to enable coverage for a Simulink® model and adjust the type of information that is reported.

Move the current MATLAB® directory to the location that contains the example files.

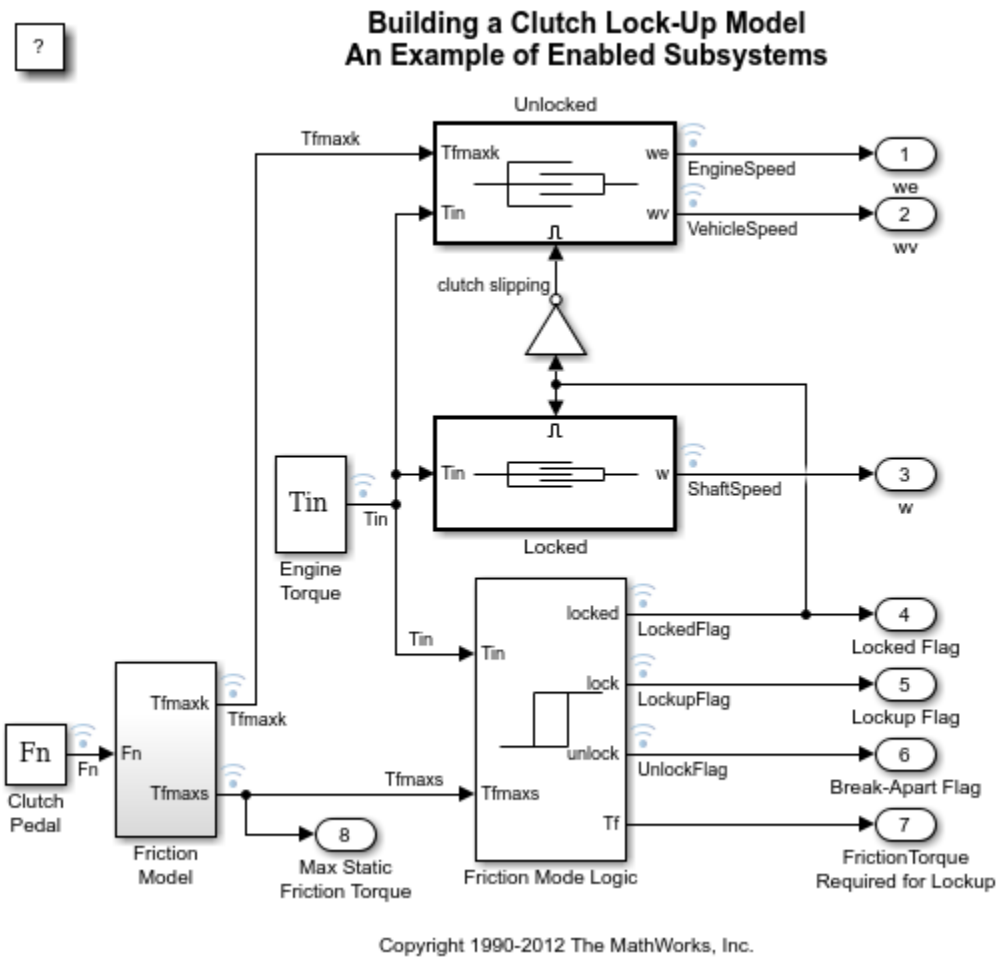
```
openExample('slcoverage/BasicOperationOfTheModelCoverageToolExample');
```



Open Example Model

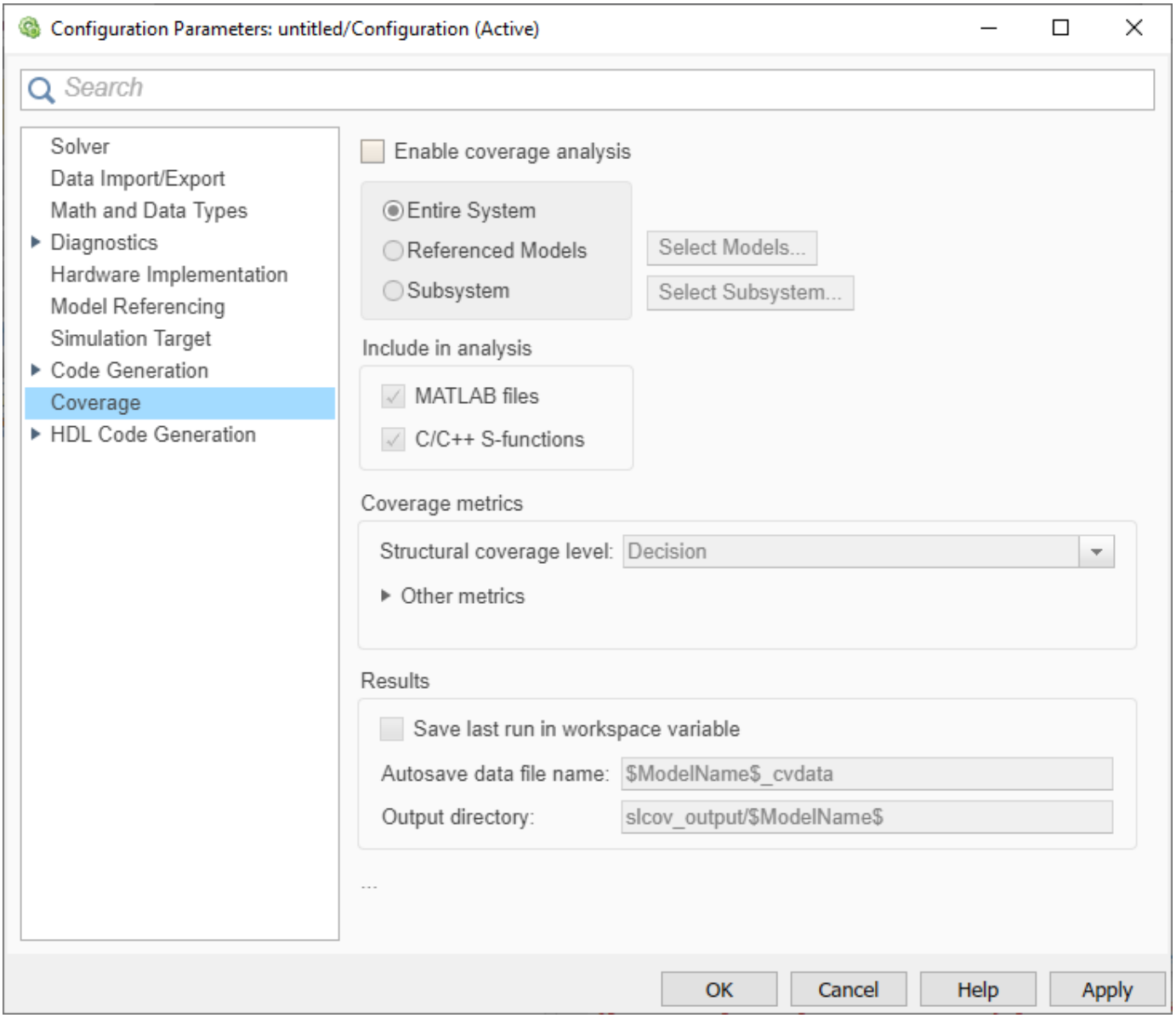
The `sldemo_clutch` example model that ships with Simulink provides a good introduction to model coverage. This model contains several blocks that have intrinsic decisions, places where control flow can take more than one path.

Open sldemo_clutch



Open Coverage Settings Dialog

You can find coverage settings under the **Coverage** pane of the Configuration Parameters dialog. To navigate to this pane, from the **Modeling** tab, select **Model Settings**.



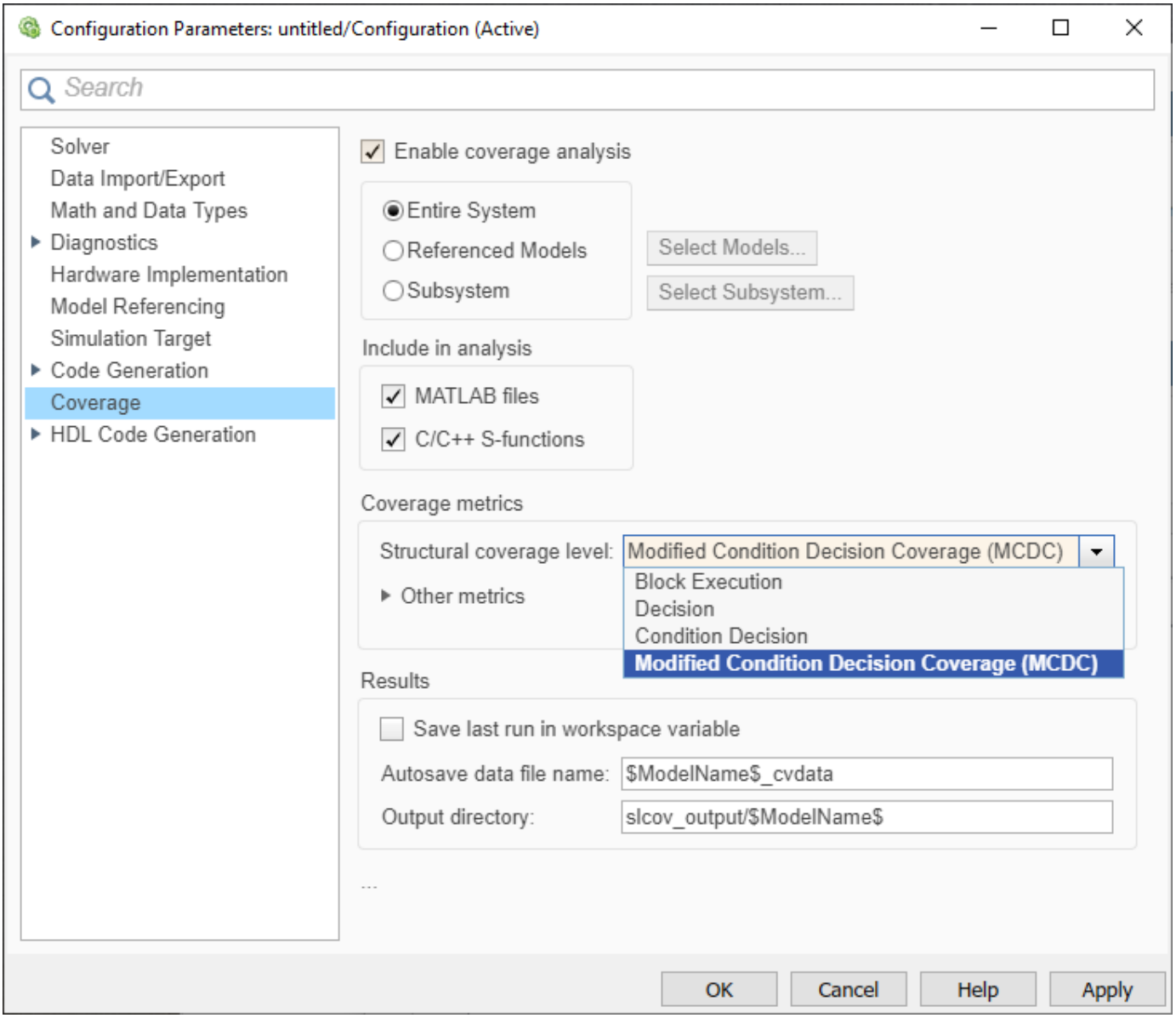
Enable Multiple Coverage Metrics

To enable the coverage tool, select **Enable coverage analysis**. This setting enables the other options in the Coverage pane.

The Coverage metrics group controls the type of coverage information that is collected during simulation.

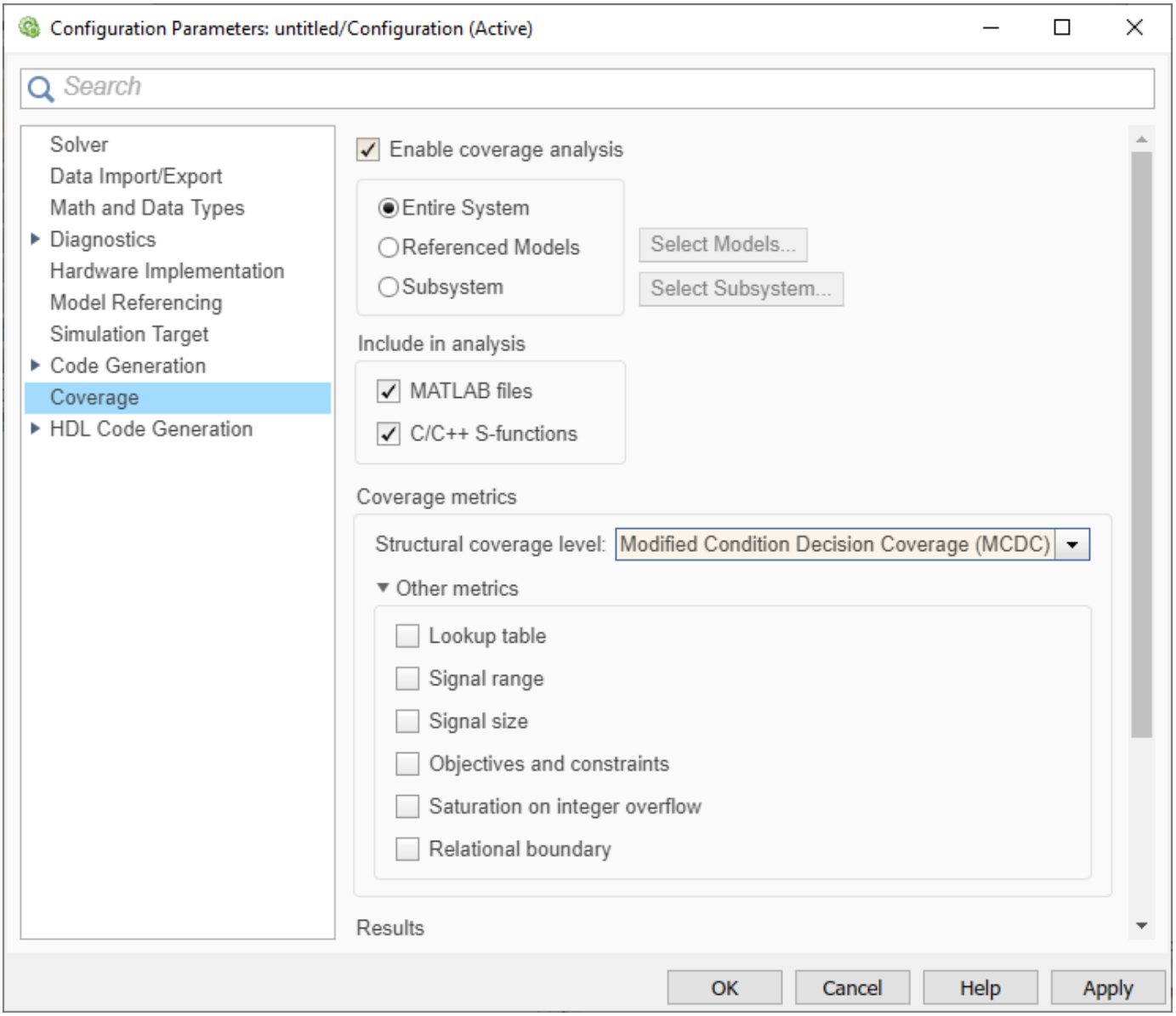
The **Structural coverage level** drop-down menu allows you to select which structural coverage metrics will be analyzed during simulation. These are ordered from the least rigorous (*Block Execution*) to the most rigorous (*Modified Condition Decision (MCDC)*).

For this example, select the *Modified Condition Decision (MCDC)* structural coverage level. The resulting report also includes decision and condition coverage results.



Additional coverage metrics can be found under the **Other metrics** toggle panel. Click the black arrow to expand this panel and see the available metrics. Selecting all coverage metrics provides the most coverage information.

For this example, select **Signal Range** and **Lookup Table**.

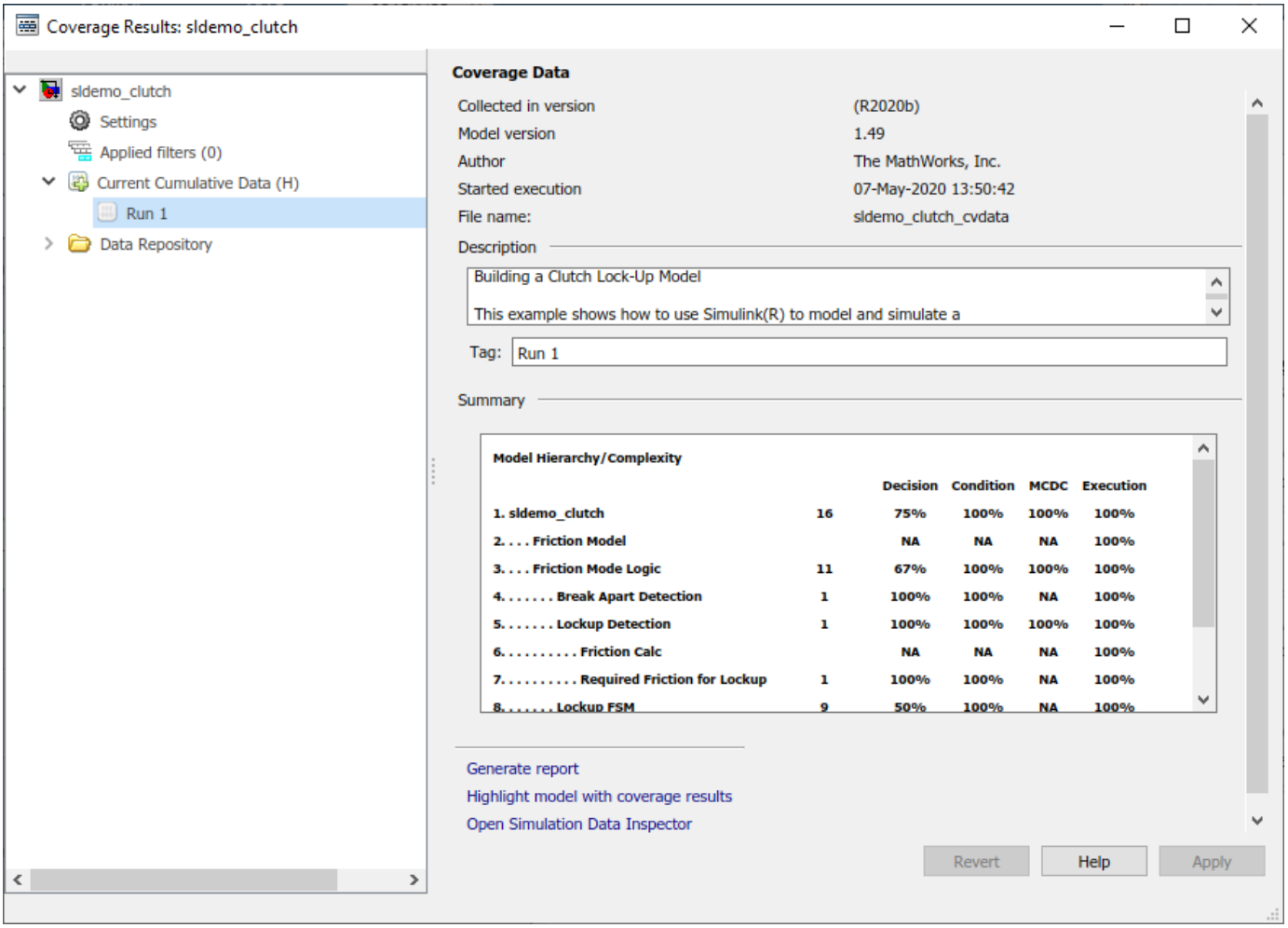


Click OK to apply your selected settings and close the Coverage Settings dialog box.

Run Simulation and Explore Results

Once you enable coverage collection for your model, coverage information is automatically recorded when you simulate the model. At the end of the simulation, the Coverage Results Explorer is opened, showing results for the latest coverage analysis.

Click the **Run (Coverage)** button to simulate the model and collect coverage.



Produce Coverage Report from Results Explorer

The Coverage Results Explorer offers various functionality for processing, displaying, and reporting coverage results from previous simulations of your model.

Click the **Generate report** link at the bottom of the Coverage Results Explorer window. This produces an HTML report of coverage information that displays within the built-in MATLAB® web browser.

Coverage Report for sldemo_clutch

Table of Contents

1. Analysis Information
2. Tests
3. Summary
4. Details
5. Signal Ranges

Analysis Information

Coverage Data Information

Collected in version	(R2020b)

Model Information

Model version	1.49
Author	The MathWorks, Inc.
Last saved	Wed Apr 15 08:09:26 2020

Simulation Optimization Options

Default parameter behavior	tunable
Block reduction	off
Conditional branch optimization	on

Coverage Options

Analyzed model	sldemo_clutch
Logic block short circuiting	on
MCDC mode	masking

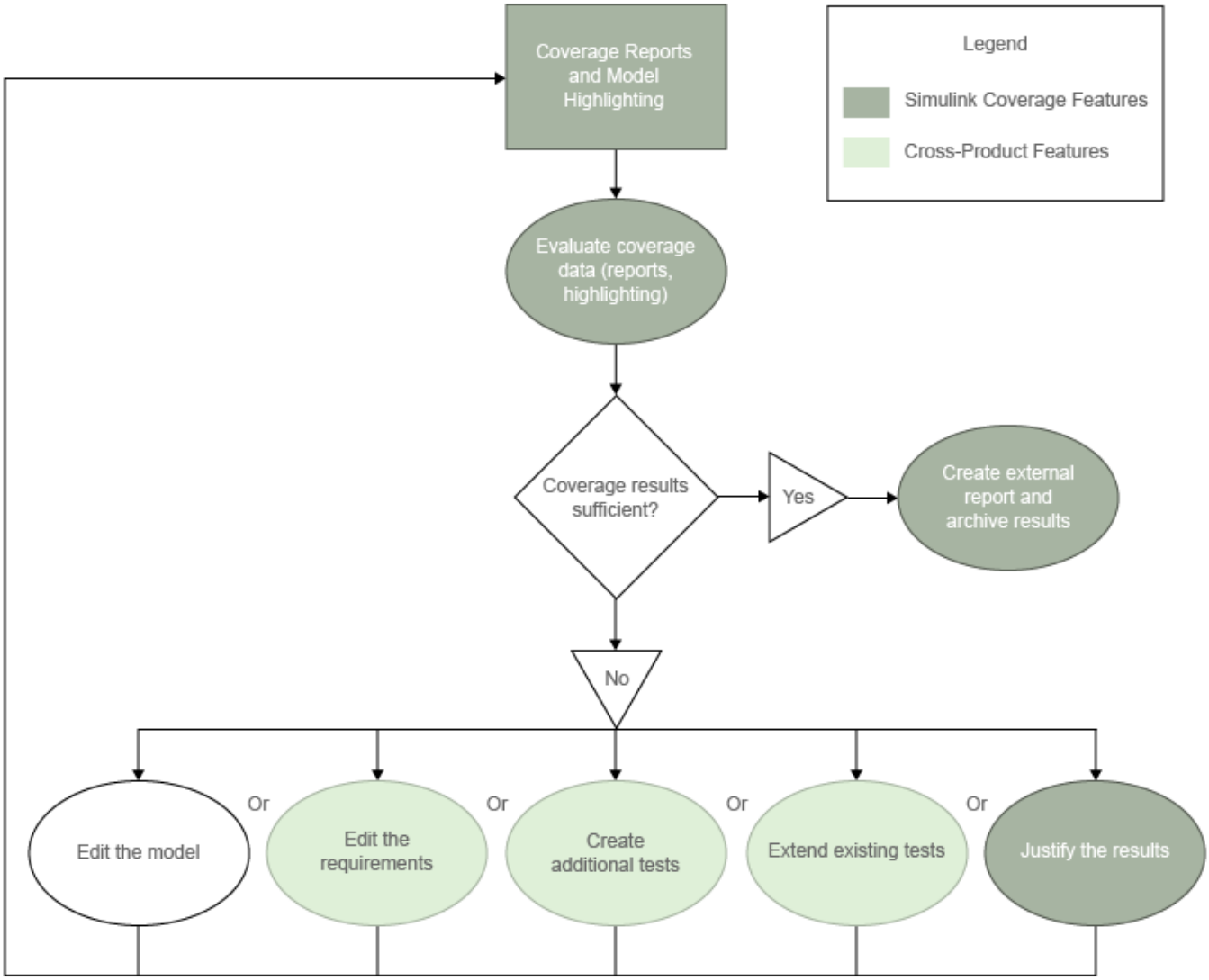
Tests

Test#	Started execution	Ended execution	Description
Test 1	07-May-2020 13:50:42	07-May-2020 13:50:44	Building a Clutch Lock-Up Model This example shows how to use Simulink(R) to model and simulate a rotating clutch system. Although modeling a clutch system is difficult because of topological changes in the system dynamics during lockup, this example shows how Simulinks enabled subsystems feature easily handles such problems. We illustrate how to employ important Simulink modeling concepts in the creation of the clutch simulation. Designers can apply these concepts to many models with strong discontinuities and constraints that may change dynamically. In the example, we use enabled subsystems to build the clutch model. Two enabled subsystems model the clutch dynamics in either the locked or unlocked position. After running the simulation, a GUI opens. Checking any of the boxes on the GUI produces a plot of any of the selected variables (versus time).

Resolving Missing Coverage

In this section...
“Recording and Evaluating Coverage” on page 2-11 “Resolving Missing Coverage” on page 2-12 “Reporting and Archiving Results” on page 2-12

After you generate a model coverage report, you can use Simulink Coverage to help you resolve missing coverage for your model.



Recording and Evaluating Coverage

After you enable coverage recording and simulate your model, you then evaluate the coverage data to find gaps in your testing. Coverage reports and model highlighting help you to understand which parts of your design are sufficiently exercised by your test cases.

For more information, see:

- “Specify Coverage Options”
- “View Coverage Results in a Model”
- “Types of Coverage Reports”
- “Overview of Model Coverage Highlighting”

Resolving Missing Coverage

If your coverage tests do not sufficiently exercise your model, there are a few steps you can take to increase your coverage:

- **Edit the model** — Your model might contain unintended functionality that is not part of your required design. Remove the unintended functionality.
- **Edit the requirements** — Your requirements might not sufficiently detail the testing required to exercise all parts of your design. You can use Simulink Requirements™ to author and edit requirements from within the Simulink environment. For more information, see “Test Model Against Requirements and Report Results”.
- **Create additional tests** — Your existing tests might not fully exercise the intended simulation inputs according to your requirements. You can use Simulink Coverage to create additional tests to model these inputs. For more information, see “Automating Model Coverage Tasks” and “Generate Test Cases” (Simulink Design Verifier).
- **Extend existing tests** — Your existing tests might not fully exercise all parts of your design. If you have a Simulink Design Verifier™ license, you may be able to automatically generate additional tests to exercise untested parts of your design. For more information, see “Incrementally Increase Test Coverage Using Test Case Generation”.
- **Justify the results** — Parts of your model might not be exercised during simulation according to your design, such as subsystems that only enable during failures. To achieve full coverage in such cases, you can justify the missing coverage. For more information, see “Create, Edit, and View Coverage Filter Rules”.

Reporting and Archiving Results

If your coverage tests sufficiently exercise your model, you can archive the reported results. For more information, see:

- “Top-Level Model Coverage Report”
- “Access, Manage, and Accumulate Coverage Results by Using the Results Explorer”
- “Code Coverage Report”
- “Export Model Coverage Web View”
- `cvhtml`

See Also

More About

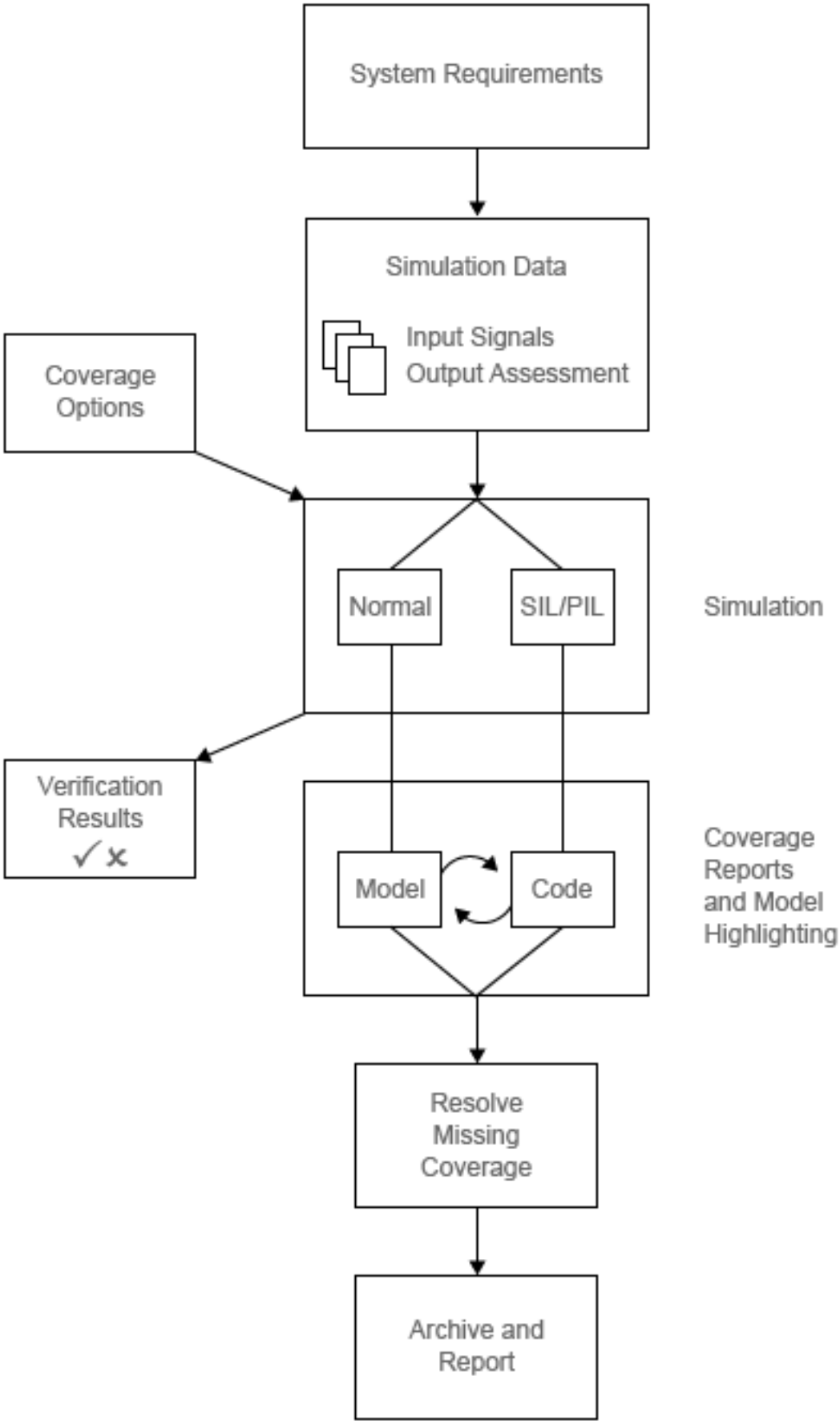
- “Perform Functional Testing and Analyze Test Coverage”

Simulink Coverage in End-to-End Systematic Verification

In this section...

“System Requirements” on page 2-15
“Simulation Data” on page 2-15
“Simulation” on page 2-15
“Coverage Reports and Model Highlighting” on page 2-15
“Resolve Missing Coverage” on page 2-16
“Archive and Report” on page 2-16

You can use Simulink Coverage to increase confidence in your design and testing through end-to-end systematic verification.


System Requirements
Simulation Data
Input Signals
Output Assessment
Coverage Options
Normal
SIL/PIL
Simulation
Verification Results
Model
Code
Coverage Reports and Model Highlighting
Resolve Missing Coverage
Archive and Report

System Requirements

End-to-end systematic verification begins with system requirements. The system requirements detail the model design and the testing and verification specifications.

If you have a Simulink Requirements license, you can author and manage system requirements, link Simulink blocks to requirements, and link test cases to the requirements that they verify from within the Simulink environment. For more information, see “Test Model Against Requirements and Report Results”.

Simulation Data

To record coverage, you first specify input signals for your model. For more information, see “Create and Run Test Cases” and “Perform Functional Testing and Analyze Test Coverage”.

If you have a Simulink Design Verifier license, you can also specify expected output signals for the specified input signals. For more information, see “Perform Functional Testing and Analyze Test Coverage” (Simulink Design Verifier). You can also automatically generate test case for a system. For more information, see “Workflow for Test Case Generation” (Simulink Design Verifier).

Simulation

After you “Specify Coverage Options” for your model, you then simulate the model and record model coverage. For more information on the types of model coverage, see “Types of Model Coverage”. You can record several runs of coverage data and accumulate the results. For more information, see “Access, Manage, and Accumulate Coverage Results by Using the Results Explorer” and “Cumulative Coverage Data”.

If you have an Embedded Coder license, you can also record code coverage for models in software-in-the-loop (SIL) mode and processor-in-the-loop (PIL) mode. The code coverage reports tell you which parts of your generated code are exercised by your tests, and also which elements of your model are associated with which parts of your generated code. For more information on enabling SIL or PIL code coverage for a model, see “Specify Code Coverage Options”.

If you have a Simulink Design Verifier license, you can model and verify design requirements using property proving. For more information, see “Requirements-Based Verification” (Simulink Design Verifier).

Coverage Reports and Model Highlighting

After you record coverage for a simulation, you then review the coverage reports and model highlighting to identify gaps in your testing, with the goal of gaining confidence that your tests and verification are complete and adequate. For more information on coverage reports and model highlighting, see:

- “View Coverage Results in a Model”
- “Top-Level Model Coverage Report”
- “Code Coverage Report”
- “Access, Manage, and Accumulate Coverage Results by Using the Results Explorer”

If you have an Embedded Coder license and you record code coverage for models in software-in-the-loop (SIL) mode and processor-in-the-loop (PIL) mode, code coverage reports tell you which parts of

your generated code are exercised by your tests, and also which elements of your model are associated with which parts of your model. For more information on enabling SIL or PIL code coverage for a model, see “Code Coverage for Models in Software-in-the-Loop (SIL) Mode and Processor-in-the-Loop (PIL) Mode”.

Resolve Missing Coverage

If you find that parts of your design are not fully tested, you can take steps to resolve the missing coverage and gain confidence that your tests and verification are complete and adequate. For more information, see “Resolving Missing Coverage” on page 2-11.

Archive and Report

When you are confident in the testing and verification of your design, you can archive and report the results of the coverage recording. For more information, see:

- “Top-Level Model Coverage Report”
- “Code Coverage Report”
- “Access, Manage, and Accumulate Coverage Results by Using the Results Explorer”
- “Export Model Coverage Web View”
- `cvhtml`