

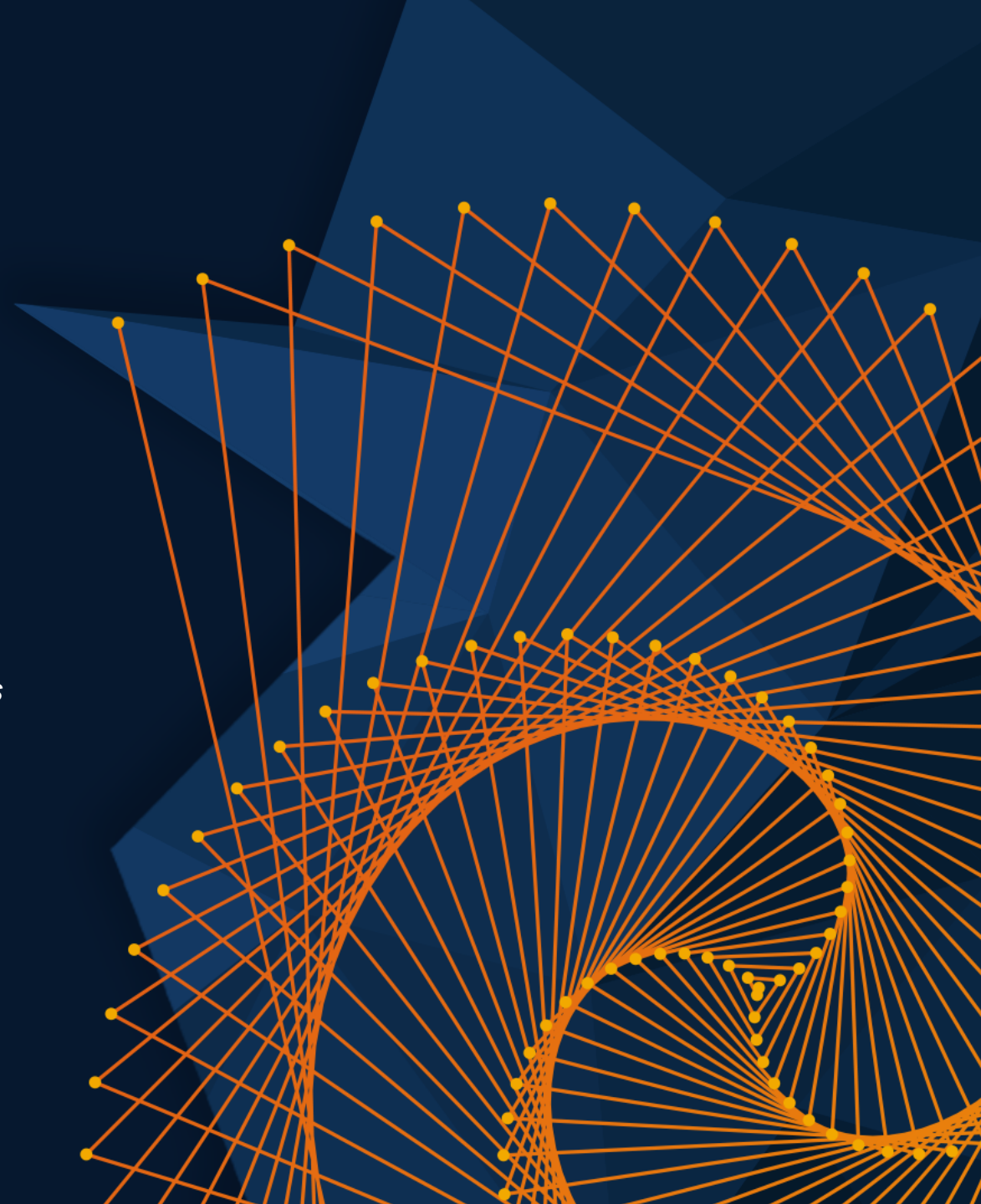
# MATLAB EXPO

## CI for Simulink: Speed Up Model-Based Design with Automated Pipelines

*Sameer Muckatira, MathWorks*



*Dr. Jason Ghidella, MathWorks*



# CI for Simulink: Speed Up Model-Based Design with Automated Pipelines

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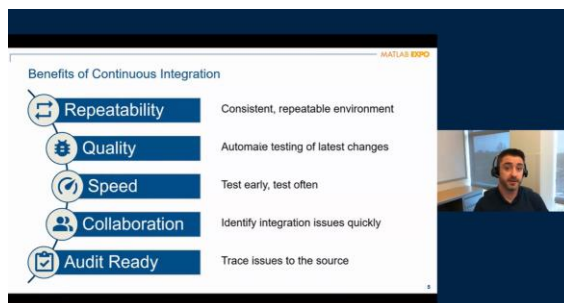
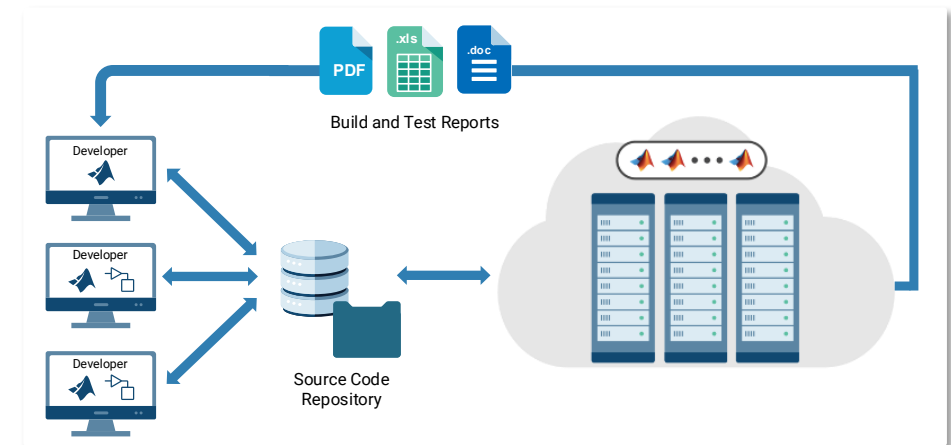
# What is Continuous Integration (CI)? Do I need CI for my work?

# What is Continuous Integration (CI)?

- **Frequent integration:** Developers regularly merge code changes into a shared repository
- **Automated testing:** Each merge triggers an automated build and test process
- **Early error detection:** CI identifies issues early, keeping the codebase stable and release-ready

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## Continuous Integration with MATLAB and Simulink



# CI in Action

## Let's look at an example

- **“Launch Mode” for an Electric Vehicle**



**Driver Activates  
“Launch Mode”**



**Increase Battery  
Current by 70%**

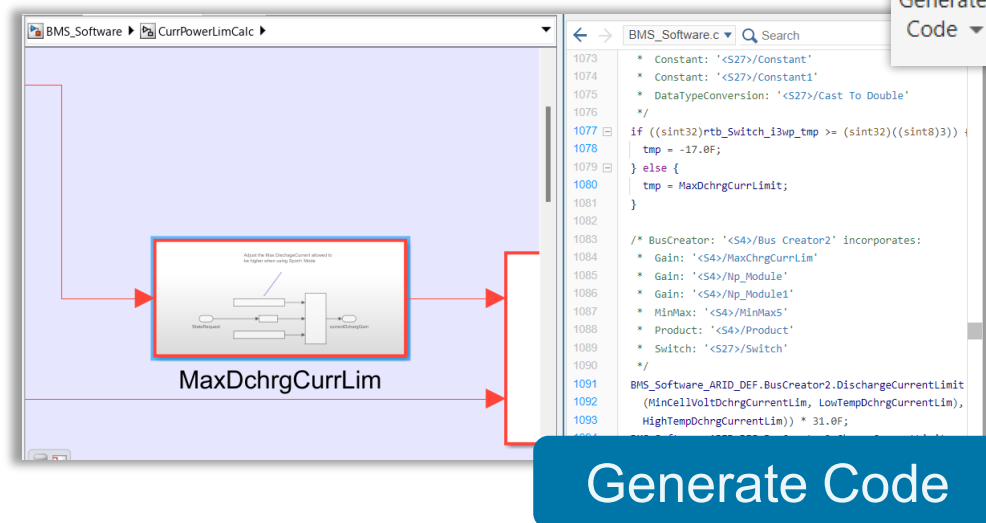
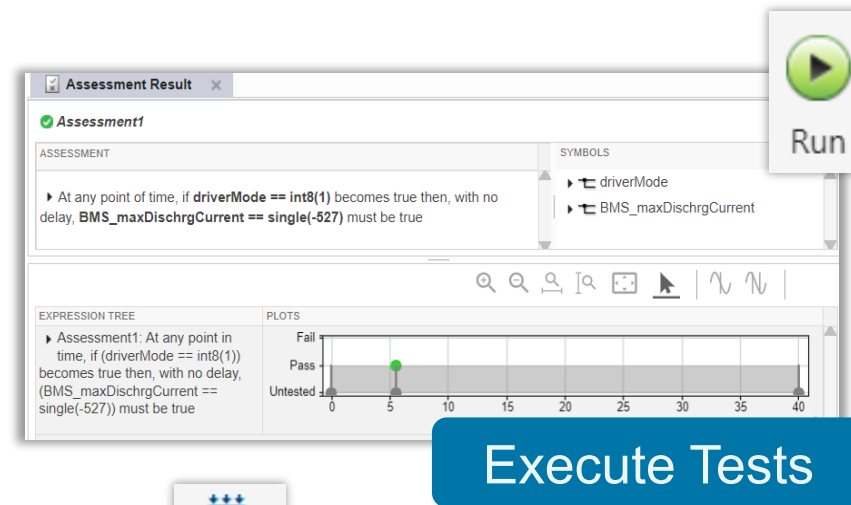
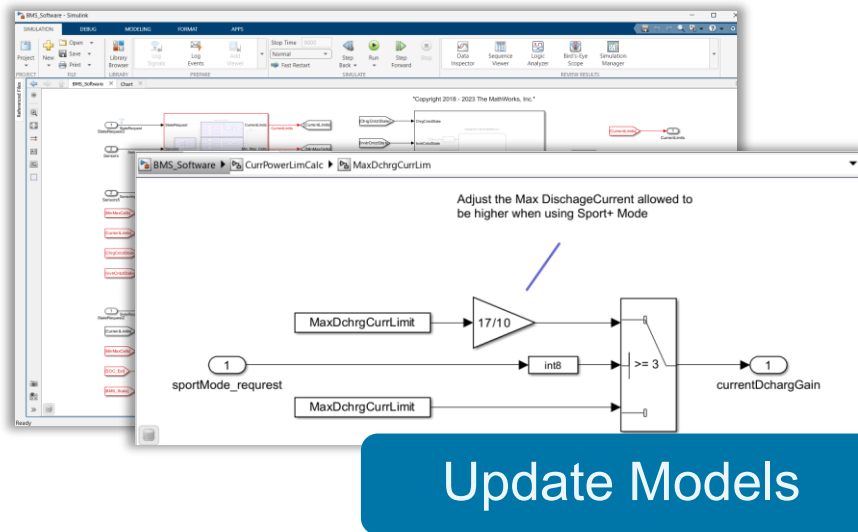
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# A typical MBD workflow starts by implementing requirements through modeling, testing, and code generation.

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Is my development work complete?



# Meeting requirements is not enough

## Many tasks remain before a model is release-ready

- ✓ Create Diff Reports
- ✓ MiL Tests
- ✓ Run Model Checks
- ✓ Generate C/C++ Code
- ✓ Check Design Errors
- ✓ SiL Tests
- ✓ Build
- ✓ Look for Dead Logic / DBZ errors
- ✓ Polyspace Code Prover
- ✓ PiL Tests
- ✓ Generate Model Web Views
- ✓ Generate Standalone Apps
- ✓ Update Testing/Quality Dashboards
- ✓ Deploy to production servers

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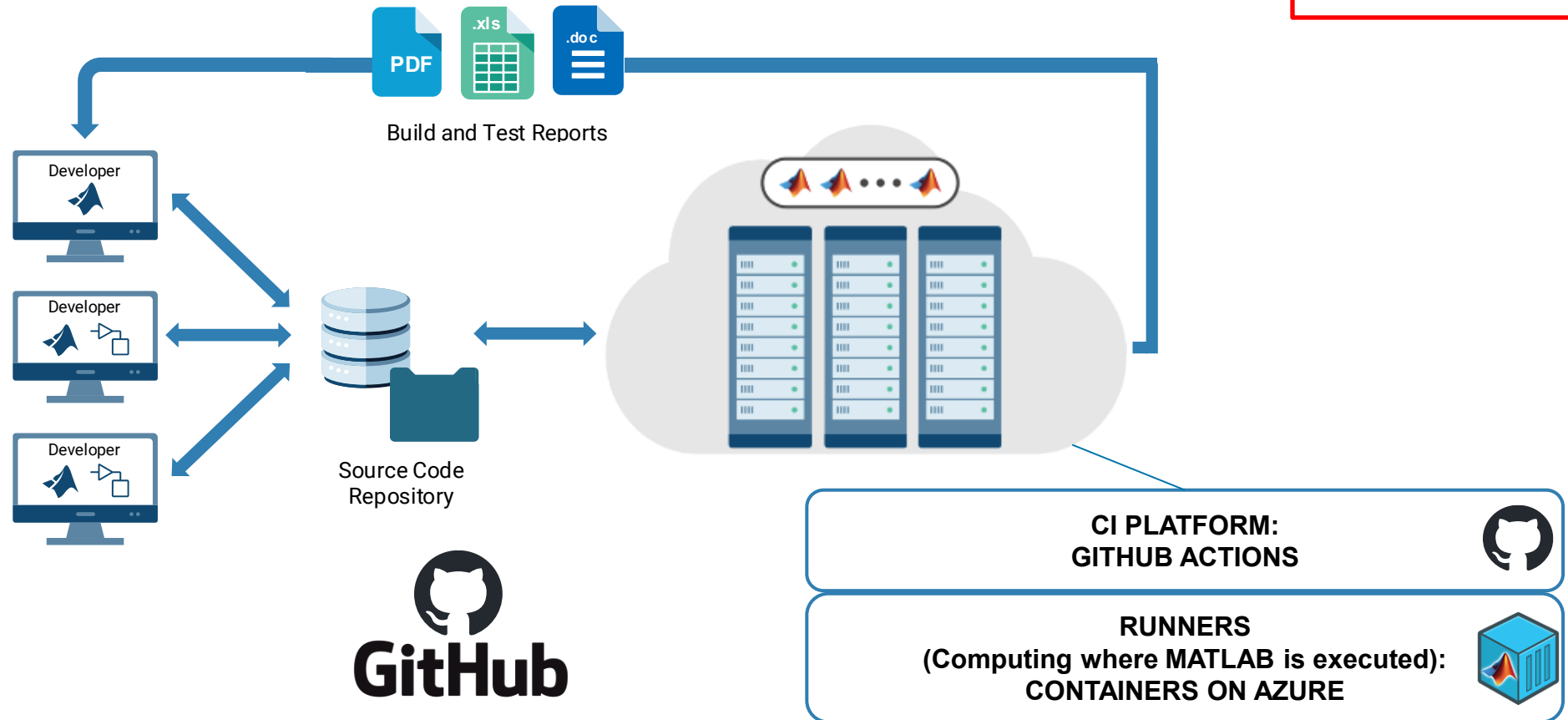
**Can we automate these tasks ?**



# CI Turns Manual Effort into an Automated Flow

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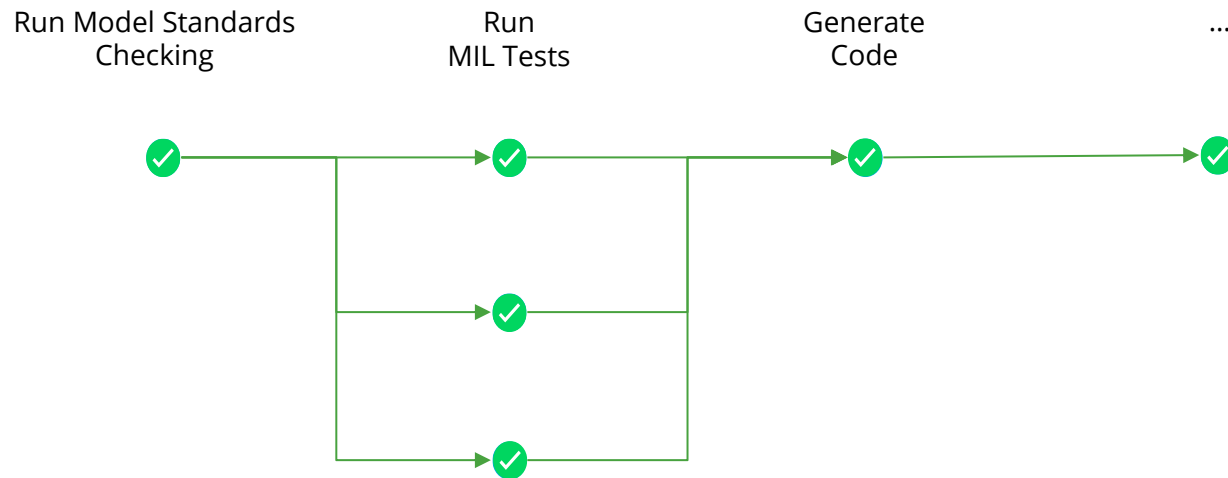
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# How to setup a Pipeline for Model-Based Design Tasks



# Identify tasks and define the process

- Which tasks need to be performed first?
- Which tasks are dependent?
- What can be executed simultaneously?



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# How do I execute Model-Based Design tasks?

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- Model-Based Design products have APIs

```
>> slbuild('mymodel'); % to generate code
```

- You can run MATLAB in a “headless” mode to run commands



```
matlab -batch "RunYourCommand"
```

- But how do I build a pipeline?

- A lot more scripting is needed
- Keep updating as I add more models/tests
- Need to manage outputs, scheduling, and more...



build.m

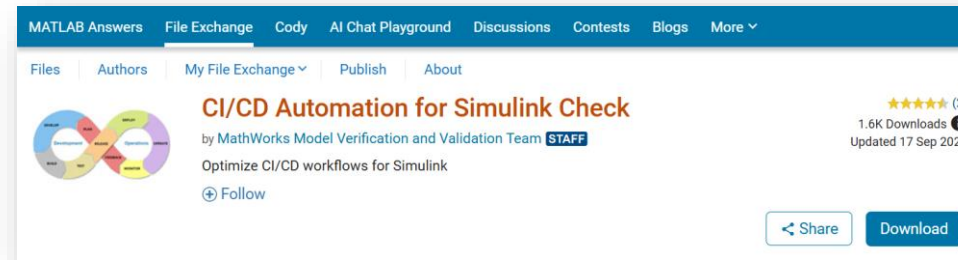


genCode.m



- This is why we introduced the CI Support package for Simulink

# CI Support Package for Simulink

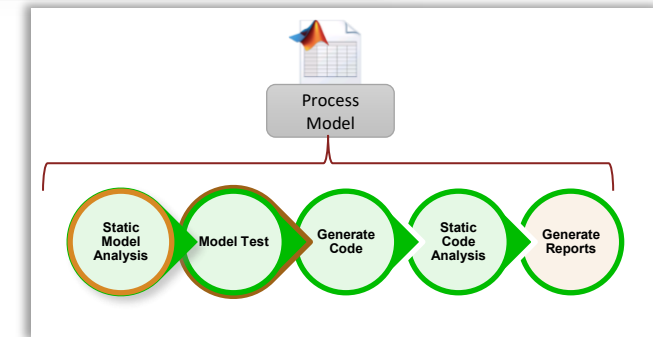


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## 1) Simple to Setup

- Prebuilt classes for common Model-Based Design tasks
- Single file to define the process
- Tailorable – add in your own tasks/variations

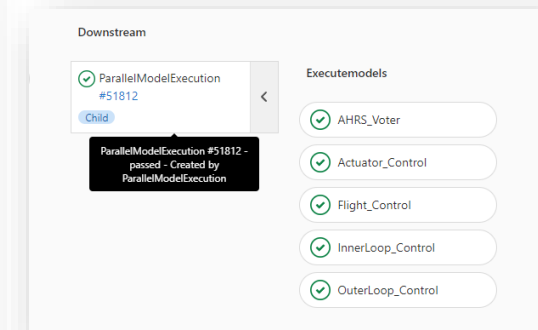
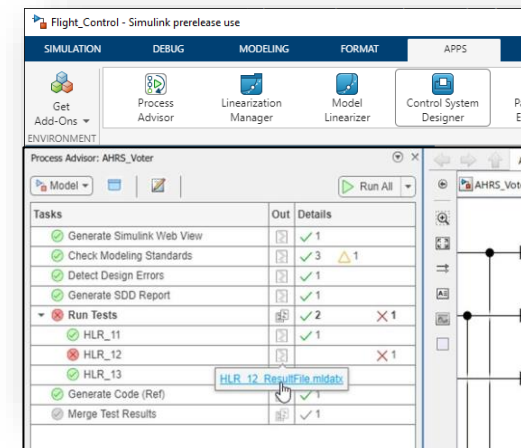


## 2) Desktop Integration with Process Advisor app

- Local prequalification, debugging
- Automatically recognizes changes

## 3) CI Integration

- Easy to integrate into CI platforms
- Automatic YAML generation for:
  - Jenkins/Gitlab/GitHub Actions/Azure DevOps
- CI Results Integration



# Demo

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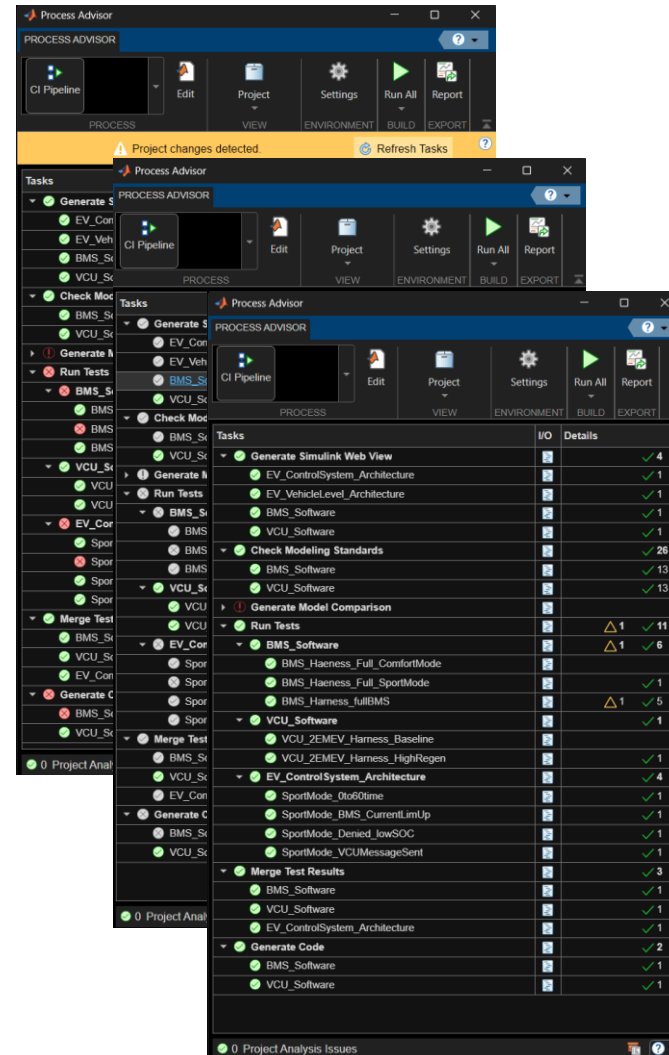
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```
processmodel.m x +
C:\Working\Test\I75\EV_BatteryManagement_Controllers\processmodel.m

8
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27

%% Include/Exclude Tasks in processmodel
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

includeModelMaintainabilityMetricTask = false;
includeModelTestingMetricTask = false;
includeModelStandardsTask = true;
includeDesignErrorDetectionTask = false;
includeFindClones = false;
includeModelComparisonTask = true;
includeSDDTask = false;
includeSimulinkWebViewTask = true;
includeTestsPerTestCaseTask = true;
includeMergeTestResultsTask = true;
includeGenerateCodeTask = true;
includeAnalyzeModelCode = true && ~padv.internal.isMACA64 && exist('polyspaceroor','f')
includeProveCodeQuality = true && ~padv.internal.isMACA64 && (~isempty(ver('pscodepro
includeCodeInspection = false;
includeGenerateRequirementsReport = false;
```



```
Command Window
>> runprocess
#####
## Starting Process Advisor build at 22-Sep-2025 08:03:39
## requiredDependencies: 1
## force: 0
## Tasks to run:
padv.builtin.task.GenerateSimulinkWebView::01 - System Model/Architecture Overview/EV_ControlSystem_Architecture.slx
padv.builtin.task.GenerateSimulinkWebView::01 - System Model/Architecture Overview/EV_VehicleLevel_Architecture.slx
padv.builtin.task.GenerateSimulinkWebView::02_BMS_Models/BMS_Software.slx
padv.builtin.task.RunModelStandards::02_BMS_Models/BMS_Software.slx
padv.builtin.task.GenerateModelComparison::02_BMS_Models/BMS_Software.slx
padv.builtin.task.RunTestsPerTestCase::02_BMS_Models/Tests/BMS_Tests.mldatx::BMS_Haeness_Full_ComfortMode
padv.builtin.task.RunTestsPerTestCase::02_BMS_Models/Tests/BMS_Tests.mldatx::BMS_Haeness_Full_SportMode
padv.builtin.task.MergeTestResults::02_BMS_Models/BMS_Software.slx
padv.builtin.task.GenerateCode::02_BMS_Models/BMS_Software.slx
padv.builtin.task.GenerateSimulinkWebView::03_VCU_Models/VCU_Software.slx
padv.builtin.task.RunModelStandards::03_VCU_Models/VCU_Software.slx
padv.builtin.task.GenerateModelComparison::03_VCU_Models/VCU_Software.slx
padv.builtin.task.RunTestsPerTestCase::03_VCU_Models/Tests/EV2M_VCU_MilTests.mldatx::VCU_2EMEVEV_Harness_Baseline
padv.builtin.task.RunTestsPerTestCase::03_VCU_Models/Tests/EV2M_VCU_MilTests.mldatx::VCU_2EMEVEV_Harness_HighRegen
padv.builtin.task.MergeTestResults::03_VCU_Models/VCU_Software.slx
padv.builtin.task.GenerateCode::03_VCU_Models/VCU_Software.slx
padv.builtin.task.GenerateModelComparison::01 - System Model/Architecture Overview/EV_ControlSystem_Architecture.slx
padv.builtin.task.RunTestsPerTestCase::01 - System Model/Architecture Overview/EV_VehicleLevel_Architecture.slx
padv.builtin.task.MergeTestResults::01_VCU_Models/VCU_Software.slx
padv.builtin.task.RunTestsPerTestCase::01 - System Model/Tests/EV_SysLevel_Mil.mldatx::SportMode_0to60time
padv.builtin.task.RunTestsPerTestCase::01 - System Model/Tests/EV_SysLevel_Mil.mldatx::SportMode_BMS_CurrentLimUp
padv.builtin.task.RunTestsPerTestCase::01 - System Model/Tests/EV_SysLevel_Mil.mldatx::SportMode_Denied_lowSOC
padv.builtin.task.RunTestsPerTestCase::01 - System Model/Tests/EV_SysLevel_Mil.mldatx::SportMode_VCUMessageSent
padv.builtin.task.MergeTestResults::01 - System Model/Architecture Overview/EV_ControlSystem_Architecture.slx
#####
```

# How do I execute Model-Based Design tasks in CI?

- We can support for small groups to enterprise levels
- Individual runner in GitHub Actions for small groups

## Continuous Integration with MATLAB on CI Platforms

### ON THIS PAGE

Azure DevOps

Bamboo

CircleCI

GitHub Actions

**GitLab CI/CD**

Jenkins

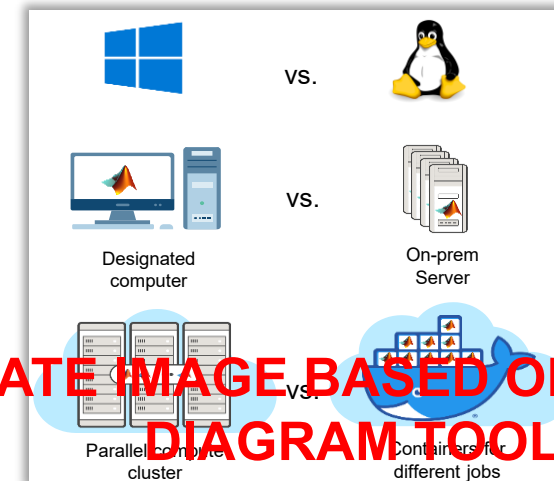
TeamCity

Other Platforms

See Also

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**UPDATE IMAGE BASED ON TECHNICAL DIAGRAM TOOLKIT**

[MATLAB Support for CI Platforms](#)

[Dockerfile for creating a MATLAB container for CI](#)  
[MATLAB containers on Docker Hub](#)



# Demo

<YAML  
File>

GHA running

<Small to large  
scaling is possible>

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# Extend-Right from Desktop to Pipeline

- Publish your test results and coverage in open-source formats
- <Image pending>

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**File Comparison Report**

File name	Left File
File path	BMS_Soft
Last modified	C:\GitLab
MD5 checksum	Content\c
Model Version	14-May-2
Saved in Simulink version	1905428c
Model Description	8.3
	R2024a

**Model Diff for GitHub Pull Requests**

**PullRequest - Diff to Ancestor, Publish and attach Report, and RunTests**

3 workflow runs

- Newest feature**  
PullRequest - Diff to Ancestor and attach Report  
Tests #4: Pull request #3 synchronize by
- Newest feature**  
PullRequest - Diff to Ancestor and attach Report  
Tests #3: Pull request #3 opened by
- Change model files for my feature**  
PullRequest - Diff to Ancestor and attach Report  
Tests #2: Pull request #2 opened by

**MATLAB Help Center**

**CONTENTS**

- Documentation Home
- Verification, Validation, and Test
- Simulink Test
- Continuous Integration

**Output Results for Continuous Integration Systems**

You can create model tests that are compatible with continuous integration (CI) systems such as Jenkins®. To create CI-compatible results, run your Simulink® Test™ files using MATLAB® Unit Test.

To run CI-compatible tests, follow this general procedure:

1. Create a test suite from the MLDATX test file.
2. Create a test runner.
3. Create plugins for the test output or coverage results.
  - For test outputs, use the [TAPPlugin](#) or [XMLPlugin](#).
  - For model coverage, use the [ModelCoveragePlugin](#) and [CoberturaFormat](#). When collecting model coverage in Cobertura format:
    - Only top model coverage is reflected in the Cobertura XML.
    - Only model Decision coverage is reflected, and it is mapped to Condition elements in Cobertura XML.
4. Create plugins for CI-compatible output.
5. Add the plugins to the test output or coverage results.
6. Add the test output plugins or coverage result plugins to the test runner.
7. Run the test.

# Extend-Right from Desktop to Pipeline

- Engineers can Review and Debug pipeline, Results in desktop MATLAB

padv_artifacts.zip 2 MB				
.git	2/6/2024 11:05 AM	File folder		
01_Requirements	1/15/2024 8:29 AM	File folder		
02_Models	1/15/2024 8:29 AM	File folder		
03_Code	7/18/2024 11:39 AM	File folder		
04_Results	1/15/2024 8:29 AM	File folder		
derived	7/18/2024 11:39 AM	File folder		
resources	1/16/2024 11:57 AM	File folder		
tools	1/15/2024 8:29 AM	File folder		
work	7/10/2024 11:00 AM	File folder		
.gitattributes	11/18/2022 7:16 AM	GITATTRIBUTES File	1 KB	
.gitignore	8/3/2022 8:28 AM	GITIGNORE File	1 KB	
Dockerfile	1/16/2024 11:58 AM	File	8 KB	
ProcessAdvisorExample.prj	1/16/2024 11:57 AM	PRJ File	1 KB	
processmodel.m	7/1/2024 12:07 PM	MATLAB.m.24.1.0	9 KB	
utility.m	2/6/2024 11:05 AM	MATLAB.m.24.1.0	1 KB	



PROCESS ADVISOR		
CI Pipeline	Edit	Settings
Run All		
PROCESS	ENVIRONMENT	BUILD
Tasks	I/O	Details
Collect Model Maintainability Metrics	5	5
AHRS_Voter	1	1
Actuator_Control	1	1
Flight_Control	1	1
InnerLoop_Control	1	1
OuterLoop_Control	1	1
Run Tests	9	9
AHRS_Voter	3	3
HLR_11	1	1
HLR_12	1	1
HLR_13	1	1
OuterLoop_Control	6	6
HLR_6	2	2
HLR_7	2	2
HLR_8	2	2
Merge Test Results	2	2
AHRS_Voter	1	1
OuterLoop_Control	1	1
Generate Code	5	5
AHRS_Voter	1	1
OuterLoop_Control	1	1
Actuator_Control	1	1
Flight_Control	1	1
InnerLoop_Control	1	1
0 Project Analysis Issues		

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## MathWorks Support Resources

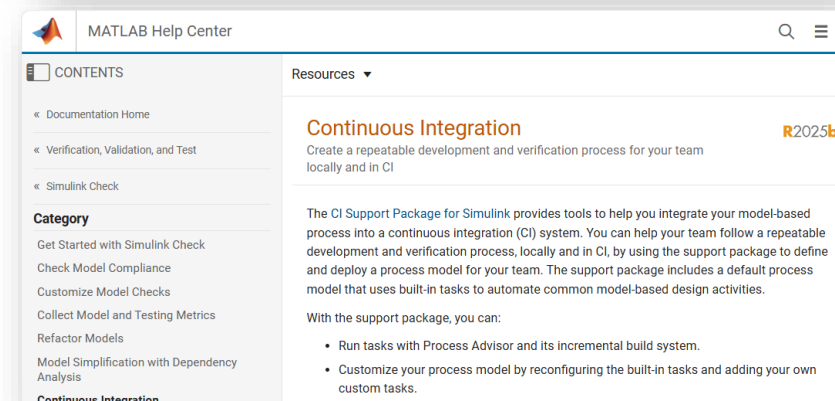
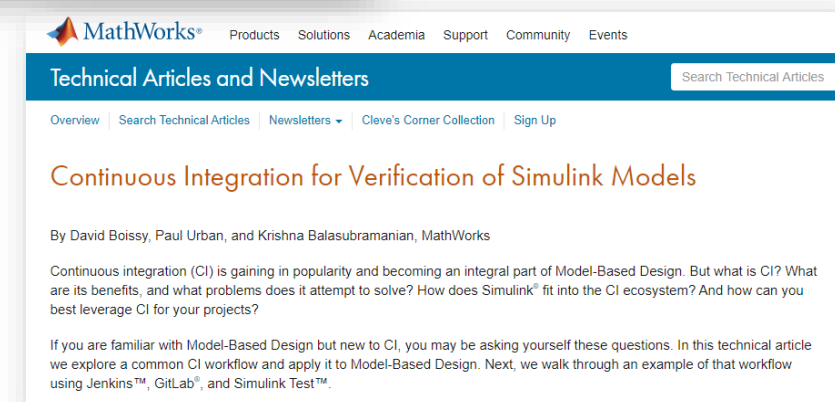
# Resources for you

- [Continuous Integration Solution Page](#)
- [Continuous Integration for Model-Based Design](#)
- Customer Videos:
  - [CI/CD 2.0: From Scripted Jenkins Pipelines to Process Advisor](#)
  - [The Software Factory Approach: Model-Based Design for Safety-Critical Application](#)
  - [Accelerating Model-Based Design Through Continuous Integration](#)
  - [Automotive DevOps for Model-Based Design with AWS](#)
- Technical Articles:
  - [Integrating Cloud-Based Continuous Integration](#)
  - [Zeekr Innovates Software-Defined Vehicle Engineering](#)
  - [Continuous Integration for Verification of Simulink Models](#)
  - [Continuous Integration for Verification of Simulink Models Using GitLab](#)
  - [Agile Model-Based Design: Accelerating Simulink Simulations in CI Workflows](#)
- Documentation:
  - [CI Support Package for Simulink](#)
  - [Continuous Integration Documentation Hub](#)
  - [Tests for Continuous Integration](#)
- [Developer Zone: Continuous Integration](#)



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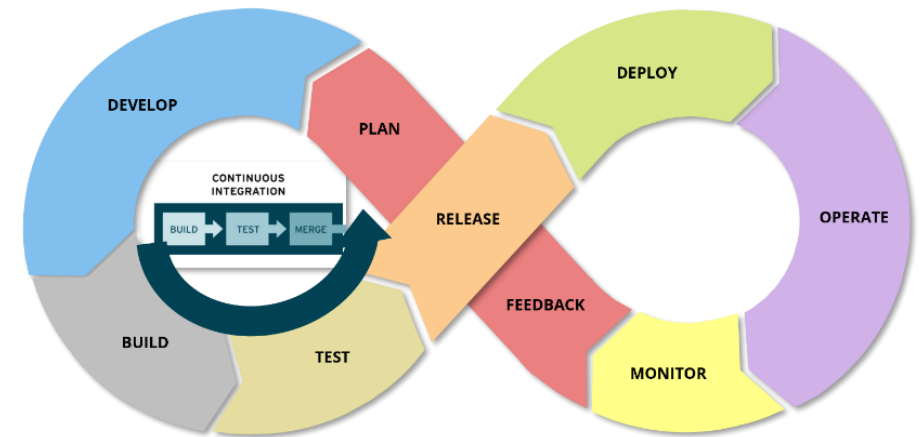
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contact us at: [continuous-integration@mathworks.com](mailto:continuous-integration@mathworks.com) MATLAB EXPO

# We are here to support you on this journey

- Continuous Integration Advisory Service
  - Leverage our expertise in workflow and tool integration
  - Implement best practices for more efficient workflows
  - Receive expedited support from our experts



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# We are here to support you on this journey

- Continuous Integration Advisory Service
- Fast reviews with improved Unified Diff Report

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The screenshot displays the MATLAB Simulink environment. On the left, the 'File Comparison Report' is open, showing a comparison between 'f14\_main.slx' and 'f14\_dev.slx'. The report includes file names, paths, last modified dates, MD5 checksums, model versions, and saved in Simulink versions. Below the report, two small thumbnails of the Simulink models are shown. On the right, two Simulink model windows are visible. The top window, 'f14\_main', shows a control system model with blocks for 'Controller', 'Aircraft Dynamics Model', and 'Pitch Rate q (rad/sec)'. The bottom window, 'f14\_dev', shows a similar model but with a different configuration for the 'Pitch Rate q (rad/sec)' block. The 'Property Inspector' on the far right shows parameters for the selected block in each model.

Files	Left File	Right File
File name	f14_main.slx	f14_dev.slx
File path	C:\projects\modelreview\actions_test\modelsco	C:\projects\modelreview\actions_test\modelsco
File path	py	py
Last modified	22-Sep-2025 15:38:12	22-Sep-2025 15:38:12
MD5 checksum	3e0317b91069e259cd10f4c33885463c	422aa37fce04021f5ea37ea2f422d23
Model version	15.0	15.2
Saved in Simulink version	R2024b	R2024b
Model Description		

Environment
MATLAB 25.2 (R2025b)
Simulink 25.2 (R2025b)

Filters
No built-in filters applied

Comparison Results
<b>Simulink</b>
<b>f14_main</b>
<b>f14_dev</b>

Simulink
LastModifiedDate : Sat Jun 07 17:33:24 2025
Location : 320 115 1300 860
ModelVersion : 15.0
ModelVersionFormat : %<AutoIncrement:15.0>

Simulink
LastModifiedDate : Tue Jul 29 10:55:31 2025
Location : 3179 262 4159 1007
ModelVersion : 15.2
ModelVersionFormat : %<AutoIncrement:15.2>

Aircraft Dynamics Model
Location : 837 363 1817 1108

Aircraft Dynamics Model
Location : 3064 150 4044 895

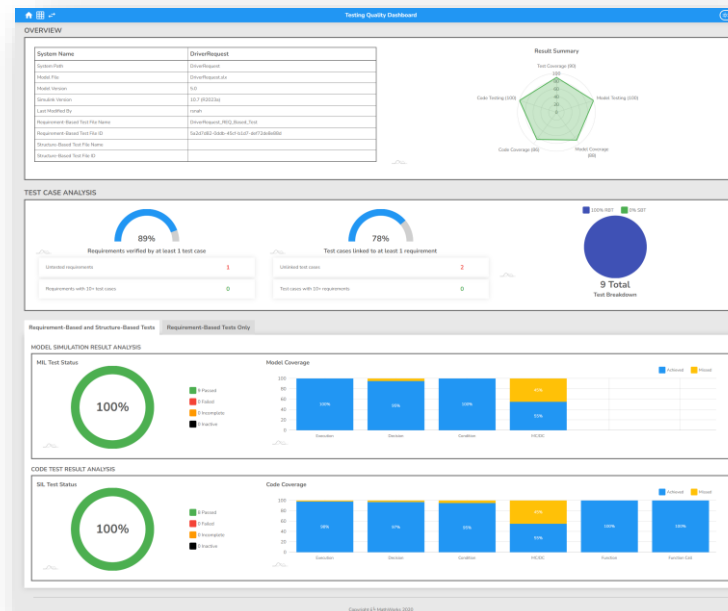
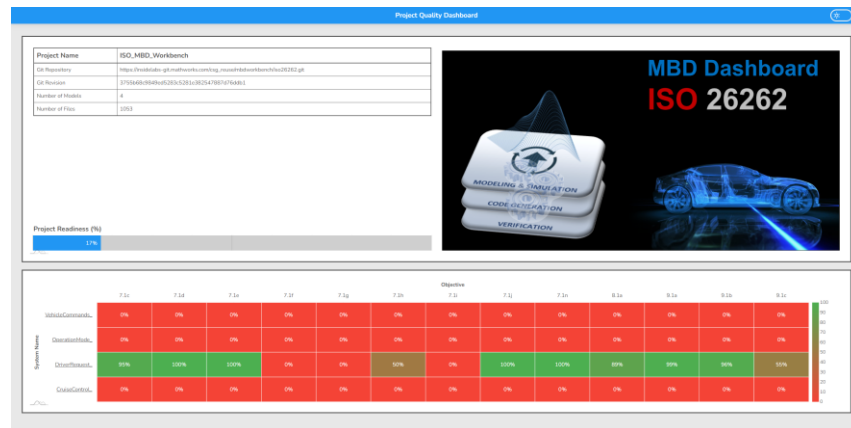
Controller
Location : 320 115 1300 860

Controller
Location : 3064 150 4044 895



# We are here to support you on this journey

- Continuous Integration Advisory Service
- Fast reviews with improved Unified Diff Report
- End-to-end software development environment for Model-Based Design



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# Key Takeaways

- Continuous integration helps you develop high quality software, faster!
- MATLAB and Simulink support you through all stages of CI
- Getting started with CI is easy with the CI support package, CI plugins and examples
- MathWorks Services can help you structure and scale your development work!

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sameer-k-muckatira



jason-ghidella



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## Thank you



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