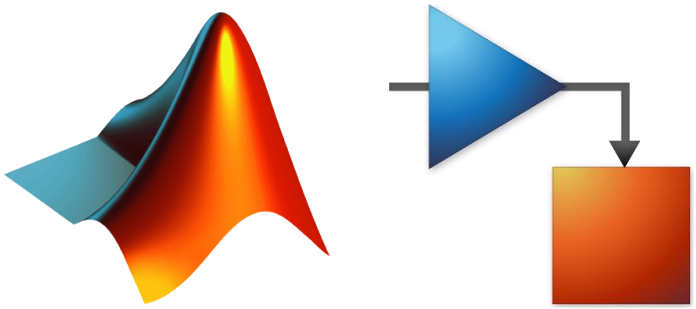
What's New in MATLAB and Simulink



R2015b

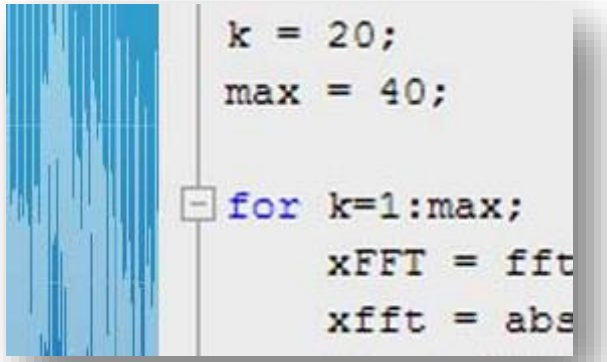
R2016a

Prashant Rao
Technical Manager
MathWorks India

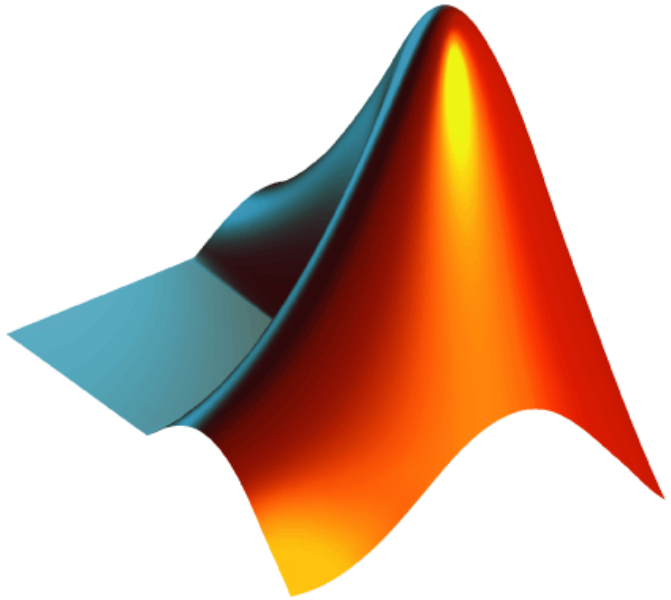
MATLAB EXPO 2016 INDIA

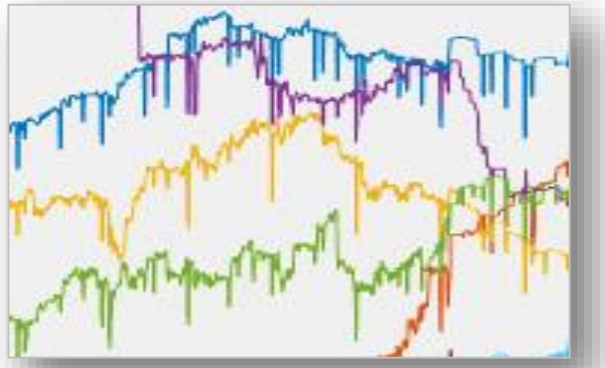
Engineers and scientists…

Engineers and scientists…



Develop algorithms

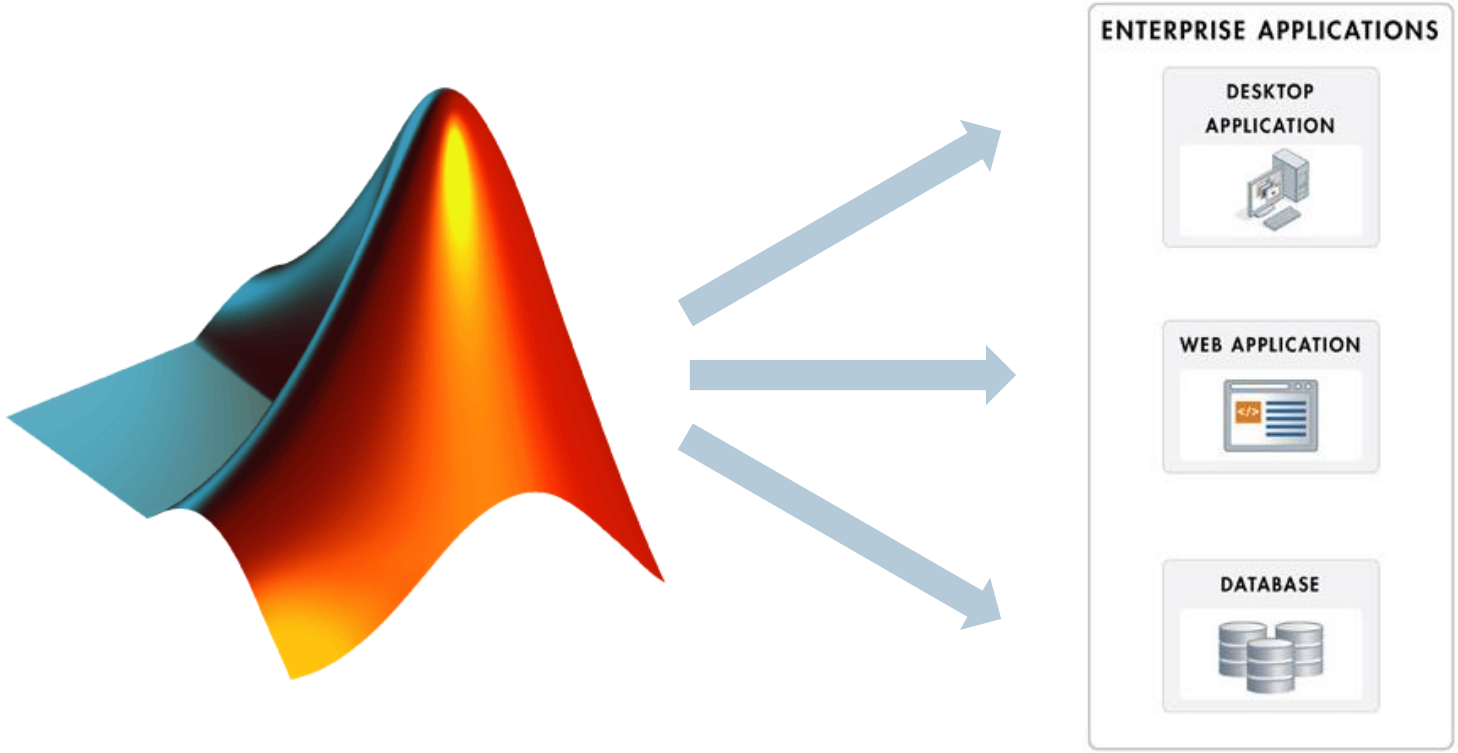




Analyze data

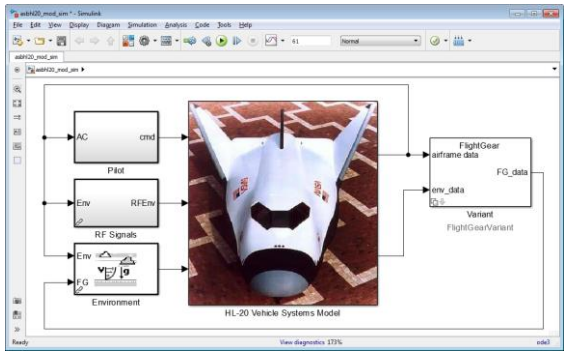
write MATLAB code.

Engineers and scientists…

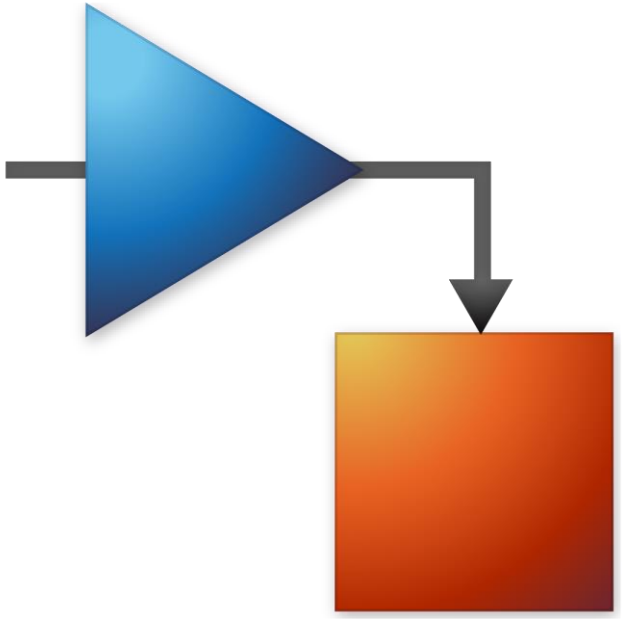


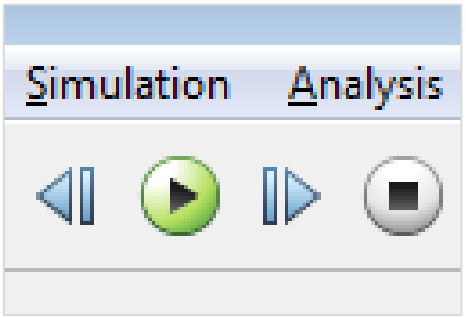
deploy algorithms and applications within web, enterprise, and production systems.

Engineers and scientists…



Model systems

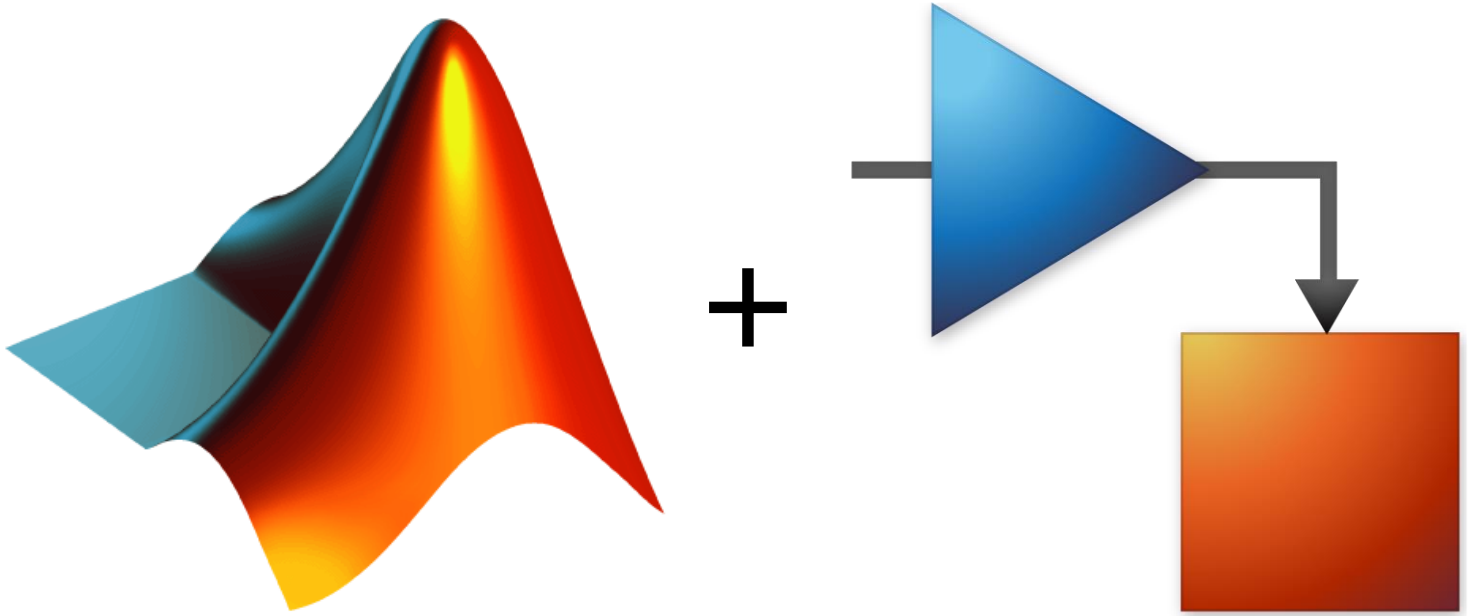




Run simulations

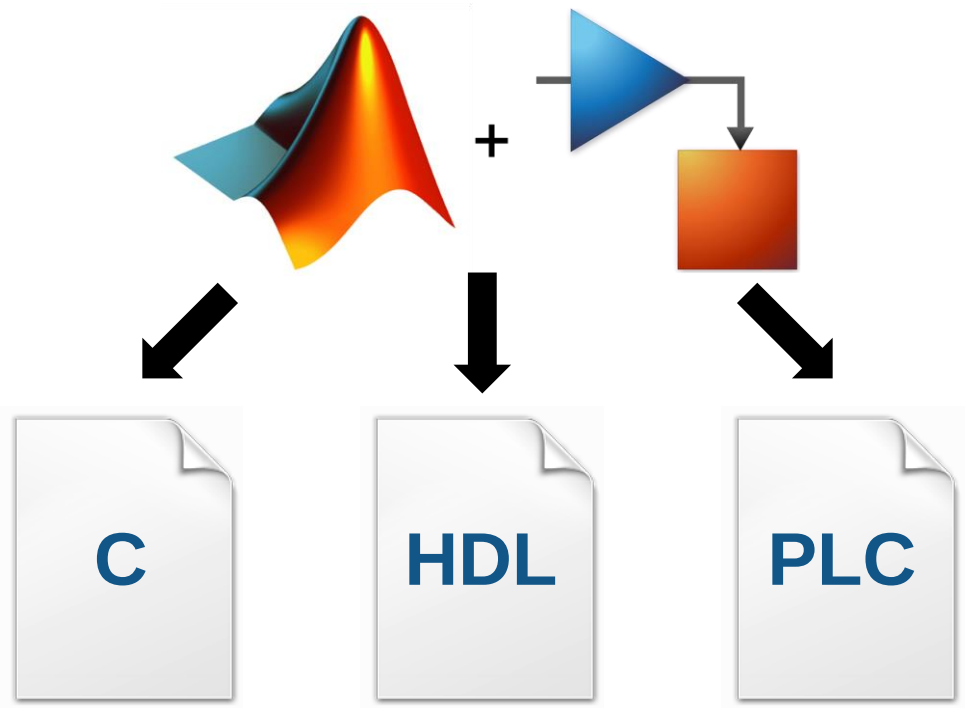
build Simulink models.

Engineers and scientists…



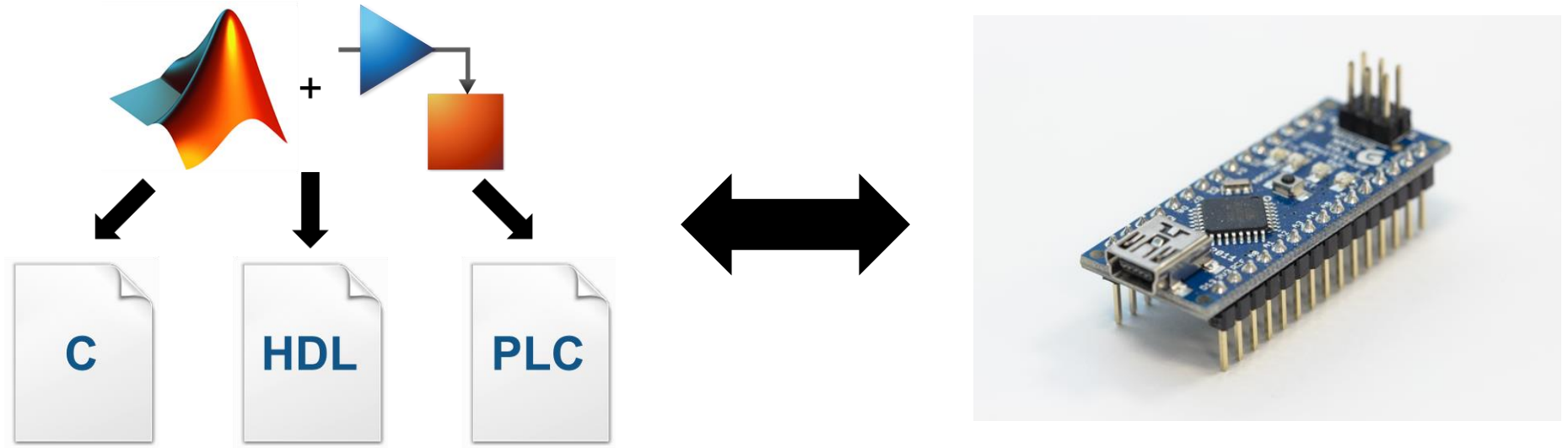
combine MATLAB code and Simulink models together.

Engineers and scientists…



generate code.

Engineers and scientists…



connect software to hardware.

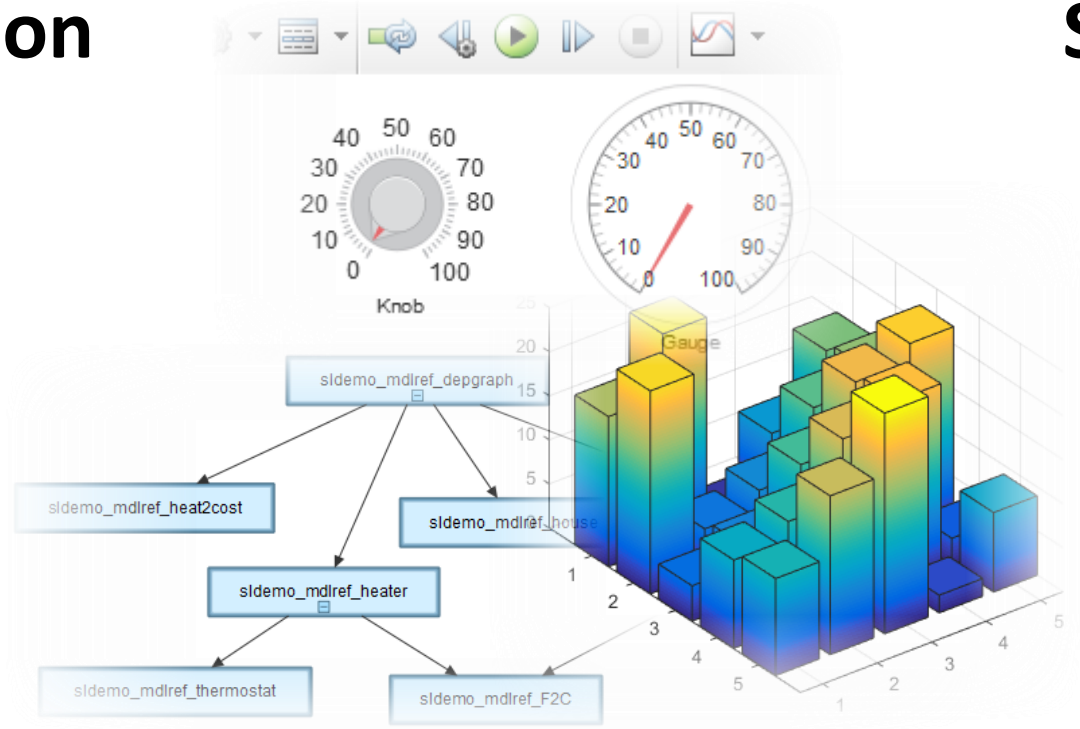
And it’s all easier to do in the latest releases.

R2015b

R2016a

Analysis and Visualization

Modeling and Simulation



Testing and Verification

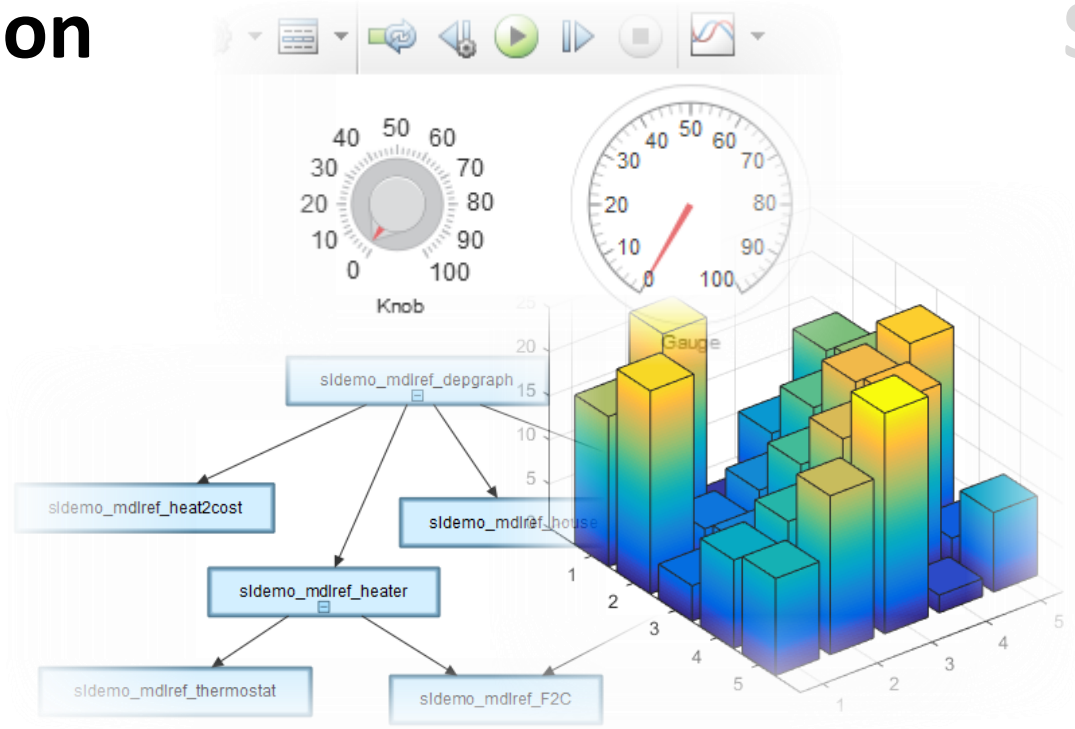
Sharing and Collaboration

Performance

Support and Services

Analysis and Visualization

Modeling and Simulation



Testing and Verification

Sharing and Collaboration

Performance

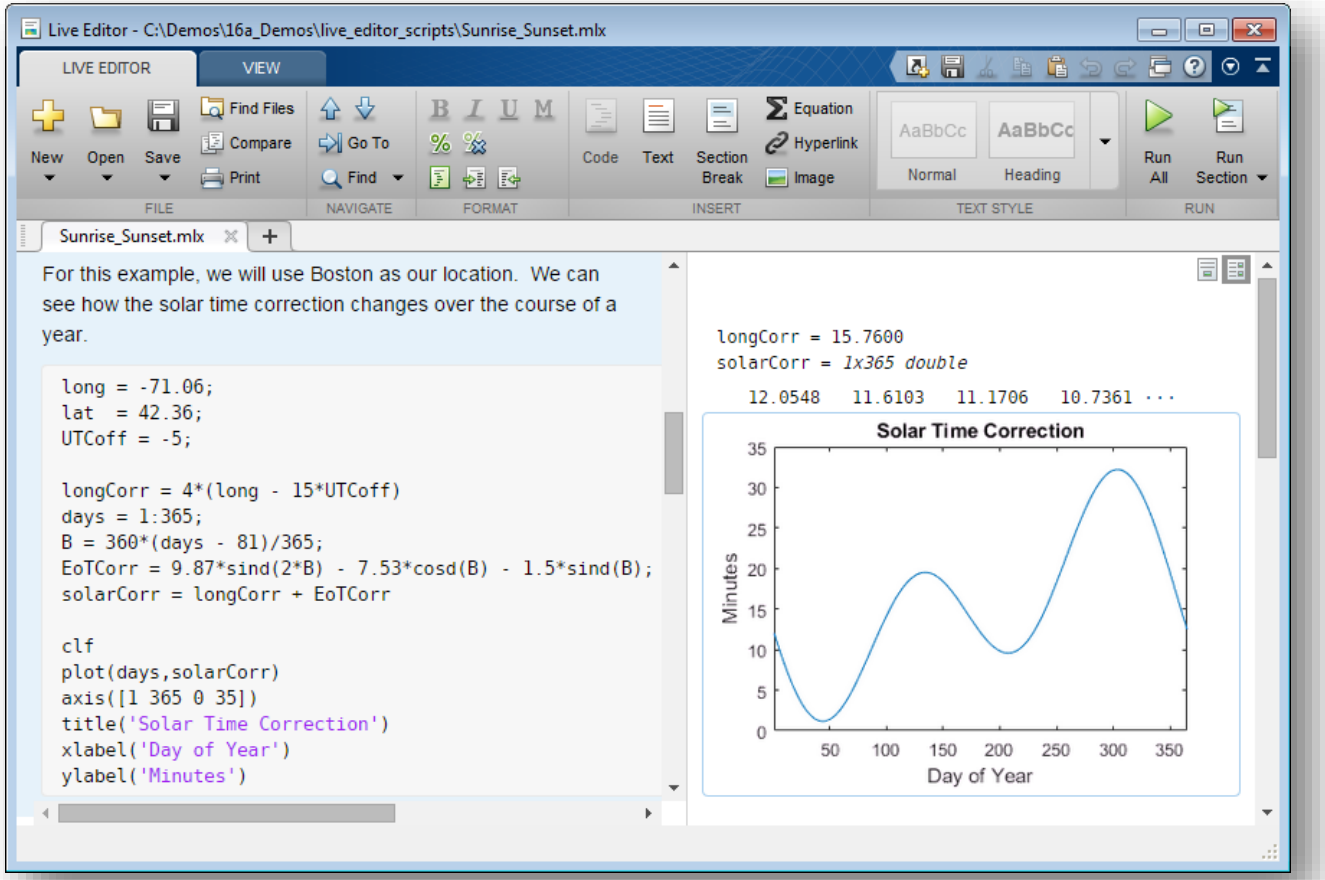
Support and Services

MATLAB Live Editor

R2016a

Change the way you work in MATLAB

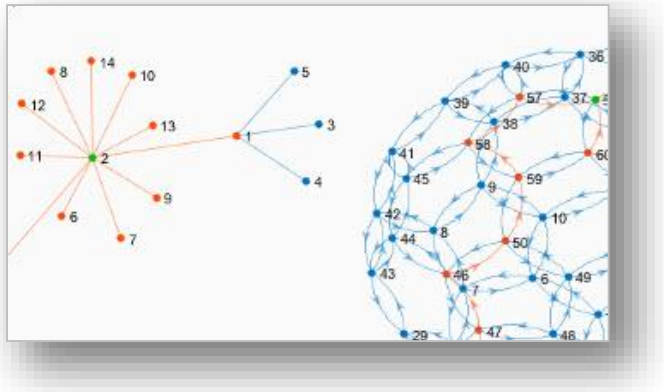
- See results together with the code that produced them, accelerating exploratory programming and analysis
- Add equations, images, hyperlinks, and formatted text to create interactive narratives
- Create lectures that combine explanatory text, mathematical equations, code and results



Graphs and Network Algorithms

R2015b

- Graphs model the connections in a network
  - Widely applicable in physical, biological, and information systems
- Two new functions for creating graphs
  - `graph` (undirected graphs)
  - `digraph` (directed graphs)



- Graph objects work just like other MATLAB objects
- Multiple graph layouts available (circular, force-directed, tiered)
- New functions available for working with graphs
  - `shortestpath`, `shortestpathtree`, `minspantree`, `distances` *(and many others)*

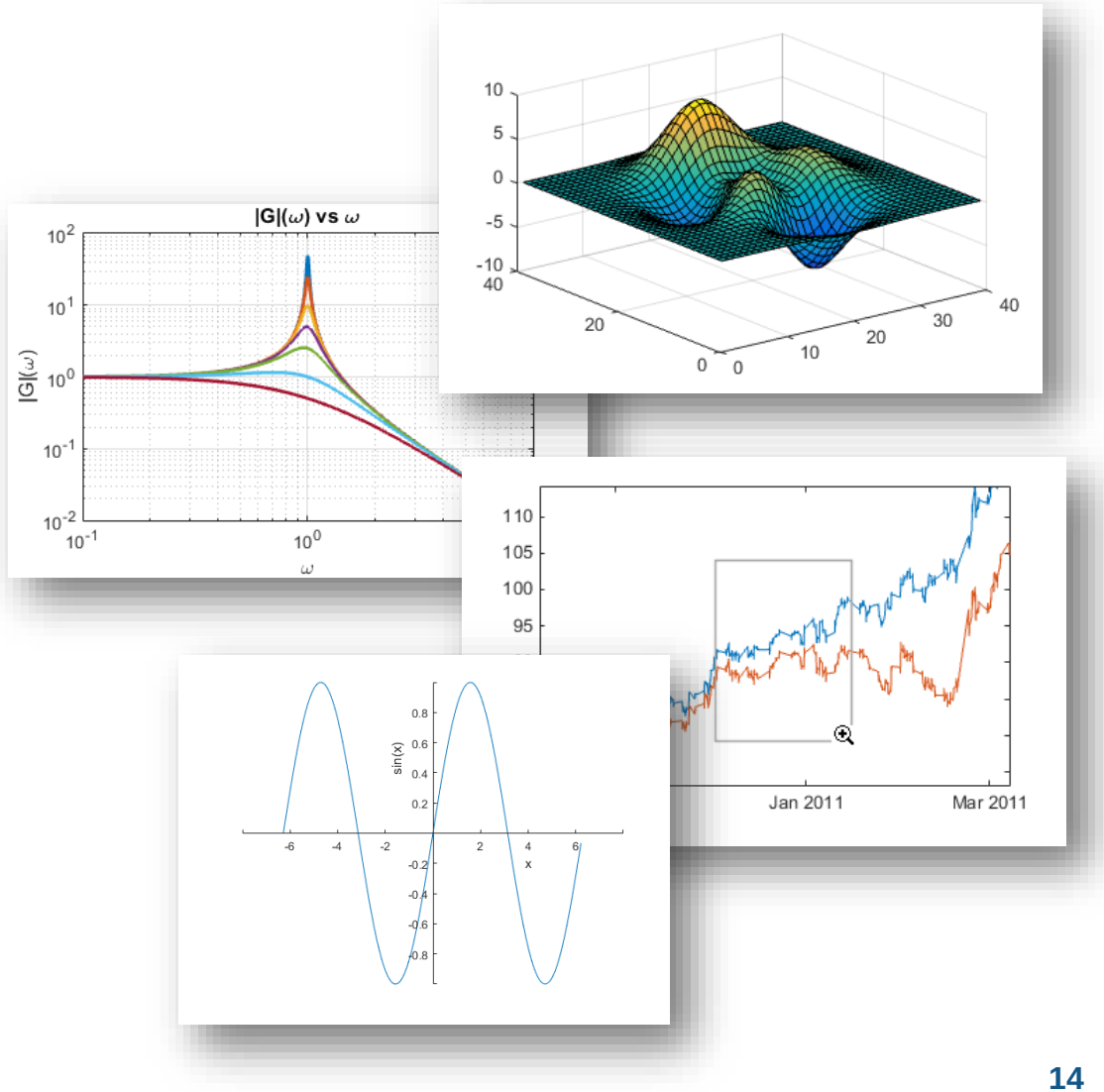
MATLAB Graphics

R2015b R2016a

New look makes data easier to interpret and graphics objects are easier to customize

- **R2015b**
  - increased control for customizing plot axes

- **R2016a**
  - Polar plots
  - Multiple y-axis plots
  - Functions for plotting mathematical expressions and equations

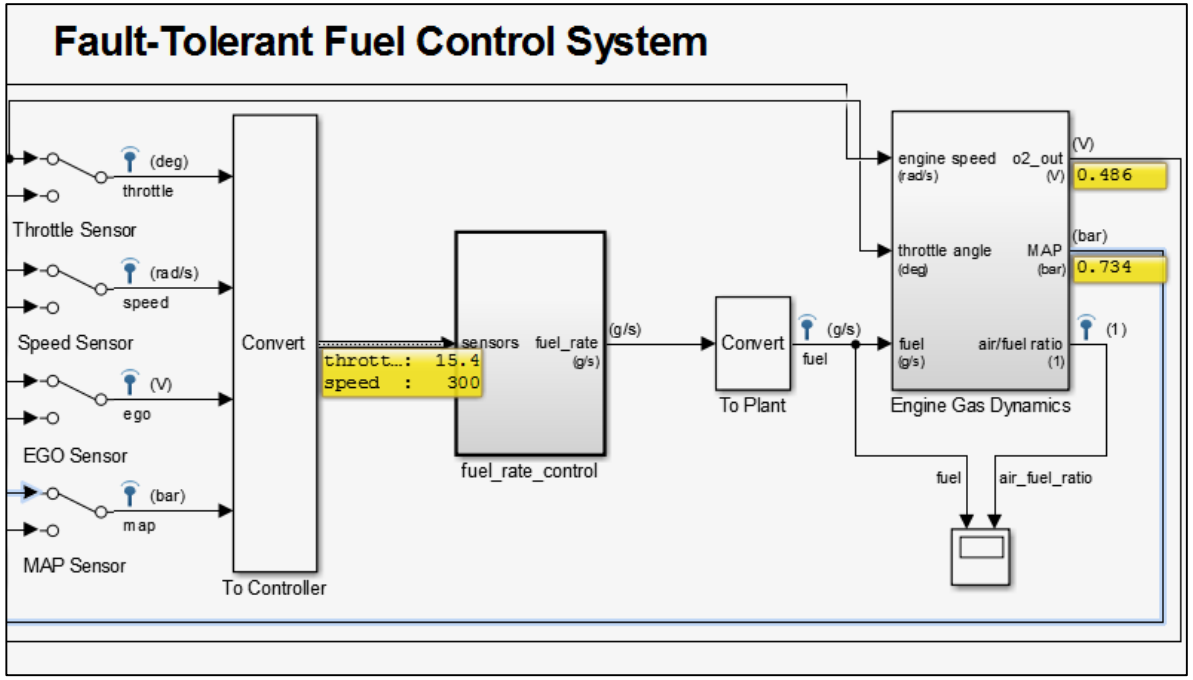


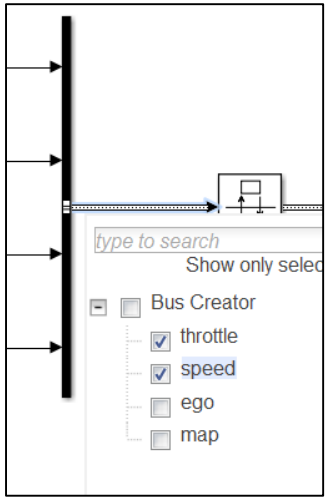
One-Click Display

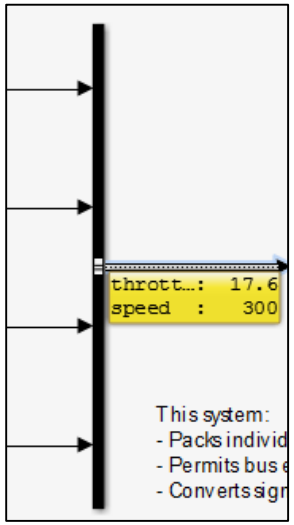
R2016a

Click a signal line when the simulation is running to view the current value

- Display port value for a signal by clicking it during simulation for easy debugging
- For bus signals, select the signals of interest before simulation





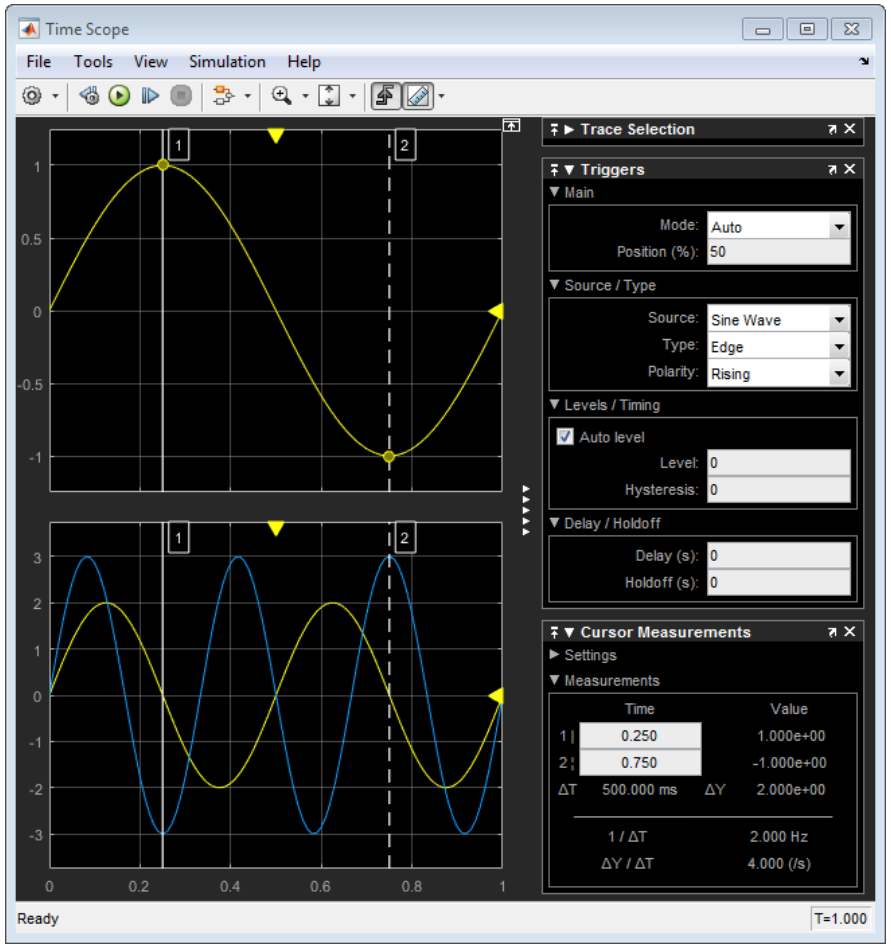


New Interface for Scopes

R2015b

View and debug signals with cursors and measurements

- Scope, Floating Scope, and Viewers all upgraded with new UI
- Includes simulation data analysis and debugging tools
  - Cursors
  - Measurements
  - Triggers



Flight Instruments Library

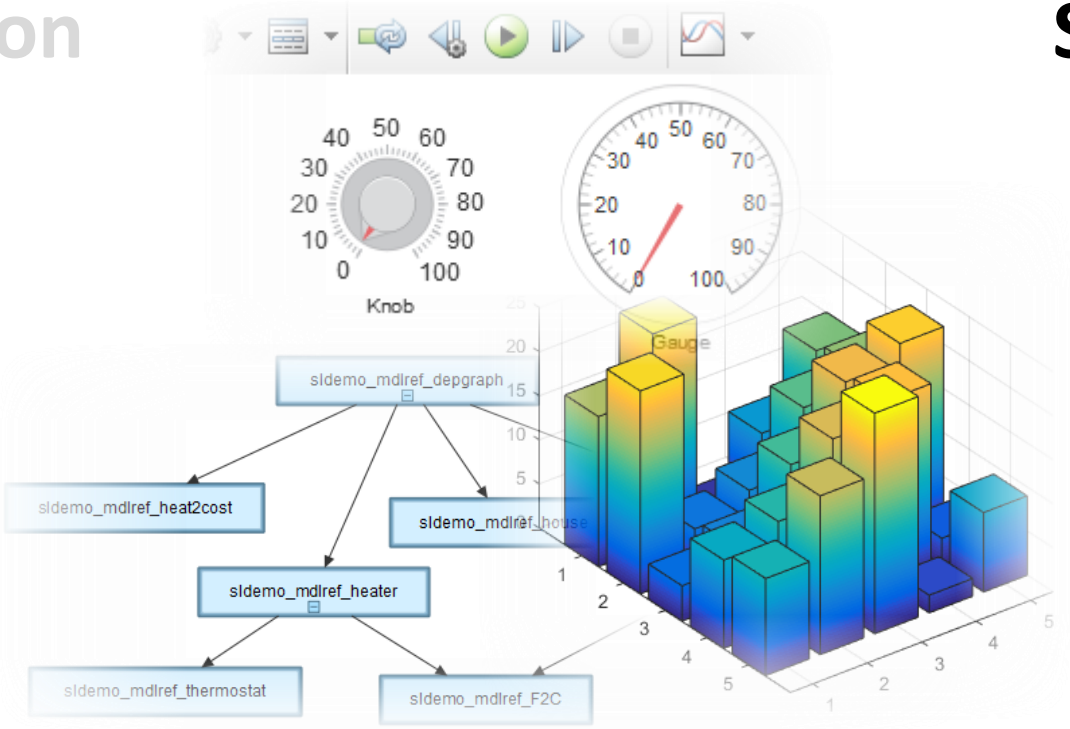
R2016a

Display measurements through standard cockpit instruments using Aerospace Blockset

- Visualize simulation results using realistic cockpit instrumentation, including:
  - Airspeed Indicator
  - Altimeter
  - Artificial Horizon
  - Climb Rate Indicator
  - Heading Indicator
  - Turn Coordinator

Analysis and Visualization

Modeling and Simulation



Testing and Verification

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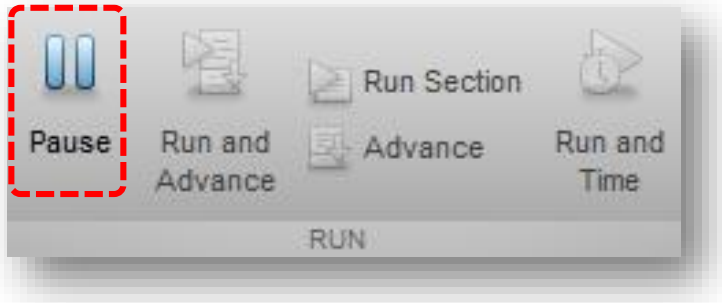
Support and Services

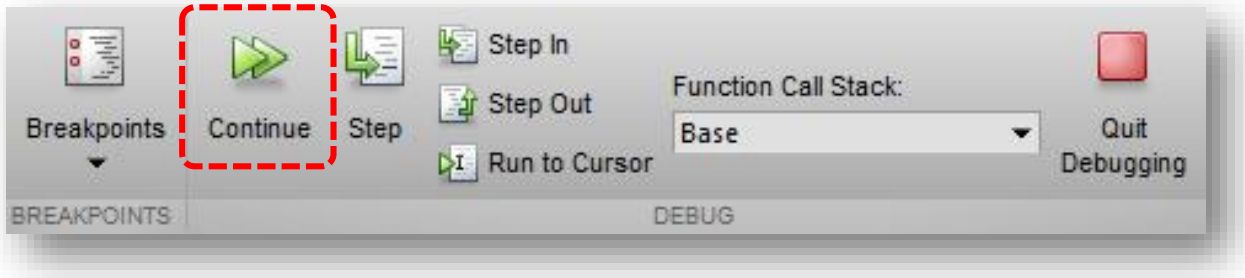
MATLAB Pause Button

R2016a

Troubleshoot problems without specifying breakpoints in advance

- Pause the execution of a program from the Editor and enter debug mode
- Check on the progress of long running programs to ensure they are running as expected
- Resume program execution

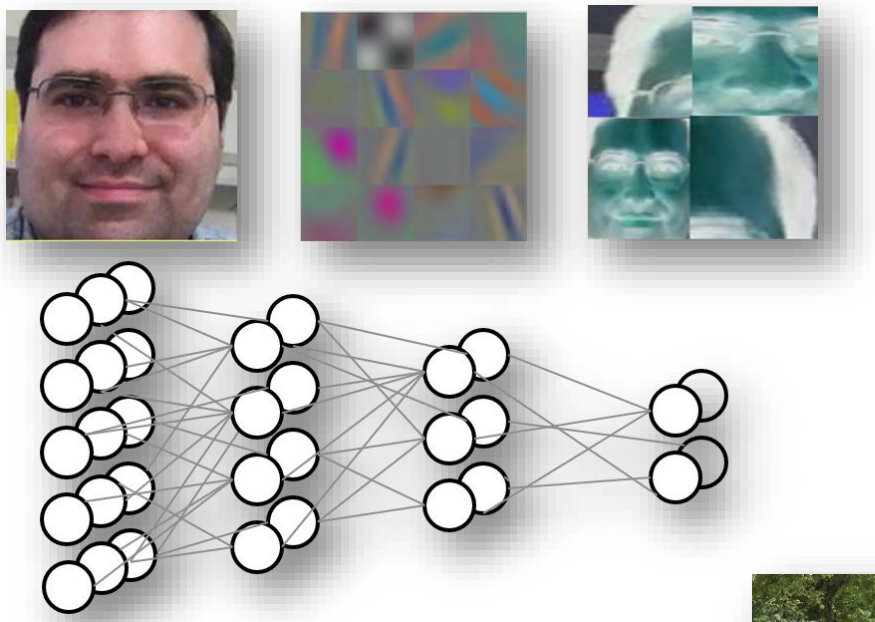




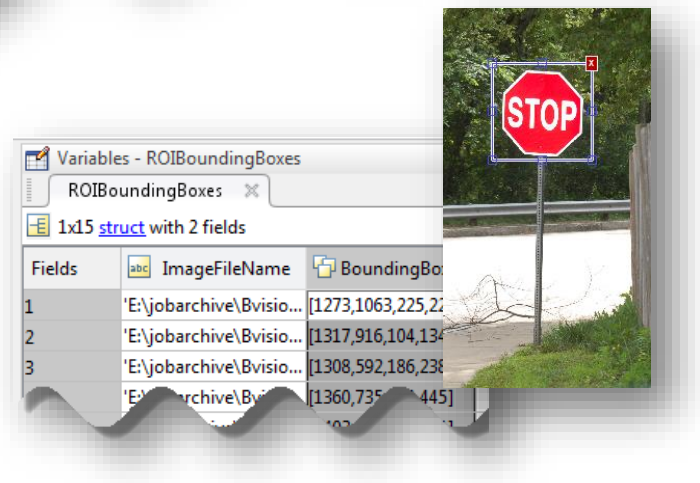
Deep Learning

R2016a

Perform fast, accurate image classification



- Enables recognition workflows in autonomous robotics and ADAS
- Convolutional neural network (CNN) algorithm added to Neural Network Toolbox
- Uses cuDNN (a GPU-accelerated library from NVIDIA) *(requires Parallel Computing Toolbox)*



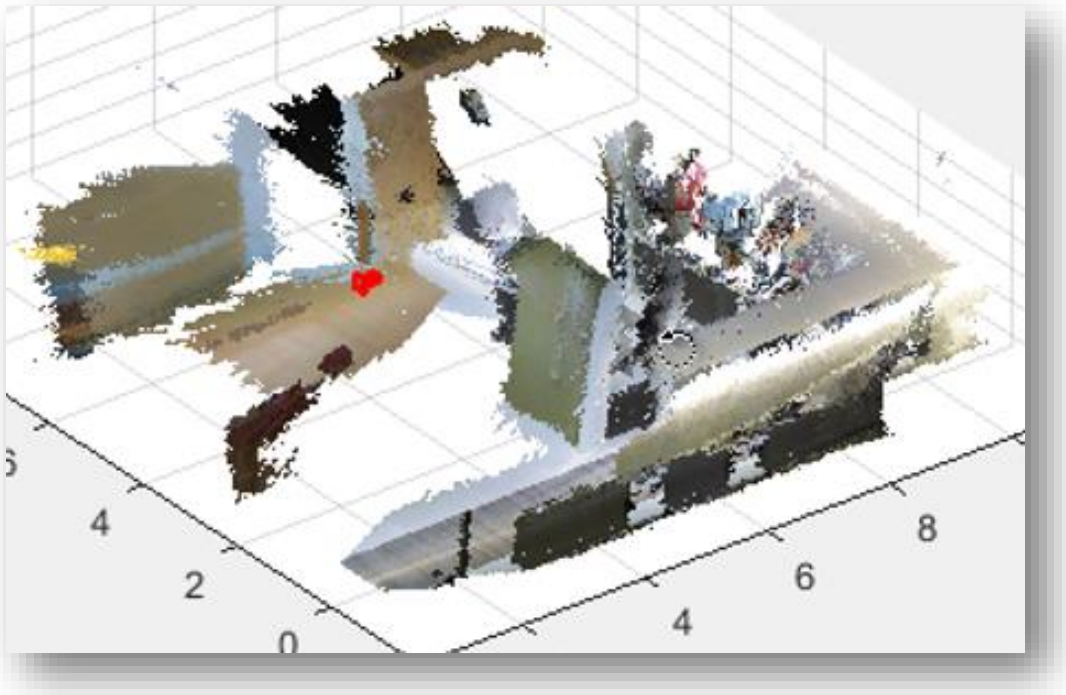
Session

3D Vision

R2016a

Enables autonomous systems to map and measure the world

- Supports workflows for ADAS, autonomous driving, and robotics
- New functionality to support:
  - 3D point cloud processing
  - Structure from motion



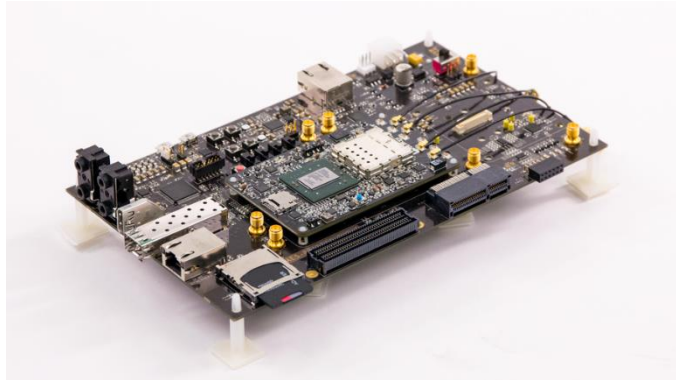
Demo Booth

Wireless System Design

R2015b R2016a

WLAN System Toolbox

802.11 a/b/g/n/ac/j/p PHY models



Communications System Toolbox

cdma2000 and 1xEV-DO waveform generation

Support for PicoZed SDRs

LTE System Toolbox

3GPP Release 12 features

RF Toolbox & SimRF

RF Budget Analyzer App

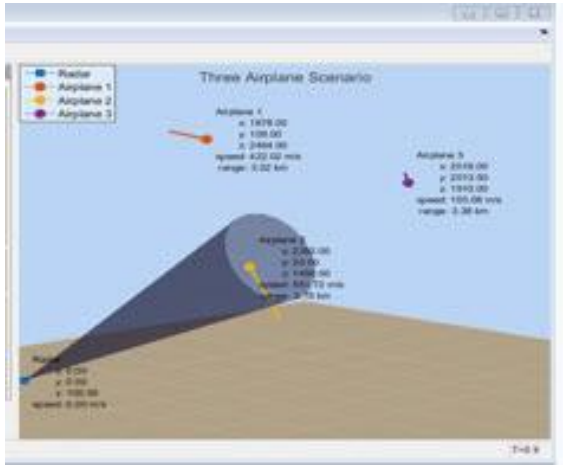
Automatic testbench generation

Antenna Toolbox

Model custom antennas and dielectrics

Phased Array System Toolbox

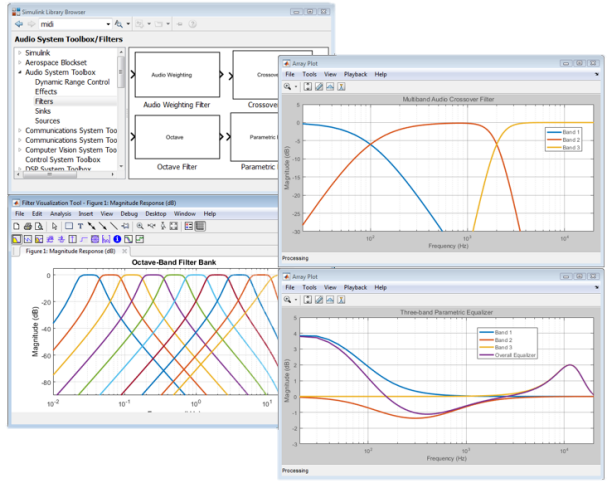
Scenario viewer, phase shift quantization



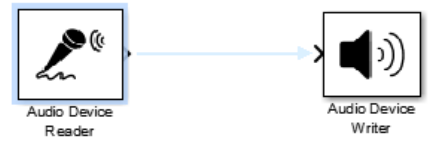
Audio System Toolbox

Design and test audio processing systems

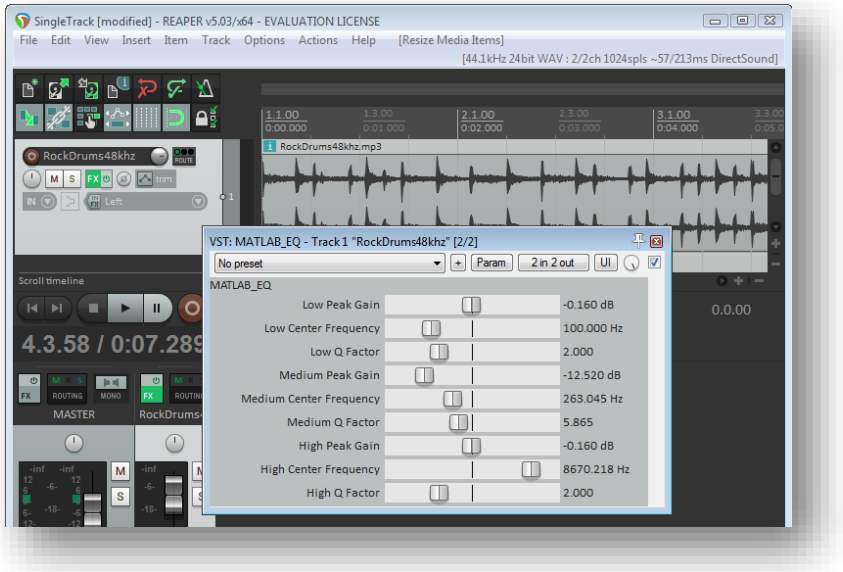
NEW PRODUCT



- Enables real-time audio processing in MATLAB and Simulink
- Libraries of audio processing algorithms and examples
- Low-latency audio streaming from and to standard audio interfaces (e.g. ASIO, CoreAudio, ALSA)
- Live-tuning of MATLAB and Simulink via UI and MIDI controls
- VST plugin generation to run on Digital Audio Workstations



Session

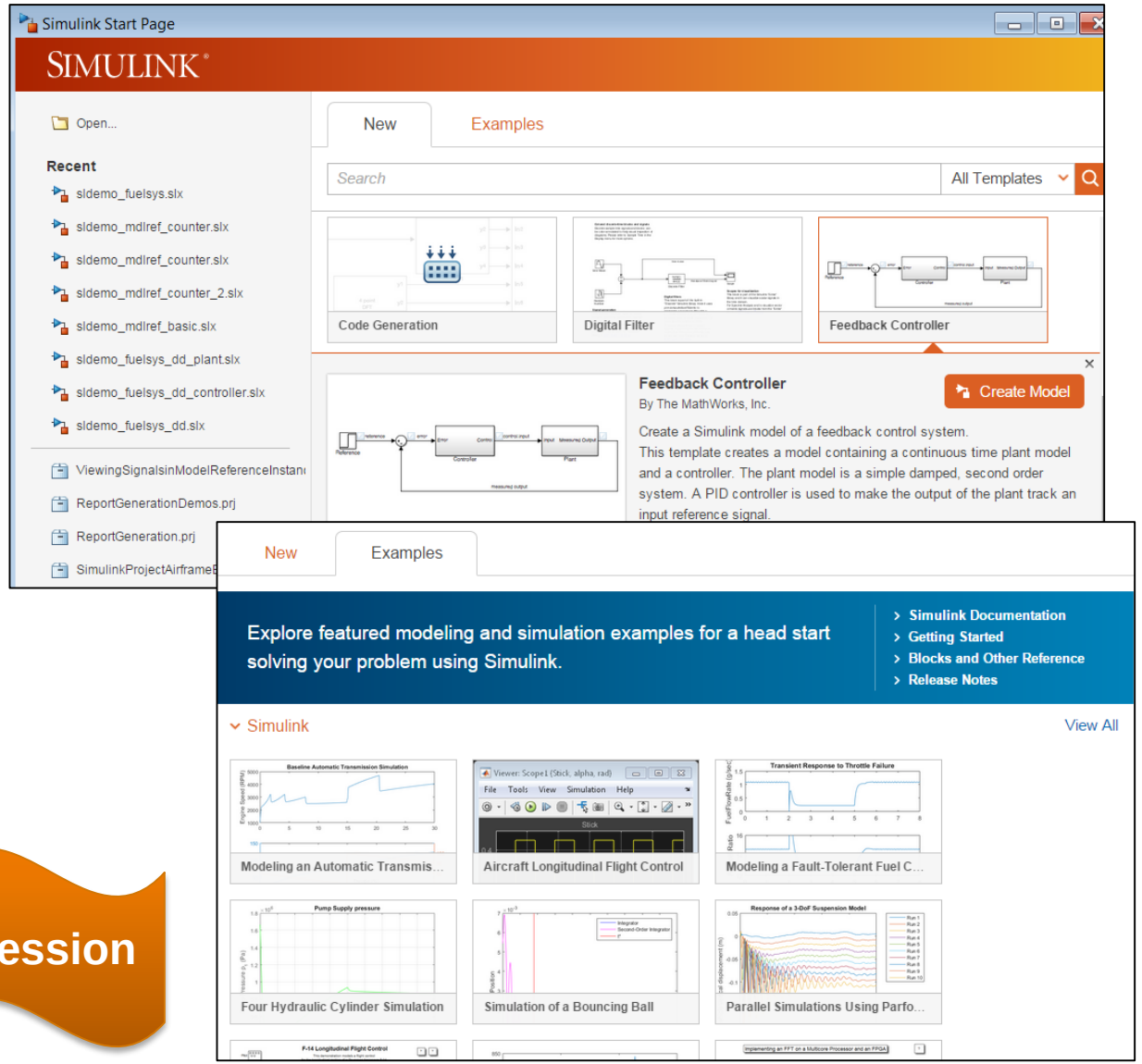


Simulink Start Page

R2016a

Get started or resume work faster by accessing templates, recent models, and featured examples

- Create new Simulink models using templates
- Use fully developed example models as a reference
- Quickly access most recent Simulink models



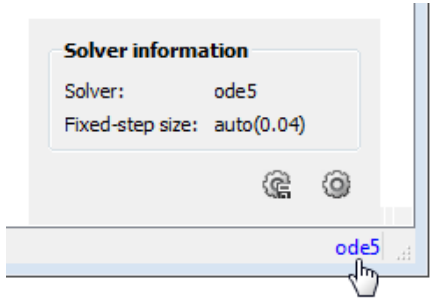
Session

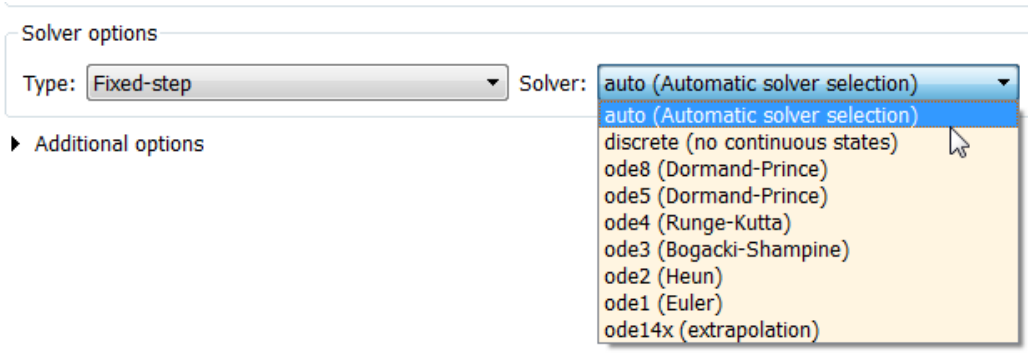
Automatic Solver Option

R2015b

Set up and simulate your model more quickly with automatically selected solver settings

- Simulink will select a solver and step size that is optimized for your specific model
- Considers factors such as model stiffness and simulation performance
- All new Simulink models use the automatic solver option
- Can optionally lock down solver so that it does not change from one simulation to another





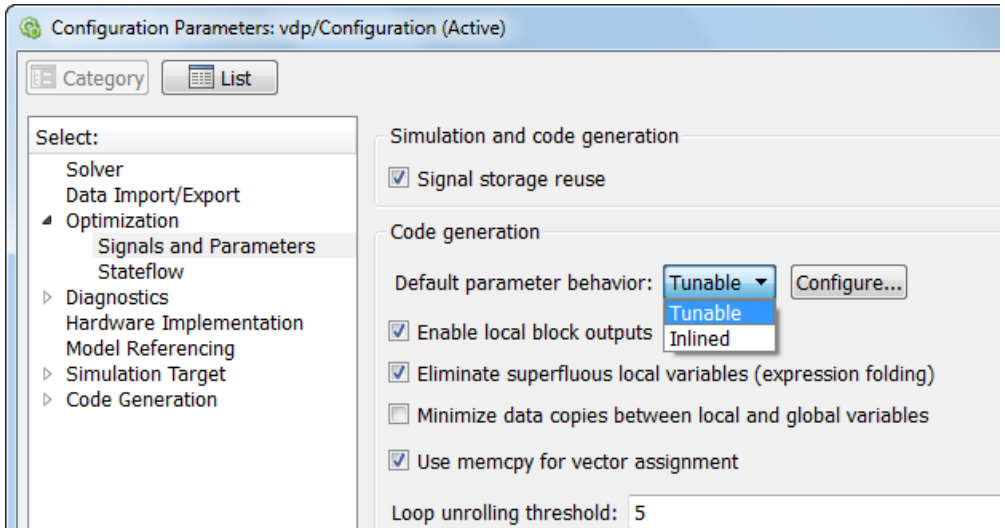
Session

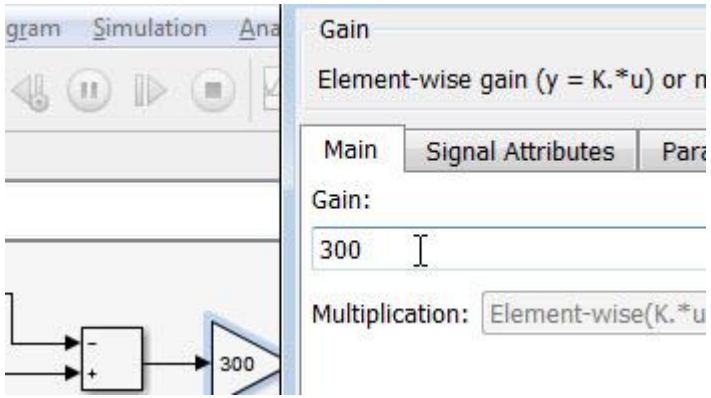
Always-On Tunability

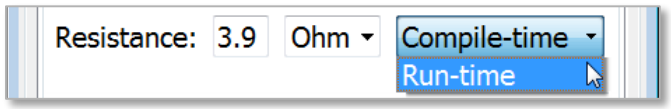
R2015b

Tune all block parameters and workspace variables during a simulation

- All tunable block parameters can be tuned during simulation while retaining the simulation speed
- Choose between tunable and inline for default parameter behavior during code generation
- Simscape block parameters now tunable as well





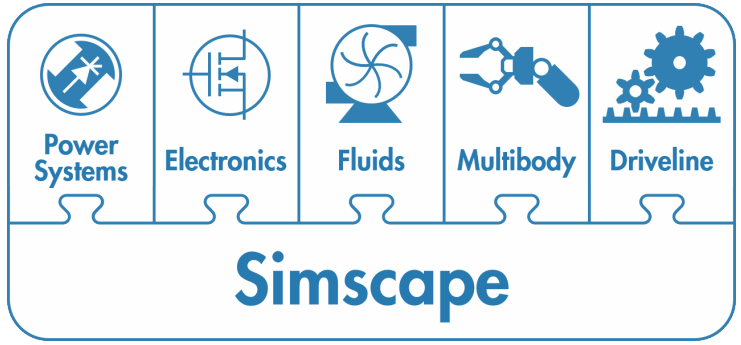


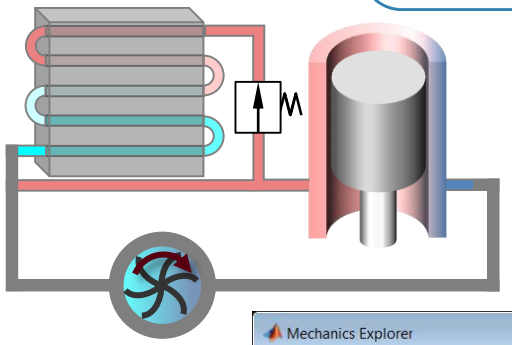
R2016a

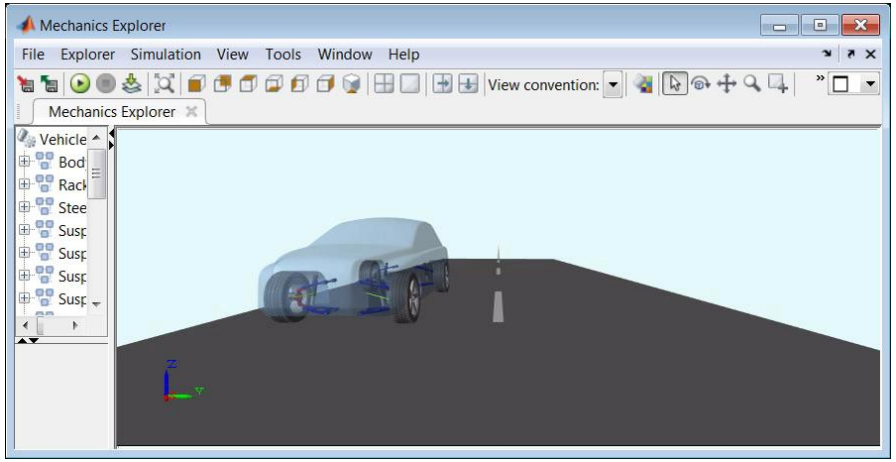
Simscape Product Family

R2016a

- Product names are realigned under the Simscape family
- Thermal liquid library in Simscape Fluids
  - Properties of liquids can vary with temperature
  - Heating and cooling systems, fuel systems, and actuation systems where temperature affects behavior
- Dynamic camera in Simscape Multibody
  - Track moving objects in animations
- Run-time parameters
  - Change parameter values without recompiling model
  - Used for HIL, Model Reference and Fast Restart







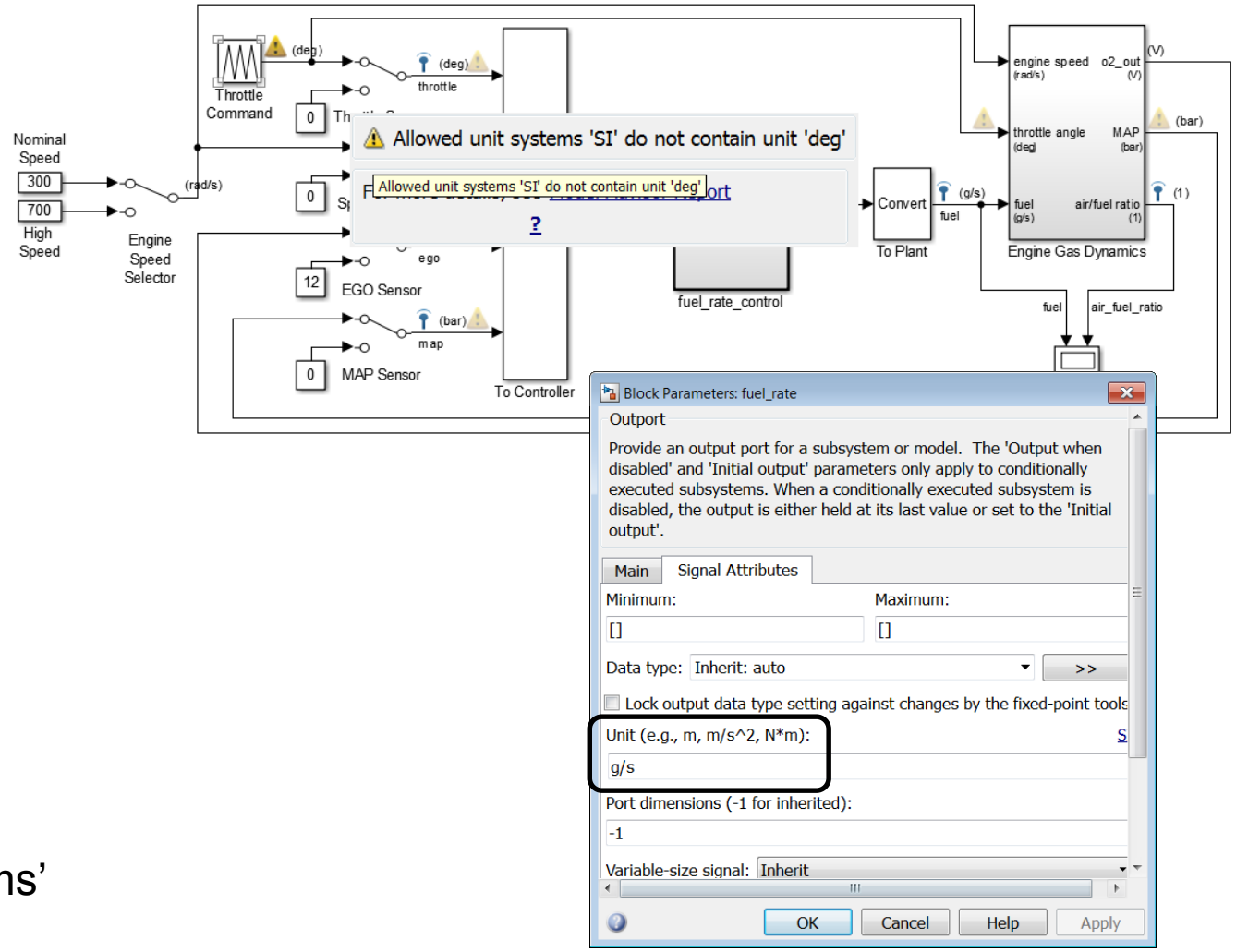
Session

Simulink Units

R2016a

Specify, visualize, and check consistency of units on interfaces

- Specify physical units for Simulink signals and bus elements at the interfaces of components such as subsystems, model references, Stateflow charts and MATLAB function blocks
- Identify unit mismatches at the component interfaces
- Enforce consistency by restricting the unit systems for certain components using the configuration parameter, ‘Allowed unit systems’

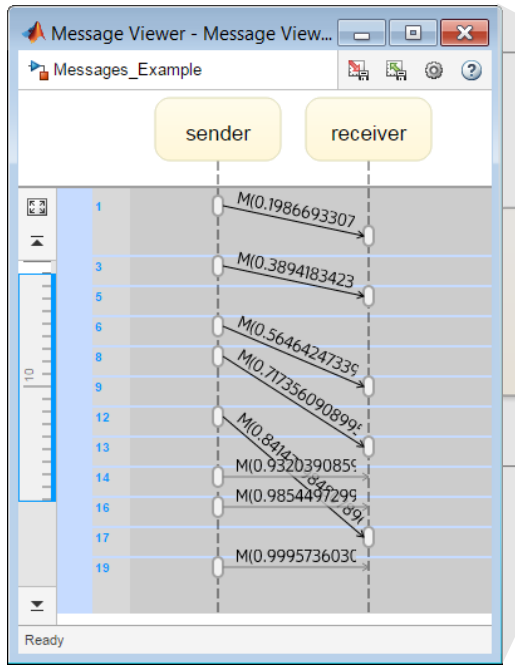


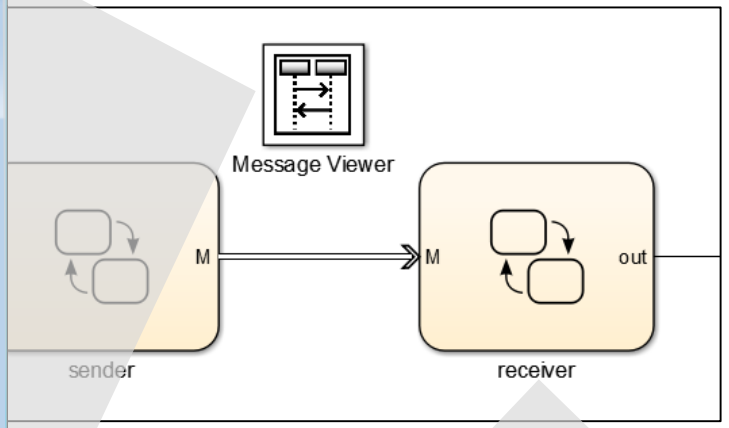
Messages

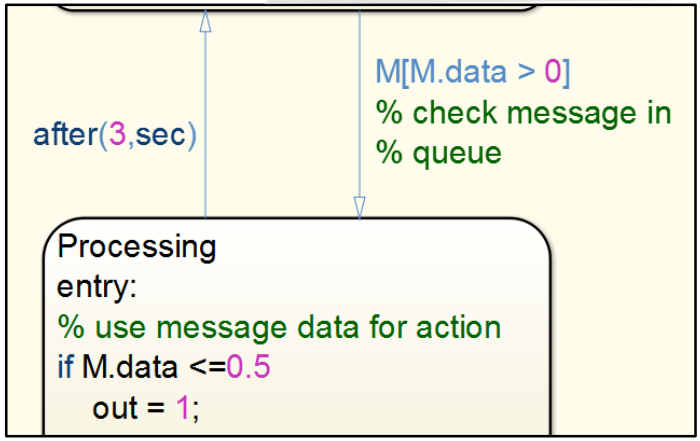
R2015b

Model asynchronous operations in state charts using objects that carry data and can be queued

- New message object and queue
- Message Viewer block to visualize lifetime of a message
- Signal lines in Simulink to transfer messages between charts





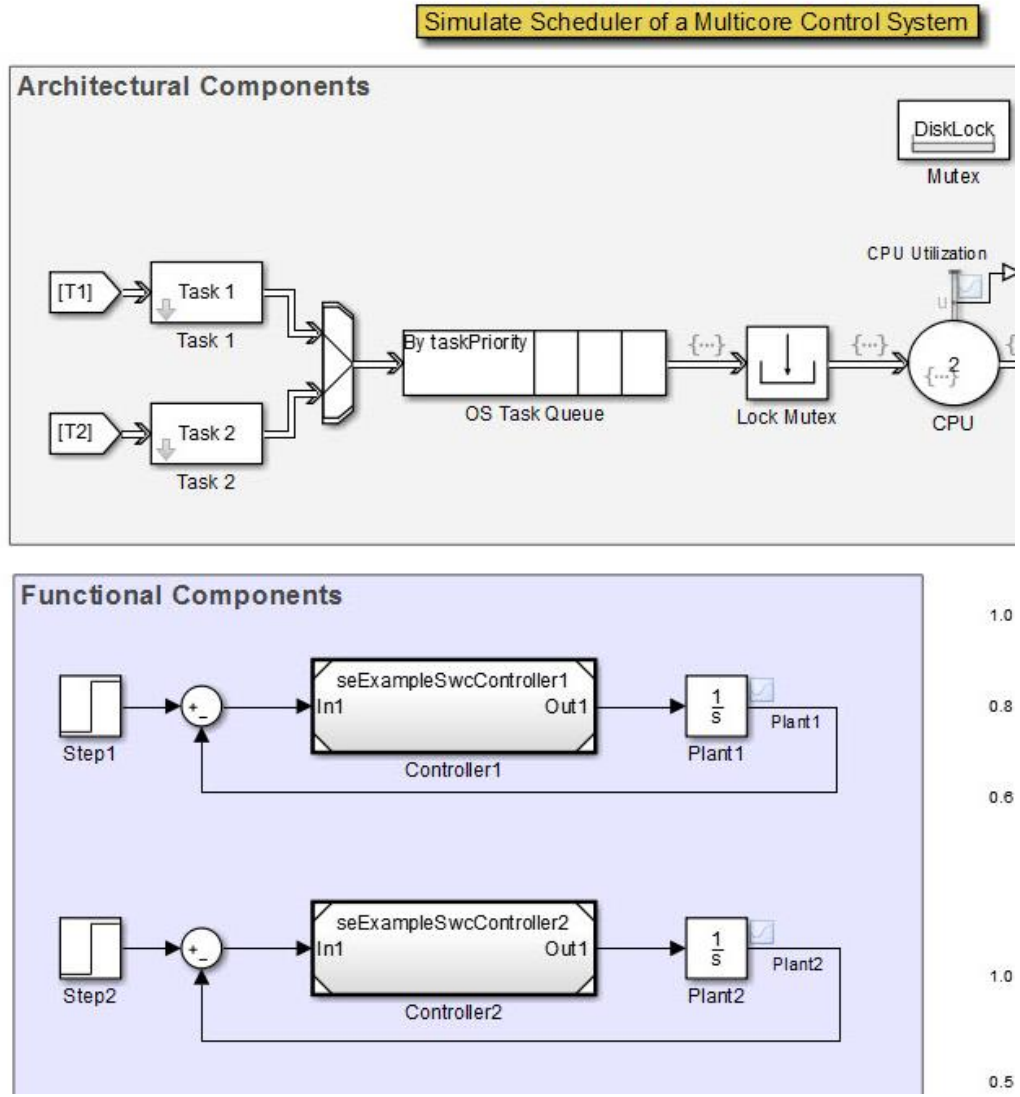


New SimEvents Engine and Block Library

R2016a

Model operating system task scheduling and communication

- Model interrupts, shared resources, network delays, and other characteristics of multicore and distributed systems
- Predict data races, deadlocks, and livelocks that can effect system performance before going to hardware
- Customize reactions to events using MATLAB and the Discrete Event System block

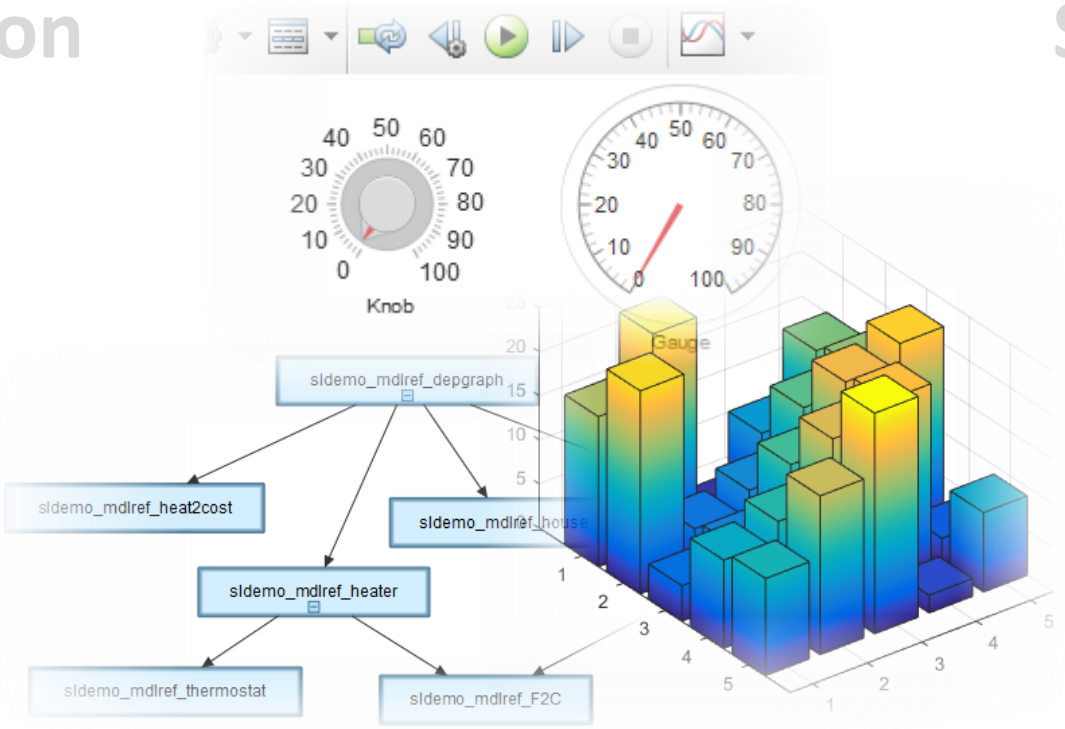


Session

Analysis and Visualization

Modeling and Simulation

Testing and Verification



Sharing and Collaboration

Performance

Support and Services

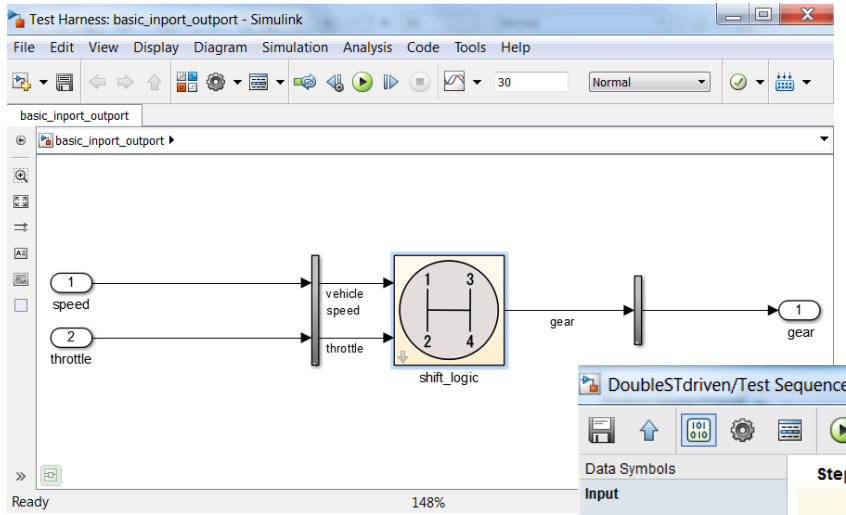
Simulink Test

R2015a

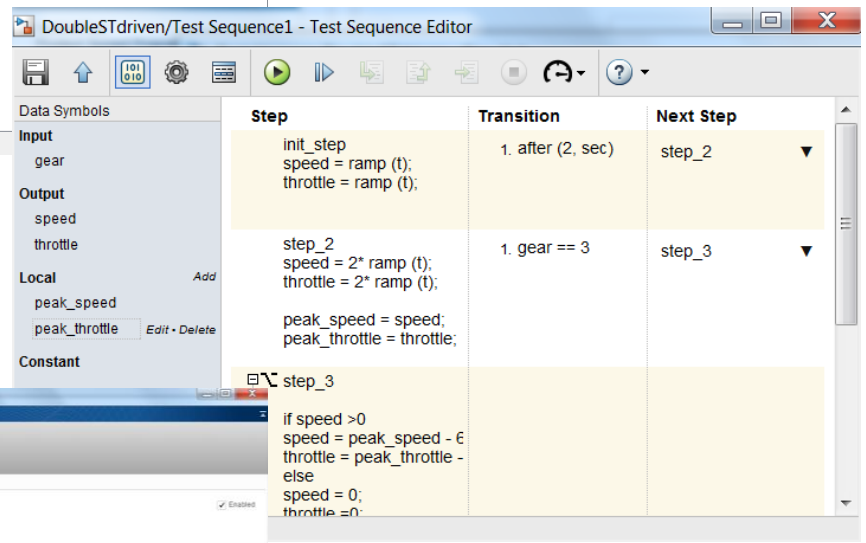
Author, execute and manage simulation-based testing

- Build synchronized executable test environments
- Create inputs and assessments based on logic or temporal conditions
- Qualifiable for safety critical applications
  - DO Qualification Kit (for DO-178)
  - IEC Certification Kit (for ISO 26262 and IEC 61508)

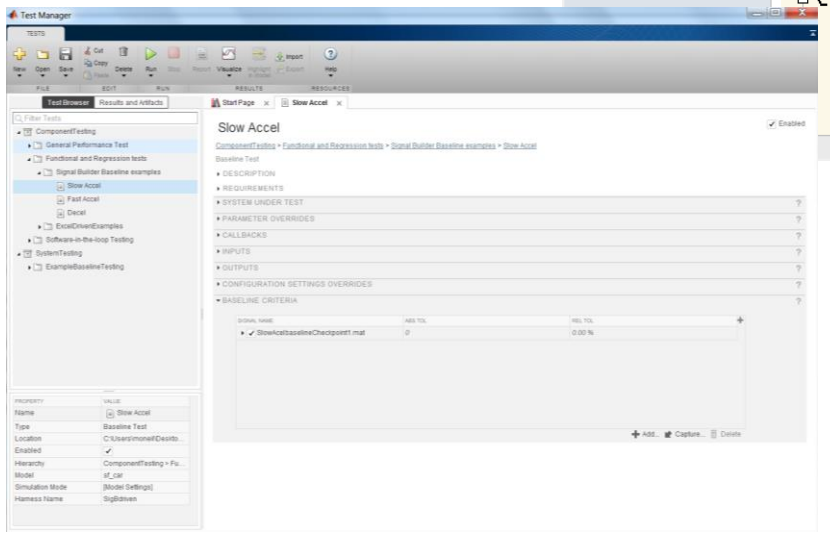
Test Harness



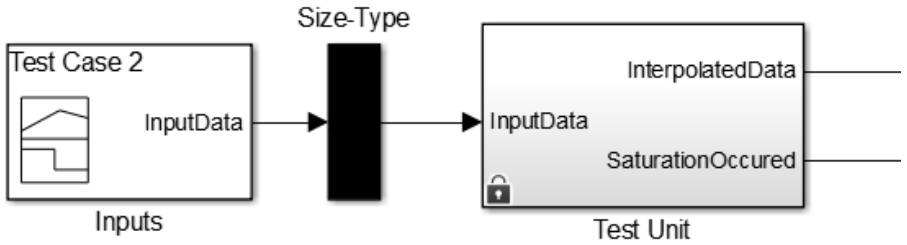
Test Sequence Block



Test Manager

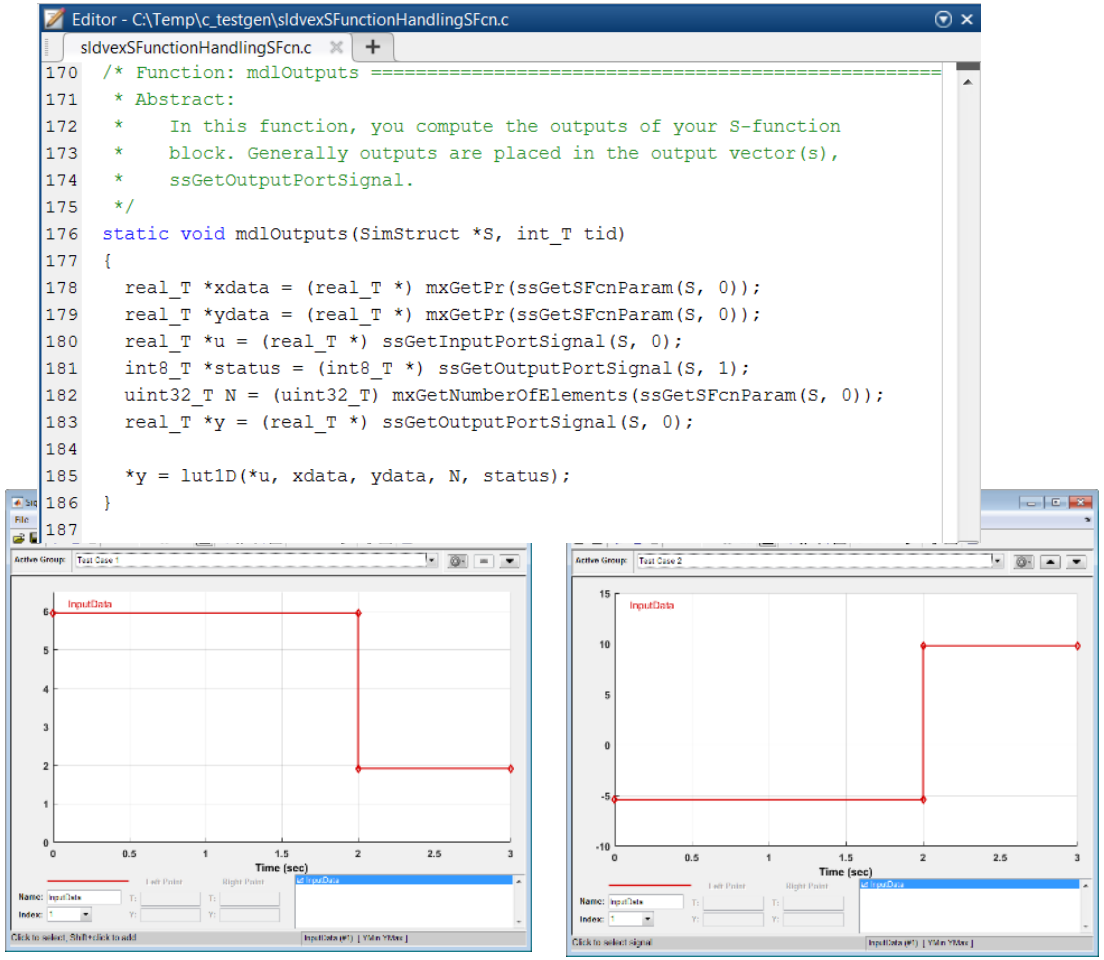


Test Generation for C Code



Automatically generate tests for C code S-functions using Simulink Design Verifier

- Test generation automates a difficult task
- Generated tests lets you gain insight into the simulation of your design containing S-functions

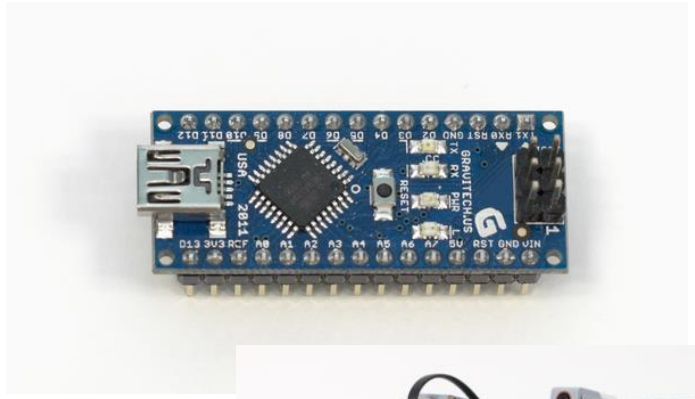


Deploying to Hardware

R2016a

Run your models on low-cost hardware and stream data into MATLAB

- Acquire images from Raspberry Pi and Kinect V2 into MATLAB and Simulink
- Run Simulink models on Lego EV3, Raspberry Pi 2, Raspberry Pi 3, and Arduino Yun
- Adds to existing support for Arduino, Lego, and Raspberry Pi platforms

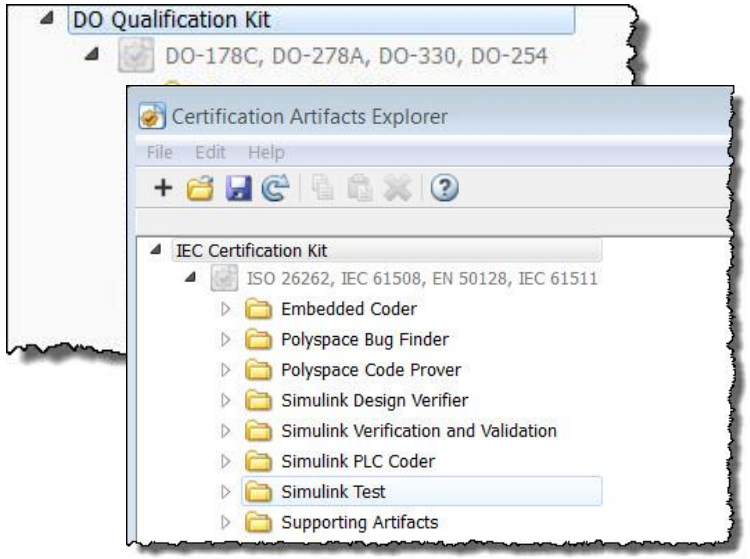


Hardware Workshops

Certification and Standards

R2015b R2016a

- New Standards and Versions
  - DO-330 TQL-4 (aerospace)
  - AUTOSAR 4.1.3 & 4.2 (automotive)
  - IEC 62304 (medical)
  - MISRA-C: 2012 (many industries)



Simulink Code Inspector and Polyspace Qualified under DO-330

Qualified Code Generation with MathWorks Embedded Coder

Natick, Mass. – (21 December 2015)

MathWorks today announced that it has completed the Stage of Involvement 4 (SOI-4) audit for a program involving airborne softwa for an aircraft system with Transport Canada, the certification authority for the aircraft. As a result of the audit, MathWorks tools and supporting data packages included in the DO Qualification Kit are compliant with DO-330 Tool Qualification Level 4 (TQL-4) for DO-178C and DO-331 certification workflows:

- Qualified model verification
- Qualified code generation and verification

Successful completion of an audit process allows organizations to g ased Design, including:


CERTIFICATE

No. Z10 15 11 67052 021

Holder of Certificate: The MathWorks, Inc.
3 Apple Hill Drive
Natick MA 01760-2098
USA

Factory(ies): 67052

Certification Mark:

Product: Software Tool for Saf

Model(s): Simulink® Test™

Parameters: The verification tool, classi safety-related software dev and EN 50128.
The verification tool is a qua ISO 26262.
It is suitably validated for us development according to I

The report MN86842C is a

Tested according to: IEC 61508-3(ed.2)
EN 50128:2011
ISO 26262-8:2011

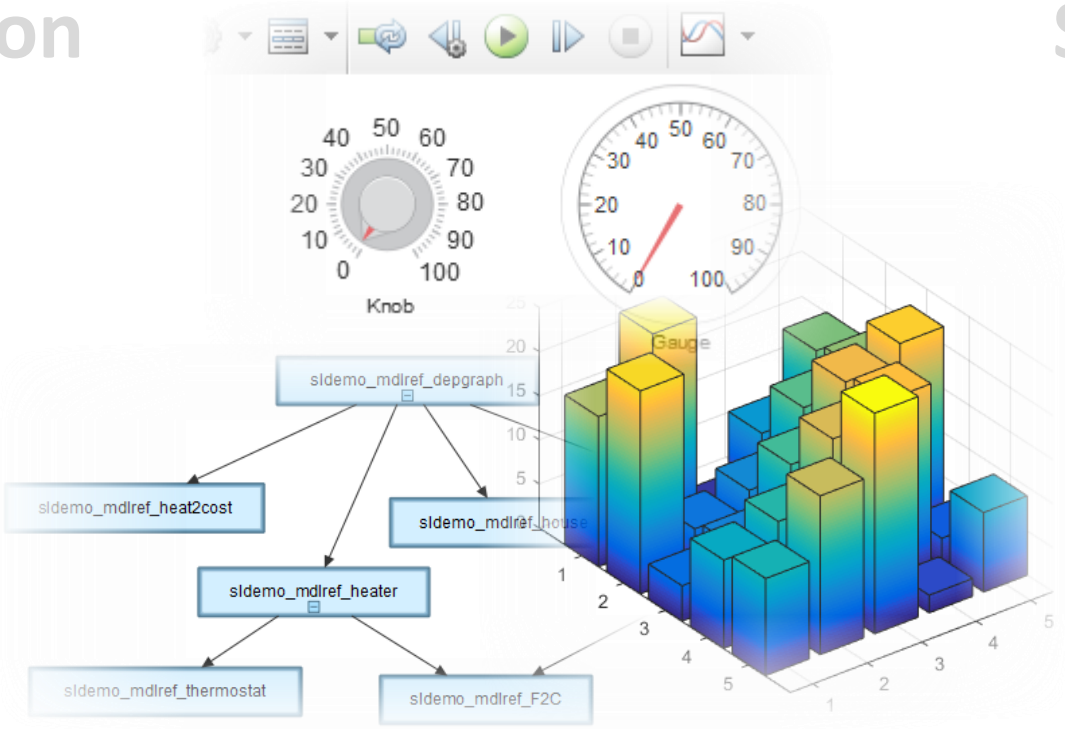
The product was tested on a voluntary basis and complies with

TE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CER

Testing and Verification

Analysis and Visualization

Modeling and Simulation



Testing and Verification

Sharing and Collaboration

Performance

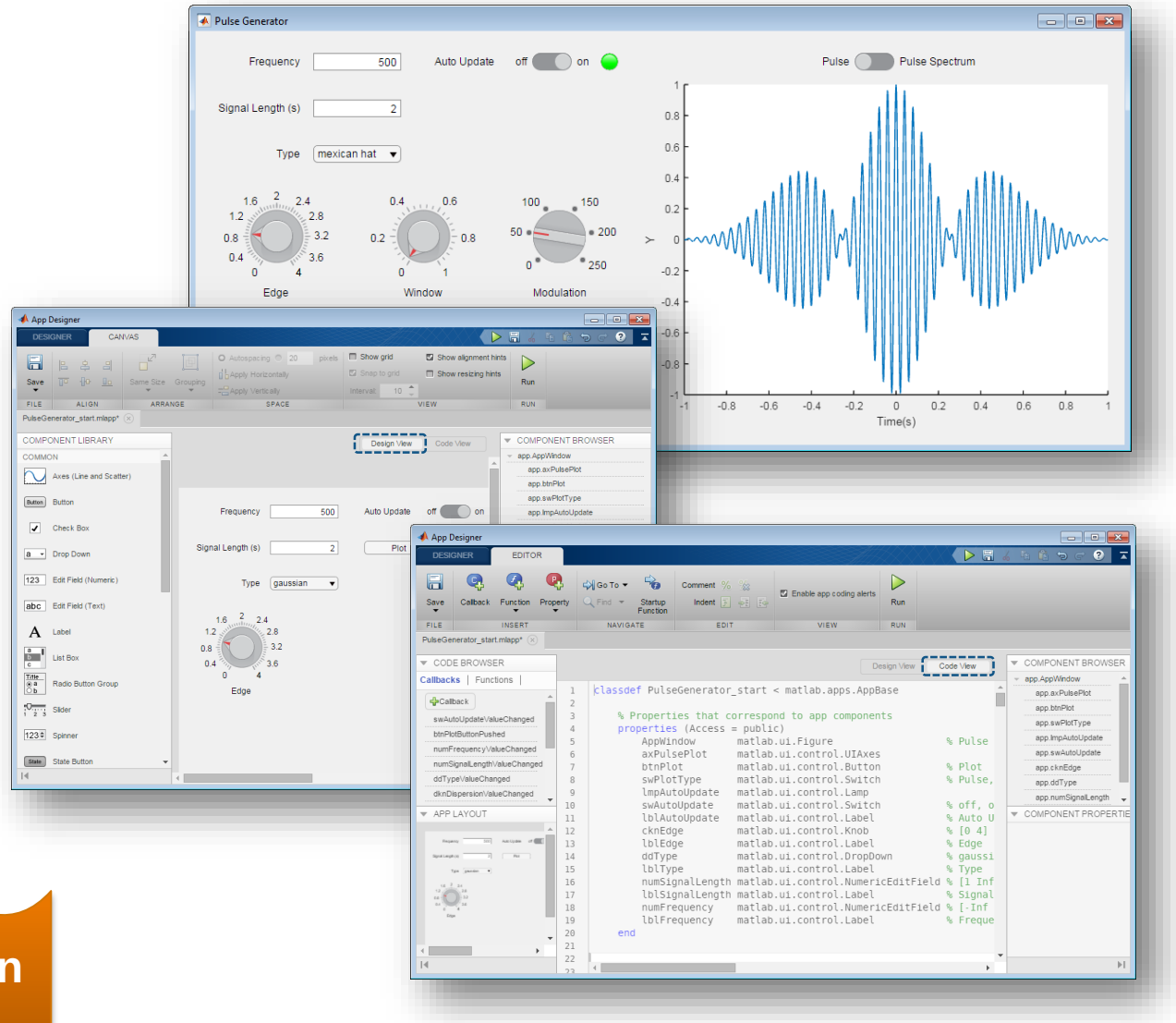
Support and Services

App Designer

R2016a

Develop MATLAB applications with an enhanced design environment and expanded UI component set

- Choose from standard components (buttons, check boxes, panels, etc.), as well as gauges, lamps, knobs and switches
- Quickly move between visual design and code development
- New object-based code format makes it easier to share data between parts of the app



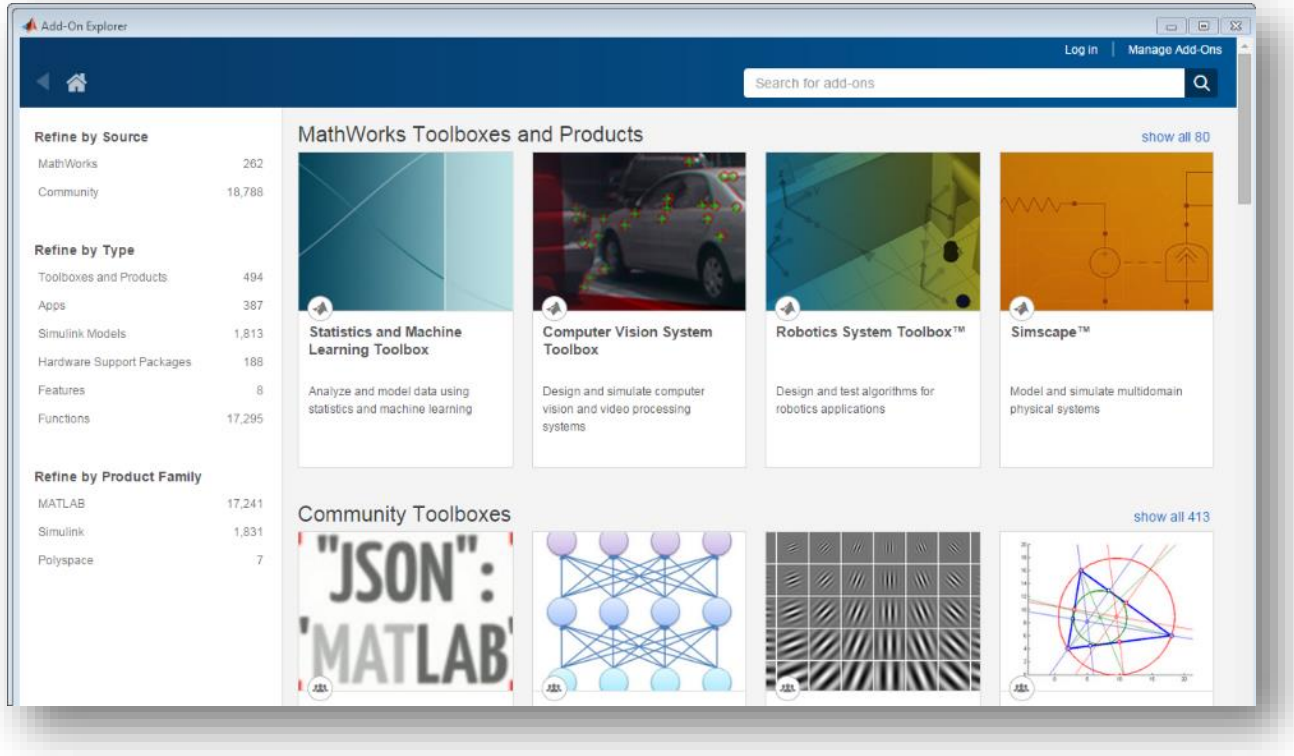
Session

Add-On Explorer

R2015b

Extend the capabilities of MATLAB by providing additional functionality for specific tasks and applications

- Browse, search, and install add-ons directly from MATLAB
- Add-ons include community-authored and MathWorks toolboxes, apps, functions, models, and hardware support

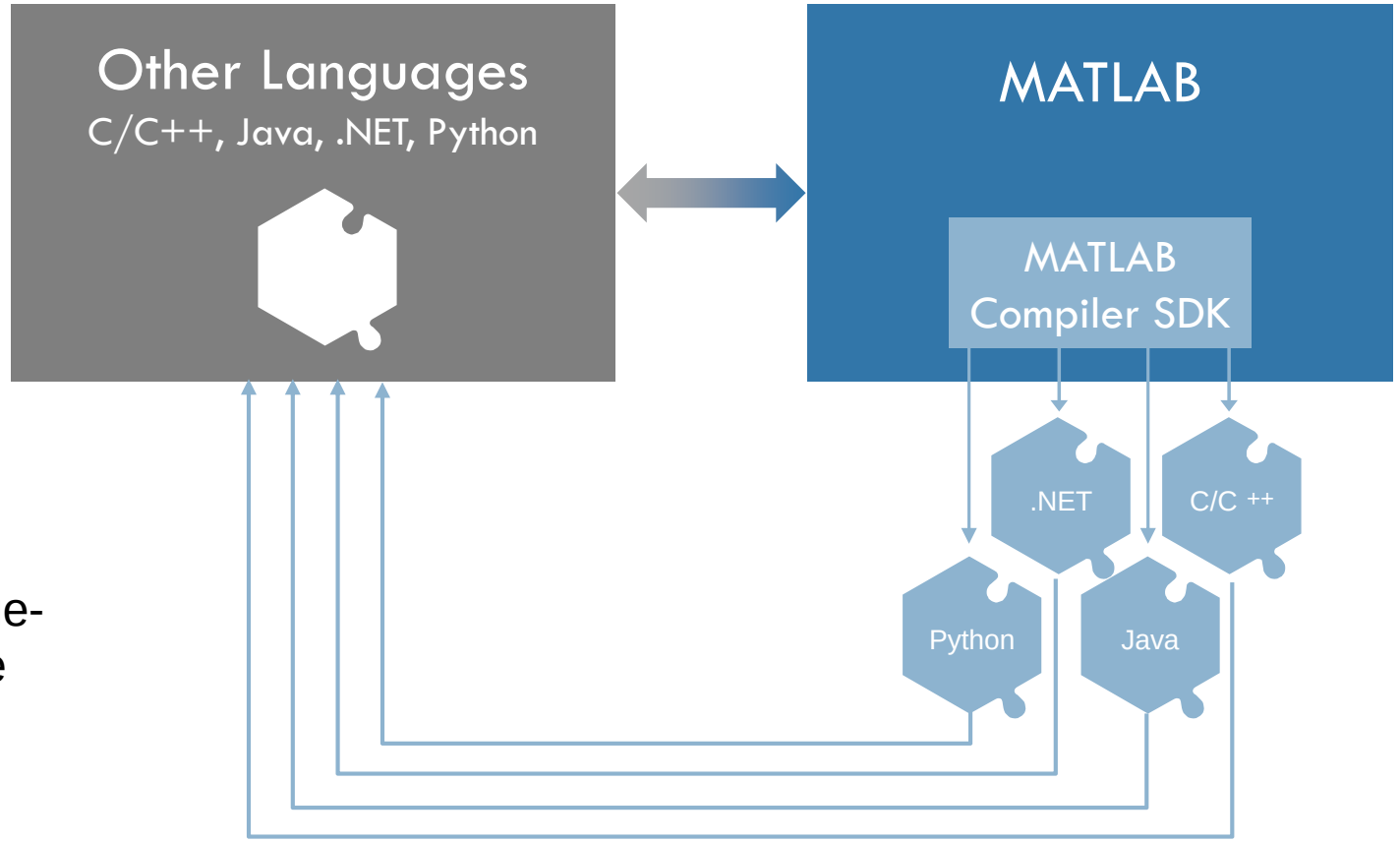


Using MATLAB with Other Languages

R2015b

Integrate MATLAB with other programming languages, including C/C++, Java, .NET, and Python

- Call MATLAB from another language
- Reuse legacy code written in another programming language within MATLAB
- Package MATLAB programs into language-specific software components to integrate with other programming languages
  - Python support added in **R2015b**



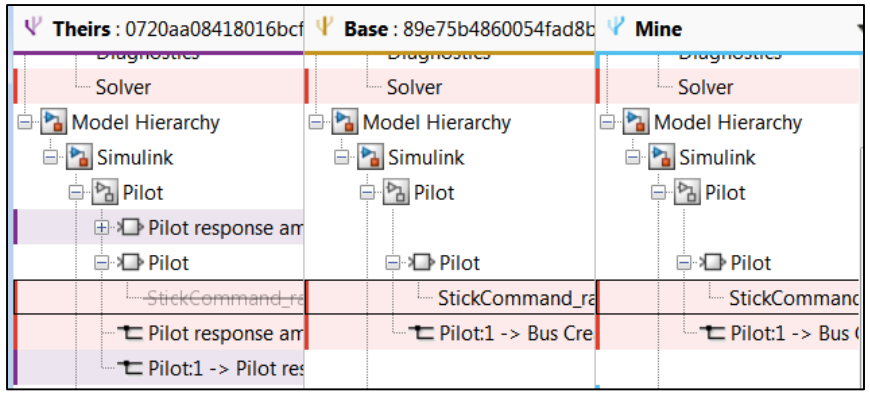
Session

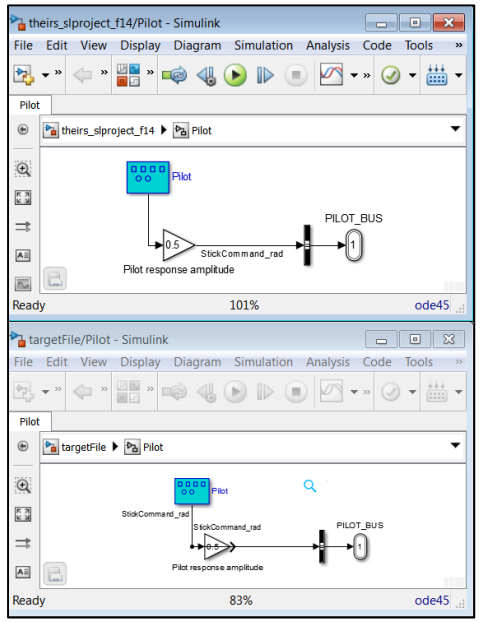
Three-Way Model Merge

R2016a

Graphically resolve conflicts between revisions within a Simulink project

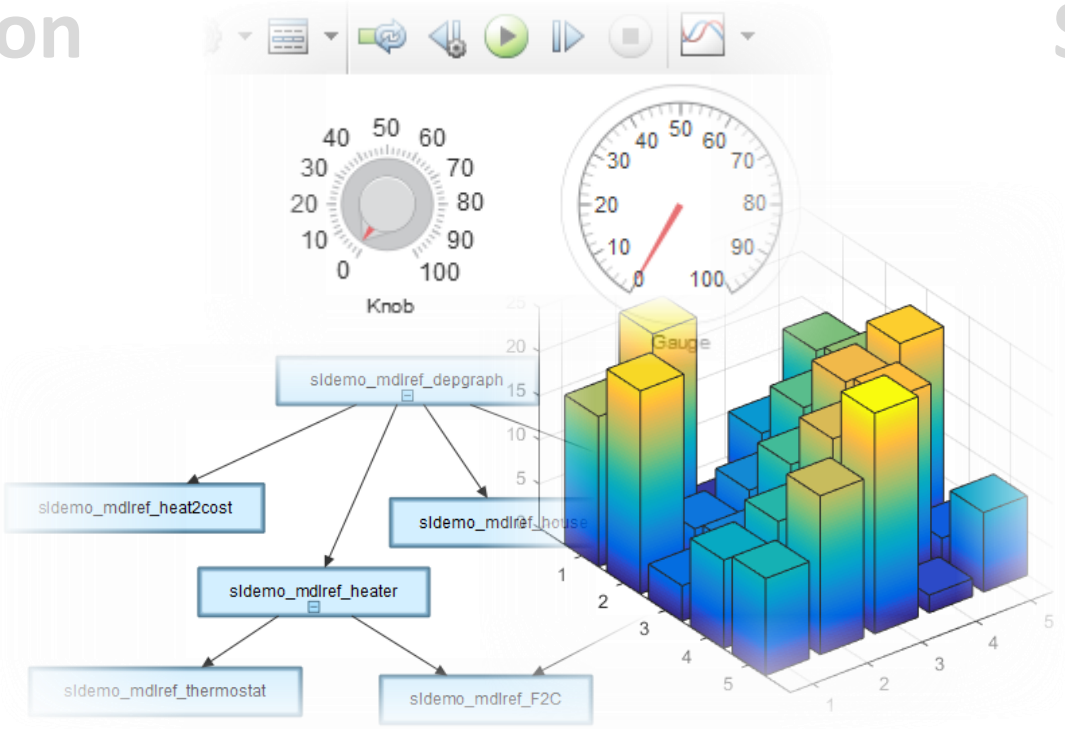
- Resolve conflicts in model files under source control
- Provides an interactive comparison report with the two conflicting designs along with the original base model





Analysis and Visualization

Modeling and Simulation



Testing and Verification

Sharing and Collaboration

Performance

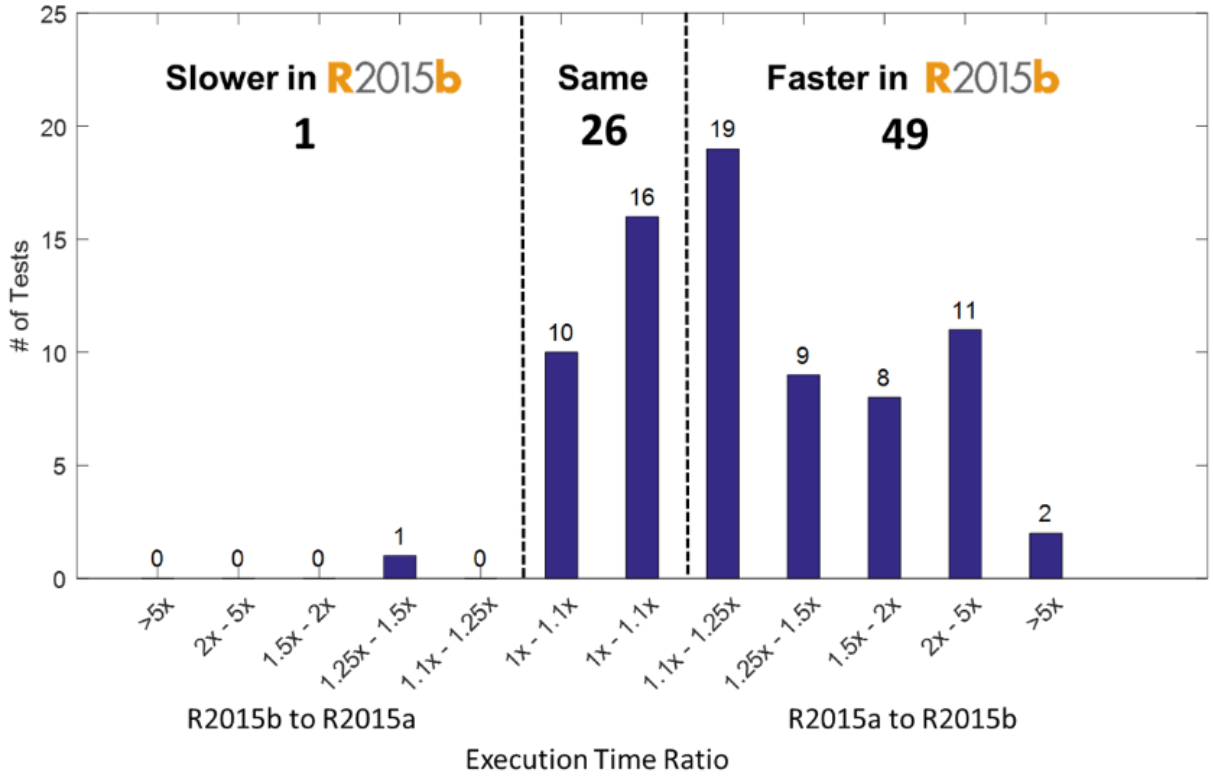
Support and Services

MATLAB Execution Engine

R2015b

Redesigned execution engine runs MATLAB code faster

- All MATLAB code can now be JIT compiled
- Average performance improvement of 40% on 76 performance-sensitive user applications
- A platform for future improvements
- Performance testing framework R2016a
  - Measure MATLAB code performance
  - Interface leverages the unit testing framework



GPU Acceleration and Parallel Computing

R2015b

Perform parallel computations using GPUs

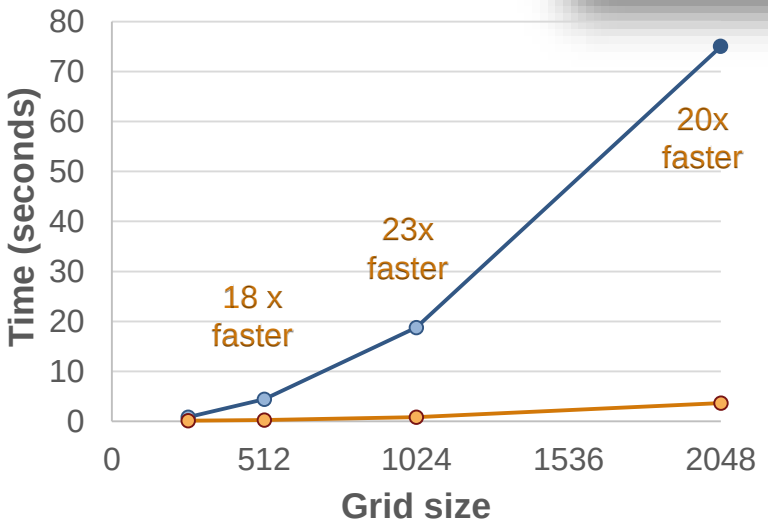
- Accelerate applications using GPU-enabled functions
  - > 300 in MATLAB
  - > 90 in Statistics and Machine Learning Toolbox
  - > 50 in Image Processing Toolbox
- Use enhanced gpuArray functions for sparse matrices on GPUs

```
Transfer data to GPU
>> GX = gpuArray(X);

GPGPU Computation
>> GY = fft2(GX);

Gather data to CPU
>> Y = gather(GY);
```

Simple GPU code in MATLAB

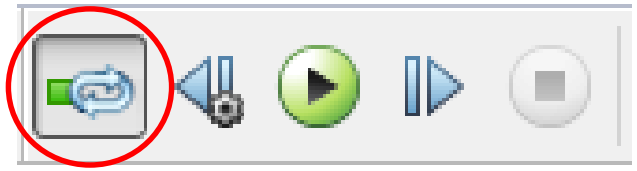


Performance

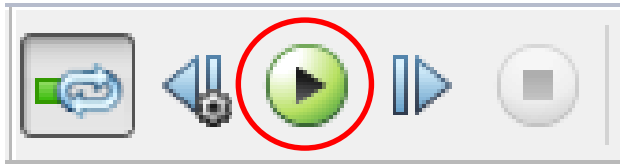
Fast Restart

R2014b

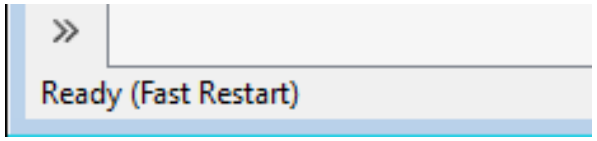
Run consecutive simulations more quickly



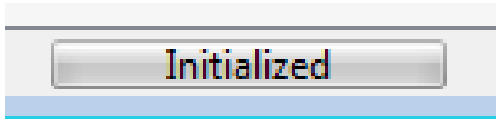
- Efficiently run multiple interactive simulations



- Saves simulation time eliminating recompilation between simulation runs



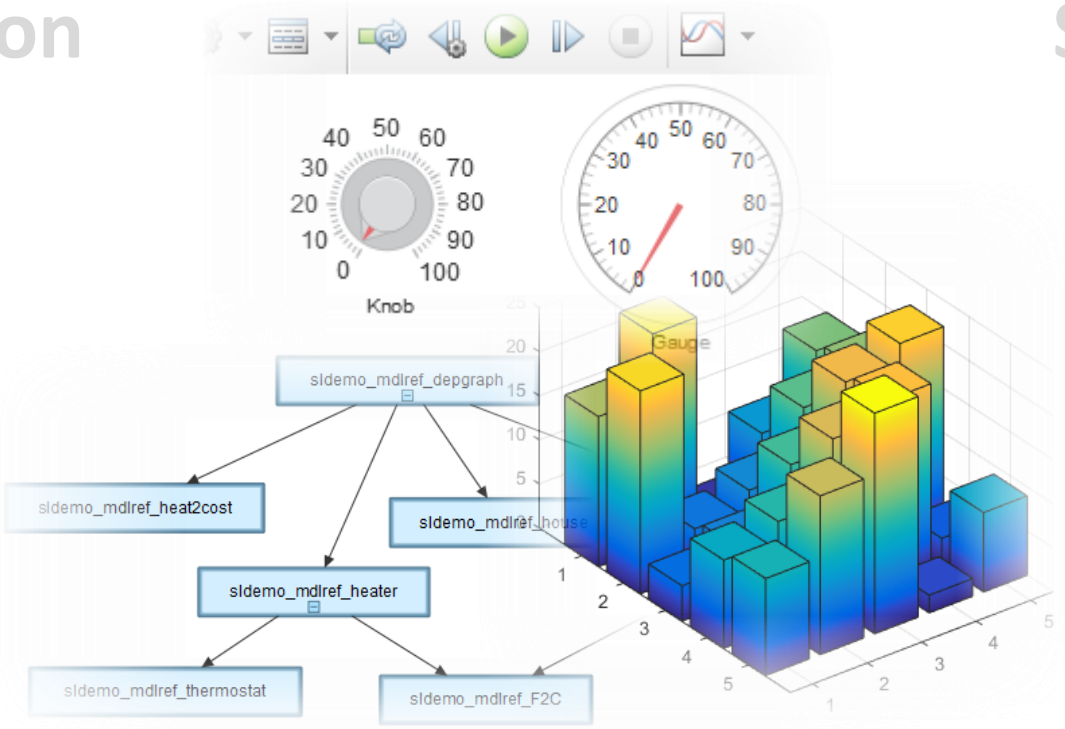
- Improves calibration workflows where the user is tuning block parameters between runs



- API introduced in **R2015b**

Analysis and Visualization

Modeling and Simulation



Testing and Verification

Sharing and Collaboration

Performance

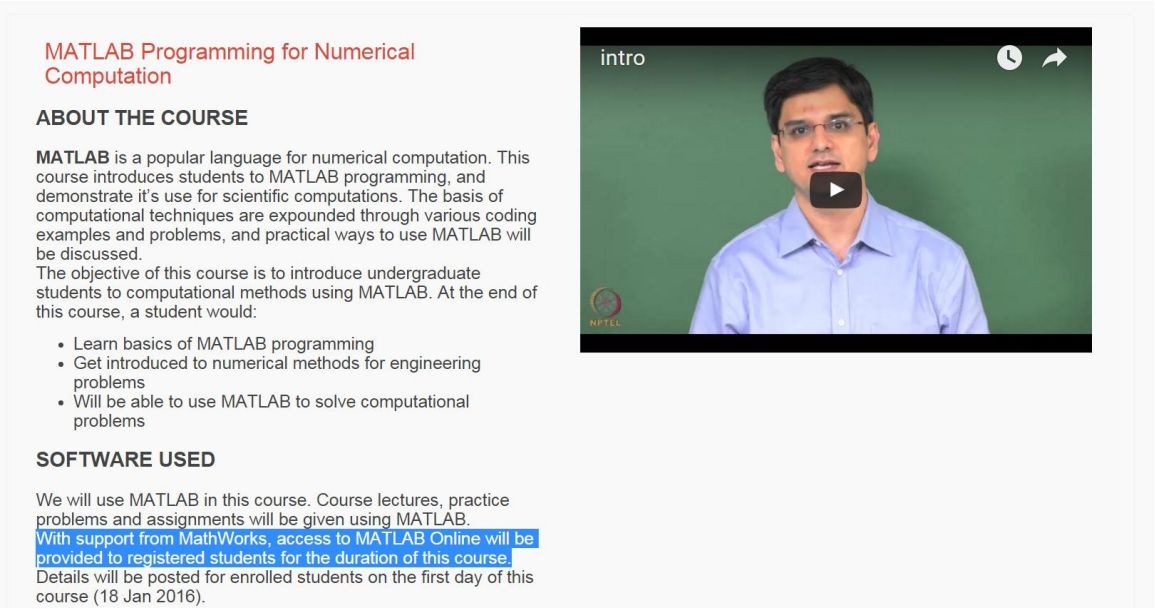
Support and Services

MOOCs

- Massive Open Online Courses (Coursera, edX)

- MathWorks MOOC Support
  - MATLAB Hosted Web Service Offering
  - Downloadable MATLAB License
  - Dedicated Engineering Team
  - MATLAB Learning Content

- NPTEL: National Programme on Technology Enhanced Learning
  - A joint initiative of the IITs and IISc

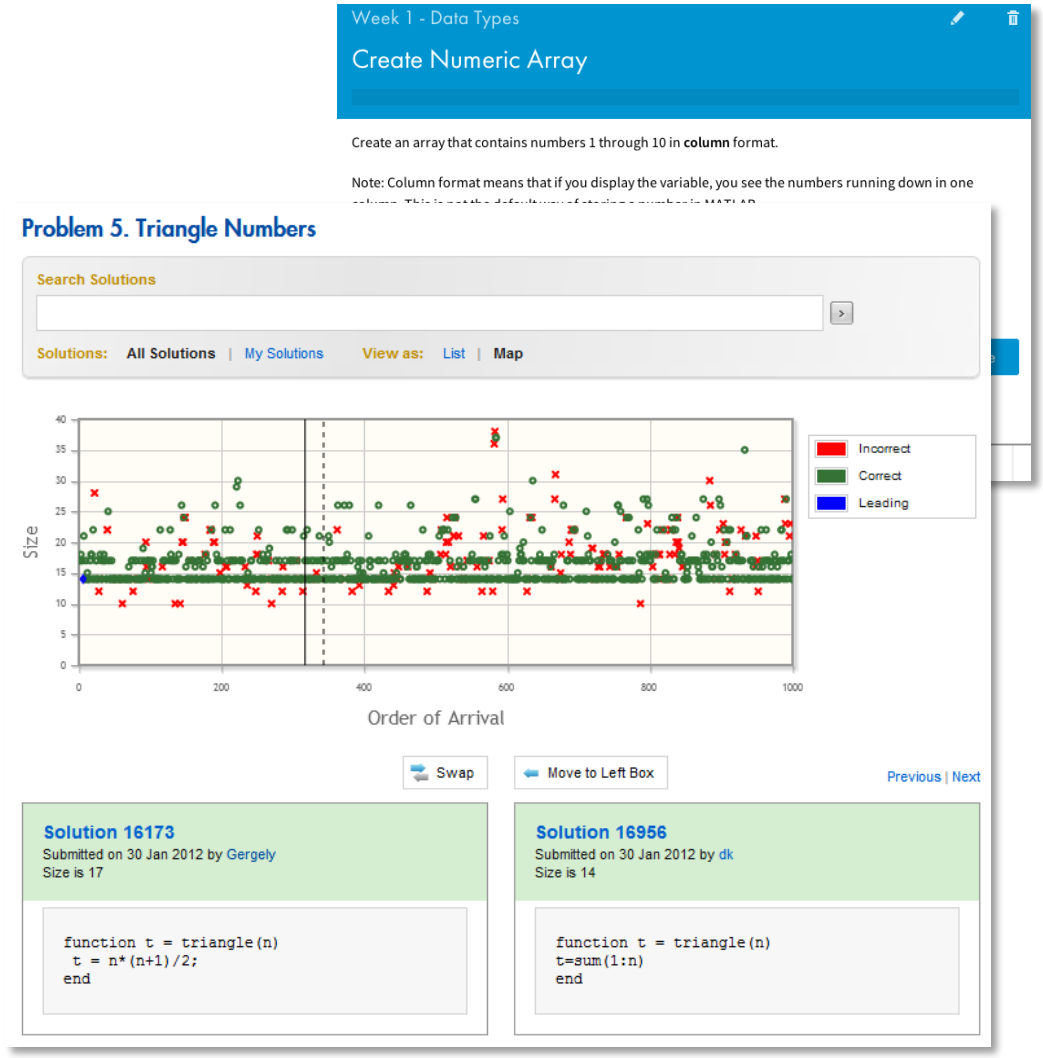


Course: MATLAB Programming for Numerical Computation
Duration: 8 weeks (Jan 18 – Mar 18 2016)
MATLAB Online access to ~11000 students registered for the course

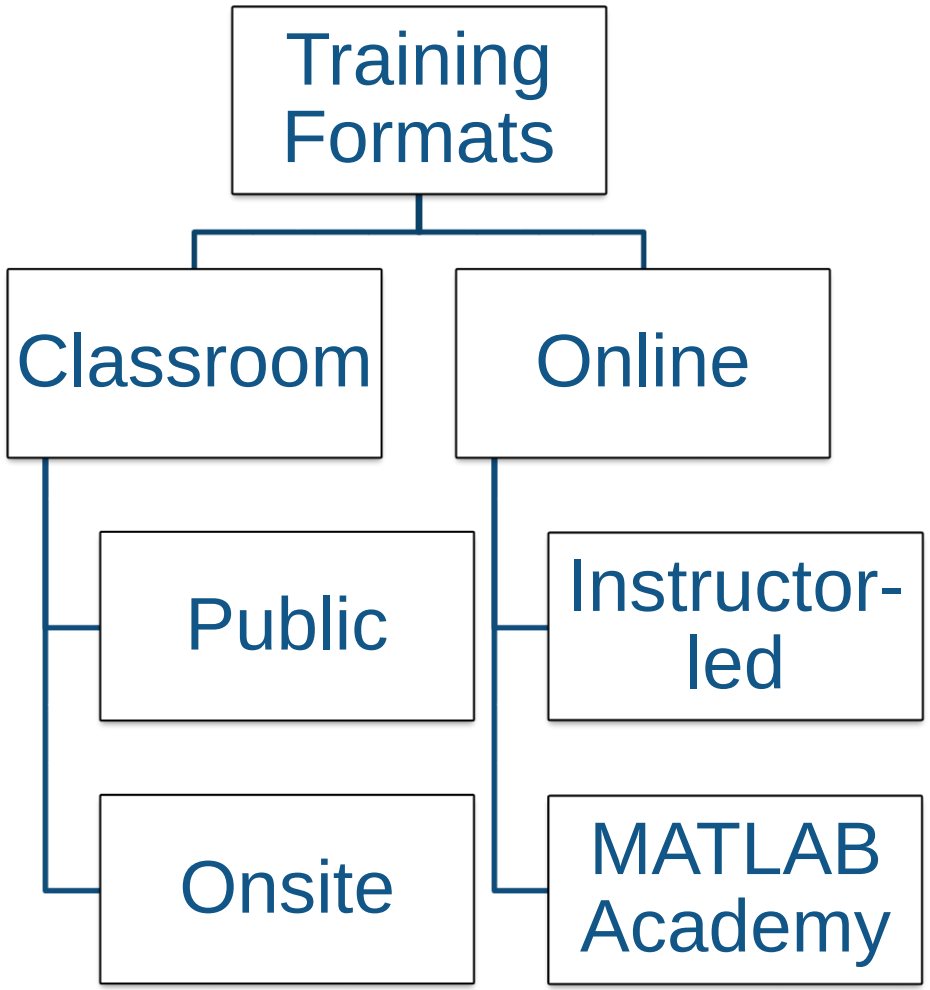
Cody Coursework™

coursework.mathworks.com

- Setup and automatically grade MATLAB assignments
- Students submit solutions online
- Prompt feedback
- Access to learning analytics and grading data
- Preloaded course content
  - 90 Cody Problems
  - 4 Course Areas (Signals, Control systems, Computational Math, Intro. MATLAB)



MathWorks Training Services



- Course offerings span entry-level to advanced topics
- Experienced expert instructors

Public Training Offerings

Upcoming Public Trainings *(see our website for full year schedule)*	Dates	Location
Signal Processing with MATLAB	May 2 -3	Bangalore
Image Processing with MATLAB	May 4 - 5	Bangalore
Computer Vision with MATLAB	May 6	Bangalore
MATLAB Fundamentals	May 16-18	Pune
Simulink for System and Algorithm Modeling	May 19-20	Pune
MATLAB Fundamentals	May 30 –June 1	Chennai
Simulink for System and Algorithm Modeling	June 2- 3	Chennai
Building Interactive Applications in MATLAB	June 13	Bangalore
Optimization Techniques in MATLAB	June 14	Bangalore
Statistical Methods in MATLAB	June 15 - 16	Bangalore
Machine Learning with MATLAB	June 17	Bangalore

Guaranteed to run

MathWorks Certified MATLAB Associate Exam

Bangalore:
29th Aug, 24th Oct, 19th Dec

Pune:
27th June

Support and Services Email: training@mathworks.in URL: http://www.mathworks.in/services/training

New Training Offerings

Training Courses

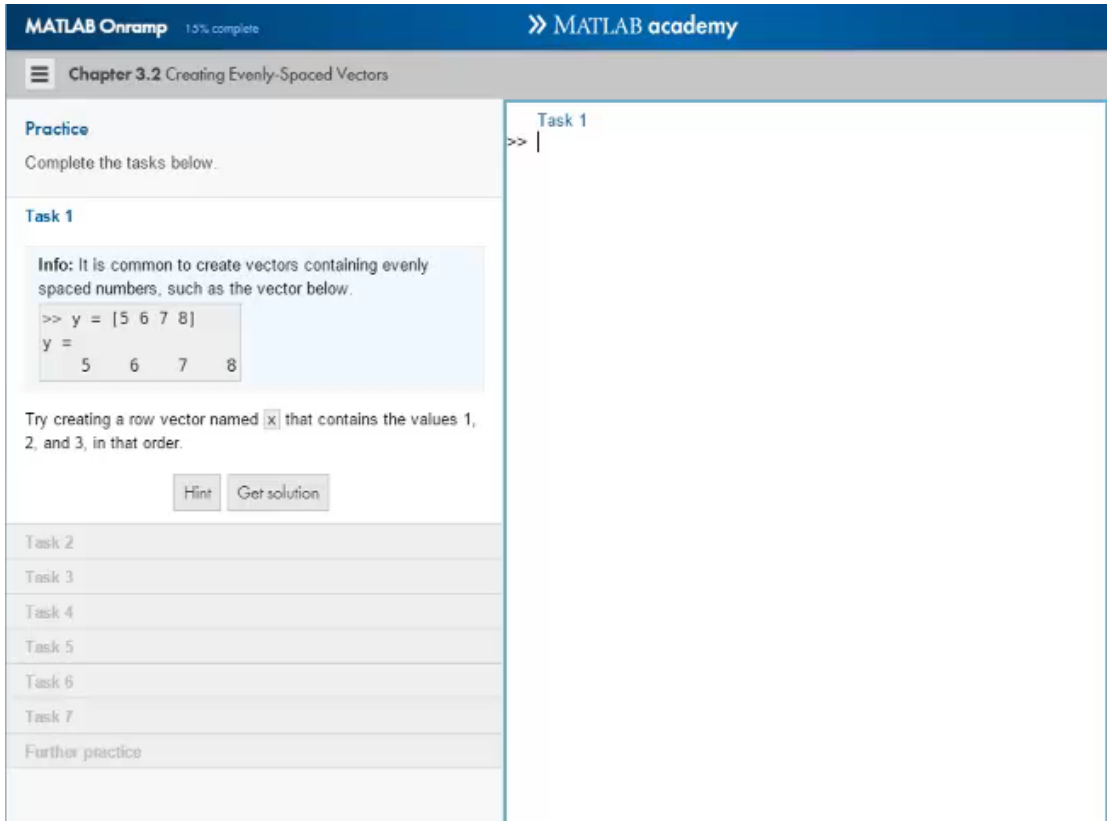
- Digital Signal Processing for FPGA
- Modeling Fluid Systems with Simscape
- Object-Oriented Programming with MATLAB

Training Modules

- System Objects
- Modeling RF Systems using MathWorks Tools
- Phased Array System Toolbox Fundamentals
- Code Generation for AUTOSAR Software Components
- Introduction to Database Toolbox

MATLAB Academy

- Online self-paced MATLAB training
  - Easy access from computers
  - Built-in access to MATLAB Online
  - On-demand access to content
- Scalable for individual or enterprise wide learning needs
- Free access to MATLAB On-Ramp (two hour content)



Student Competitions

- Formula Student India 2016
  - 50 Teams
- ABU Robocon India 2016
  - 105 Teams
  - MathWorks Innovation Prize Winners
    1. College of Engineering, Pune {Competition Runners Up}
    2. Mukesh Patel School of Technology Management and Engineering (MPSTME), Mumbai
    3. VSSUT, Sambalpur
- Complimentary software offering, workshops, online training, and technical guidance

Analysis and Visualization

Modeling and Simulation

Testing and Verification

Sharing and Collaboration

Performance

Support and Services

Thank You!