MATLAB EXPO 2016

Verification of Automatically Generated Code

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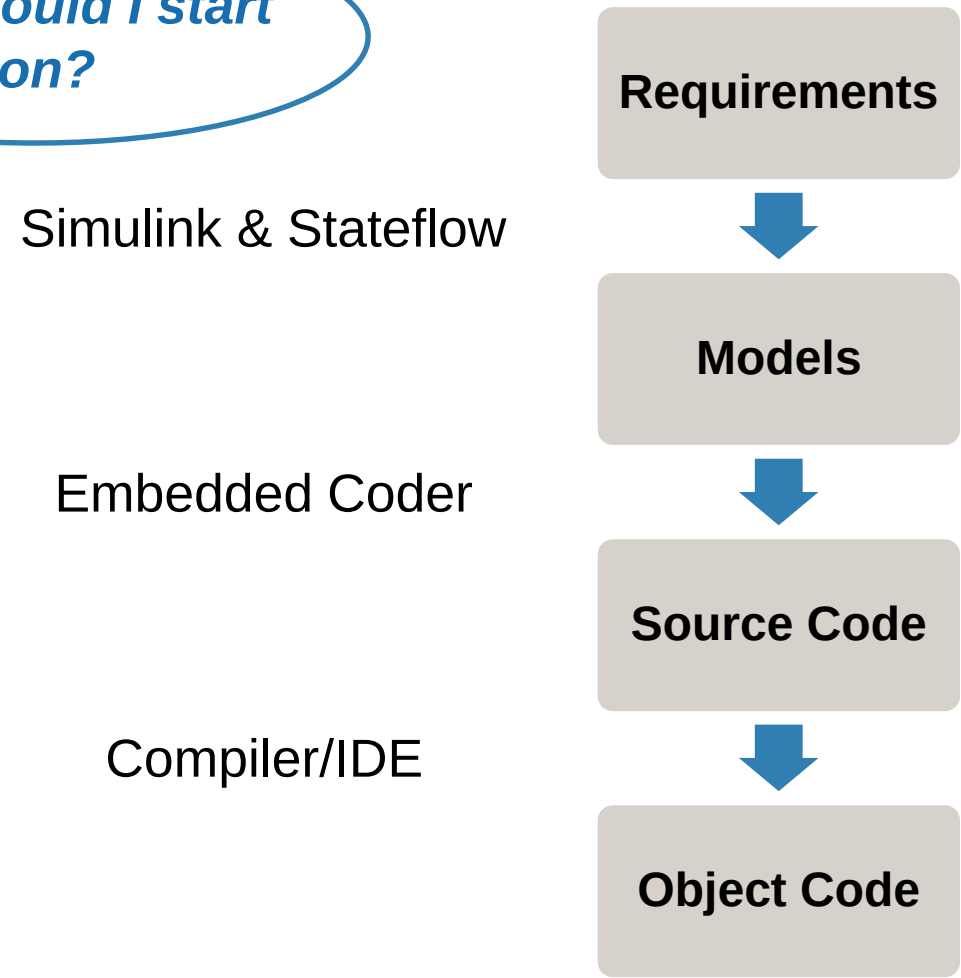
Development Lifecycle

When should I start verification?



And which tools should I use?

Verification with MATLAB and Simulink

```
simOut = sim('myModel');
```

Requirements

Simulink & Stateflow

Models

Embedded Coder

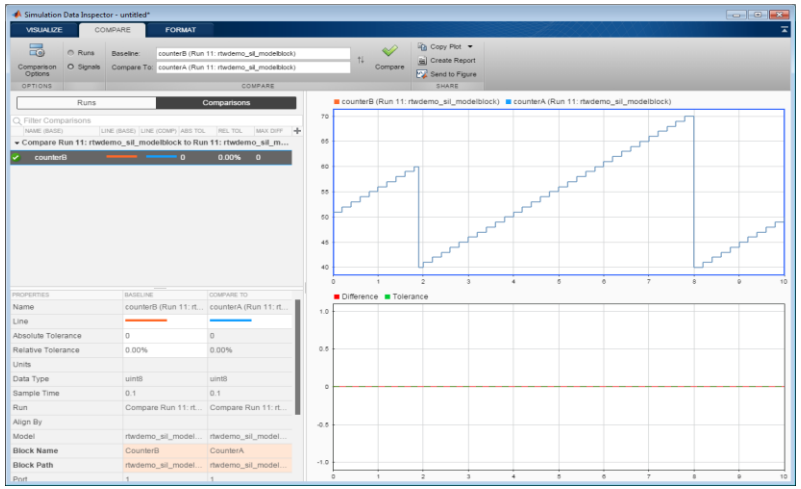
Source Code

Compiler/IDE

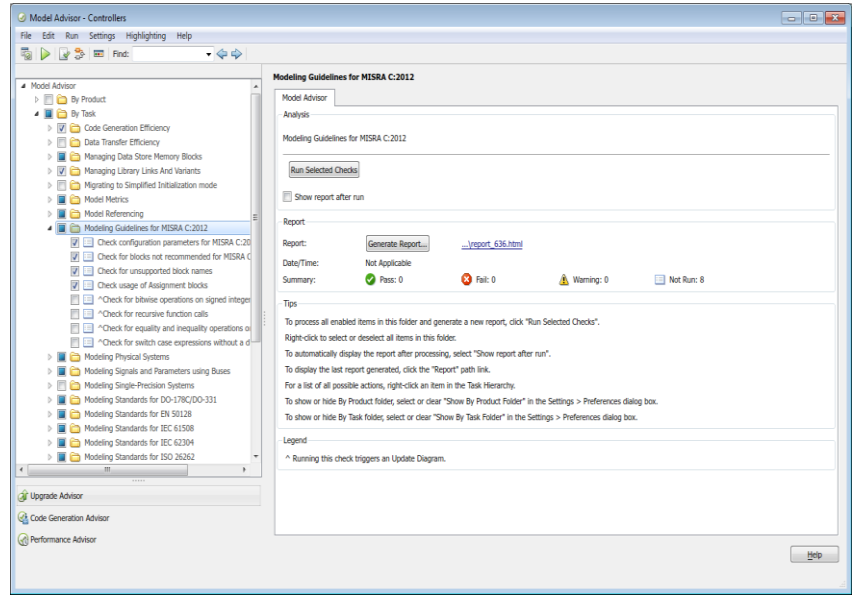
Object Code

Refine Requirements

Iterate Design

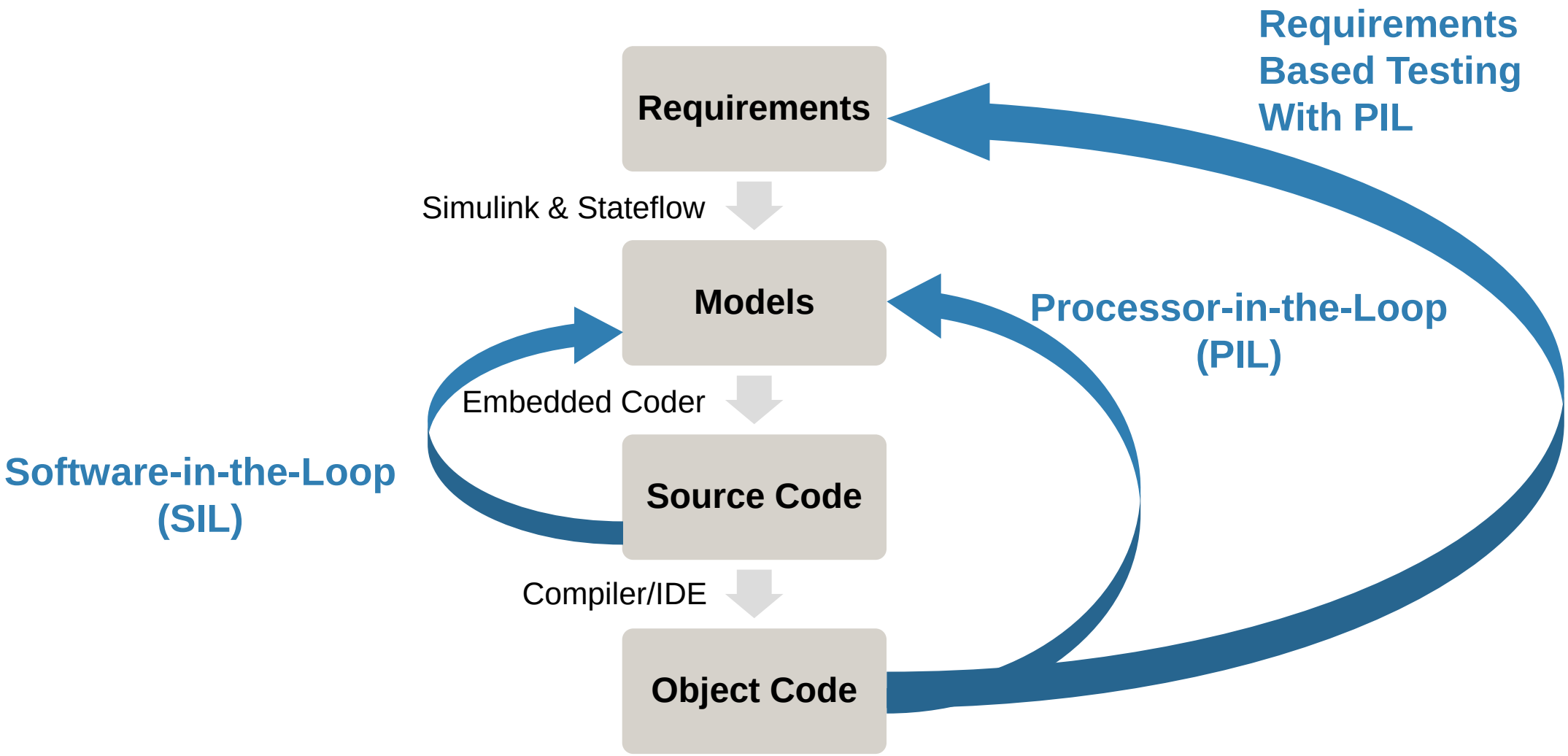


Simulation Data Inspector (SDI)



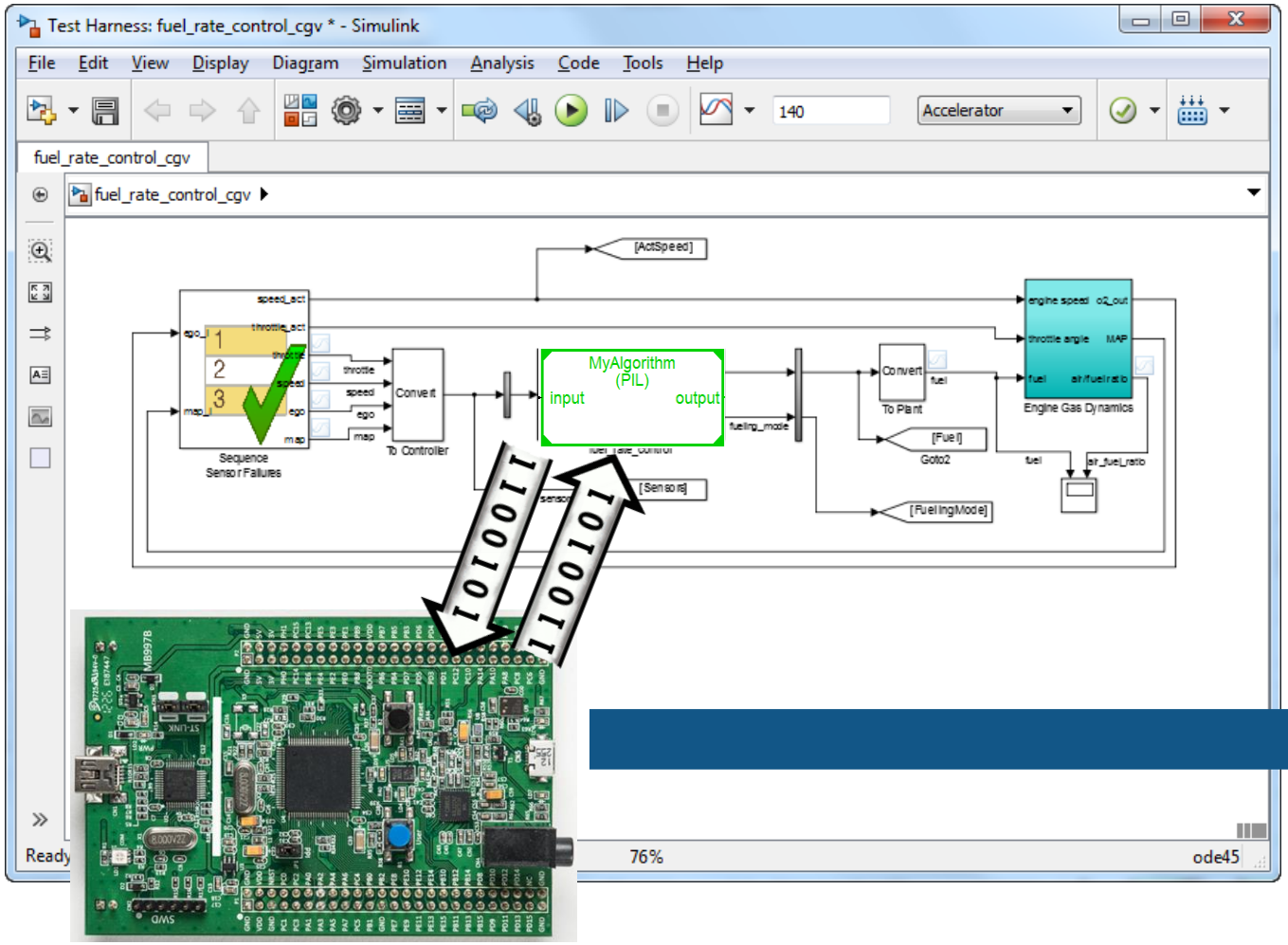
Model Advisor

Verification with Embedded Coder



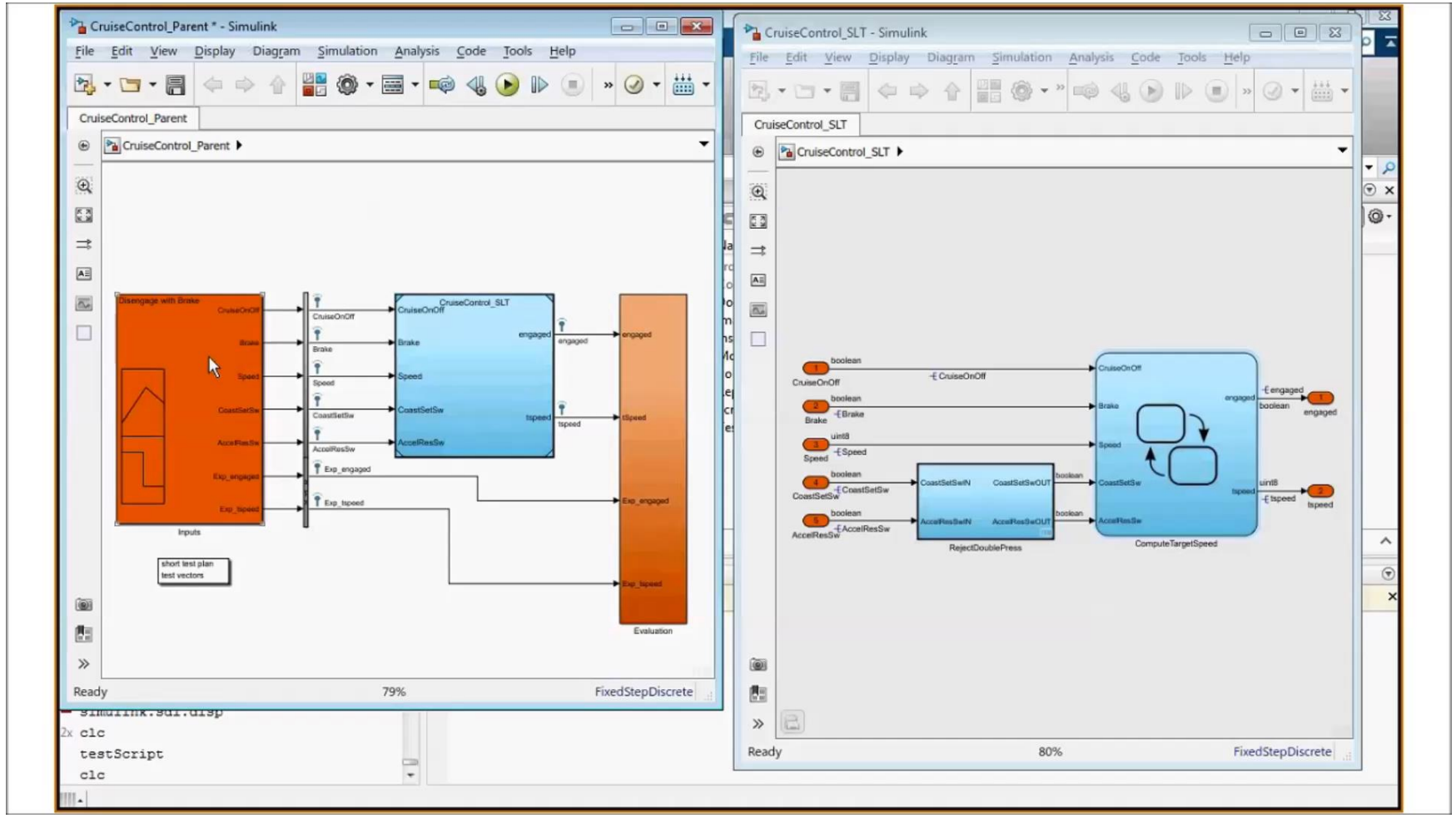
Automated Dynamic Testing

Software-in-the-Loop (SIL) and Processor-in-the-Loop (PIL)



- Verify numerical equivalence
- Assess execution time
- Assess code coverage
- Create certification artifacts

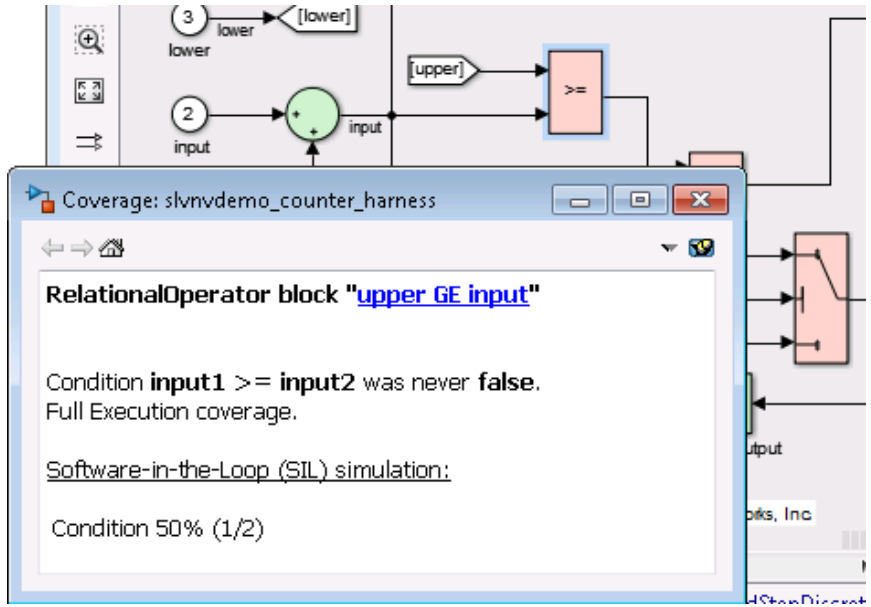
Demo – SIL/PIL with Emulator (QEMU)

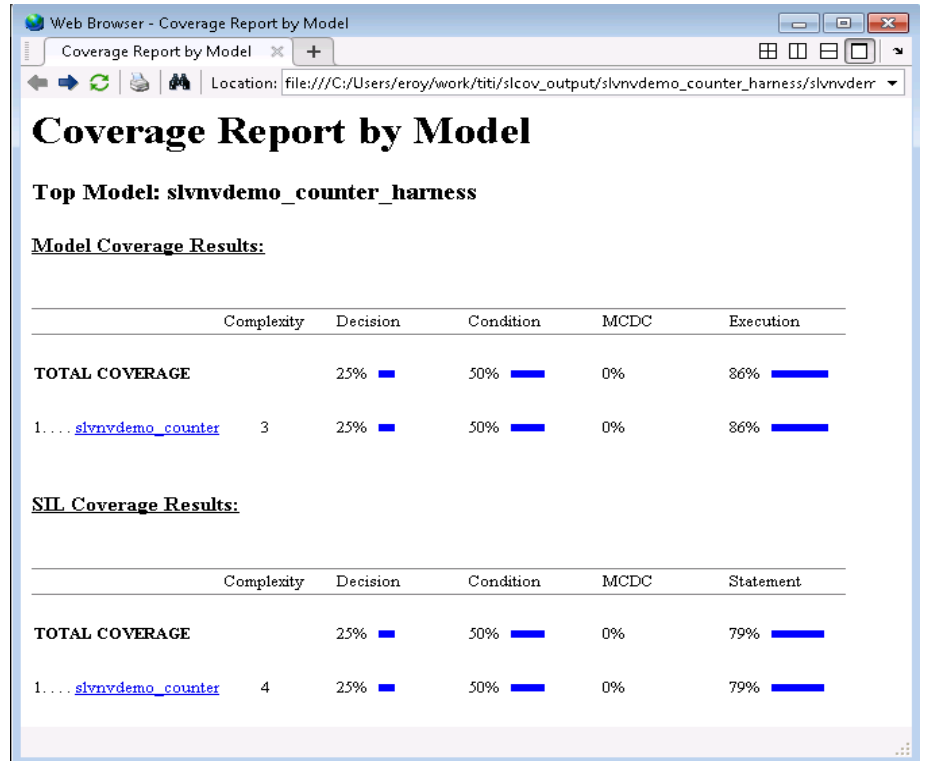


Extend Model Coverage to Code Coverage

Collect Code Coverage during SIL/PIL Simulations

- Using LDRA Testbench
- Using Simulink Verification and Validation (R2016b)



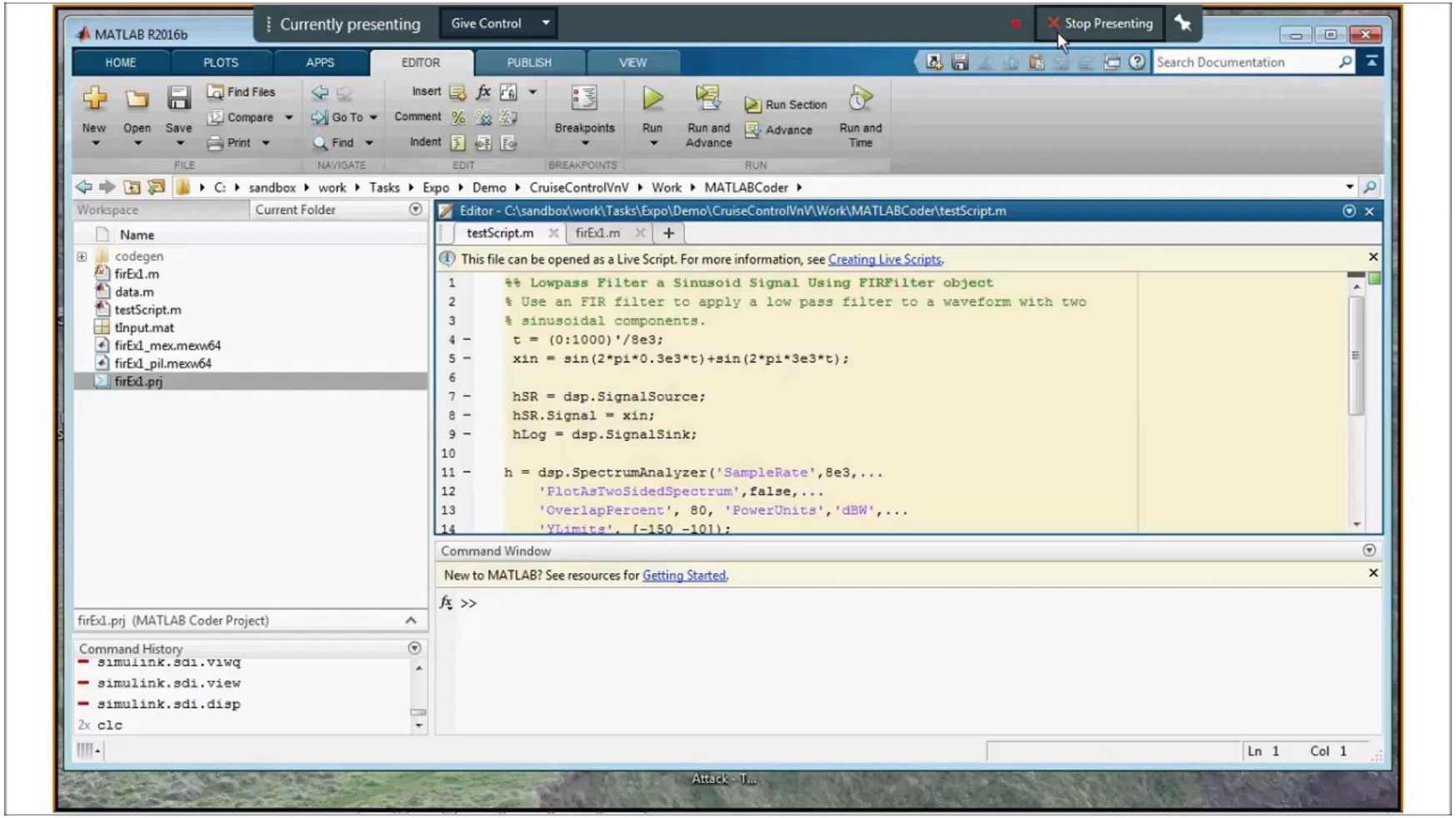


Dynamic Verification Workflow

- Use Simulink simulation to verify your models and your **code**
  - Requirements based tests
  - Functional tests
  - Coverage Tests

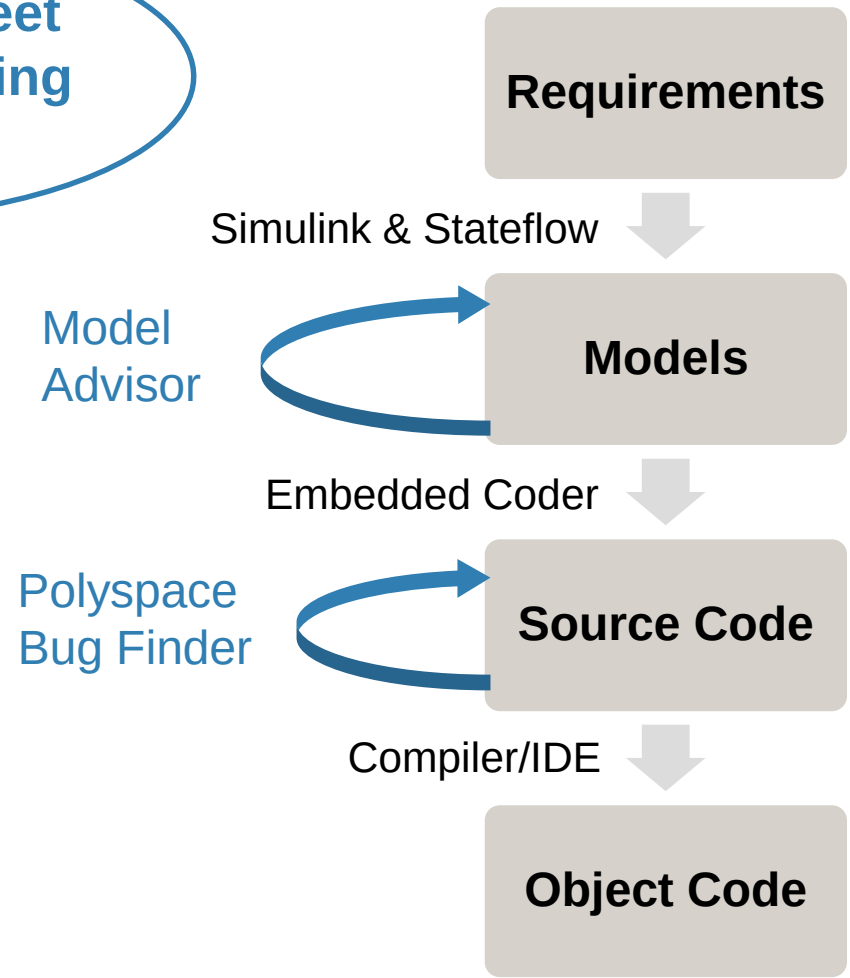
- Use Processor-in-the-Loop to
  - Assess numerical behaviour
    - Using full target toolchain and libraries
  - Gather performance metrics
  - Demonstrate testing coverage

But it's not just Simulink based



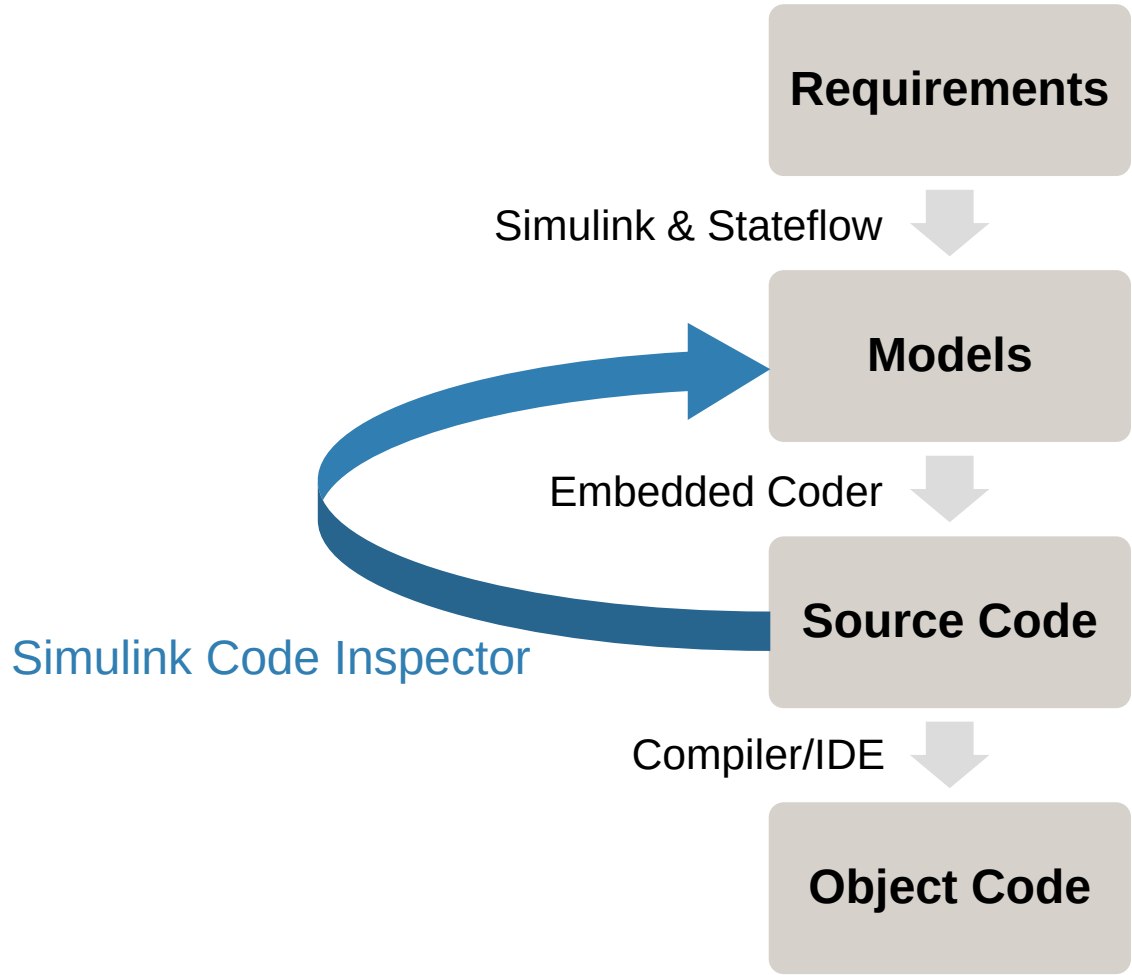
Have I missed anything?

Does the code meet my company coding standard?



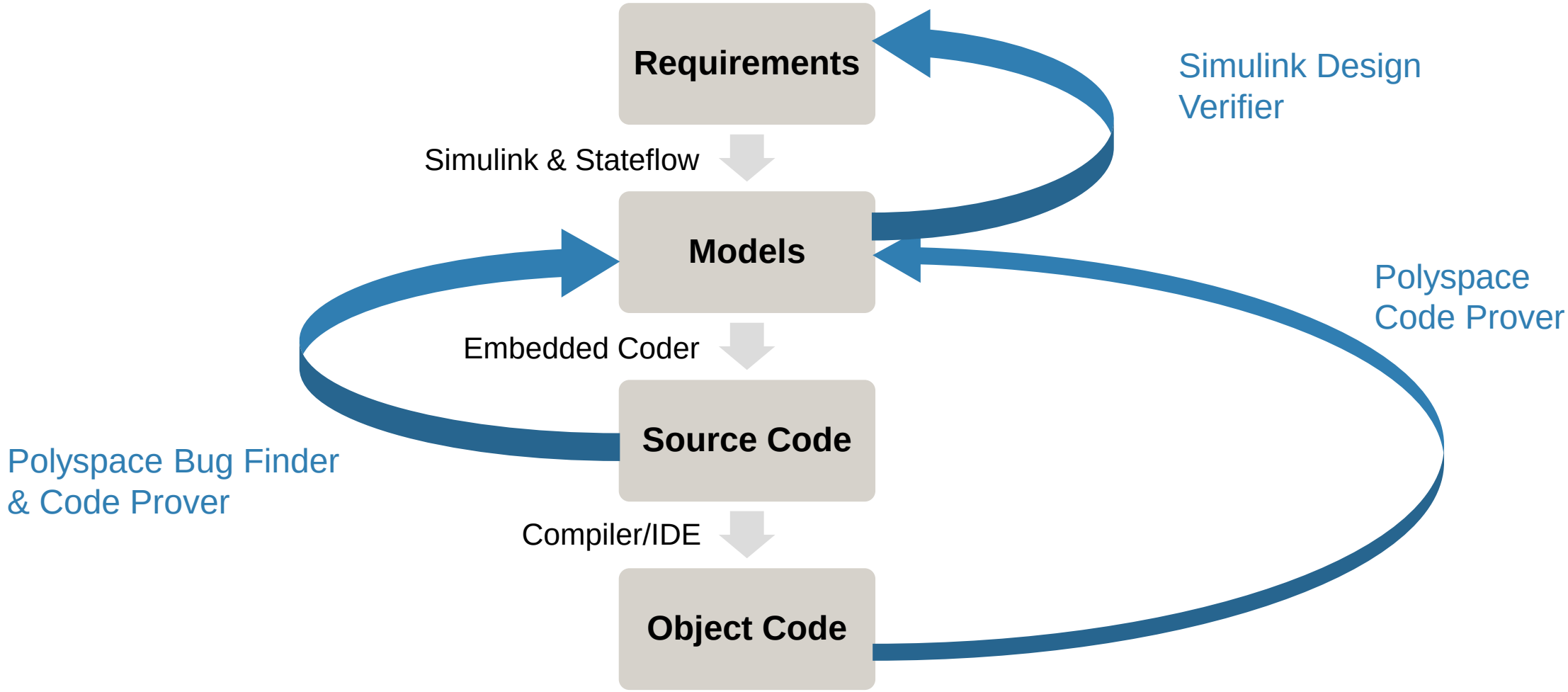
- **MISRA C Checker { 2012, 2004 }**
- **MISRA AC AGC Subset**
  - application of MISRA-C for generated code
- **MISRA C++ Checker**
- **JSF++ Checker**

Does the code match my design?

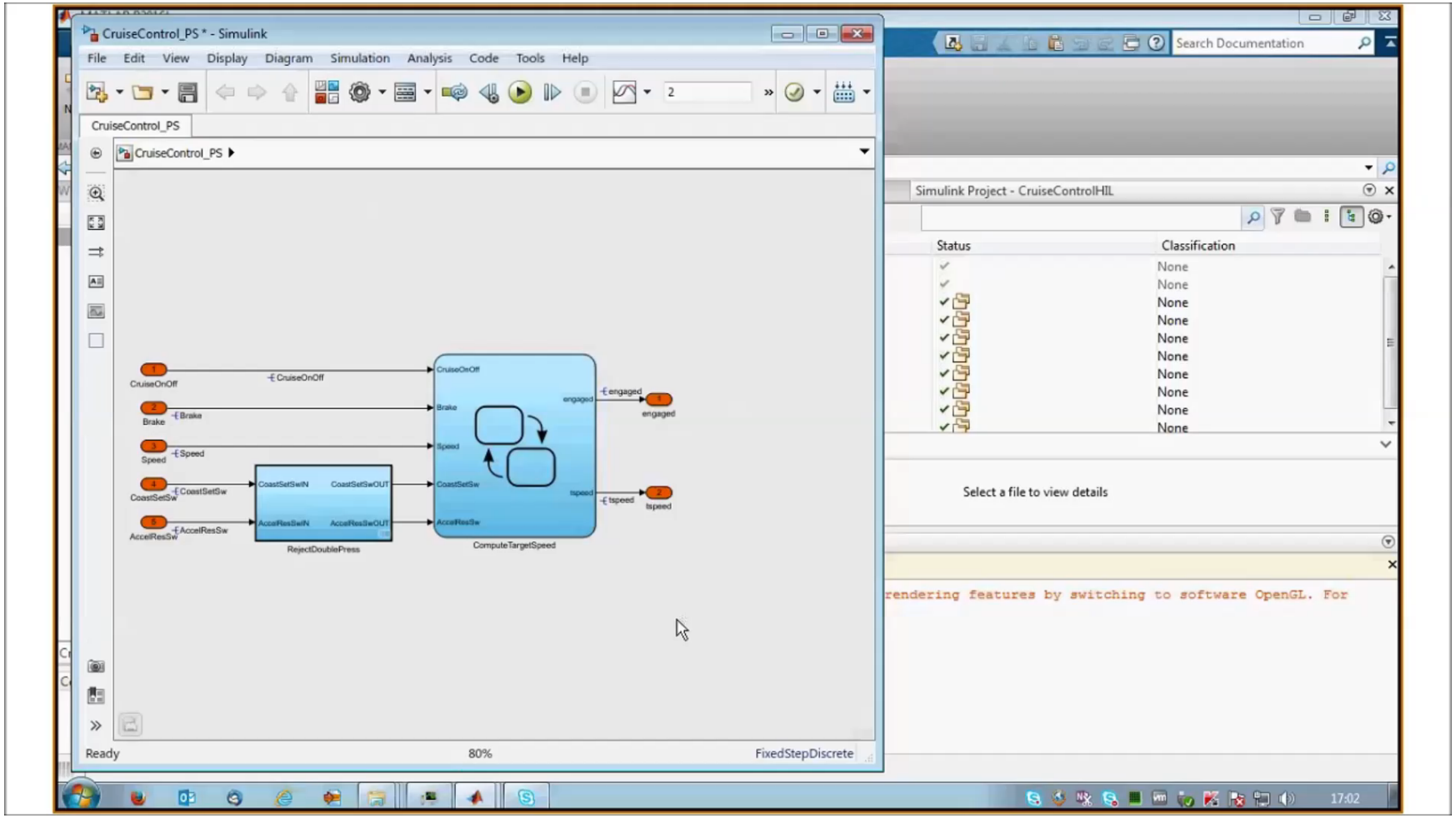


- Demonstrate that model and source code match structurally and functionally
- Provide model←→code traceability data
- Reduce manual code reviews for DO-178 software

Are there any runtime errors in the system?



Polyspace in action



Polyspace product family for C/C++

- Polyspace Bug Finder
  - Quickly find bugs in embedded software
  - Check code compliance for MISRA and JSF
  - Intended for every day use by software engineers

- Polyspace Code Prover
  - Proves code to be safe and dependable
  - Deep verification of software components
  - Perform QA signoff for production ready code

Ada language also supported for proving code

Upgrading to a New Release

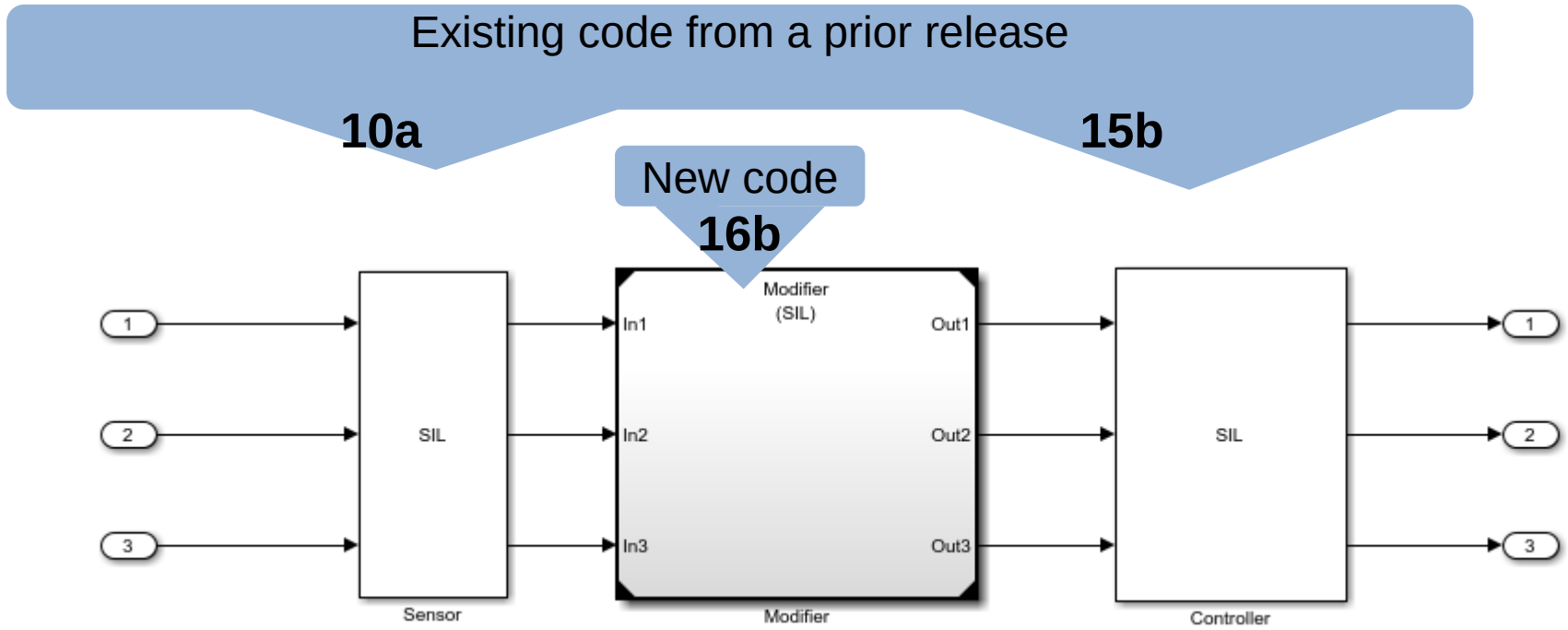
Multiple benefits:

- ✓ New features or products
- ✓ Latest advances in code generation

But, you have *already verified* code from previous release(s)

- Re-generate and re-verify the code
- Reuse and manually integrate the existing code with newly generated code

Code Reuse Across Releases (R2016b)



- Avoid re-verifying code spanning MATLAB releases
- Support simulation workflows via SIL/PIL
- Automate integration with newly generated code as part of Build action

What have I learned …

- Start verification early, using the power of MATLAB and Simulink
- Reuse your simulation tests to verify the code on real hardware with PIL
  - Gather code coverage metrics
  - Capture execution time
  - Demonstrate numerical equivalence to design
- Use static analysis to
  - Ensure code standards conformance
  - Spot weaknesses in your design
  - Prove the absence of runtime errors

Questions?