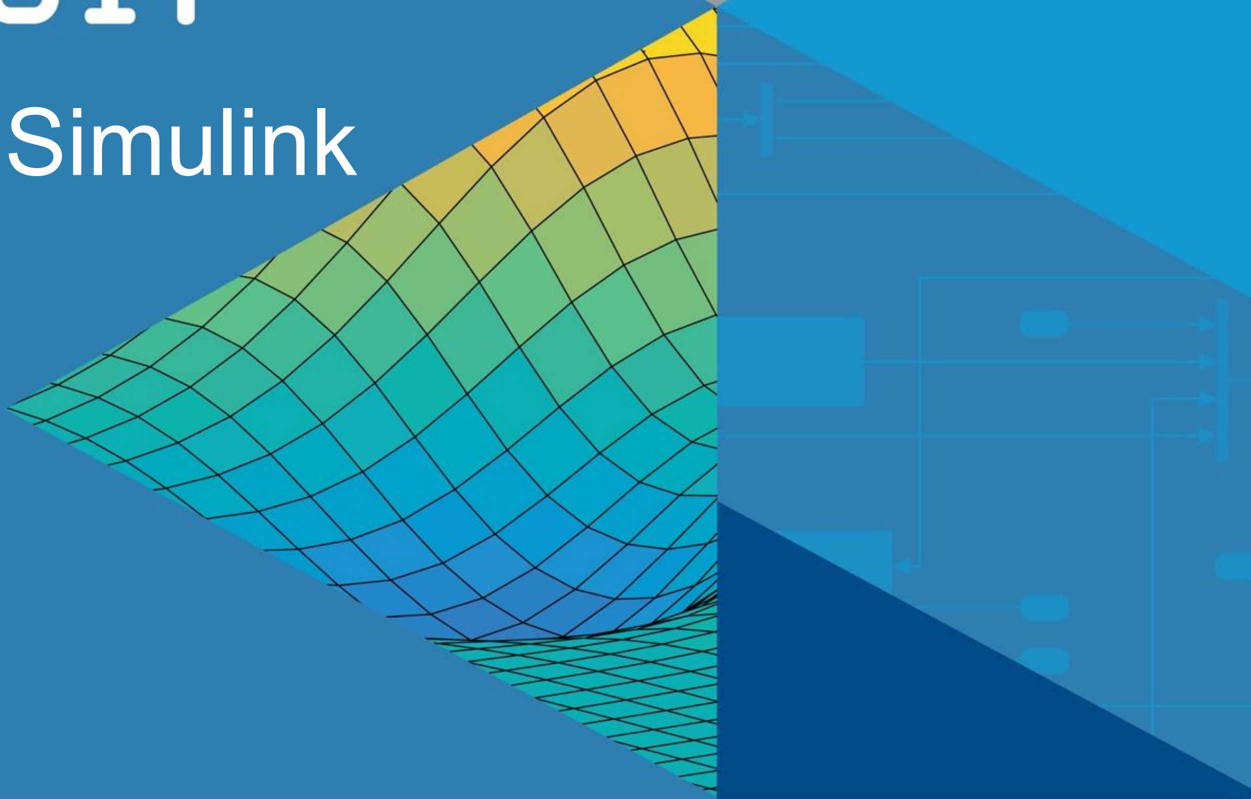
R2016b R2017a

MATLAB EXPO 2017

What’s New in MATLAB and Simulink



Paul Lambrechts & Paola Jaramillo

Platform Productivity

Getting your work done faster

Workflow Depth

Support for your entire workflow

Application Breadth

Products for the work you do

Platform Productivity

Getting your work done faster

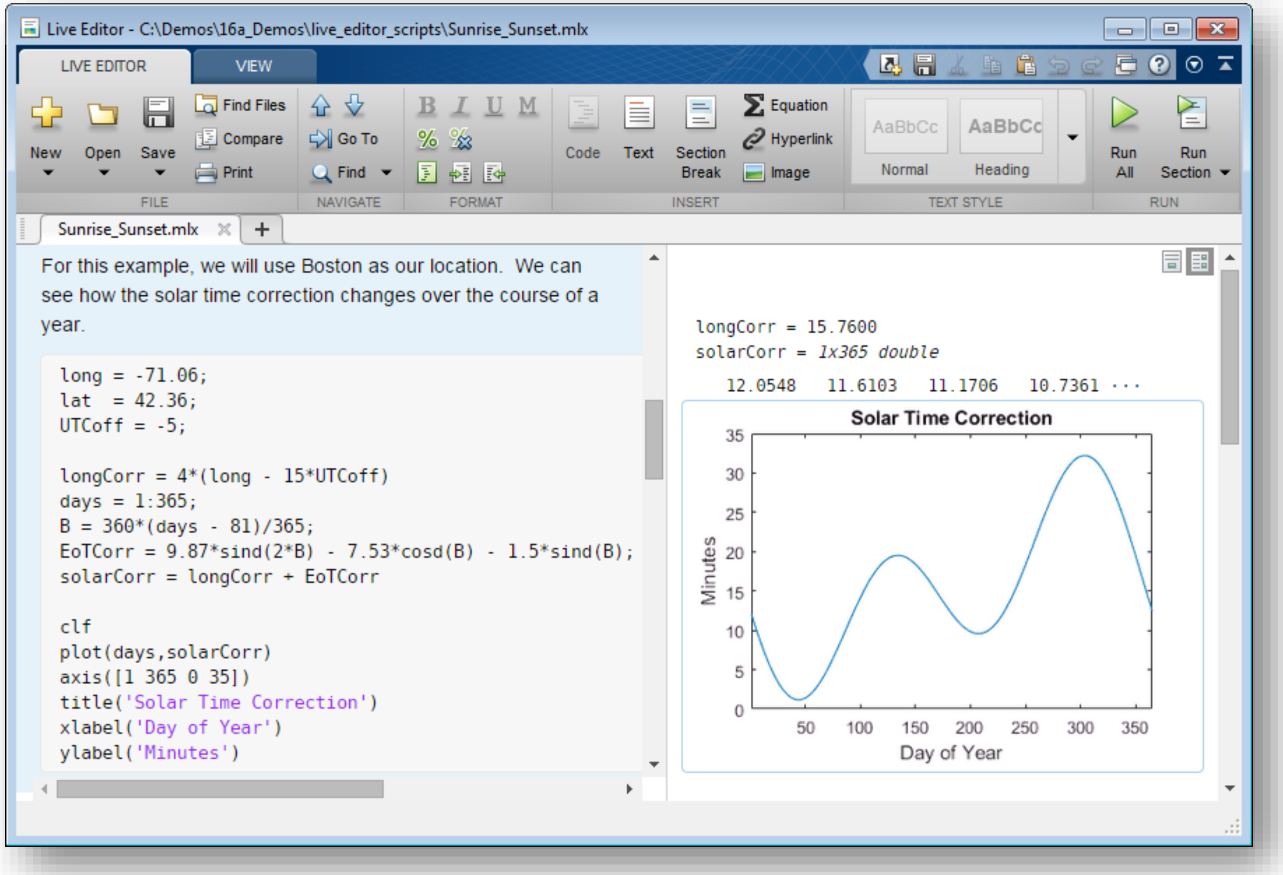
Change the Way You Work in MATLAB

R2016b R2017a

See results together with your MATLAB code in the Live Editor
(introduced in R2016a)

- Add equations, images, hyperlinks, and formatted text
- Present, share, and collaborate using interactive documents

- Interactive figure updates
  - Pan , zoom, and rotate axes
  - Interactive plot customization, with MATLAB code generation to automate work
- Interactive equation editor



For this example, we will use Boston as our location. We can see how the solar time correction changes over the course of a year.

```
long = -71.06;
lat  = 42.36;
UTCoff = -5;

longCorr = 4*(long - 15*UTCoff)
days = 1:365;
B = 360*(days - 81)/365;
EoTCorr = 9.87*sind(2*B) - 7.53*cosd(B) - 1.5*sind(B);
solarCorr = longCorr + EoTCorr

clf
plot(days,solarCorr)
axis([1 365 0 35])
title('Solar Time Correction')
xlabel('Day of Year')
ylabel('Minutes')
```

```
longCorr = 15.7600
solarCorr = 1x365 double

   12.0548   11.6103   11.1706   10.7361 ···
```

App Designer

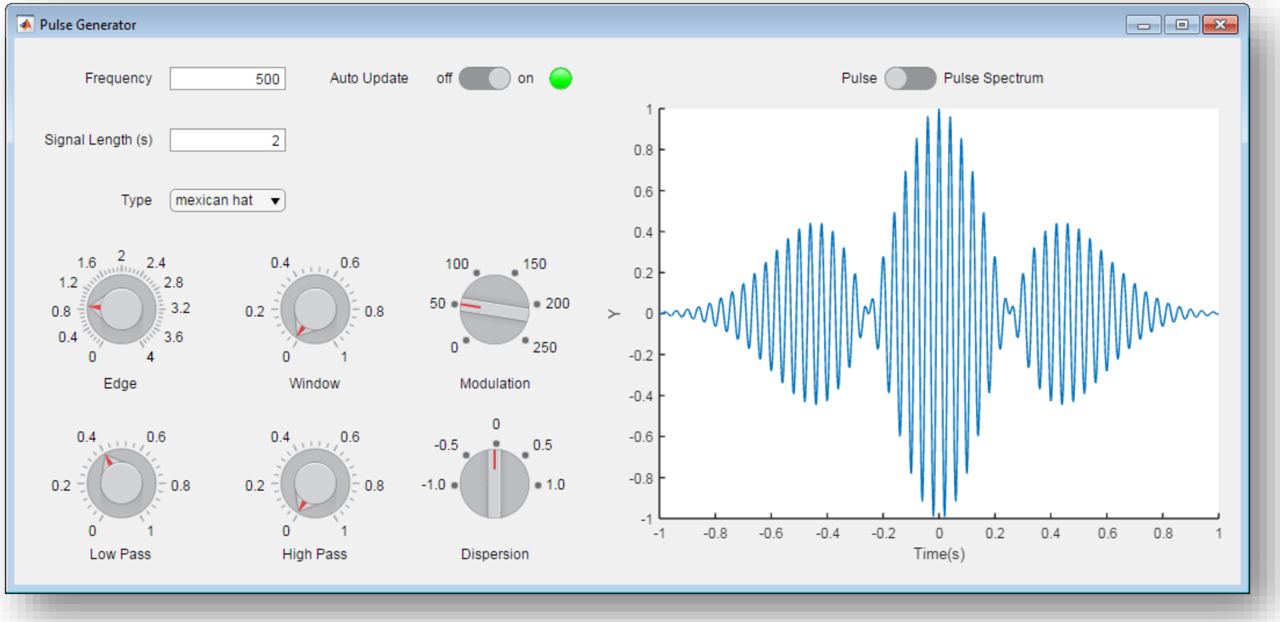
R2016b R2017a

Environment for building MATLAB apps

(introduced in R2016a)

- Full set of standard user interface components, as well as gauges, knobs, switches, and lamps
- Rich design environment for laying out apps
- Object-based code format for easily sharing data between parts of the app

- Enhancements include:
  - Majority of 2-D plots supported
  - Embed tabular displays using `uitable`
  - Zoom and pan plots in apps



Pulse Generator

Frequency 500

Signal Length (s) 2

Type mexican hat

Auto Update off on

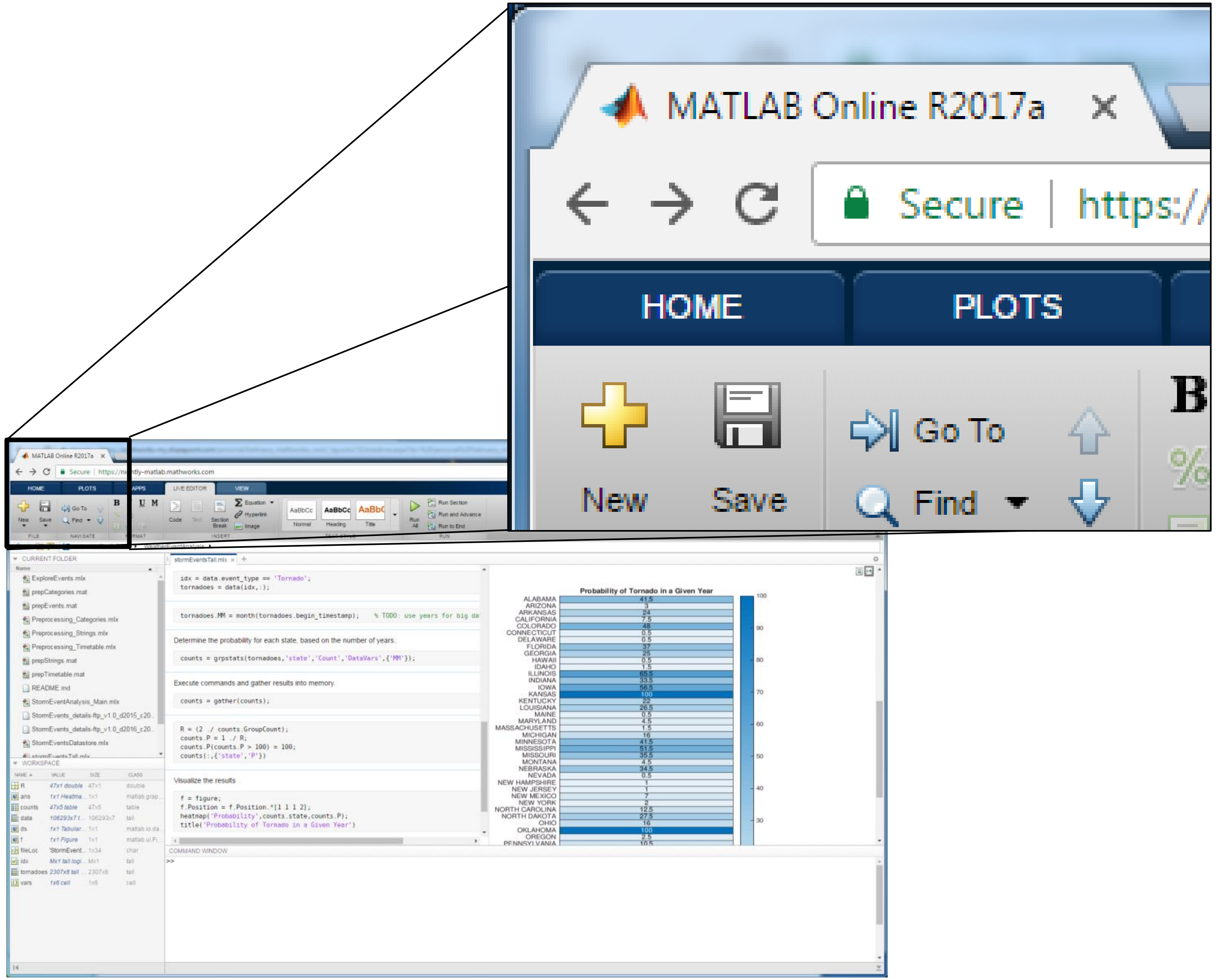
MATLAB Online

- Provides access to MATLAB desktop and full MATLAB language support from any standard web browser

- No downloads or installs

- Cloud Storage and synchronization via MATLAB Drive

- Log in here with your MathWorks Account: https://matlab.mathworks.com/



```
idx = data.event_type == 'Tornado';
tornadoes = data(idx,:);
```

```
tornadoes.MM = month(tornadoes.begin_timestamp);    % TODO: use years for big da
```

Determine the probability for each state, based on the number of years.

```
counts = grpstats(tornadoes,'state','Count','DataVars',{'MM'});
```

Execute commands and gather results into memory.

```
counts = gather(counts);
```

```
R = (2 ./ counts.GroupCount);
counts.P = 1 ./ R;
counts.P(counts.P > 100) = 100;
counts(:,{'state','P'})
```

Visualize the results

```
f = figure;
f.Position = f.Position.*[1 1 1 2];
heatmap('Probability',counts.state,counts.P);
title('Probability of Tornado in a Given Year')
```

Working with Data Just Got Easier

Numeric

double, single, …

logical

R2013b

categorical

datetime

duration

R2014b

calendarDuration

R2016b

timetable

Heterogeneous

structure

{ }
cell

R2013b

table

Text

c|h
char

{c|h}
cell string

R2016b

str
string

R2016b

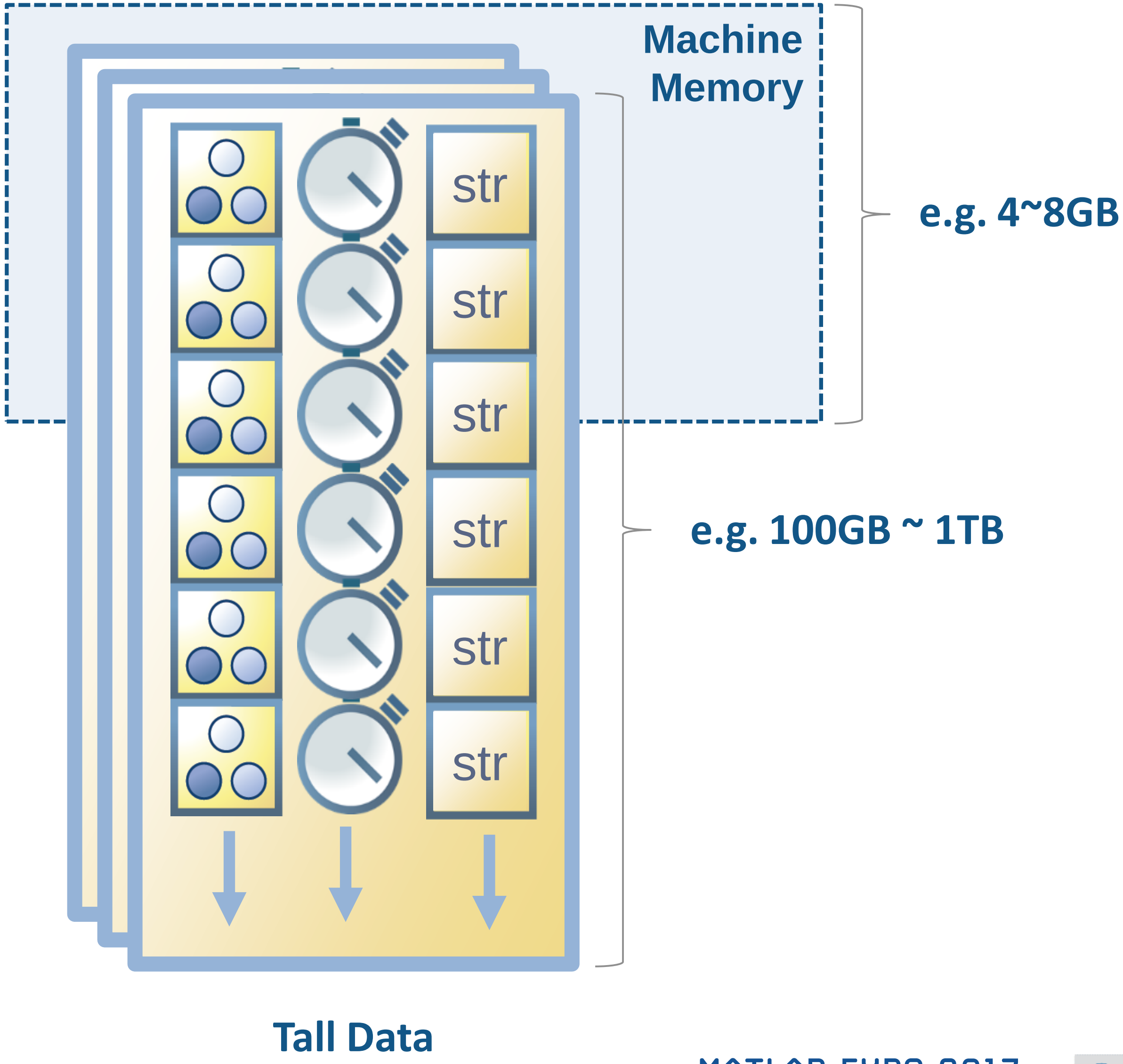
str
str
str
str

tall

Working with Big Data Just Got Easier

Use tall arrays to manipulate and analyze data that is too big to fit in memory

- Tall arrays let you use familiar MATLAB functions and syntax to work with big datasets, even if they don't fit in memory
- Support for hundreds of functions in MATLAB and Statistics and Machine Learning Toolbox
- Works with Spark + Hadoop Clusters

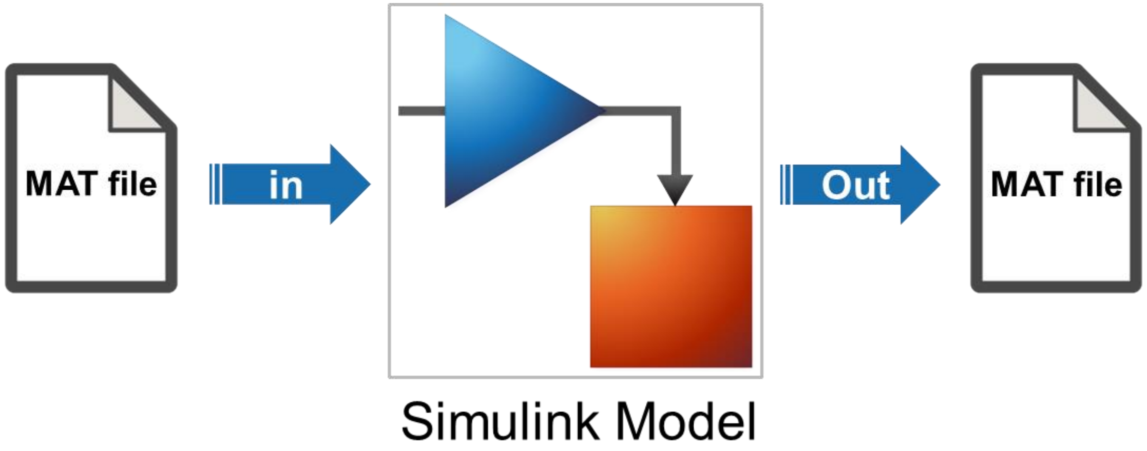


Working with Big Data Just Got Easier in Simulink Too

R2017a

Stream large input signals from MAT-files without loading the data into memory

- Provides a big data workflow for Simulink simulations
- Use big data in Simulink logging and loading
- Especially useful when running many simulations where data retrieved is too large to fit into memory

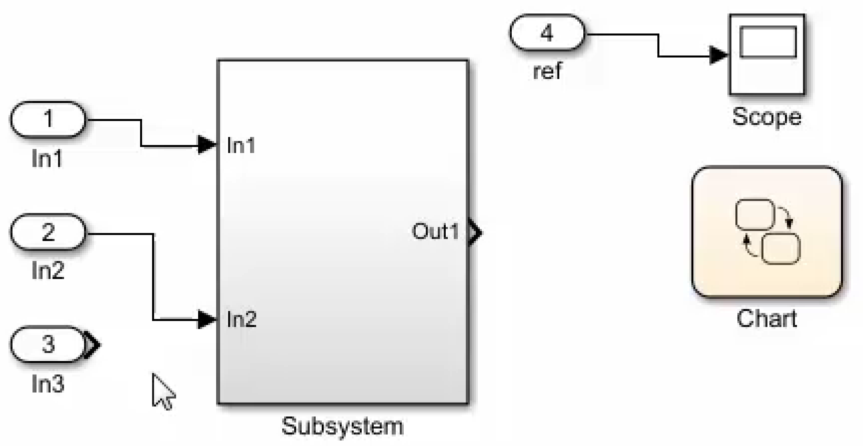


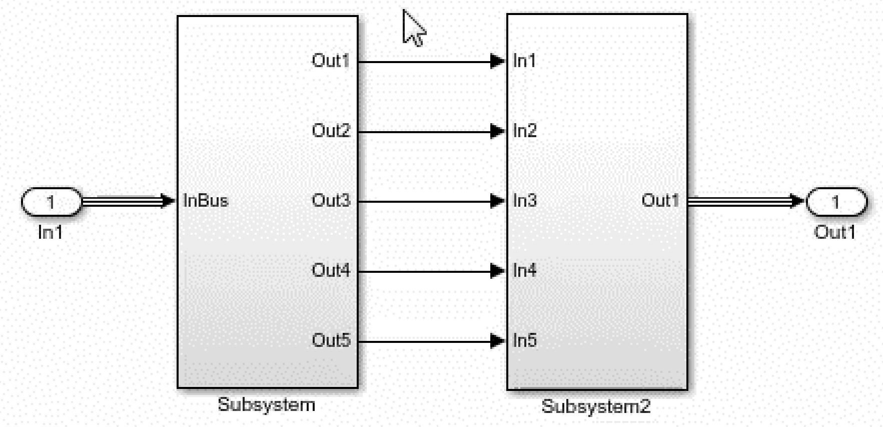
Create Your Models Faster

Use automatic port creation and reduced bus wiring

- Add inports and outports to blocks when routing signals

- Quickly group signals as buses and automatically create bus element ports for fewer signal lines



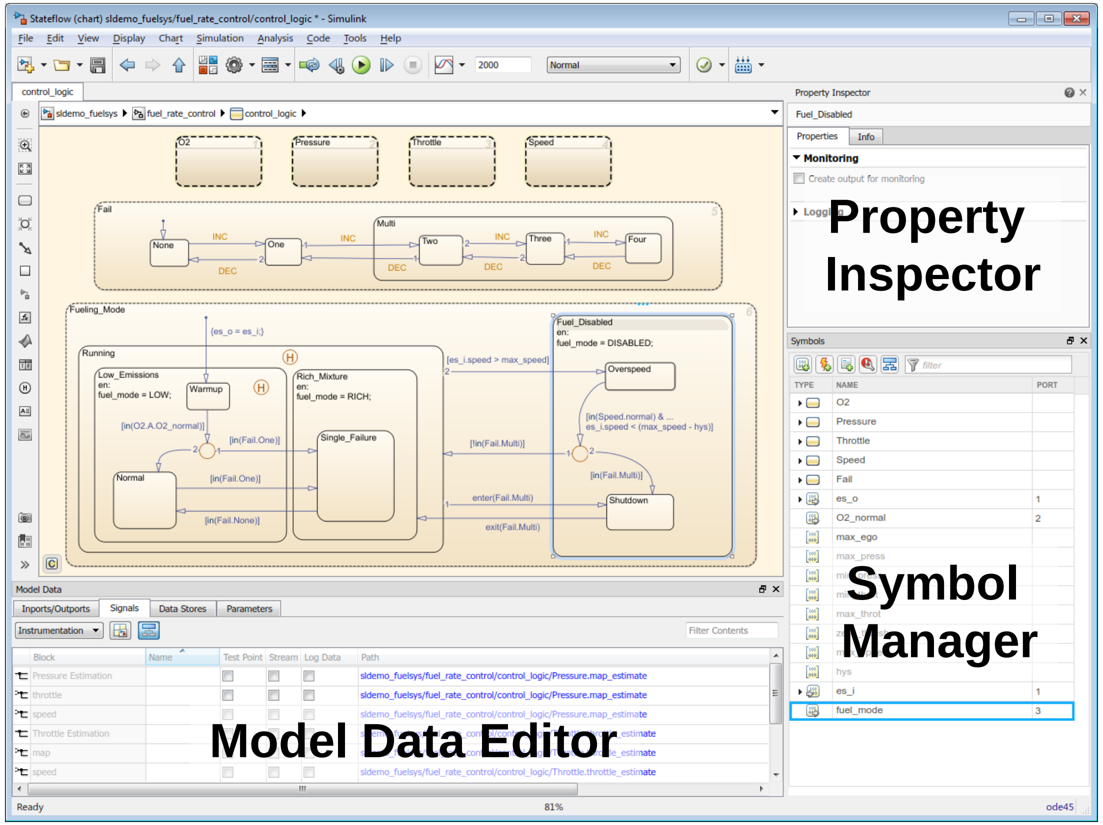


Define your Data Faster

R2016b

Reduces the need to open separate dialog boxes

- Model and block parameter data is now accessible within the main editor window
- Accessing and defining Stateflow data is also much easier



Property Inspector

Property Inspector

Fuel_Disabled

Properties | Info

Monitoring

□ Create output for monitoring

▸ Logging

Symbol Manager

Symbols

filter

TYPE	NAME	PORT
▸	O2	
▸	Pressure	
▸	Throttle	
▸	Speed	
▸	Fail	
▸	es_o	1
	O2_normal	2
	max_ego	
	max_press	
	min_press	
	min_throt	
	max_throt	
	zero_thresh	
	max_speed	
	hys	
▸	es_i	1
	fuel_mode	3

Model Data Editor

Model Data

Inports/Outports | Signals | Data Stores | Parameters

Instrumentation ▾

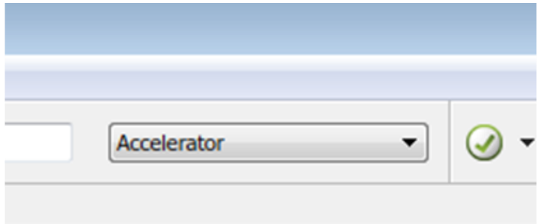
Filter Contents

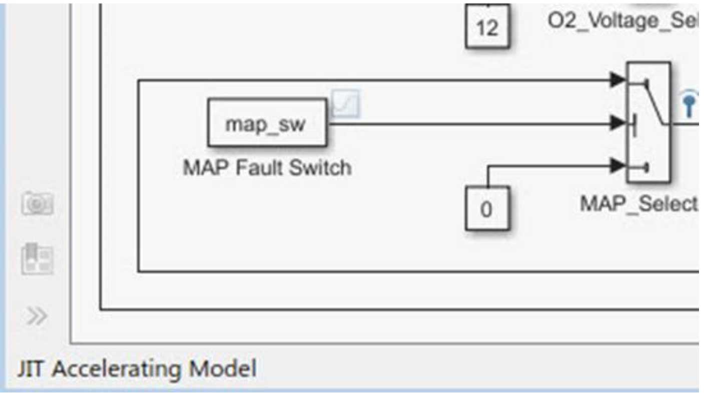
Block	Name	Test Point	Stream	Log Data	Path
Pressure Estimation		□	□	□	sldemo_fuelsys/fuel_rate_control/control_logic/Pressure.map_estimate
throttle		□	□	□	sldemo_fuelsys/fuel_rate_control/control_logic/Pressure.map_estimate
speed		□	□	□	sldemo_fuelsys/fuel_rate_control/control_logic/Pressure.map_estimate
Throttle Estimation		□	□	□	sldemo_fuelsys/fuel_rate_control/control_logic/Throttle.throttle_estimate
map		□	□	□	sldemo_fuelsys/fuel_rate_control/control_logic/Throttle.throttle_estimate
speed		□	□	□	sldemo_fuelsys/fuel_rate_control/control_logic/Throttle.throttle_estimate

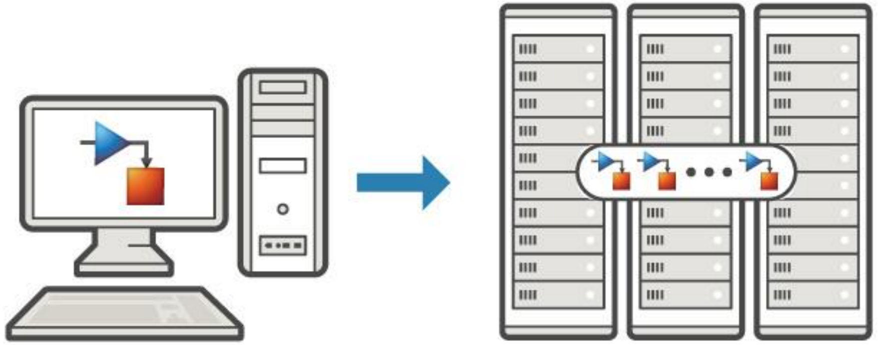
Simulate your Model Faster

Use JIT acceleration and the new `parsim` command to speed up your simulations

- Quickly build the top-level model for improved performance when running simulations in Accelerator mode
- Directly run multiple parallel simulations from the `parsim` command
- Especially use for Monte Carlo simulations and Design of Experiments







Parallel Computing Toolbox
MATLAB Distributed Computing Server

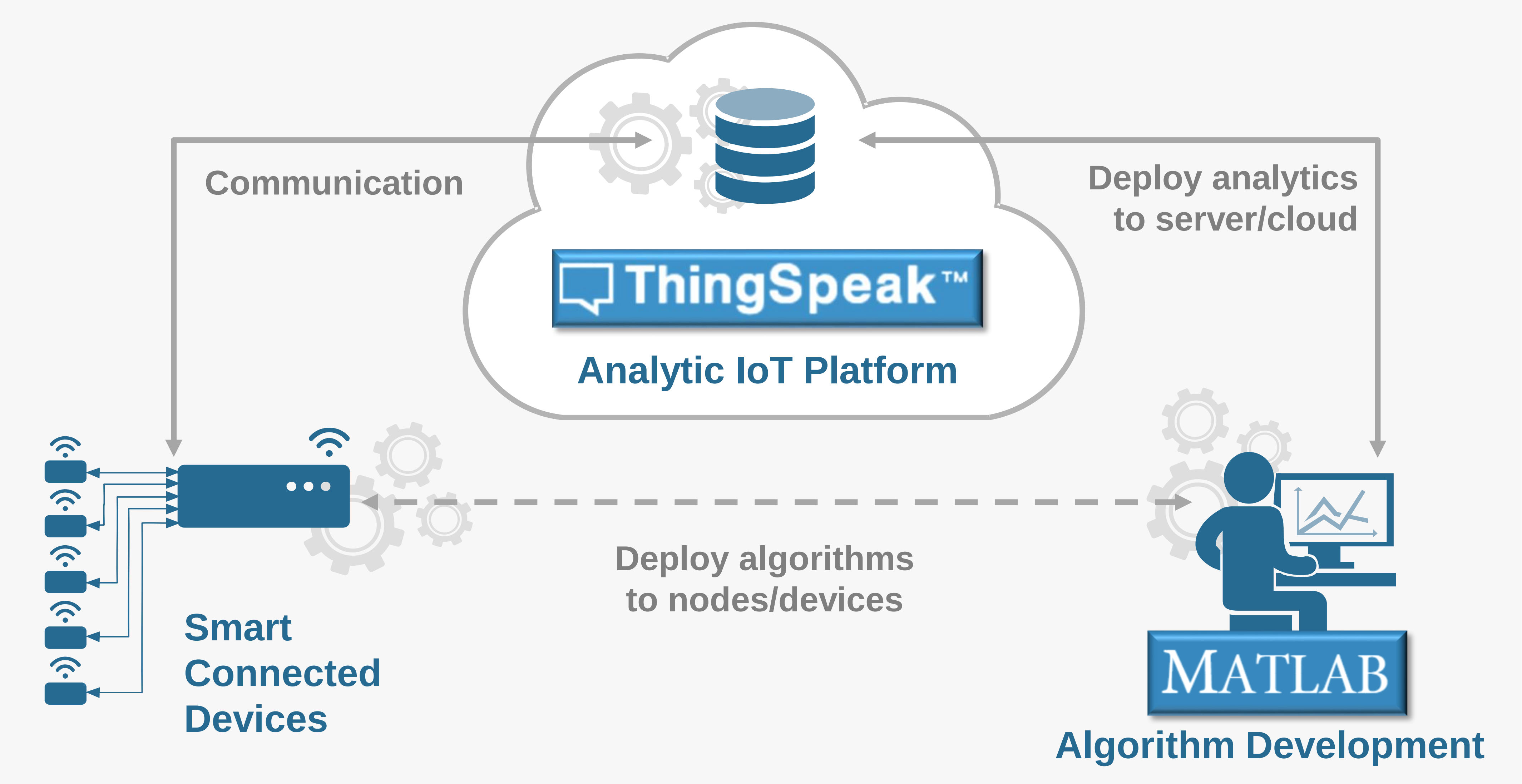
Platform Productivity

Getting your work done faster

Workflow Depth

Support for your entire workflow

Connecting MATLAB Analytics to IoT Systems



Communication

Deploy analytics to server/cloud

Analytic IoT Platform

Deploy algorithms to nodes/devices

Smart Connected Devices

Algorithm Development

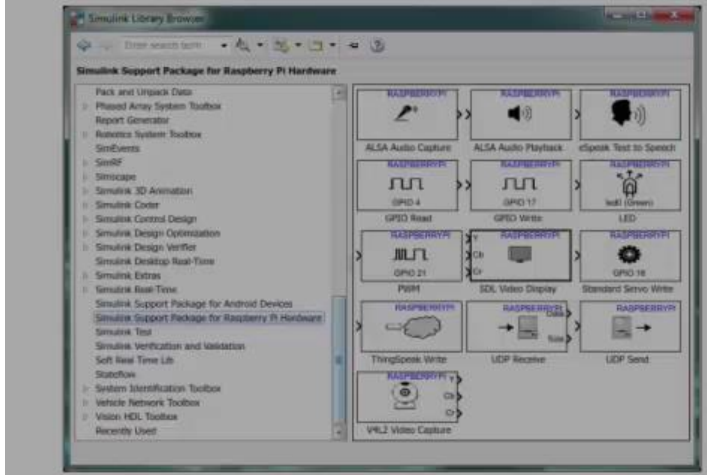
New Hardware Support

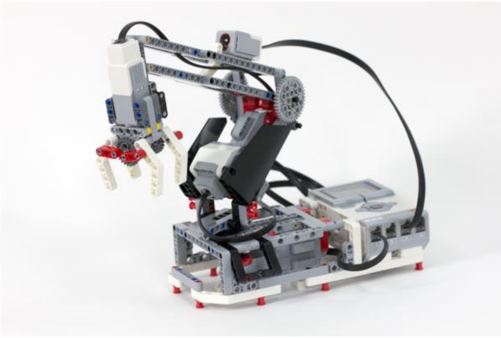
R2016b

Run Simulink models on low-cost hardware devices

- Run Simulink models on Raspberry Pi 3 and Google Nexus devices

- Adds to existing hardware support, including LEGO, Arduino, iPhone, and Android devices

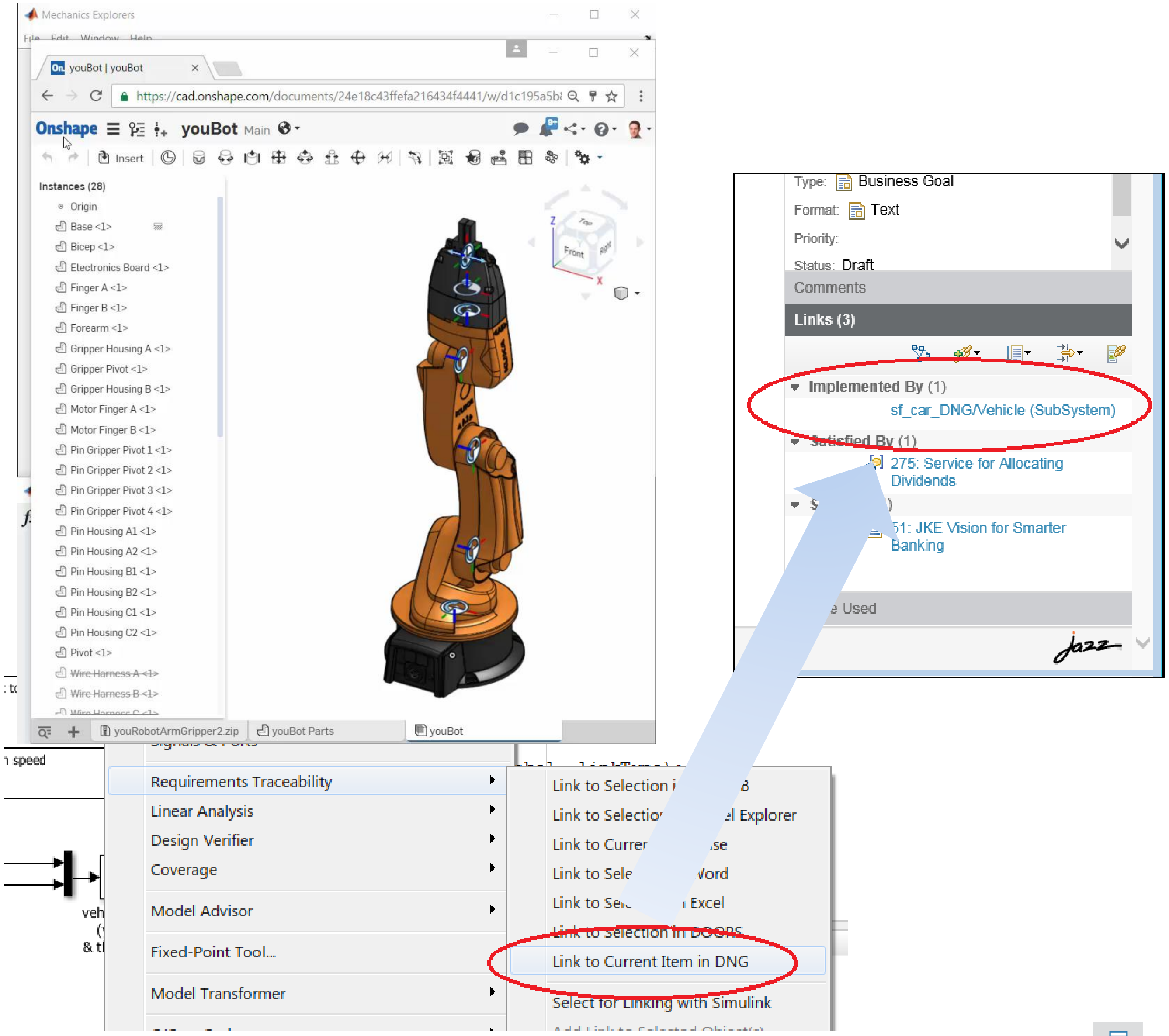




More Connections to 3rd Party Tools

Connect your models to Onshape and DOORS Next Generation

- Convert an Onshape CAD assembly into a Simscape Multibody model
- Link and trace model elements to requirements in DOORS Next Generation



Type: Business Goal
Format: Text
Priority:
Status: Draft

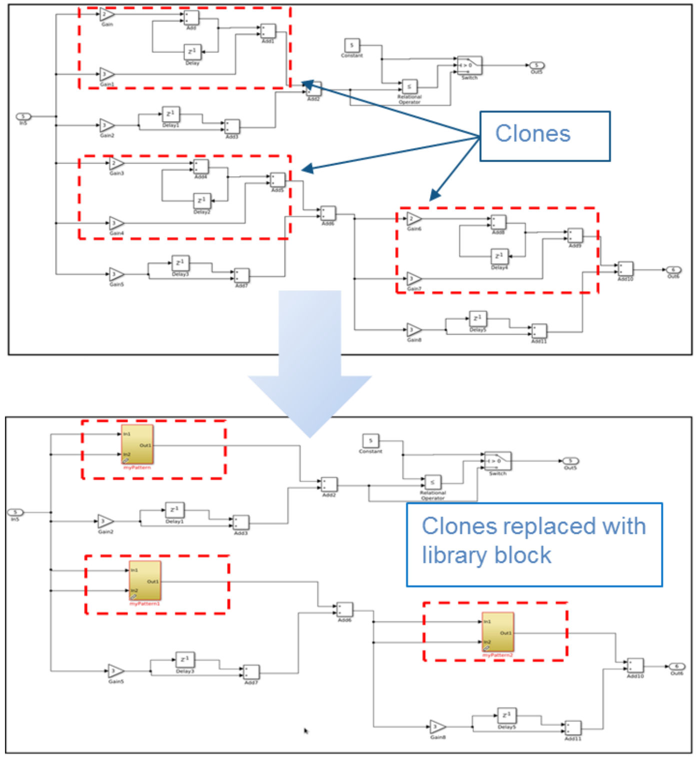
Simscape Multibody
Simulink Verification and Validation

R2017a

Efficient Code Generation

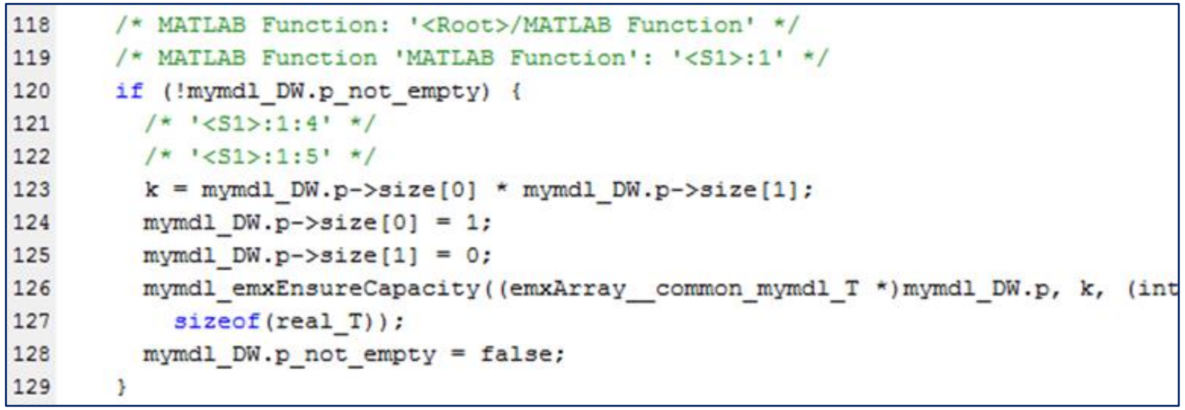
Improve code quality with clone detection and dynamic memory allocation

- Refactor repeating library patterns and subsystem clones
  - Reduces redundancy
  - Improves reusability
- Generate C code that uses dynamic memory allocation from MATLAB Function blocks
  - Allocate memory as needed at runtime



Clones

Clones replaced with library block



```
/* MATLAB Function: '<Root>/MATLAB Function' */
/* MATLAB Function 'MATLAB Function': '<S1>:1' */
if (!mymdl_DW.p_not_empty) {
  /* '<S1>:1:4' */
  /* '<S1>:1:5' */
  k = mymdl_DW.p->size[0] * mymdl_DW.p->size[1];
  mymdl_DW.p->size[0] = 1;
  mymdl_DW.p->size[1] = 0;
  mymdl_emxEnsureCapacity((emxArray__common_mymdl_T *)mymdl_DW.p, k, (int
    sizeof(real_T));
  mymdl_DW.p_not_empty = false;
}
```

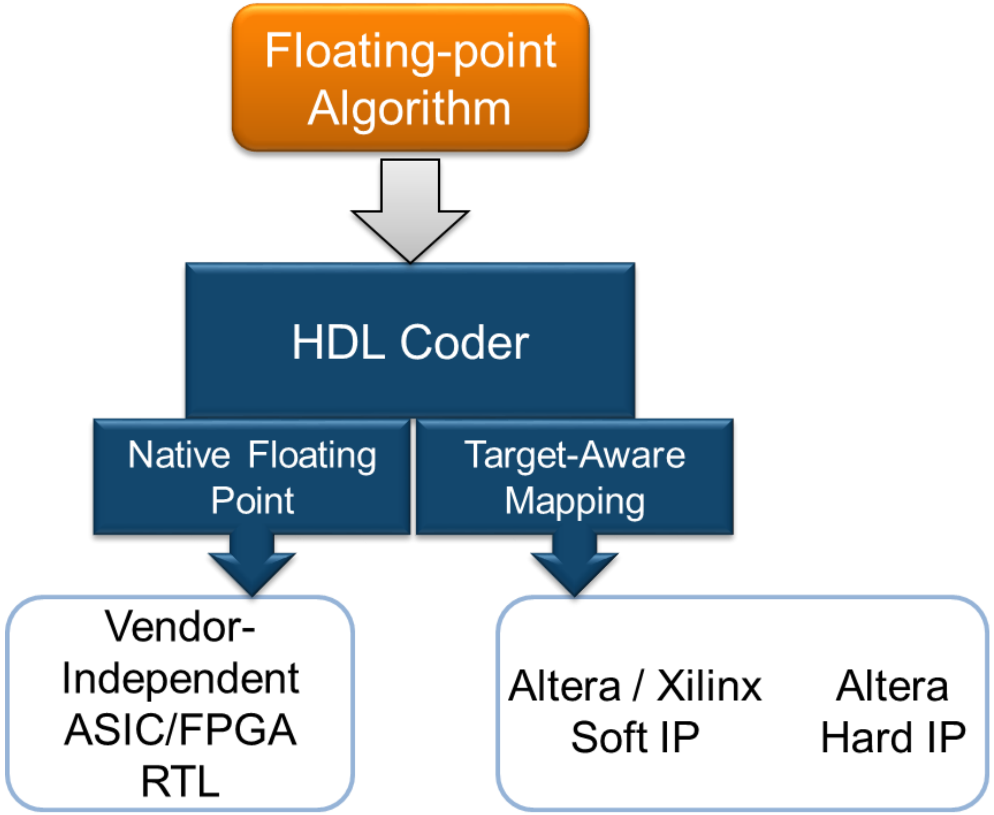
Embedded Coder

Floating Point HDL Code Generation

R2016b

Generate HDL code directly from single-precision floating point Simulink models

- Generates native floating-point arithmetic HDL code complying to IEEE-754 standard
- Optimize for speed versus area using custom block-level settings
- Balance numerical accuracy versus hardware resource usage by mixing integer, fixed-point, and floating point operations.



Complying with Safety-Critical Standards

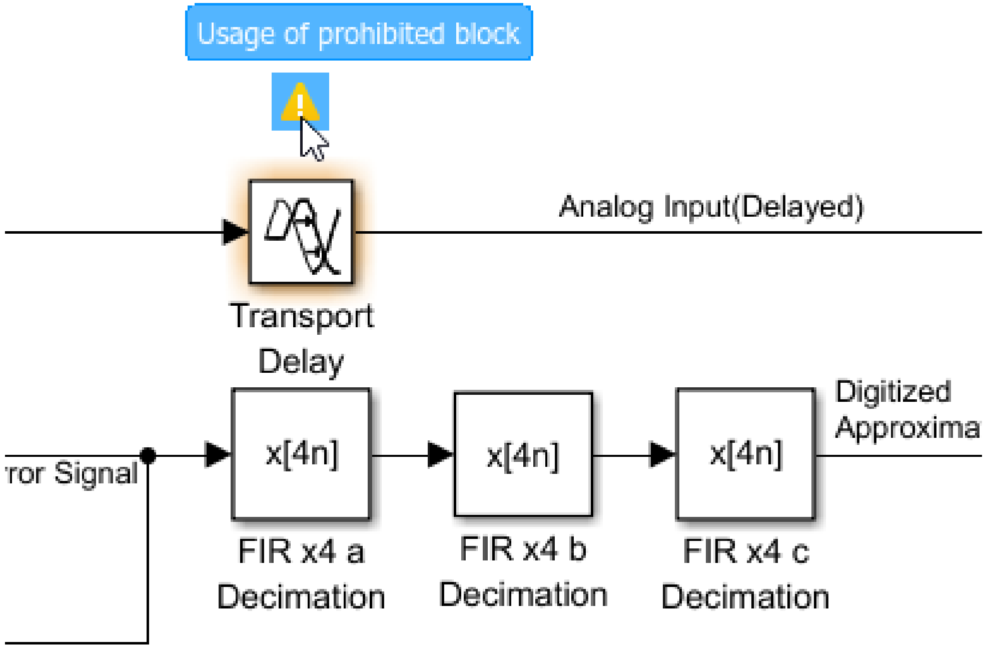
R2016b

Detect and fix standards compliance issues at design time with edit-time checking

- Quickly address compliance and modeling standards issues before running the model

- For example, check for prohibited blocks or block names

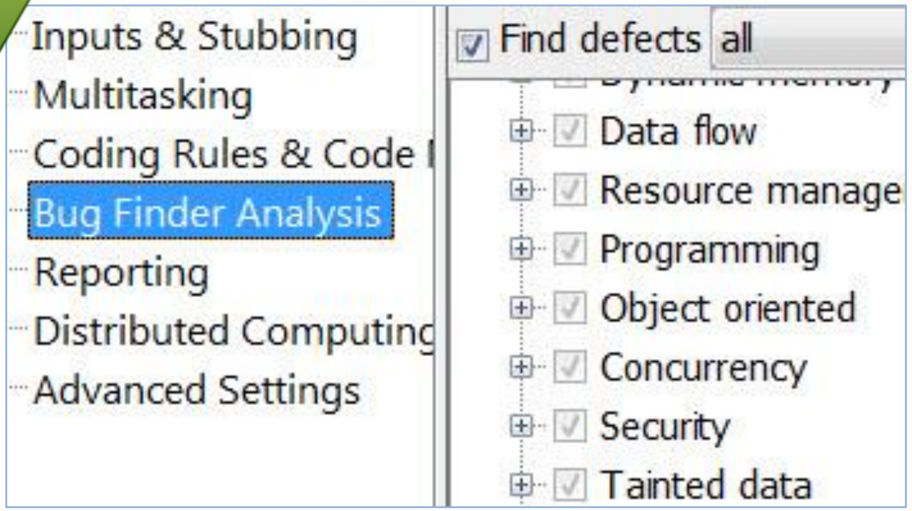
- Especially useful for applications that require compliance to standards such as DO-178, ISO 26262, IEC 62304



Code Verification

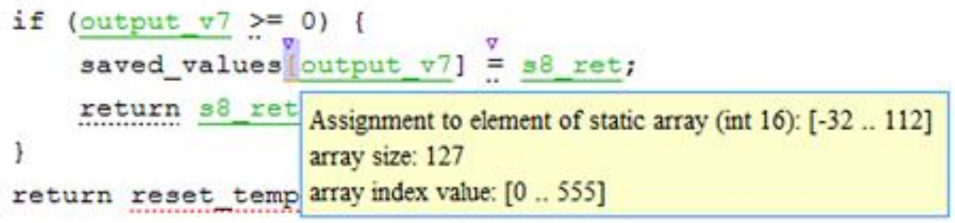
Detect and prove the absence of run-time errors in your source code using static analysis

- Identify CERT C violations using defect checkers and coding rules
- Detect security vulnerabilities highlighted by the CERT C standard
- Addresses growing concern over software security with the rise in system connectivity



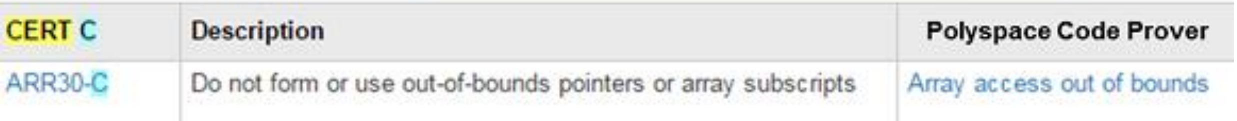
☑ Find defects all

- ☑ Data flow
- ☑ Resource manage
- ☑ Programming
- ☑ Object oriented
- ☑ Concurrency
- ☑ Security
- ☑ Tainted data



```
if (output_v7 >= 0) {
    saved_values[output_v7] = s8_ret;
    return s8_ret
}
return reset_temp
```

Assignment to element of static array (int 16): [-32 .. 112]
array size: 127
array index value: [0 .. 555]



CERT C	Description	Polyspace Code Prover
ARR30-C	Do not form or use out-of-bounds pointers or array subscripts	Array access out of bounds

Platform Productivity

Getting your work done faster

Workflow Depth

Support for your entire workflow

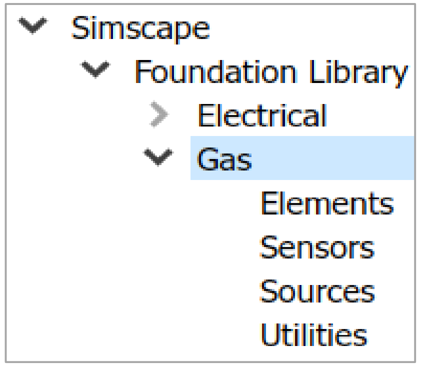
Application Breadth

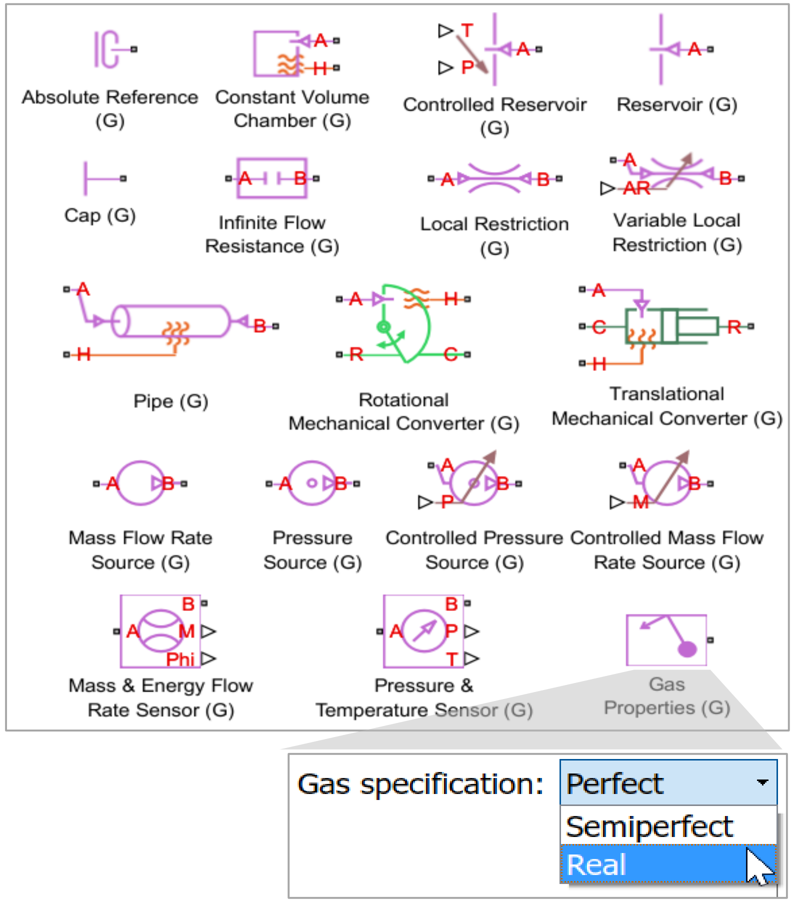
Products for the work you do

Gas Domain and Block Library

Model gas systems with various levels of idealization

- Pneumatic actuation
- Gas transport in pipe networks
- Gas turbines for power generation
- Air cooling of thermal components
- Perfect gas, semiperfect gas, or real gas




Absolute Reference (G)
Constant Volume Chamber (G)
Controlled Reservoir (G)
Reservoir (G)
Cap (G)
Infinite Flow Resistance (G)
Local Restriction (G)
Variable Local Restriction (G)
Pipe (G)
Rotational Mechanical Converter (G)
Translational Mechanical Converter (G)
Mass Flow Rate Source (G)
Pressure Source (G)
Controlled Pressure Source (G)
Controlled Mass Flow Rate Source (G)
Mass & Energy Flow Rate Sensor (G)
Pressure & Temperature Sensor (G)
Gas Properties (G)
A
B
H
T
P
AR
R
C
M
Phi

Gas specification: Perfect

Semiperfect

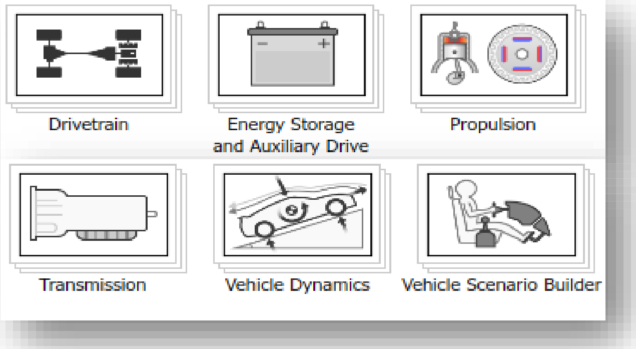
Real

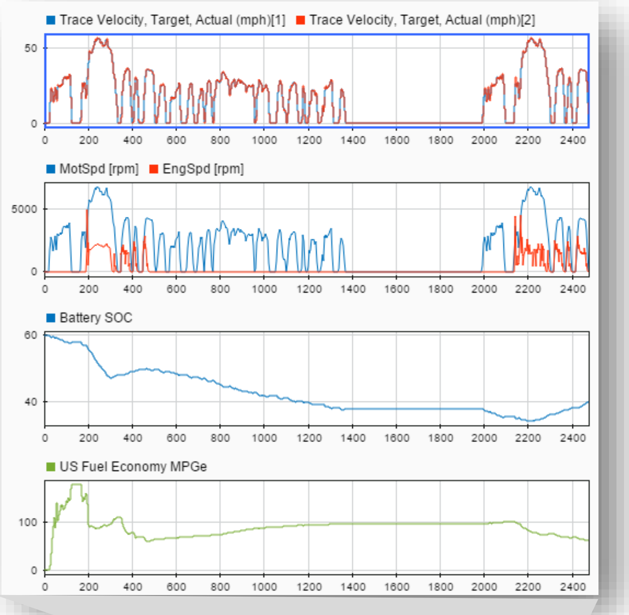
Model and simulate automotive powertrain systems

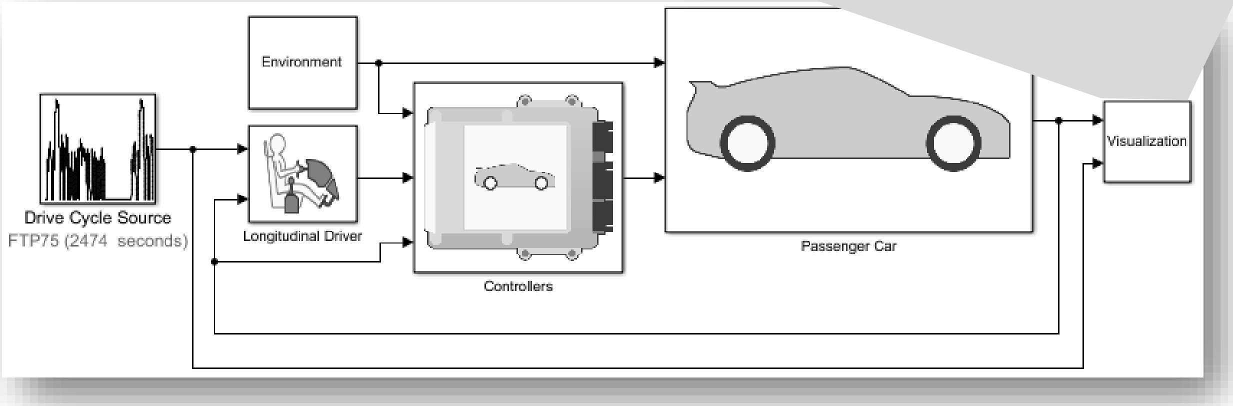
R2017a

Accelerate your powertrain controls development process

- Simulate engine and controller subsystems, transmission assemblies, battery packs
- Use pre-built conventional, EV, and HEV vehicle models that can be parameterized and customized
- Run fuel economy and performance simulations
- Deploy fast-running models onto HIL systems
- Connect to 3rd party engine models for specific components of the system

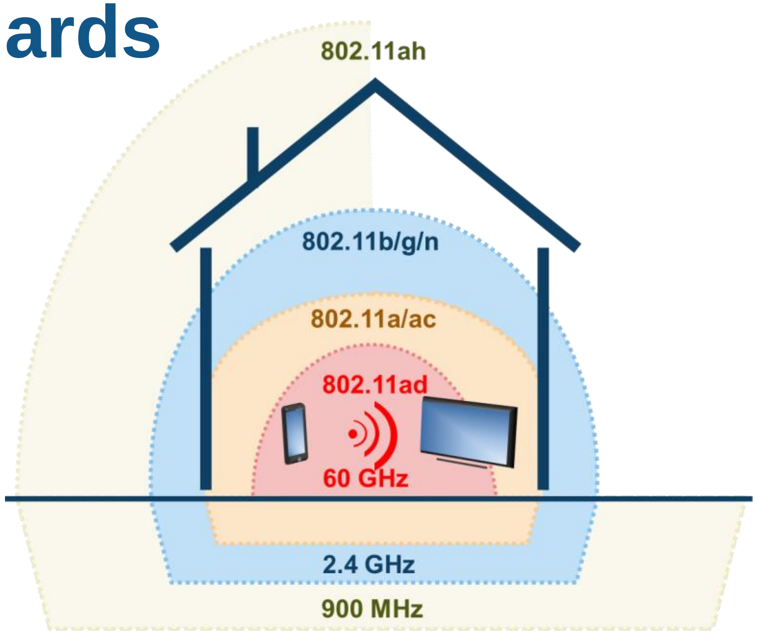






Powertrain Blockset

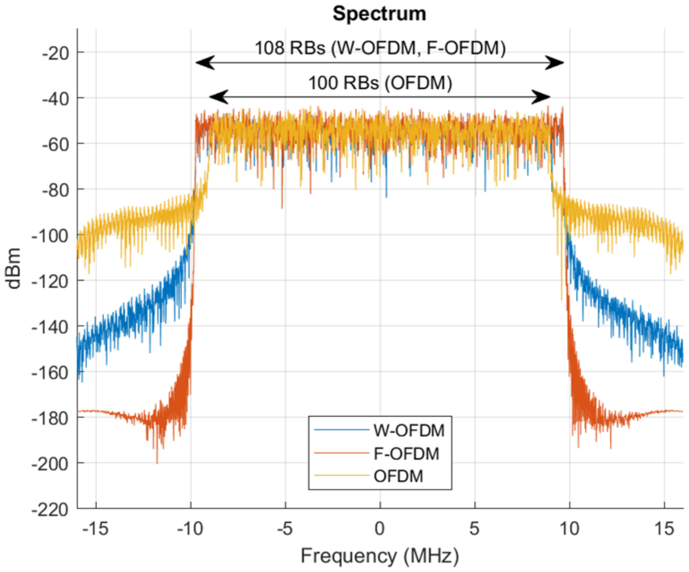
Support for the Latest Wireless Standards



Generate IEEE 802.11ad compliant waveforms and simulate 3GPP 5G radio technologies

- IEEE 802.11ad is a new Wi-Fi standard intended for high data rate short range communication
  - e.g., streaming video between a phone and a TV

- A new 5G library is available to explore the behavior and performance of new proposed 5G radio technologies

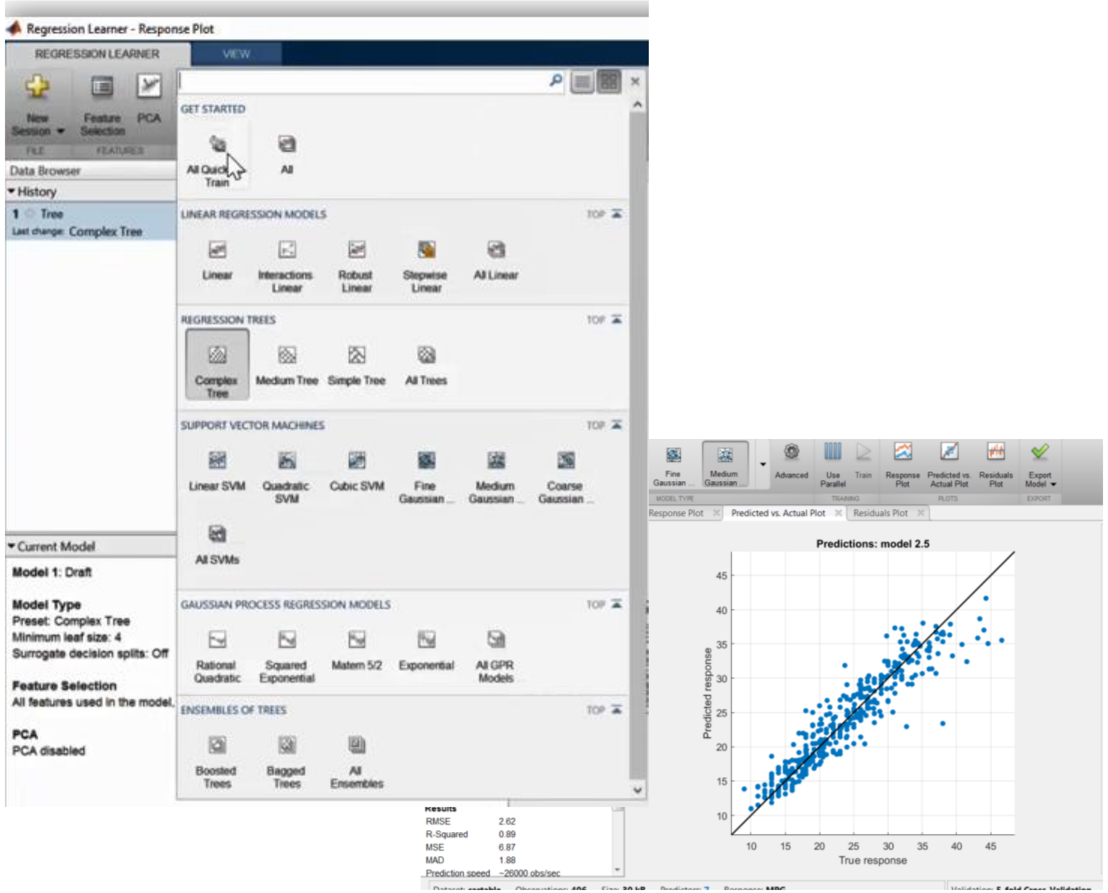


WLAN System Toolbox
LTE System Toolbox

Machine Learning

“Learn" information directly from data without assuming a predetermined equation as a model

- Regression Learner app
  - Choose from multiple algorithms
  - Train and validate multiple models
  - Assess model performance, compare results, and choose the best model
- Code generation
  - Generate C code for predictive models that can be deployed directly to hardware devices



Current Model

Model 1: Draft

Model Type
Preset: Complex Tree
Minimum leaf size: 4
Surrogate decision splits: Off

Feature Selection
All features used in the model.

PCA
PCA disabled

Results

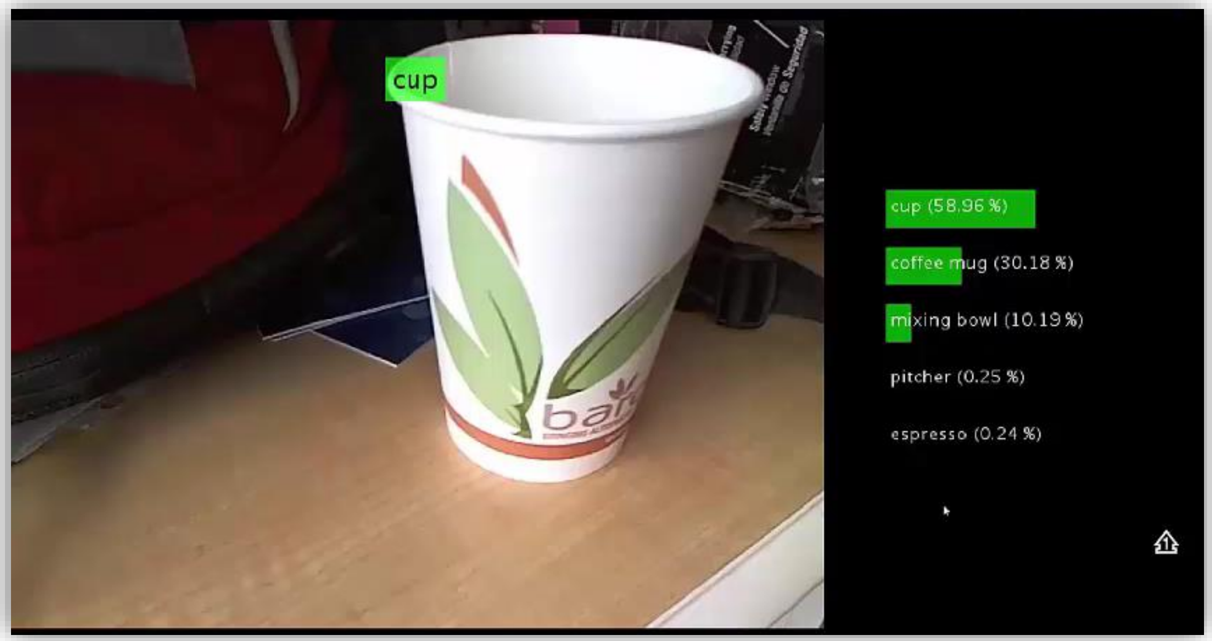
RMSE	2.62
R-Squared	0.89
MSE	6.87
MAD	1.88
Prediction speed	~26000 obs/sec

Deep Learning

R2016b R2017a

Apply deep learning to computer vision problems

- Configure and train models using object detection algorithms *(R-CNN, Fast R-CNN, Faster R-CNN)*
- Leverage pretrained models for transfer learning *(AlexNet, VGG-16, VGG-19)*
- Import models from Caffe
- Train networks using multiple GPUs *(including on Amazon EC2)*

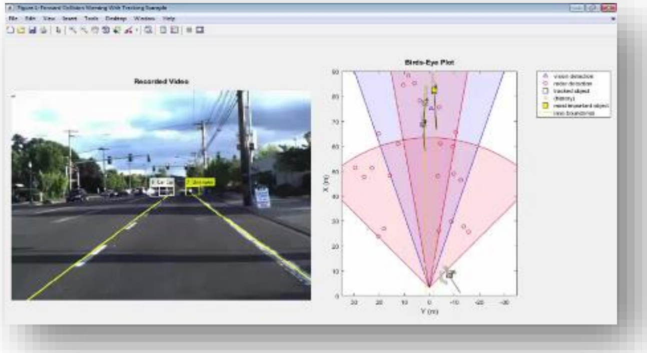


Neural Network Toolbox
Computer Vision System Toolbox

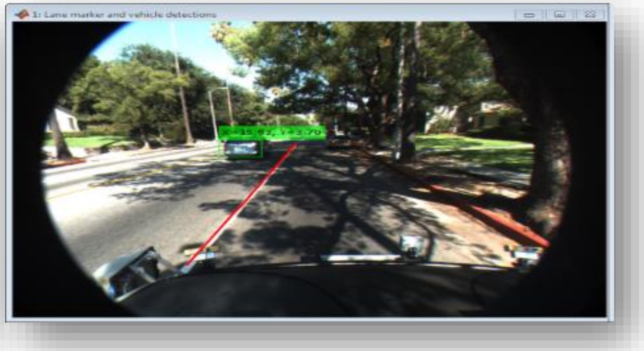
Autonomous Driving Systems

Design, simulate, and test ADAS and autonomous driving systems

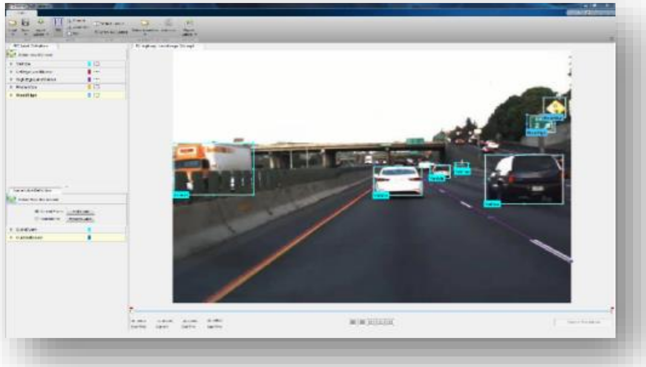
- Algorithm development
  - Sensor Fusion
  - Computer Vision
  - Deep learning
- Visualization tools
- Testing and verification
  - Ground Truth Labeling App
  - Traffic scenario generation



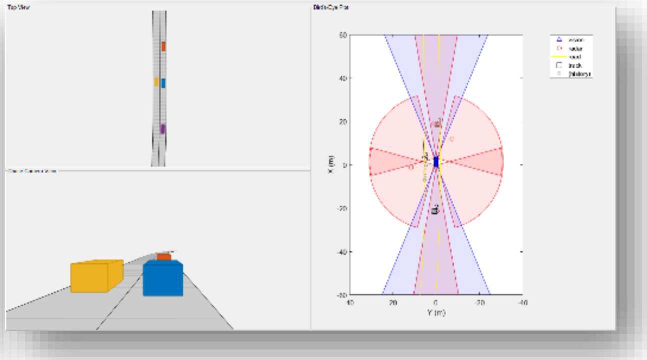
Sensor Fusion



Computer Vision & Deep Learning



Ground truth labeling



Scenario Generation

Automated Driving System Toolbox

What’s New in MATLAB and Simulink?

Platform Productivity

- Live Editor
- MATLAB Apps
- New (big) data types
- Modeling enhancements
- Release adoption

Workflow Depth

- Enterprise applications
- IoT systems
- 3rd party tool integration
- Standards compliance
- Code generation and verification

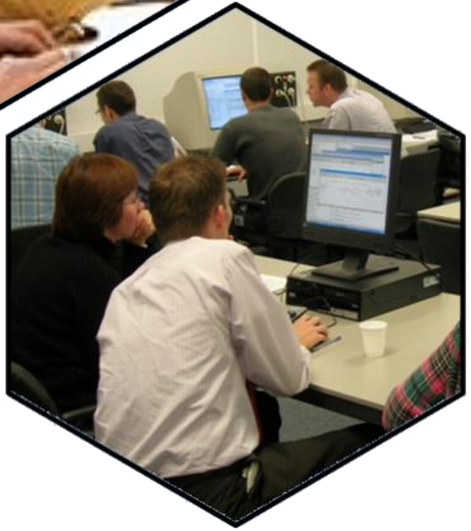
Application Breadth

- Powertrain systems
- New wireless standards
- Machine learning
- Deep learning
- Autonomous driving

What’s new in Training

Public

On-Site



RF Array Phased

SimEvents

Parallelizing

Radar Communications

Wireless

Speedgoat

Accelerating

Testing

AUTOSAR

Object Oriented

MATLAB®

Data Analytics

- Data Processing and Visualization
- Statistics
- Machine Learning
- Optimization Techniques
- Parallel Computing

Application Development

- Programming Techniques
- Building Interactive Applications
- Object-Oriented Programming

Code Generation

- MATLAB Coder
- Interfacing with C-code

Application-Specific

- Control System Design
- Signal Processing
- Communication Systems
- LTE Systems

Computational Finance

- Risk Management
- Time-Series Modelling

Signal Processing

- Using MATLAB
- Using Simulink

Image and Video Processing

- Image Processing
- Computer Vision

SIMULINK®

Model-Based Design

- Implementing MBD Workflow
- Model Management and Architecture
- Verification and Validation

STATEFLOW®

- Event-Based Modeling

Simscape™

- General Simscape™
- Simscape Multibody™
- Simscape Driveline™
- Simscape Fluids™
- Simscape Power Systems™

Code Generation

- Rapid Prototyping and HIL-Simulation
- Embedded Systems
- FPGA Design
- Generating HDL Code
- Xilinx Zynq SoCs
- AUTOSAR

Code Integration

- Integrating C and MATLAB

Polyspace©

- Polyspace Code Prover™

https://nl.mathworks.com/services/training.html

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