MATLAB EXPO 2018

MATLAB® and Simulink® 最新情報

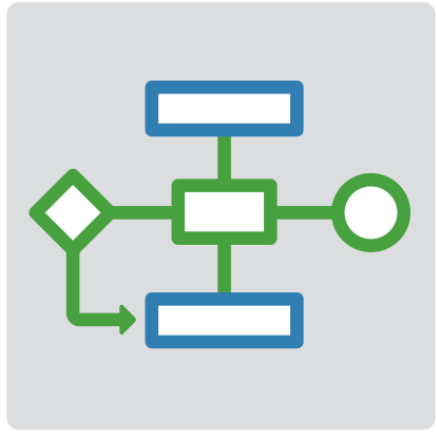
R2018a R2018b

松本 充史
山本 順久
吉田 剛士

Platform Productivity

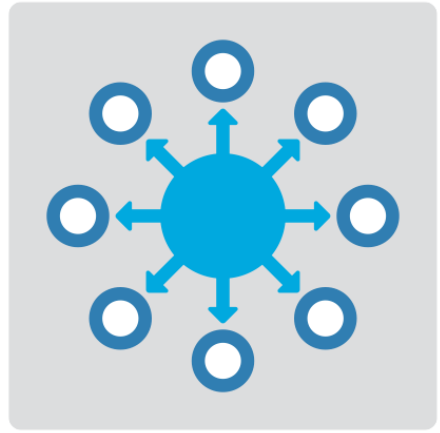
Getting your work done faster

Workflow Depth



Support for your entire workflow

Application Breadth



Products for the work you do

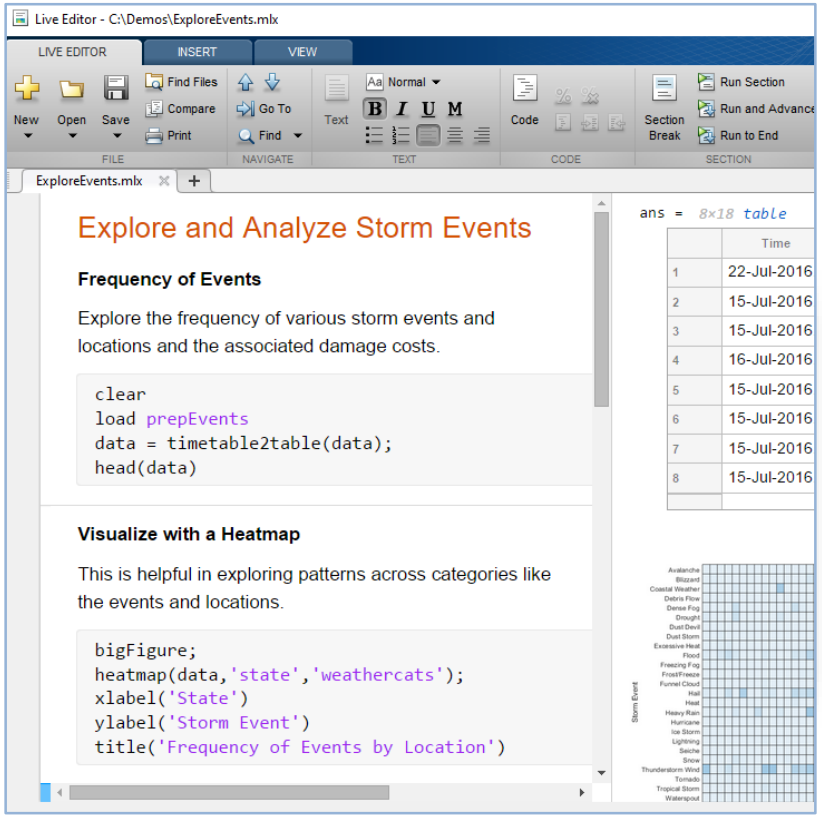
Platform Productivity

Workflow Depth

Application Breadth

- Create Your Designs Faster
- Simplify Analysis
- Simulate Faster and Scale Your Work

Create Your Designs Faster

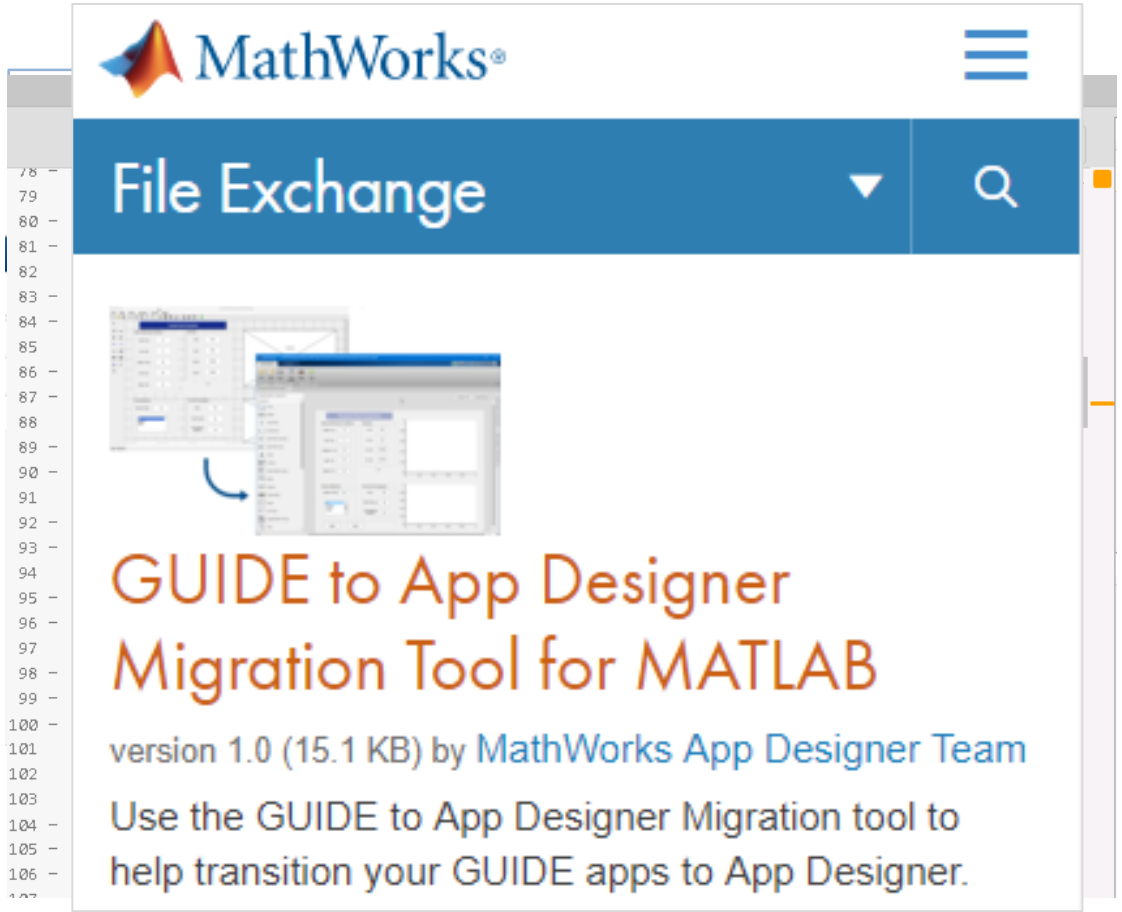


MATLAB

Live Editor

- Use interactive controls to set values in a live script
- Interactively sort table data
- Debug scripts and functions
- Additional subheading styles

Create Your Designs Faster



MATLAB

App Designer

- Date Picker / Tree Component
- Unified property inspector in Design View and Code view
- Code Analyzer
- GUI to App Designer Migration Tool

Create Your Designs Faster

```
fname
```

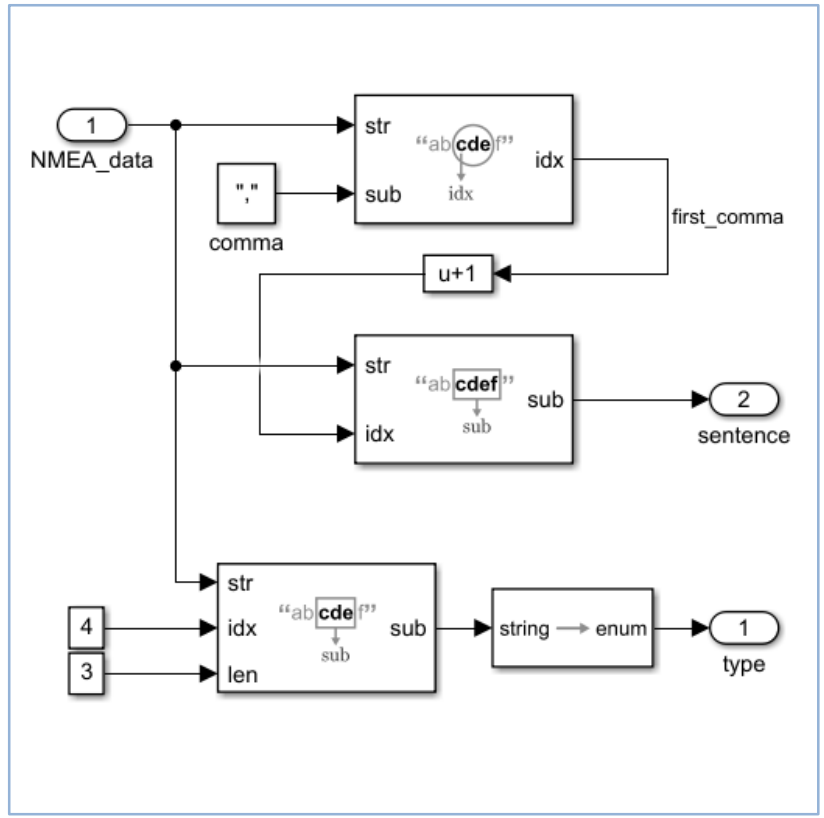
```
fname = 1×3 string array
    "test1.csv"    "test2.csv"    "test3.csv"
```

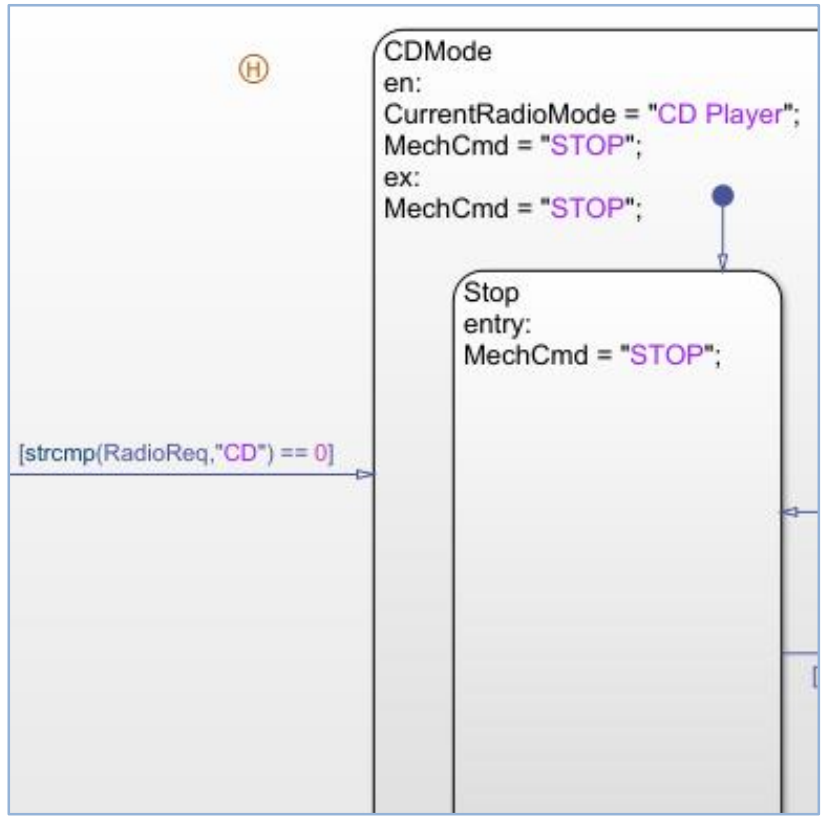
```
n = extractBetween(fname,'test','.csv')
```

```
n = 1×3 string array
    "1"    "2"    "3"
```

```
num = double(n)
```

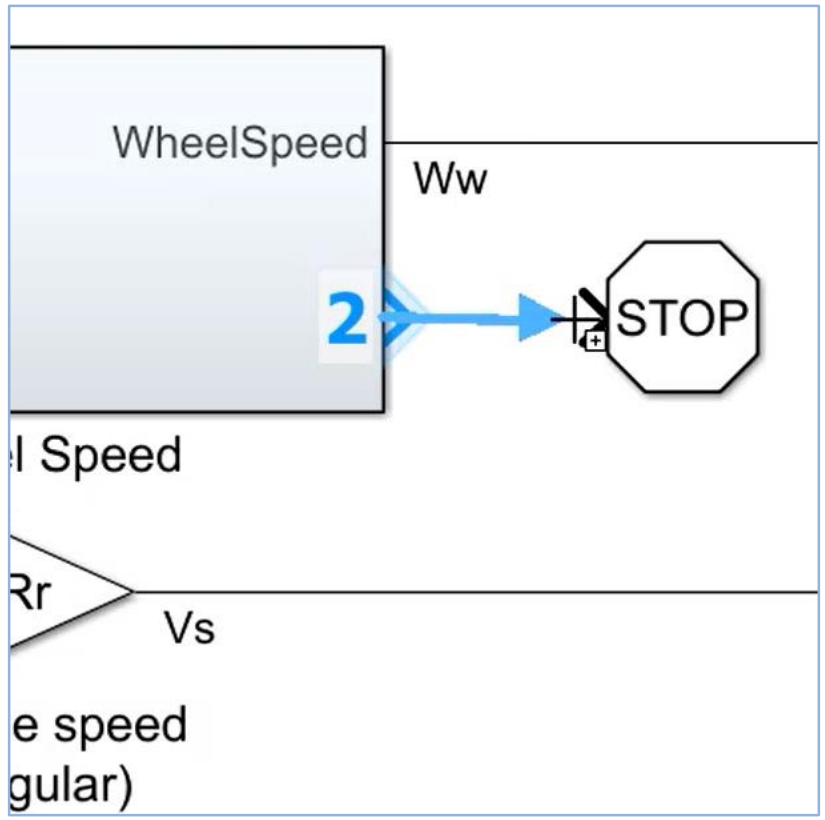
```
num = 1×3
     1     2     3
```





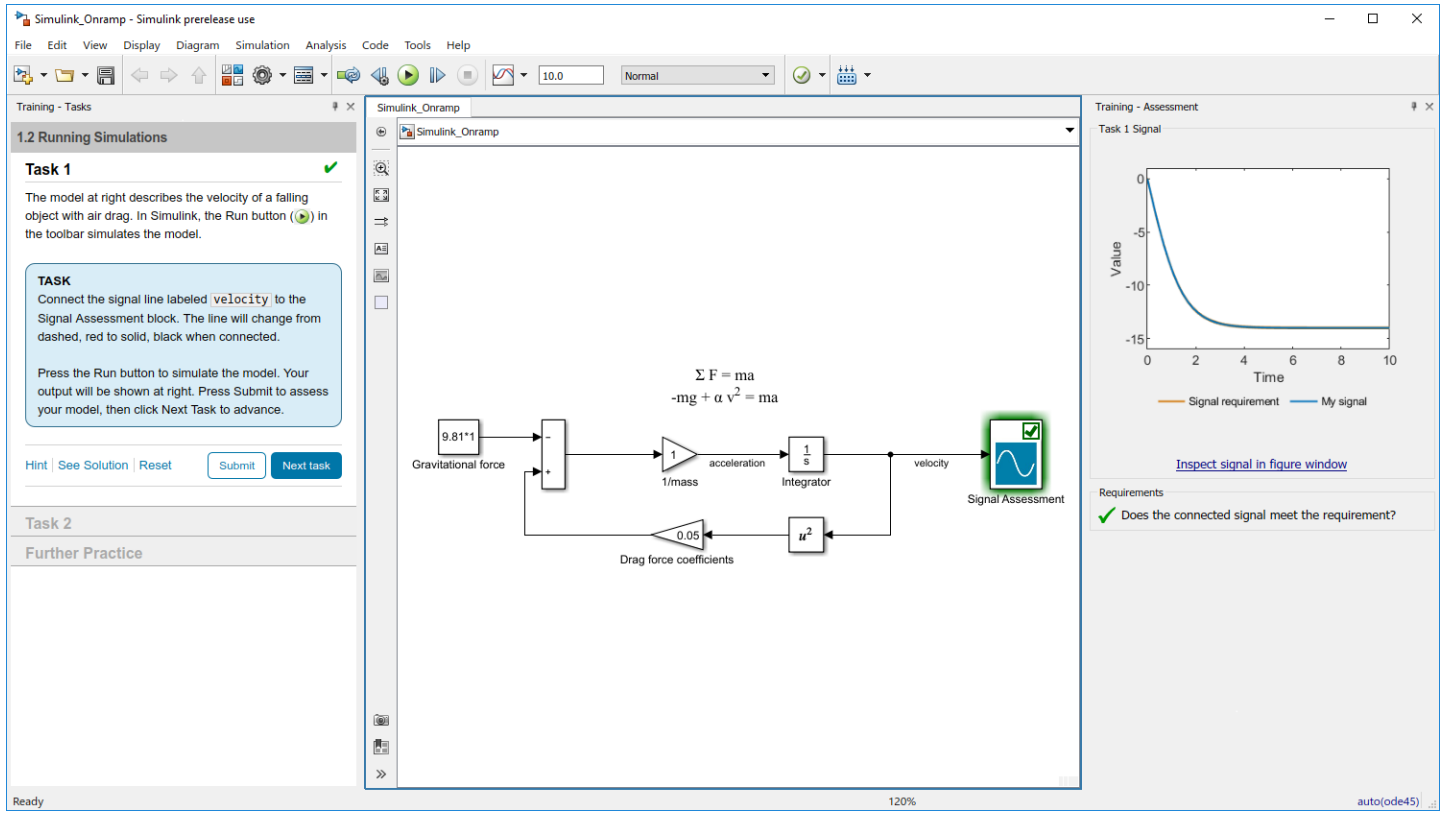
MATLAB **Simulink** **Stateflow**

Create Your Designs Faster



Simulink

Create Your Designs Faster

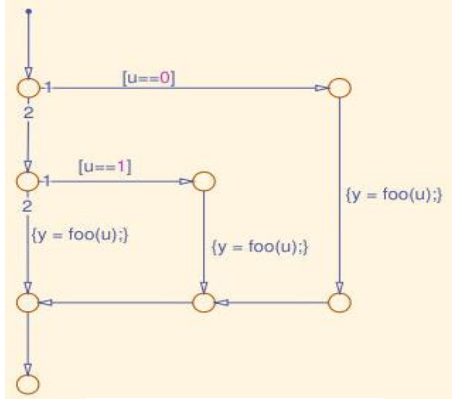


Simulink Onramp

Create Your Designs Faster


```
#include "hTimesAbsN.h"
#include "hTimesN.h"

double times_abs_n(double val, double n)
{
    if(val > 0) {
        return times_n(val, n);
    } else {
        return times_n(-val, n);
    }
}
```




```
#include "hfoo.h"

int foo(int u1) {

    switch(u1) {
        case 0:
            break;
        case 1:
            break;
        default:
            break;
    }
    return u1;
}
```

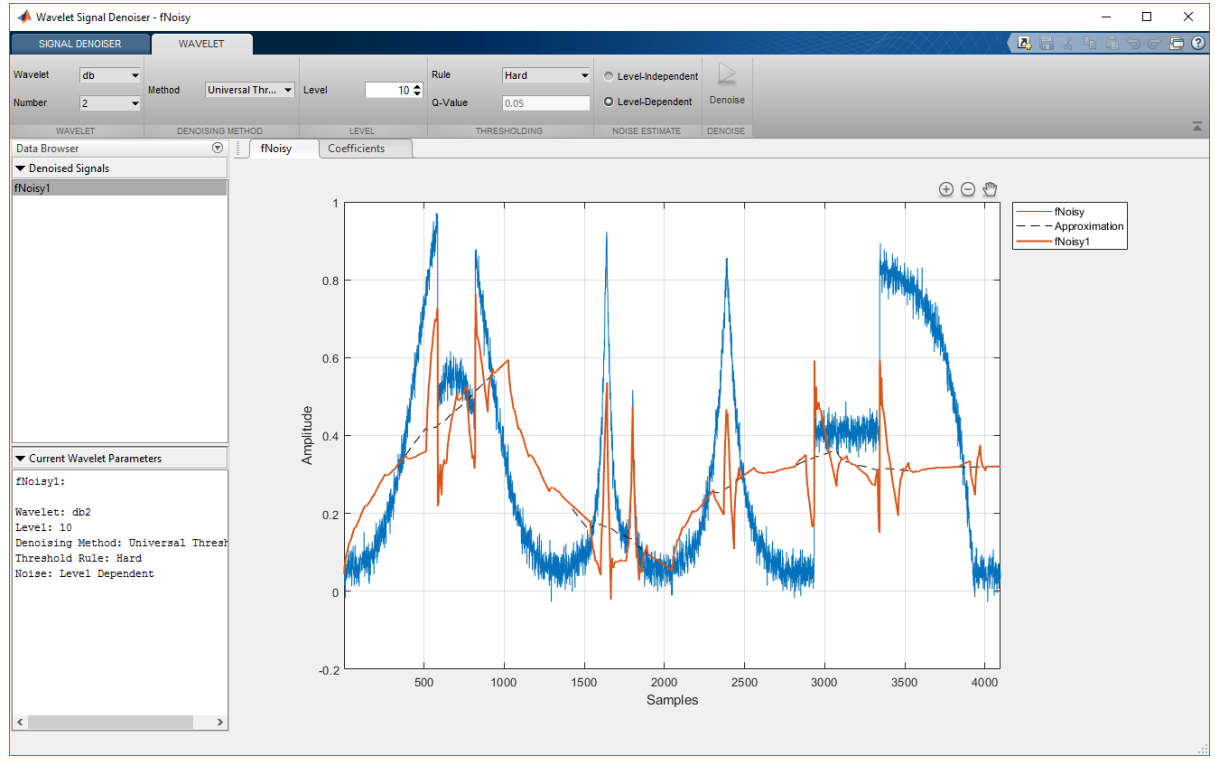
Simulink

Stateflow

Simplify Analysis with Apps

These interactive applications automate common technical computing tasks

- Signal Analyzer app
  - Visualize, measure, analyze, and compare signals in the time domain, frequency domain, and time-frequency domain
- Econometric Modeler app
  - Perform time series analysis, specification testing, modeling, and diagnostics
- Analog Input Recorder app
  - Acquire and visualize analog input signals
- Wavelet Signal Denoiser app
  - Visualize and denoise time series data

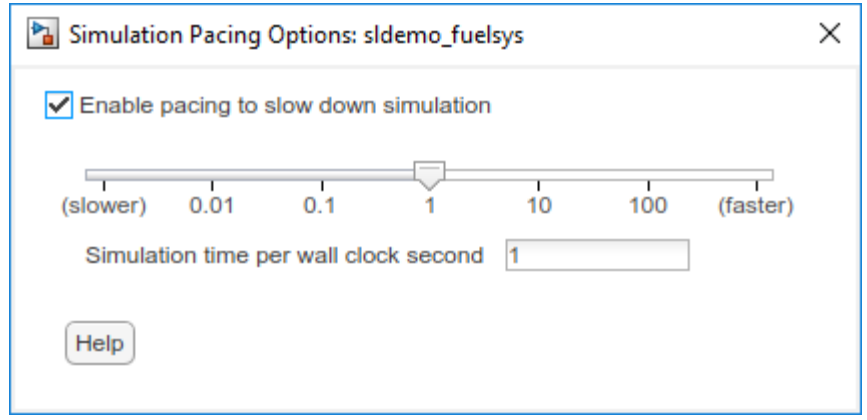


Signal Processing Toolbox
Econometrics Toolbox
Data Acquisition Toolbox
Wavelet Toolbox

Simplify Analysis by Simulating at Wall Clock Speed

Slow down the simulation for easier model interactivity

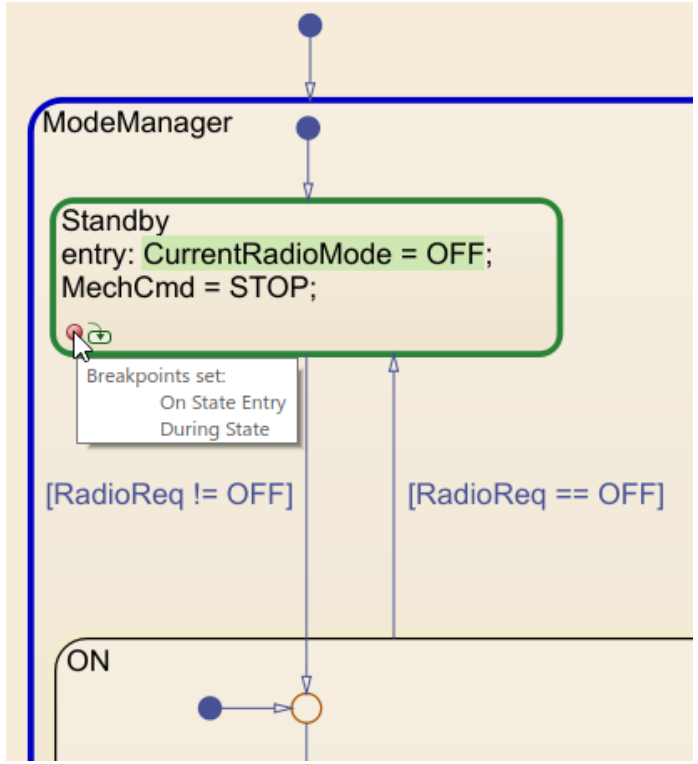
- Especially for models controlled and monitored via Dashboard blocks and other displays
- Useful when model is connected to hardware

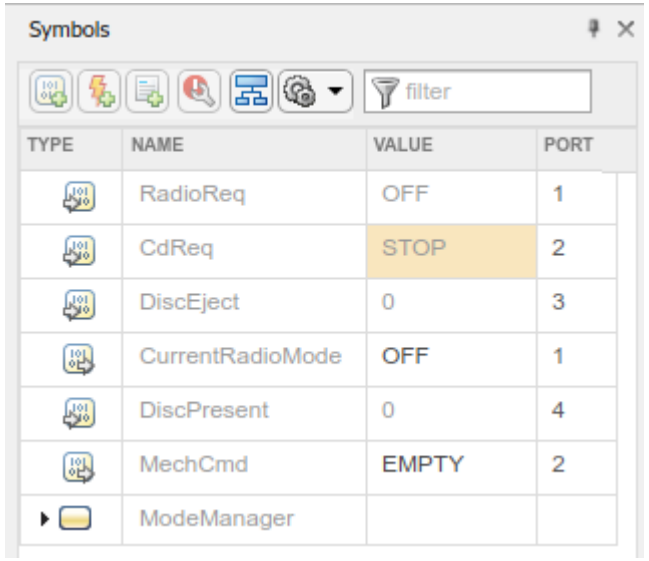


Simplify Analysis of Logic

Debug Stateflow charts with simplified breakpoint management, simulation stepping, and data visualization

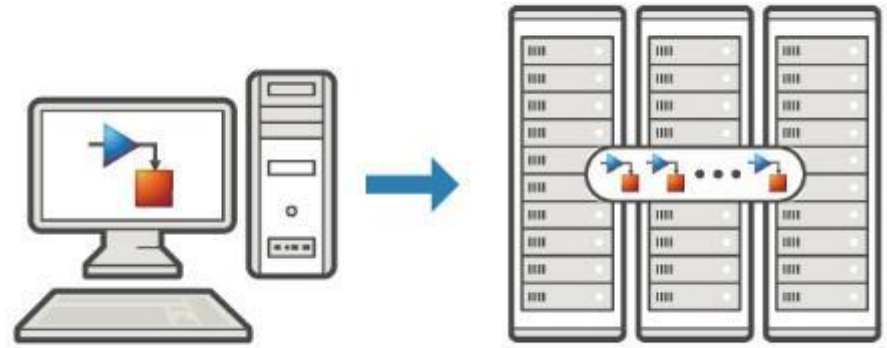
- Single menu for setting breakpoints
- Statement-by-statement debugging
- Data values shown in Symbols window



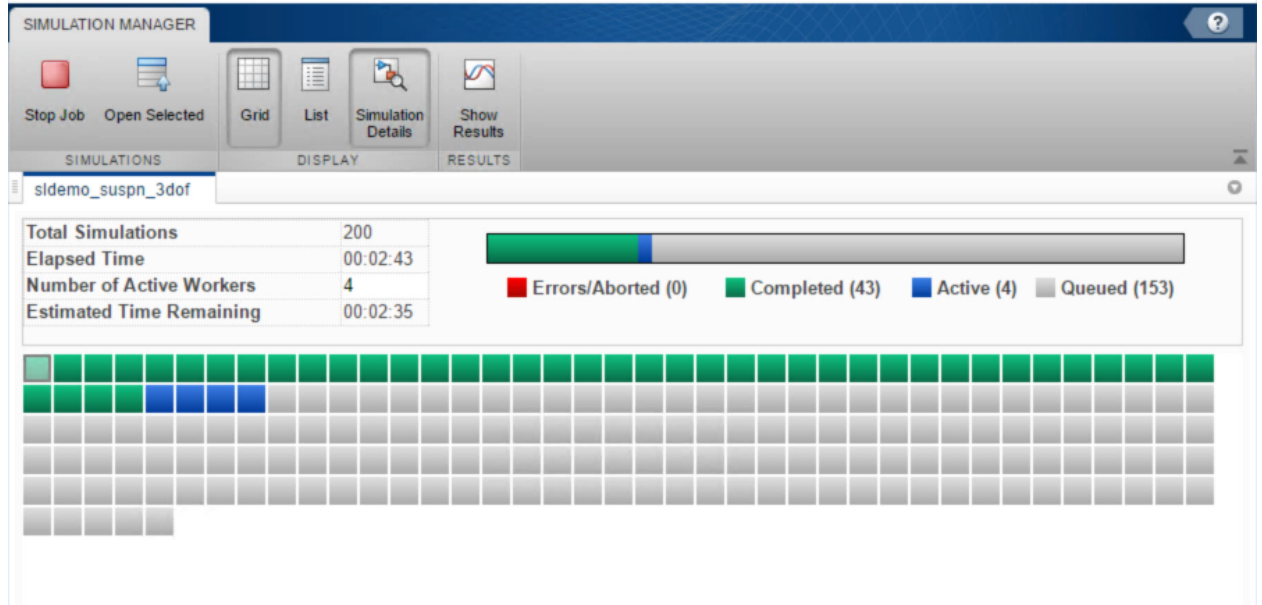


Scale Your Work

Use parallel computing to run multiple simulations faster



- Run multiple parallel simulations with **`parsim`**
- Monitor simulation status and progress in the **Simulation Manager**
- Run simulations in the background with **`batchsim`**

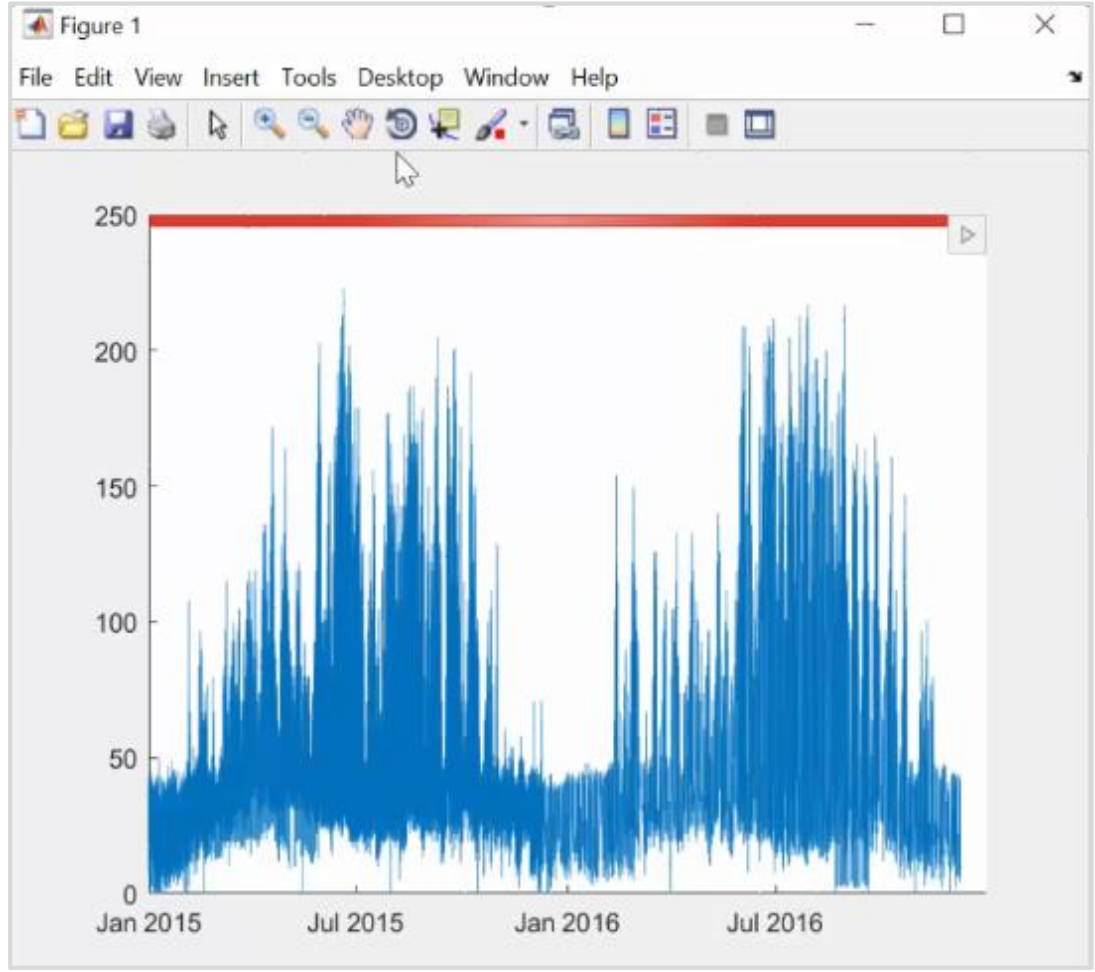


Parallel Computing Toolbox
MATLAB Distributed Computing Server

Scale Your Work

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

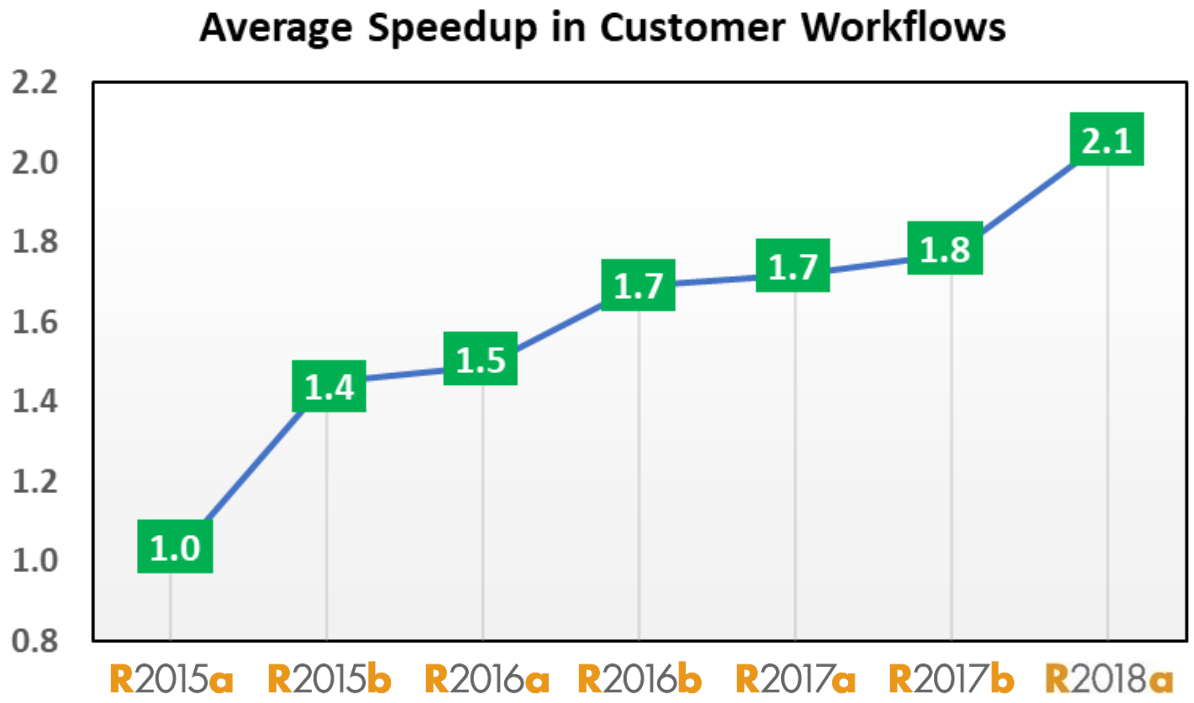
- Use familiar MATLAB functions and syntax
- Built-in support for hundreds of functions
- Customization support for importing, processing, and exporting data
- Works with Spark + Hadoop clusters



Simulate Faster

Redesigned execution engine runs MATLAB code faster

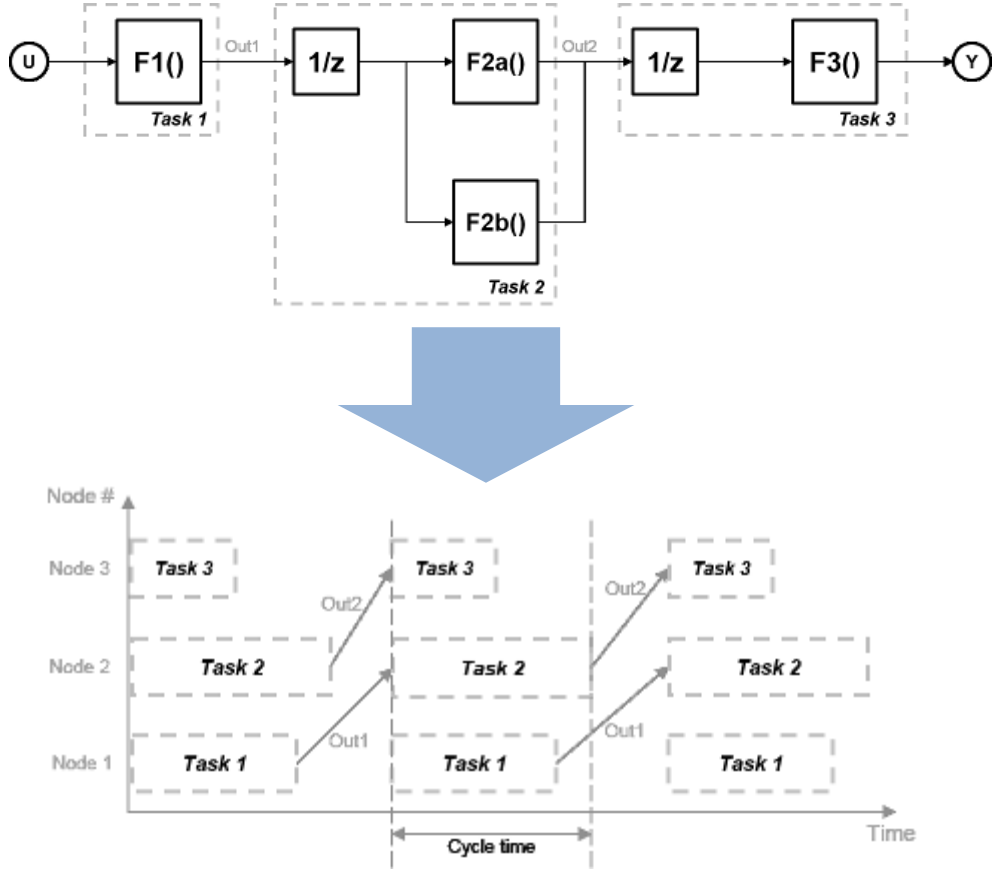
- All MATLAB code can now be JIT compiled
- MATLAB runs your code over twice as fast as it did just three years ago
- No need to change a single line of your code
- Increased speed of MATLAB startup in R2018a, R2018b



Simulate Faster

Accelerate your model using multi-threading and derive frame sizes automatically for multirate signal processing

- New dataflow execution domain available for signal processing applications
- Automatically distribute simulation and code generation across multiple cores
- Automatically calculate signal sizes in frame-based multirate models



Platform Productivity

Workflow Depth

Application Breadth

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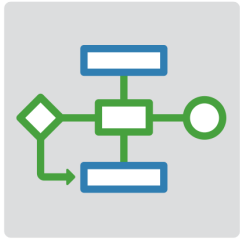
- Simplify Analysis
- Simulate Faster and Scale Your Work

Platform Productivity

Workflow Depth



Application Breadth

- **Deployment of MATLAB Algorithms and Applications**
- **Code Generation from Simulink Models**
- **Verification and Validation**

Access Data / Deploy MATLAB Algorithms and Applications

Access Data


Sensors


Files


Databases

Analyze Data

Data exploration

Preprocessing

Domain-specific algorithms

Develop

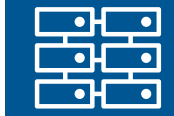
AI model

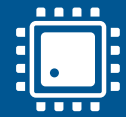
Algorithm development

Modeling & simulation

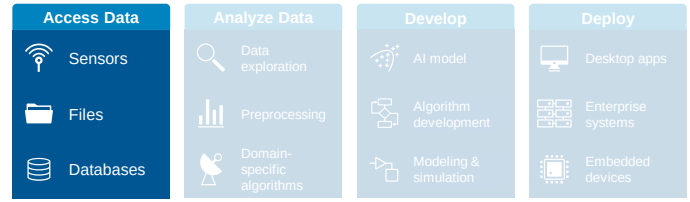
Deploy


Desktop apps


Enterprise systems


Embedded devices

Access Remote Data



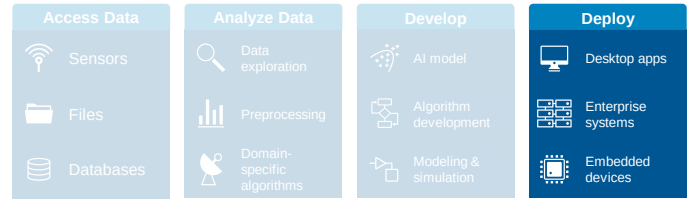
Read and write data to and from remote locations using datastore objects.

- Amazon S3
  (offered by Amazon Web Services)

- Windows Azure® Storage Blob
  (offered by Microsoft)

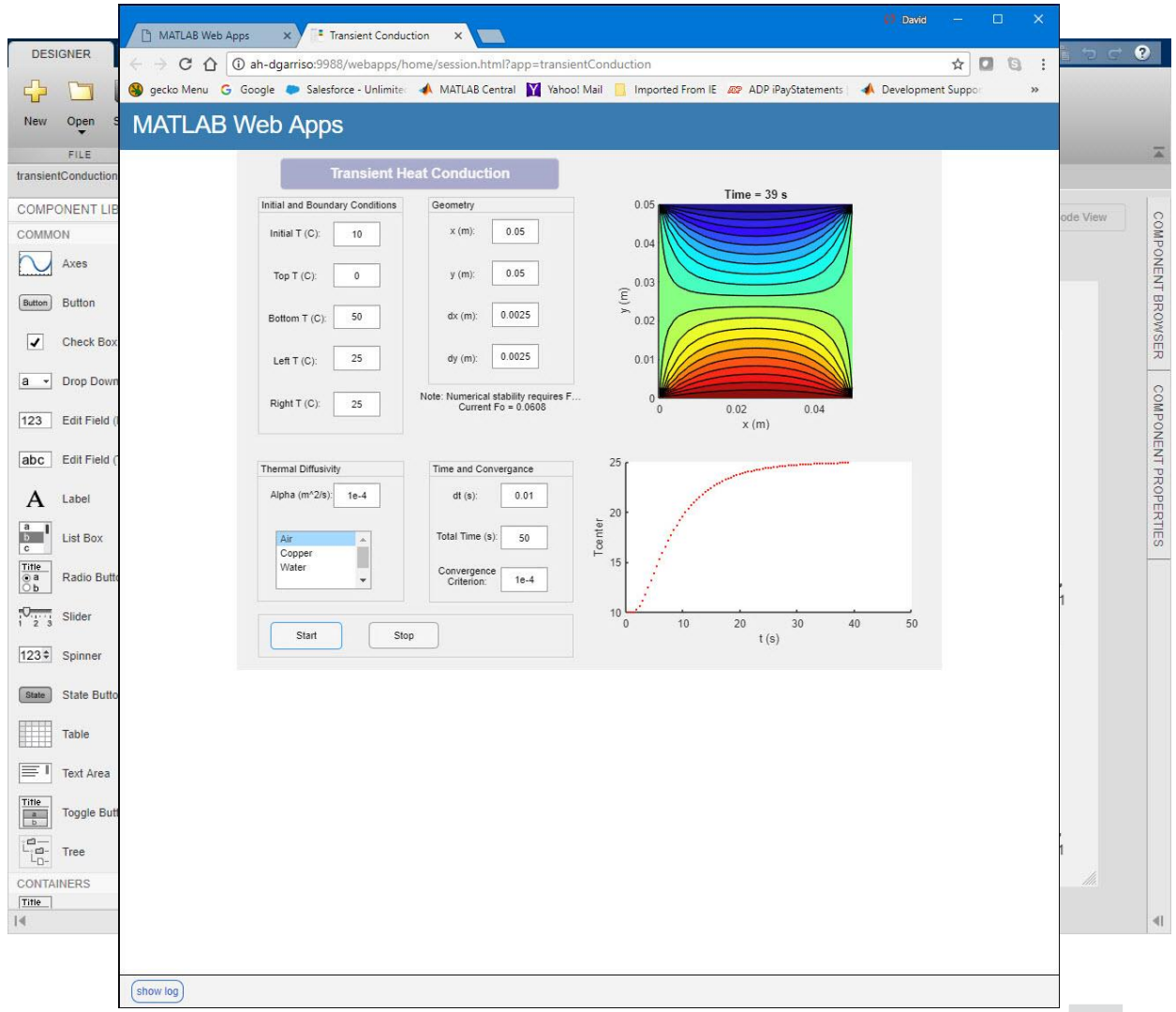
- Hadoop Distributed File System (HDFS)

Deploy MATLAB Web Apps

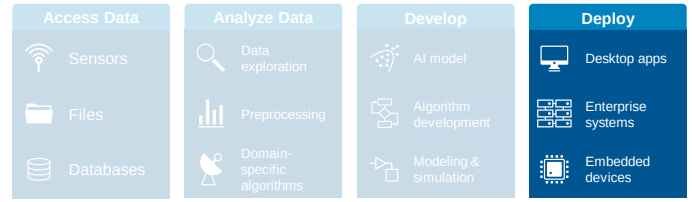


Share App Designer apps on the Web using MATLAB Compiler.

- Package the app for deployment to the MATLAB App Server
- Add the app to the library of MATLAB Web Apps on the server
- Run the app in a browser from any machine with access to the server

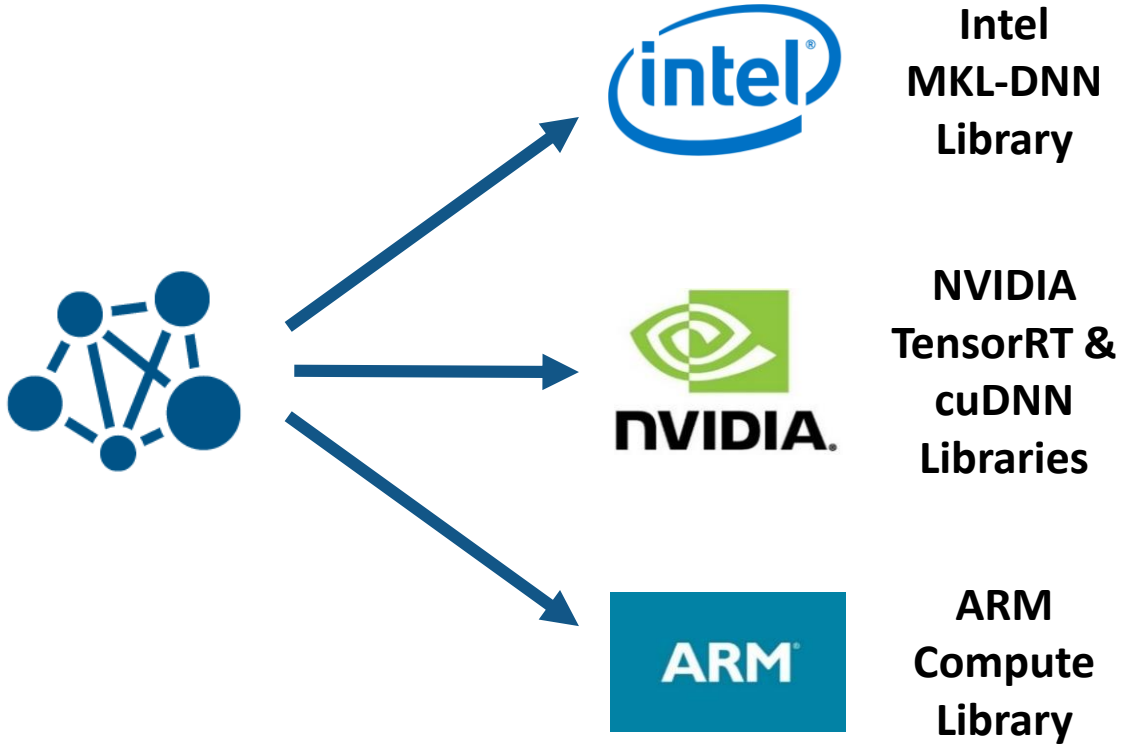


Deploy MATLAB Algorithms



Deploy machine learning and deep learning models using automatically generated code

- Generate C code for predictive machine learning and deep learning models
- Generate optimized CUDA code for deep learning, embedded vision, and autonomous systems



MATLAB Coder
GPU Coder

Connecting Your Design to Hardware

Connect directly to hardware with support packages

- Live streaming to and from hardware
- Run Simulink models on low-cost hardware, such as Arduino, Raspberry Pi, and LEGO
- Automatically generate code and run it on microprocessors, FPGAs, and more.

Arduino

Raspberry Pi Zero W

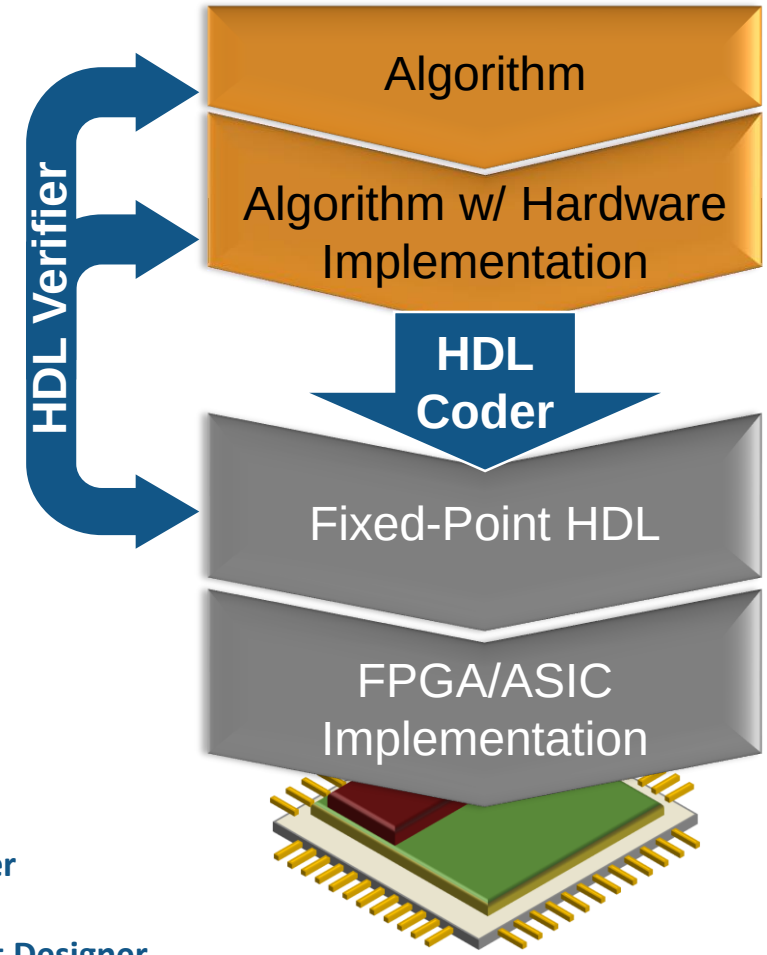
Raspberry Pi 3 Model B+

Microsemi FPGA

LEGO EV3

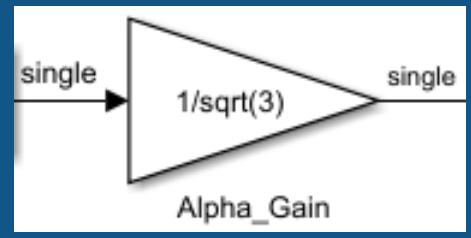
ADALM-PLUTO

Deploying to FPGA or ASIC Hardware

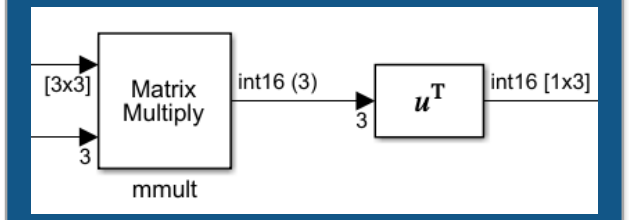


HDL Verifier
HDL Coder
Fixed-Point Designer
Vision HDL Toolbox
LTE HDL Toolbox

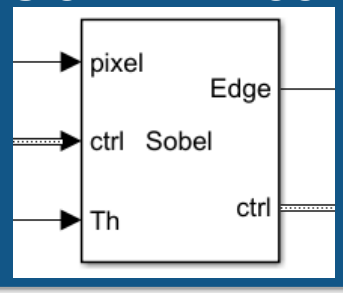
Native Floating Point



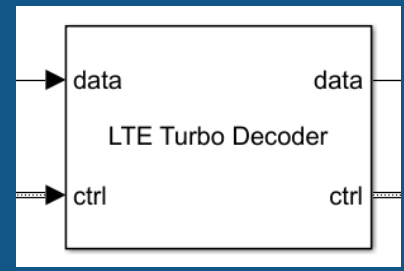
Matrix Support



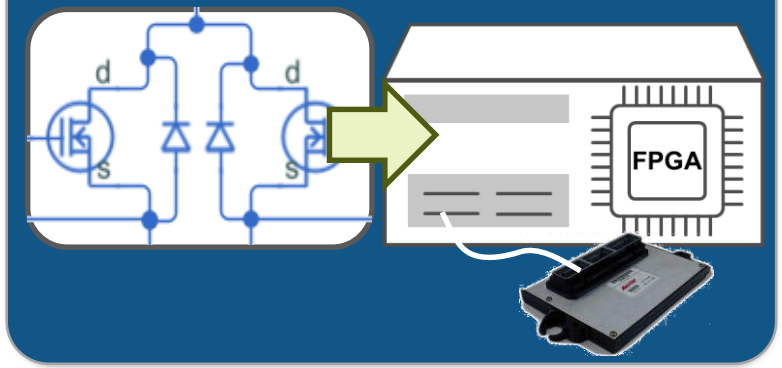
Vision HDL Toolbox



LTE HDL Toolbox



Generate HDL from Simscape



Import Verilog code

```
1  module bitselect(a,c);
2
3  input [1:0] a;
4  output [1:0] c;
5
6  assign c[0] = 0;
7  assign c[1] = a[2];
8
9  endmodule
```

Prepare Model Data for Code Generation

Optimize the data types used in your system under design

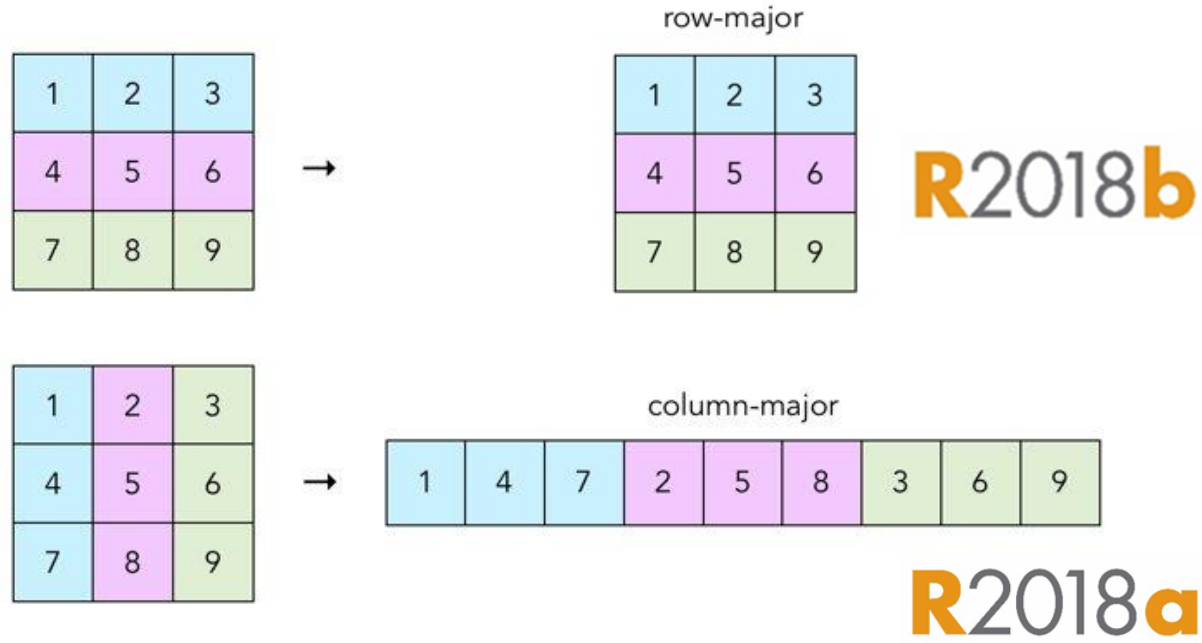
- New `fxpopt` function
- Specify constraints and tolerances to meet your design goals
- Apply data types to your system while minimizing total bit width


```
opt =

  fxpOptimizationOptions with p

            MaxIterations: 50
                  MaxTime: 600
                 Patience: 10
                Verbosity: High
    AllowableWordLengths: [10 11 12 13 14 15 16 17 18 19 20 21 22 23 24]

   Advanced Options
         AdvancedOptions: [1×1 struct]

  - Evaluating new solution: cost 246, meets the tolerances.
  - Updated best found solution, cost: 246
  - Evaluating new solution: cost 245, does not meet the tolerances.
  - Evaluating new solution: cost 244, does not meet the tolerances.
  - Evaluating new solution: cost 245, meets the tolerances.
  - Updated best found solution, cost: 245
  - Evaluating new solution: cost 244, meets the tolerances.
  - Updated best found solution, cost: 244
```

Generate Code from Simulink Models

Access and define all the information in your model related to code generation

- View and define implementation data in one place
- View implementation details without model details
- Improve code performance and ease integration with other C code



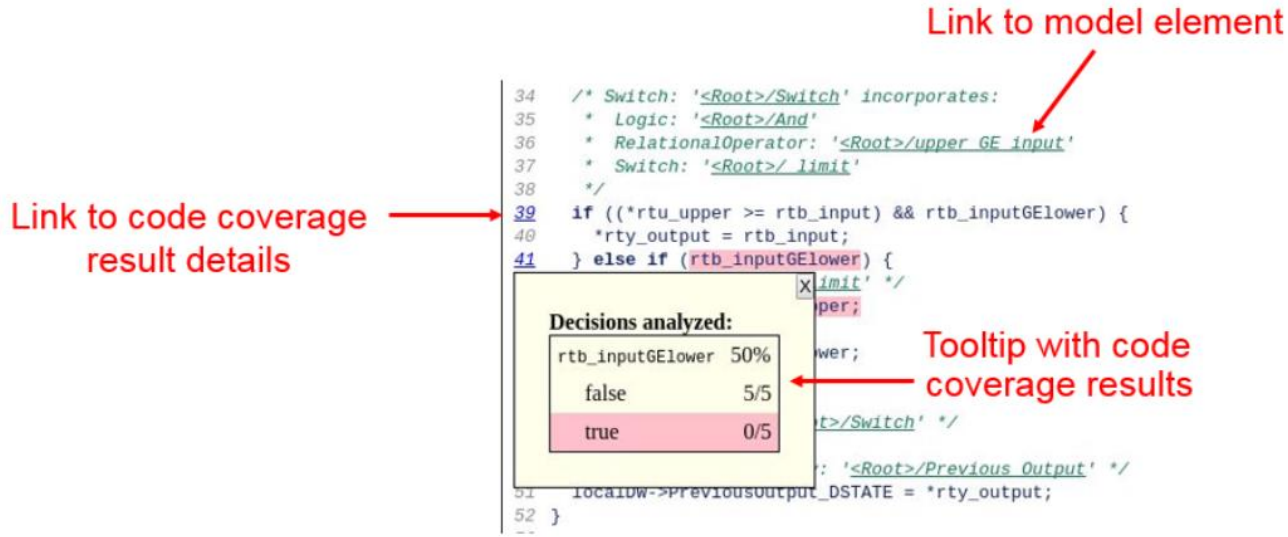
Row-major memory layout option and multi-dimensional arrays

MATLAB Coder
Simulink Coder
Embedded Coder

Create Tests from Generated Code

Generate additional tests to increase coverage of generated code

- Adds on to previously recorded model coverage results
- Covers differences that can exist between generated code and model, such as extra custom code files and shared utility files
- Can execute tests programmatically or within the Test Manager included in Simulink Test

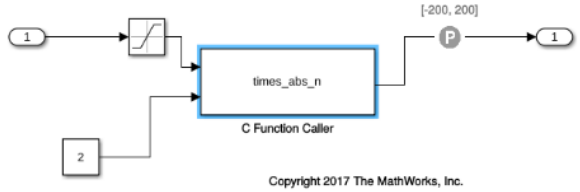


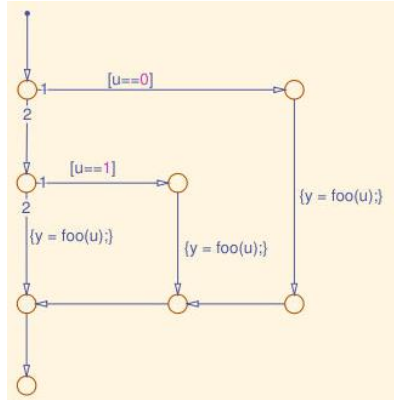
Simulink Design Verifier
Simulink Test

Verify models that include C/C++

Analyze and generate tests for Simulink and Stateflow models that use custom code

- Perform design error detection, property proving and test generation for the C/C++ code
- Works with C Caller blocks and Stateflow charts





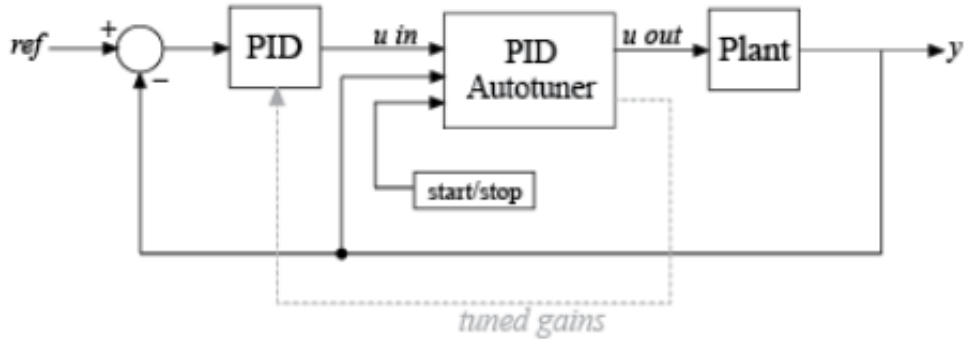

```c
#include "hTimesAbsN.h"
#include "hTimesN.h"

double times_abs_n(double val, double n)
{
    if(val > 0) {
        return times_n(val, n);
    } else {
        return times_n(-val, n);
    }
}
```

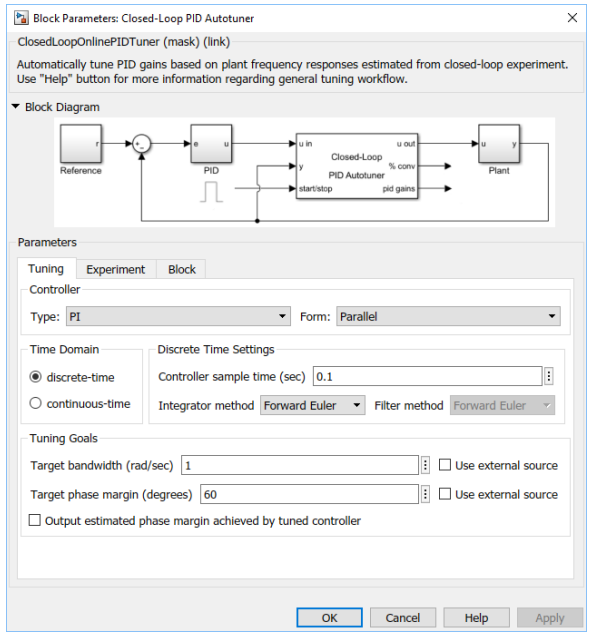
```c
#include "hfoo.h"

int foo(int u1) {

    switch(u1) {
        case 0:
            break;
        case 1:
            break;
        default:
            break;
    }
    return u1;
}
```

Closed-Loop PID Autotuning

Deploy algorithm that performs PID autotuning without opening the feedback loop

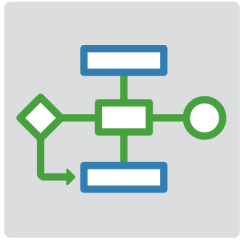
- Use Closed-Loop PID Autotuner block to generate autotuning code and deploy to embedded software
- Estimation experiment is performed without opening the feedback loop
- Use to tune PID controller gains for a plant model in Simulink or for a physical plant





Platform Productivity

Workflow Depth



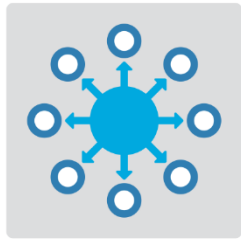
Application Breadth

- **Deployment of MATLAB Algorithms and Applications**
- **Code Generation from Simulink Models**
- **Verification and Validation**

Platform Productivity

Workflow Depth

Application Breadth

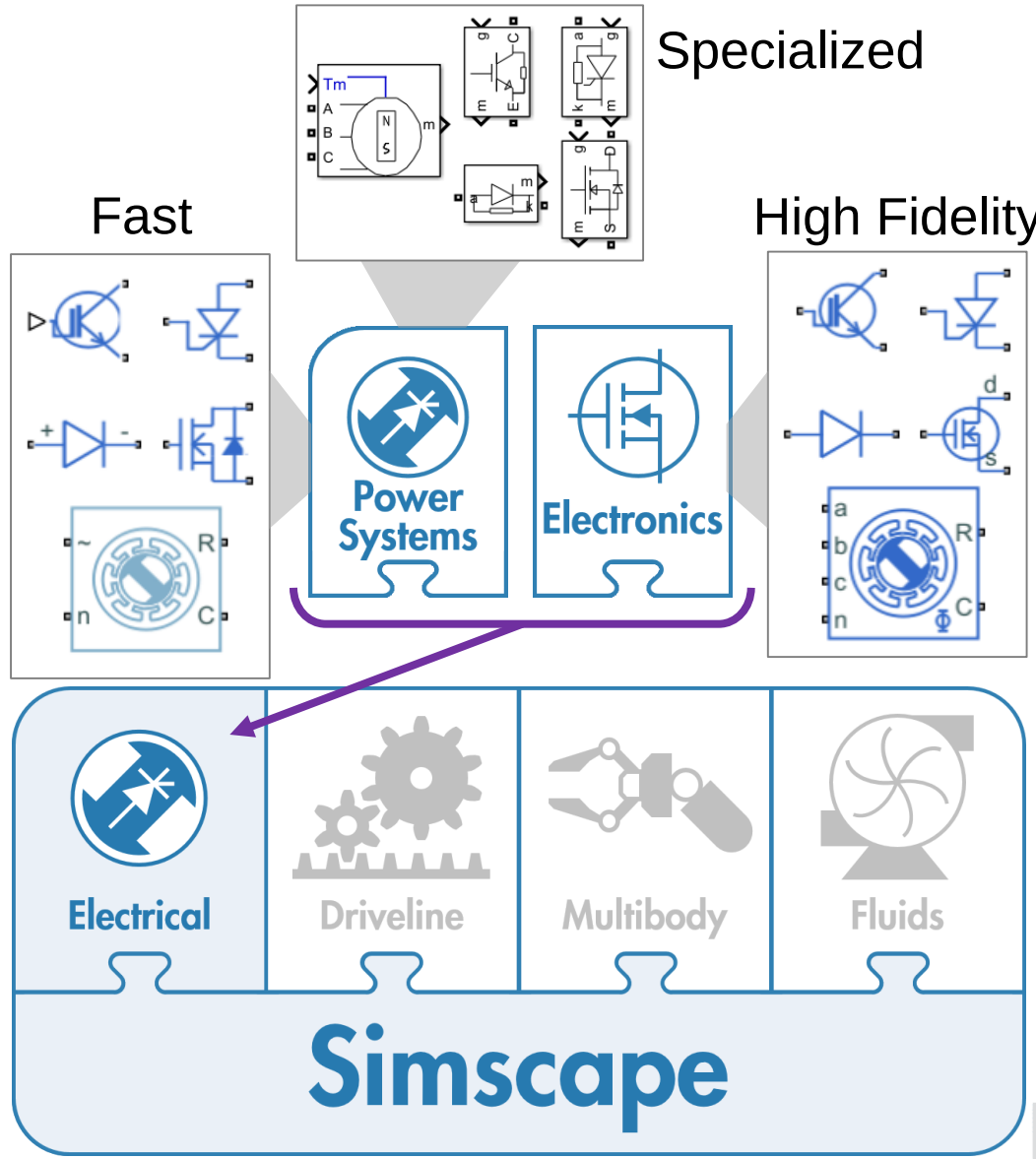


- Physical Modeling
- Autonomous Systems
- Artificial Intelligence (AI)

Model Electronic Systems with Simscape Electrical

Model and simulate electronic, mechatronic, and electrical power systems

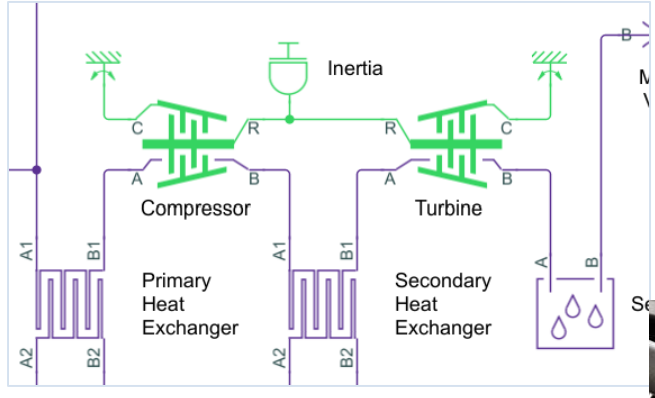
- Merge of Simscape Power Systems and Simscape Electronics
- Convert SPICE models to Simscape components
- Generate HDL code from Simscape models for faster simulation on FPGA's



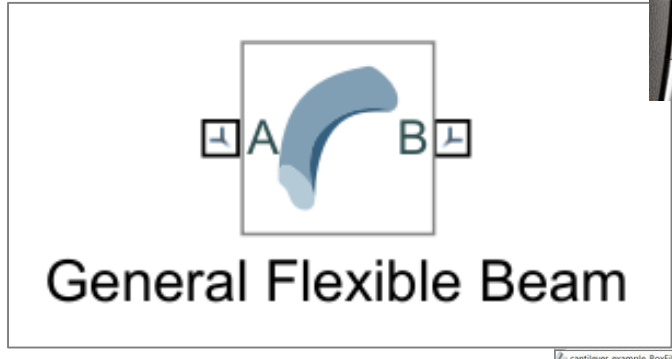
Simscape Electrical
HDL Coder

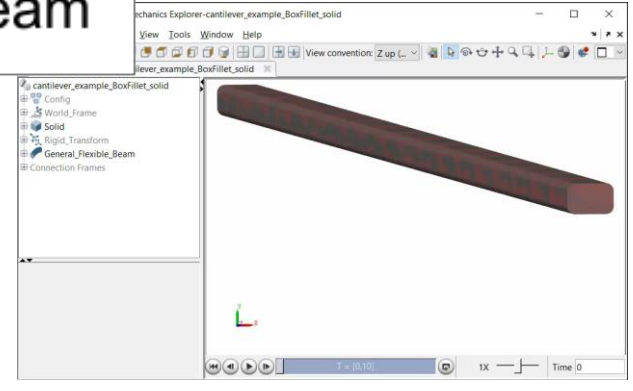
Model Physical Systems

Model HVAC control systems and flexible beams



- Model and simulate HVAC systems for a plant, such as a building, automobile, aircraft
- New library contains chambers, reservoirs, local restrictions, energy converters, sources and sensors
- Model flexible beams with symmetrical cross sections
- Note for Simscape in general: Run simulations about 5x faster with local solver option



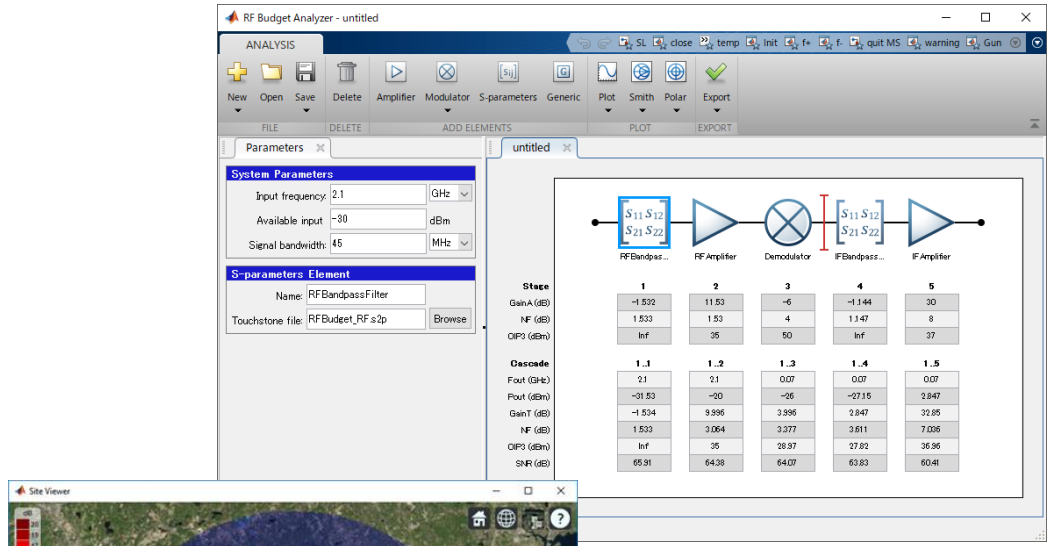


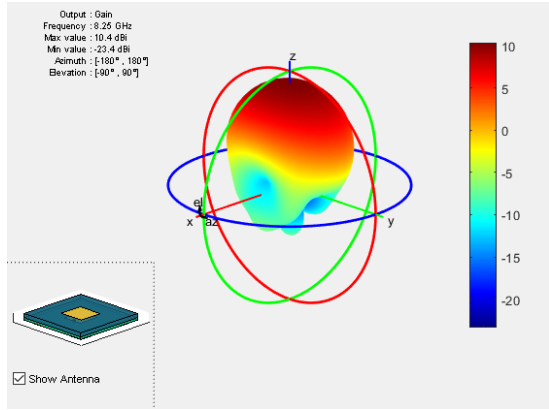
Simscape
Simscape Multibody

RF and Antenna Design and Prototyping

Use RF and Antenna models through your entire development cycle

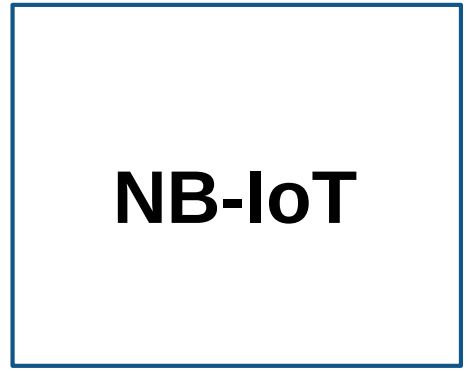
- RF top-down design with RF Budget Analyzer app
- Adaptive hybrid beamforming and MIMO system modeling
- RF Power Amplifier modeling and DPD linearization
- RF propagation and 3D terrain visualization
- Design and fabrication of printed (PCB) antennas





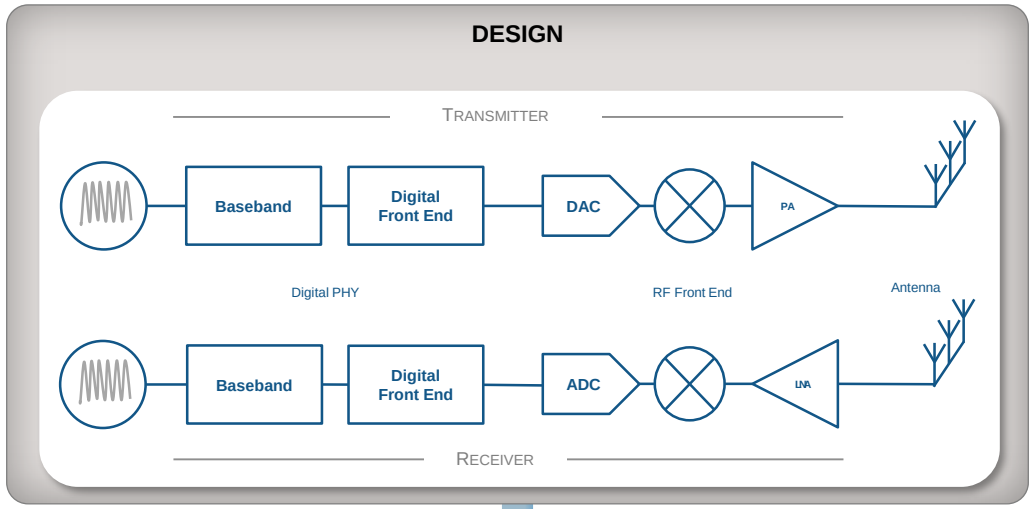
RF Toolbox
RF Blockset
Antenna Toolbox

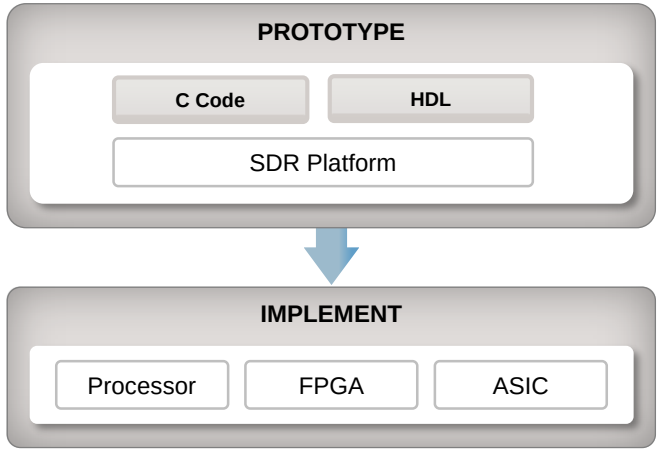
Design with the Latest Wireless Standards



5G Toolbox **New Product**
LTE Toolbox
WLAN Toolbox
Communications Toolbox

Model-Based Design for Wireless Communications

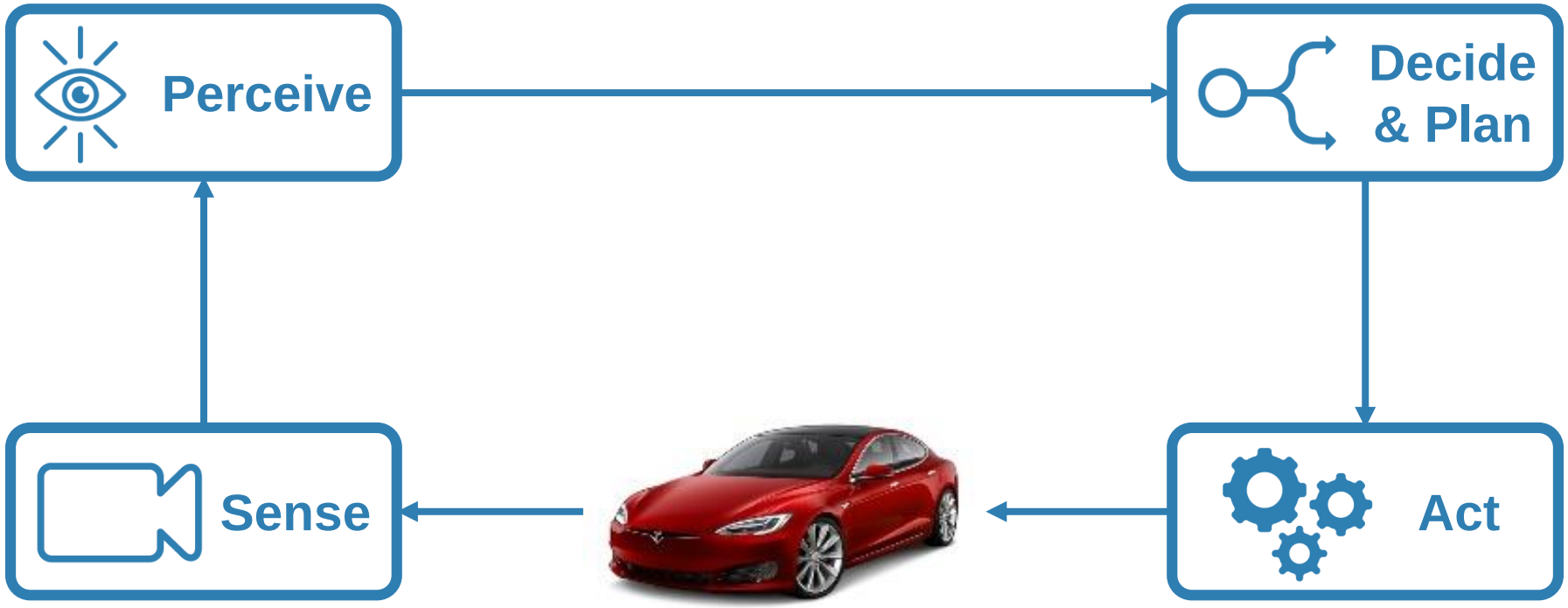




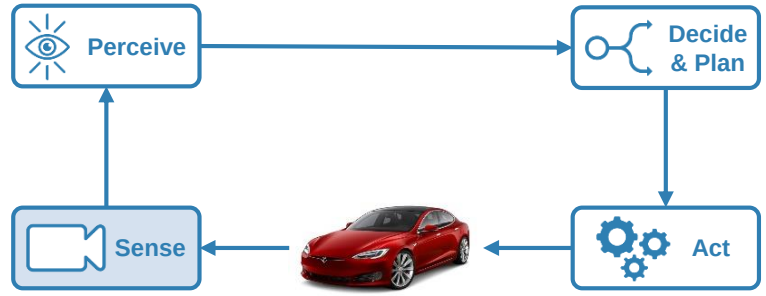
- **Algorithm Design and Verification**
- **RF, Digital and Antenna Co-Design**
- **System Verification and Testing**
- **Rapid Prototyping and Production**

Code Generation and Verification
HDL Coder
LTE HDL Toolbox

Designing Autonomous Systems

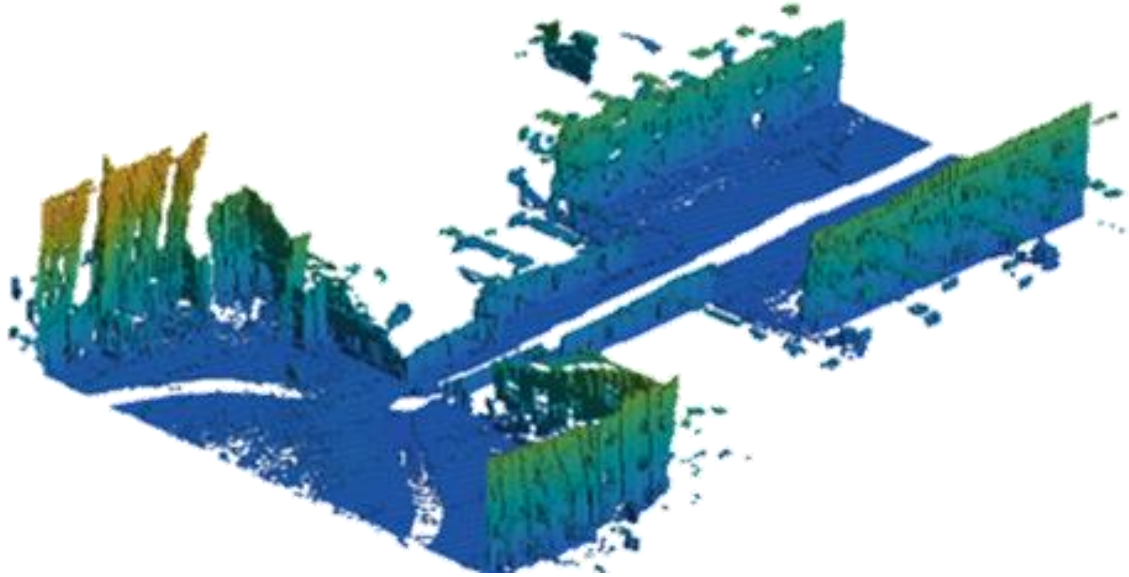


Designing Autonomous Systems



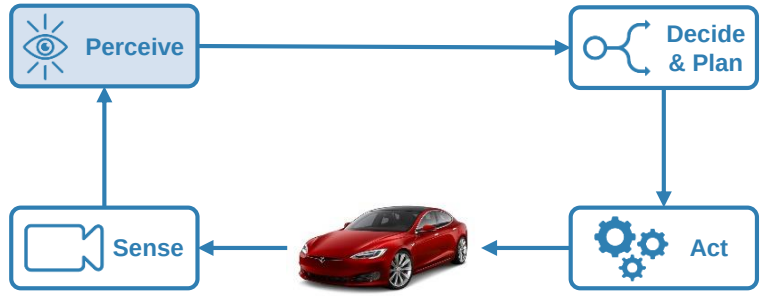
Mapping of environments using sensor data

- Segment and register lidar point clouds
- Lidar-Based SLAM: Localize robots and build map environments using lidar sensors



Computer Vision System Toolbox
Robotics System Toolbox

Designing Autonomous Systems



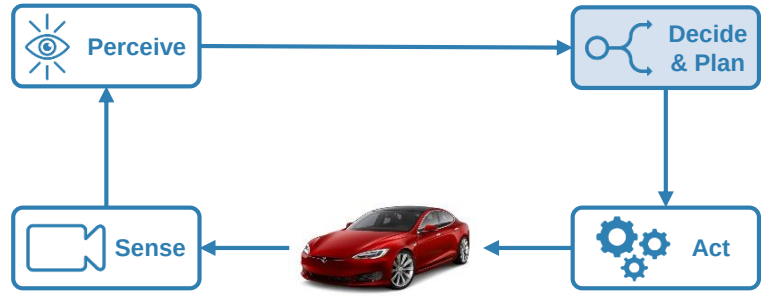
Understanding the environment using computer vision and deep learning techniques

- Object detection and tracking
- Semantic segmentation using deep learning

CamVid Database: Brostow, Gabriel J., Julien Fauqueur, and Roberto Cipolla. "Semantic object classes in video: A high-definition ground truth database." *Pattern Recognition Letters*Vol 30, Issue 2, 2009, pp 88-97.

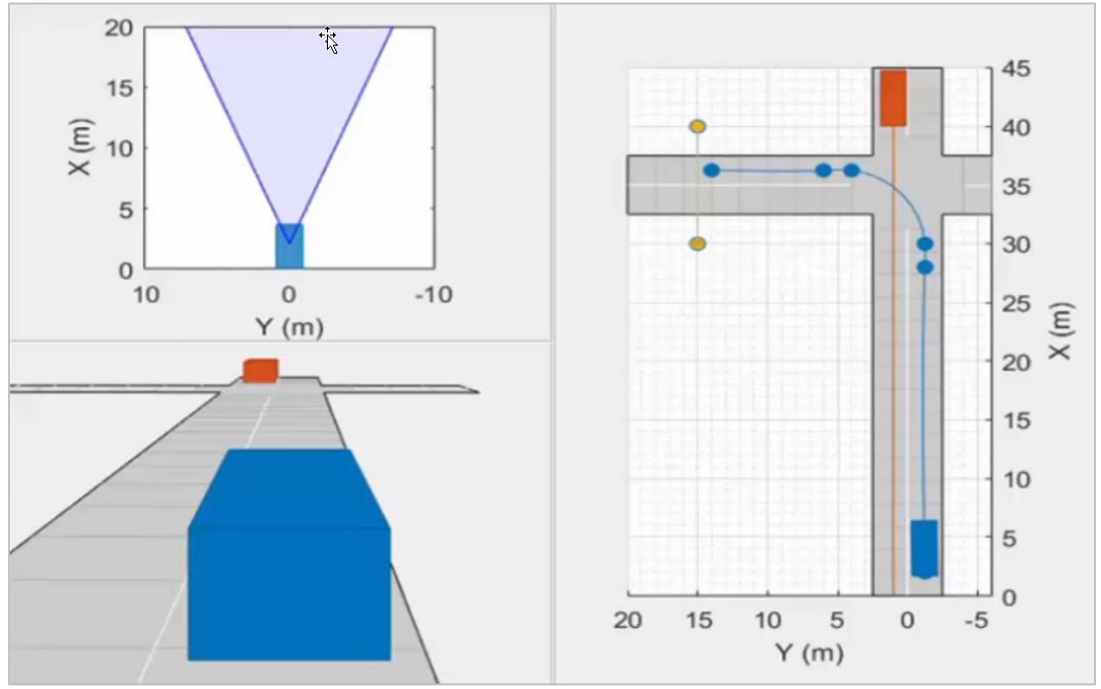
Deep Learning Toolbox
Computer Vision System Toolbox
Automated Driving System Toolbox

Designing Autonomous Systems



Design synthetic driving scenarios to test controllers and sensor fusion algorithms

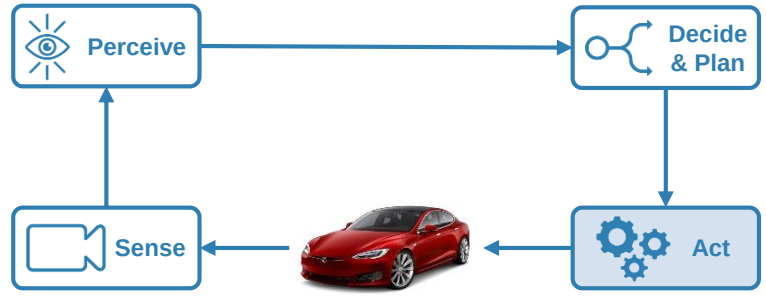
- Design and simulate multisensor tracking and navigation systems
- Interactively design synthetic driving scenarios composed of roads and actors *(vehicles, pedestrians, etc.)*, or use prebuilt Euro NCAP driving scenarios
- Generate visual and radar detections of actors



Driving Scenario Designer App

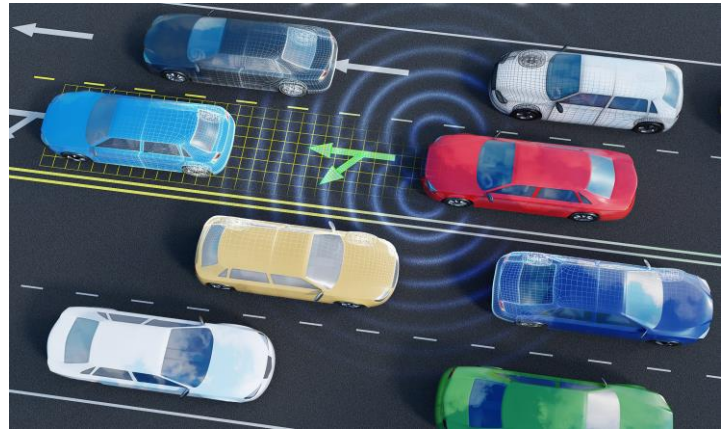
Sensor Tracking and Fusion Toolbox **New Product**
Automated Driving System Toolbox

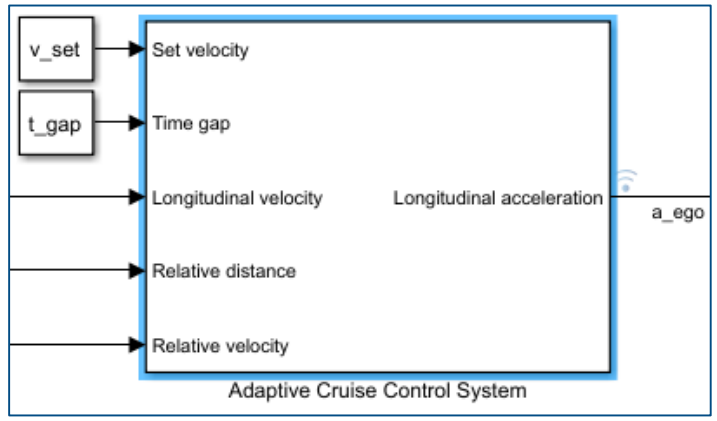
Designing Autonomous Systems

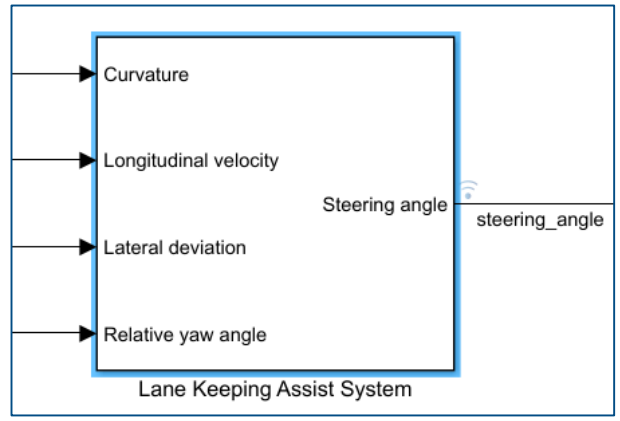


Model predictive control for adaptive cruise control and lane-keeping algorithms

- Use prebuilt blocks instead of starting from scratch
- Simplified application-specific interfaces for configuring model predictive controllers
- Flexibility to customize for your application

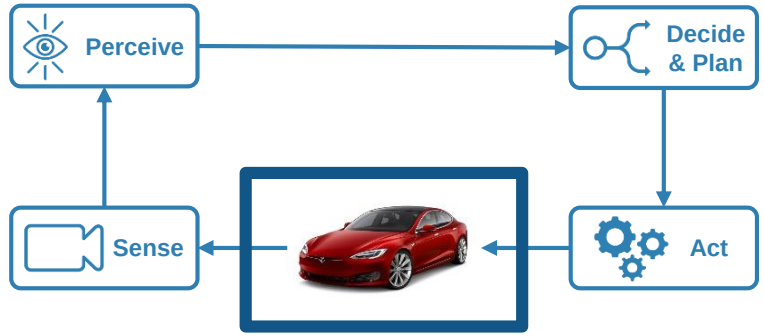






Full Vehicle Simulation

Model and simulate vehicle dynamics in a virtual 3D environment



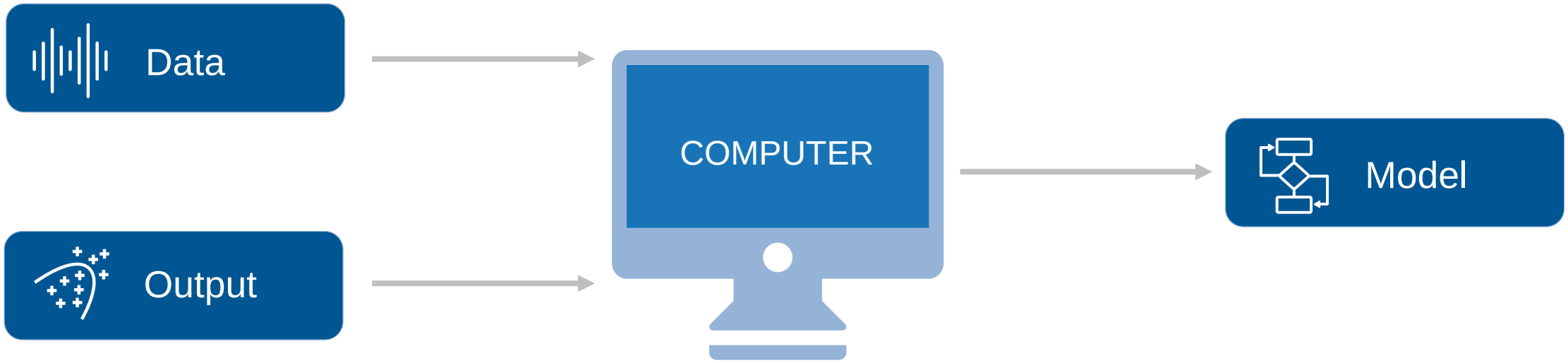
Ride & handling

Chassis controls

Automated Driving

Comes with several prebuilt scenes created with the Unreal® gaming engine

Artificial Intelligence

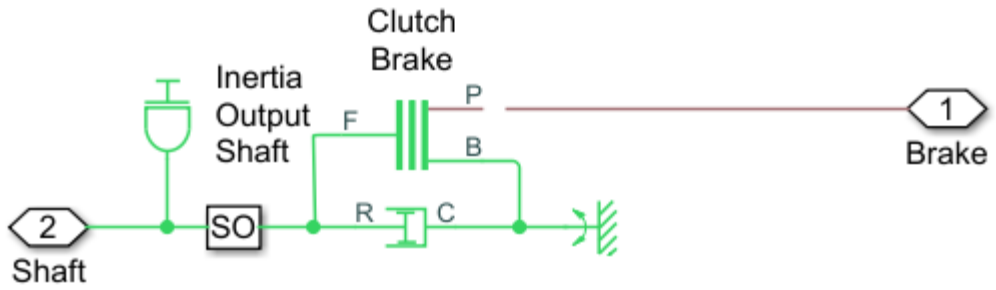


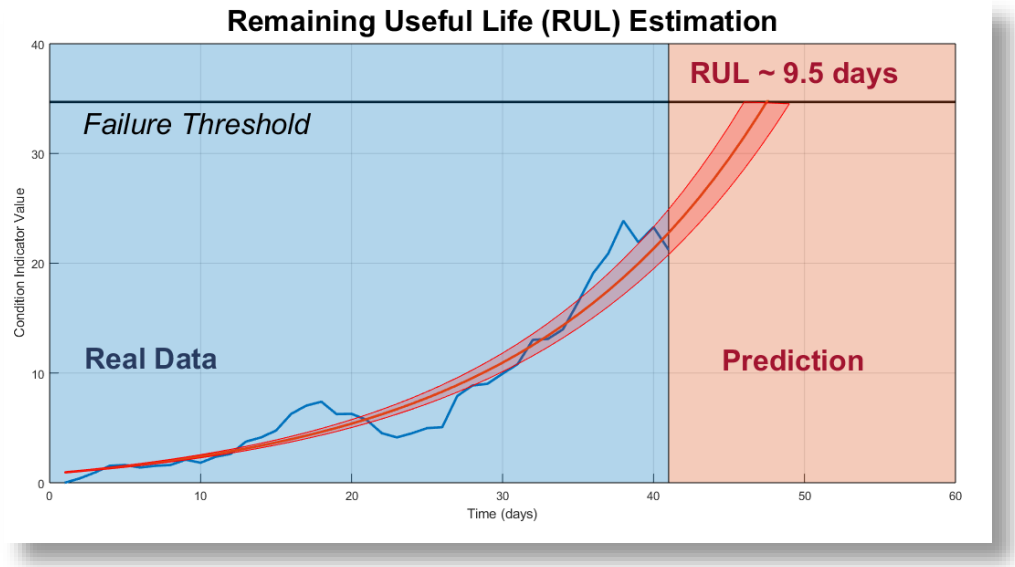
Predictive Maintenance

Data

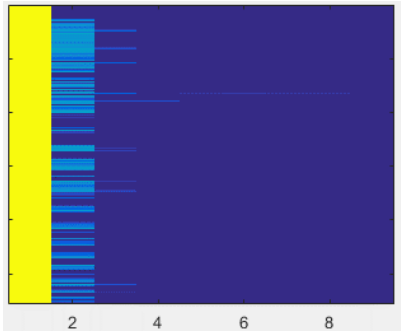
Sensors

Model

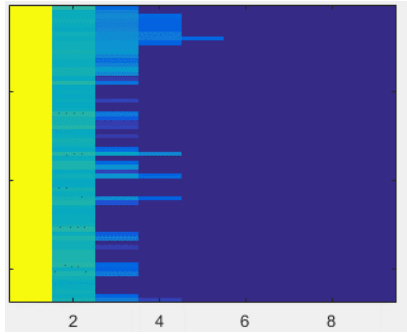




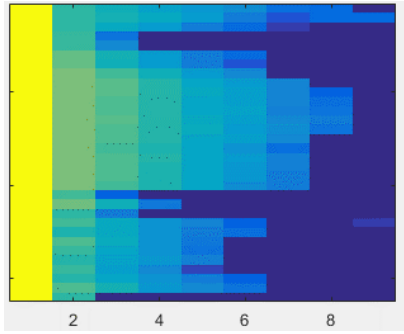
Output



Normal Operation



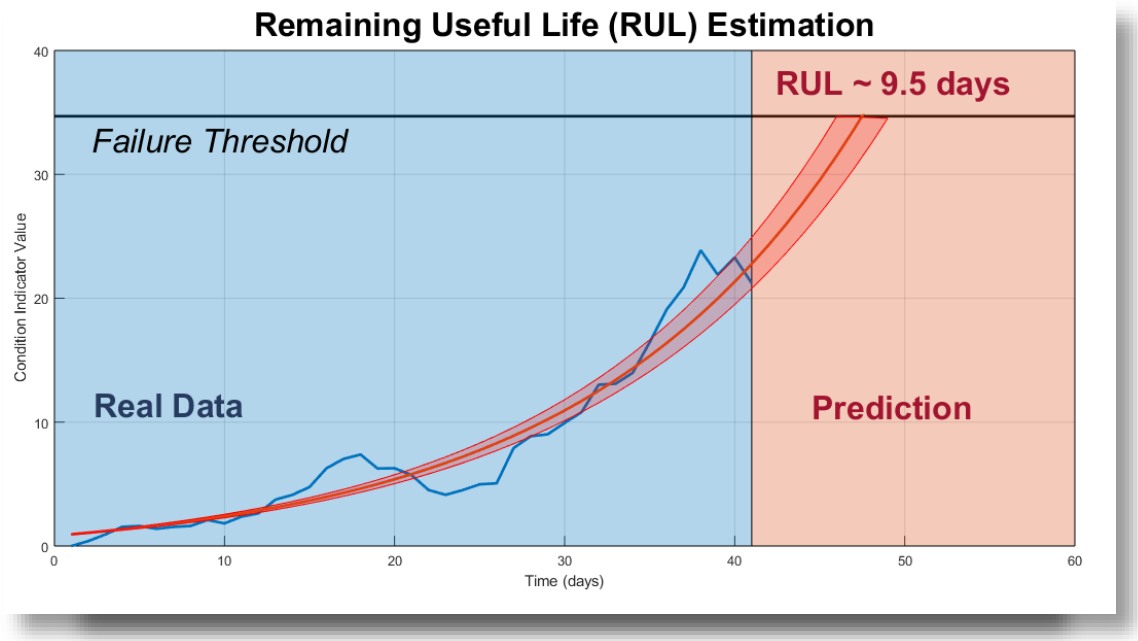
Monitor Closely



Maintenance Needed

Predictive Maintenance Toolbox New Product

Predictive Maintenance



Design and test condition monitoring and predictive maintenance algorithms

- Estimate remaining useful life (RUL)
- Extract features interactively (Diagnostic Feature Explorer app)
  ** available on MATLAB File Exchange*
- Import sensor data from local files and cloud storage
  (Amazon S3, Windows Azure Blob Storage, and Hadoop HDFS)
- Use simulated failure data from Simulink models
- Get started with examples
  (motors, gearboxes, batteries, and other machines)

Predictive Maintenance Toolbox New Product

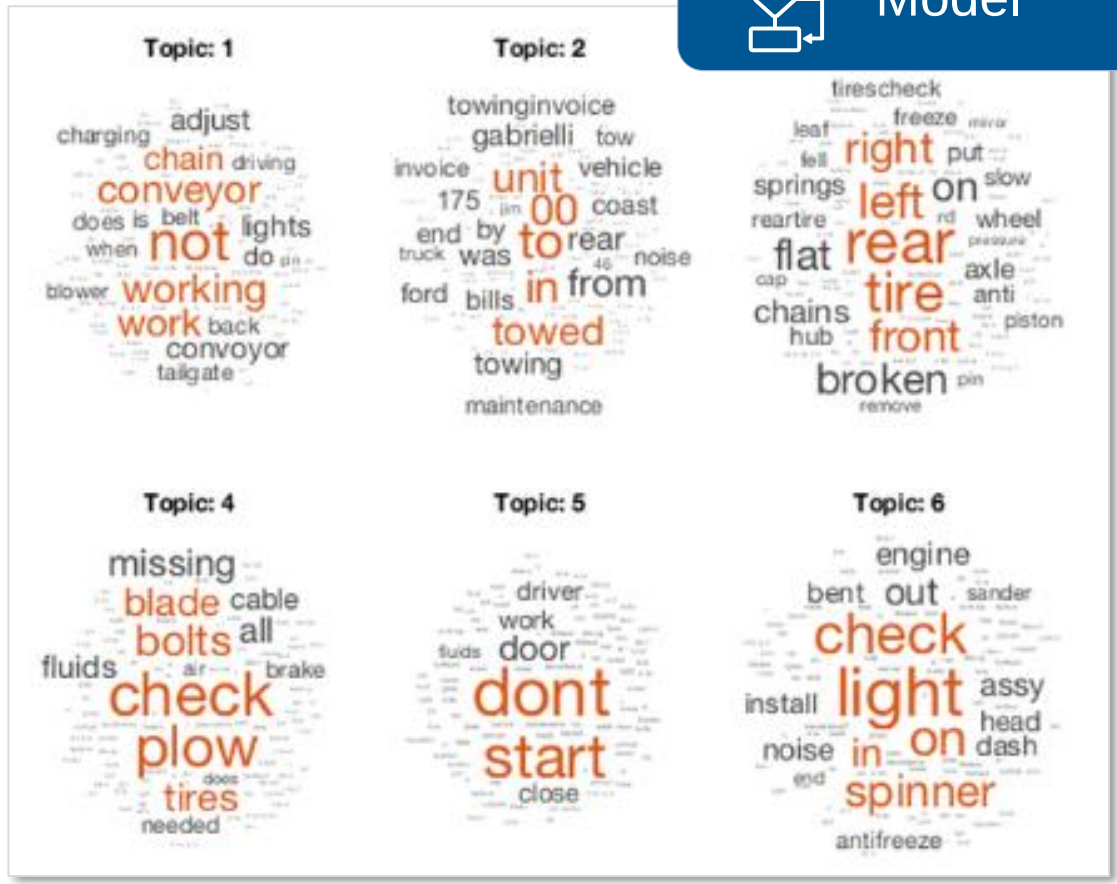
Text Analytics

Data

```
repairNotes = 617×1 string array
    "PM SERVICE, CHECK TURN SIGNAL, CLUNKING NOISE
    "SERVICEROB,EXT,5604"
    "NEED 4 PLOW PINS"
    "INSTALL SPINNER ASSY"
    "DONT START"
    "DOG BONE PIN BROKEN"
    "NEED SERVICE, CHECK BRAKES"
    "HYD CAP CHECK ENGINE LIGHT ON"
    "TARP VALVE STICKINGRIGHT SIDE MIRROR BRACKET
    "HANDLES IN CAB LOOSE"
    "NO PLOW LIGHTS"
```

Output

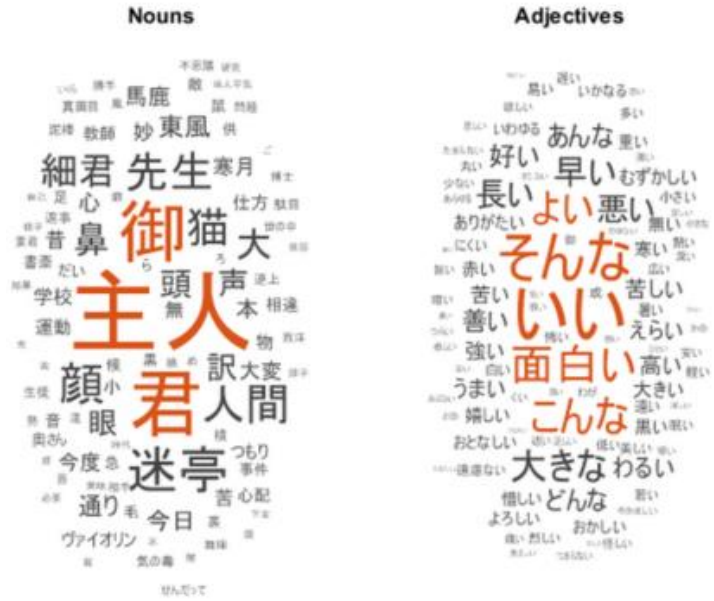
Model



Text Analytics

Data

- Morphological analysis for Japanese language

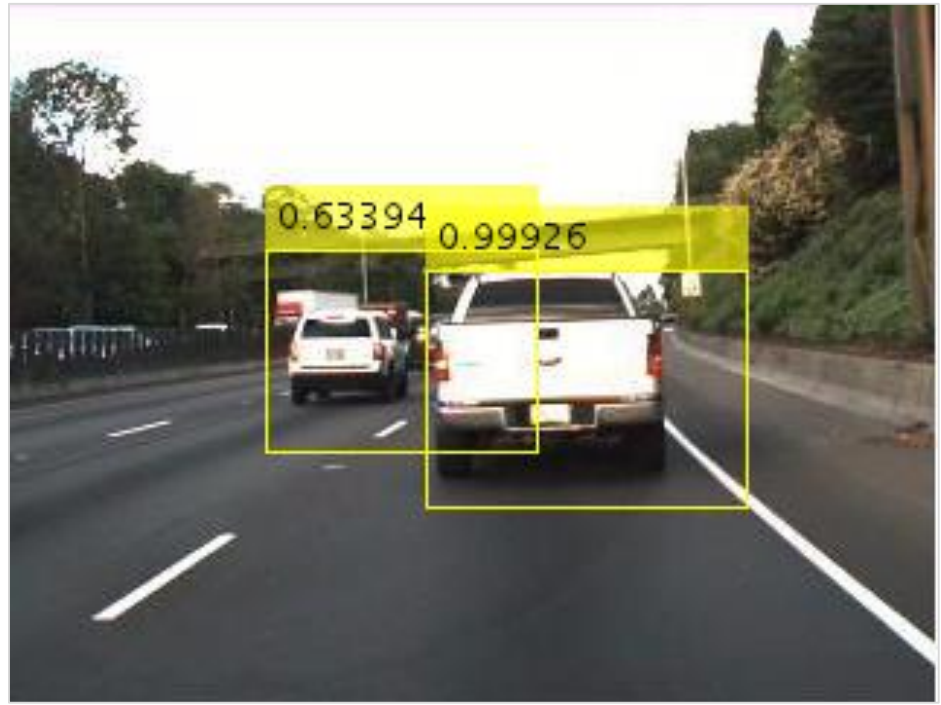



```
>> documents = tokenizedDocument("吾輩は猫である。名前はまだ無い。")

documents =

  tokenizedDocument:

    11 tokens: 吾輩 は 猫 で ある 。 名前 は まだ 無い 。
```

Deep Learning

Data

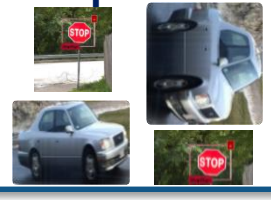
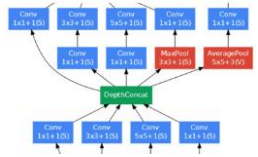
Model



Output

Deep Learning Toolbox
Computer Vision System Toolbox
GPU Coder
MATLAB Coder

Deep Learning is a Major Area of Investment

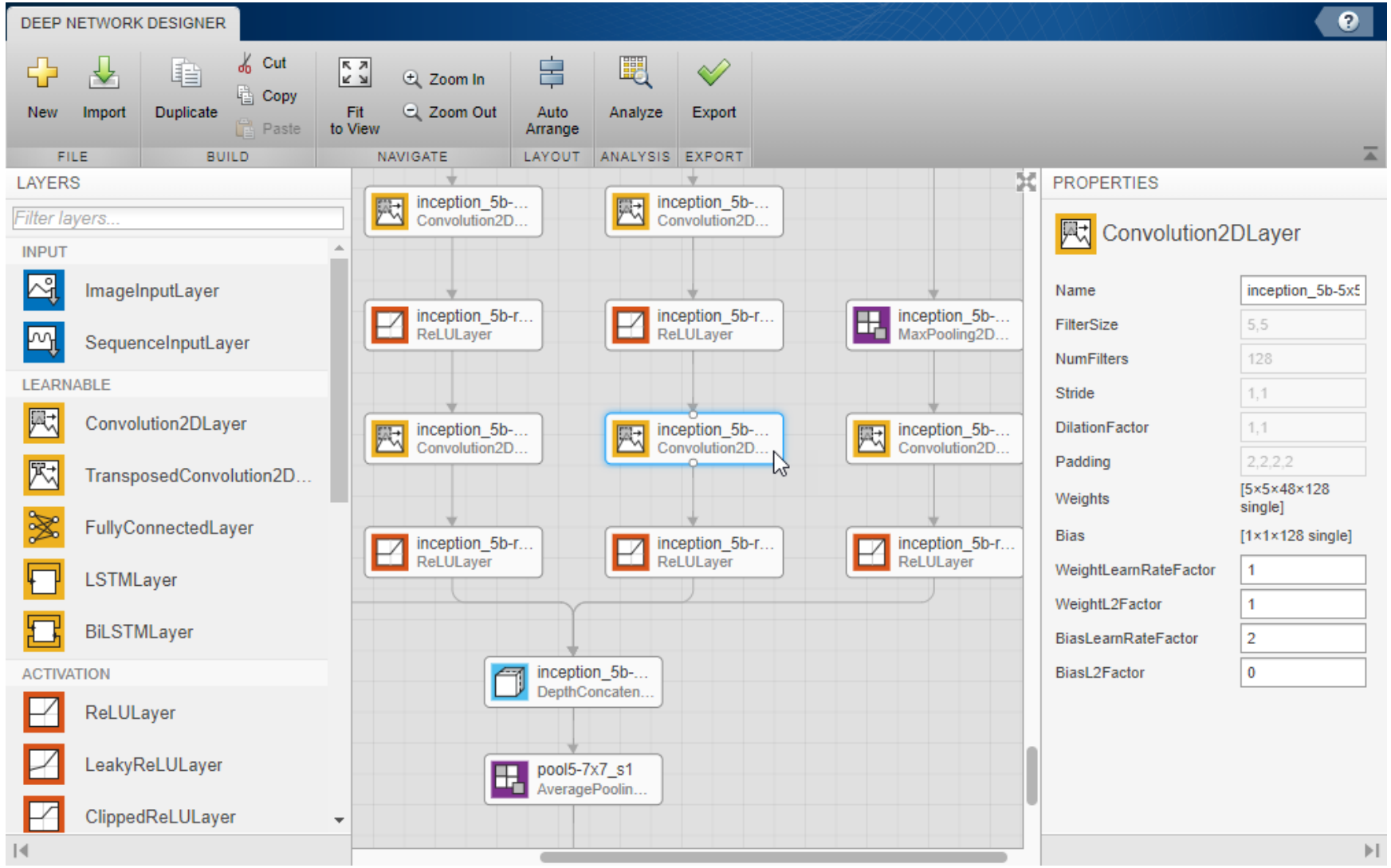
	~ 2016	2017	2018
Access Data 		• Caffe Model Importer • Alexnet • VGG-16 / VGG-19 • Tensorflow-Keras Importer • GoogLeNet • ResNet-50 / ResNet-101 • Inception-V3 • Pixel label (image) datastore	• SqueezeNet • Inception-ResNet-V2 • ResNet-18 • ONNX support • Mini-batch datastore
Preprocess 	• Image labeling (2014)	• Region and pixel labeling • Image augmentation	• Pixel labeling for Video • Audio labeling
Architectures 	• Stacked Autoencoder (2015) • CNN classification (2016) • Region-based CNN (2016)	• Fast & Faster R-CNN • CNN Regression • LSTM Classification • DAG Networks	• LSTM Regression • Bidirectional LSTM • Deep Network Designer • Network Analyzer

Deep Learning is a Major Area of Investment (cont.)

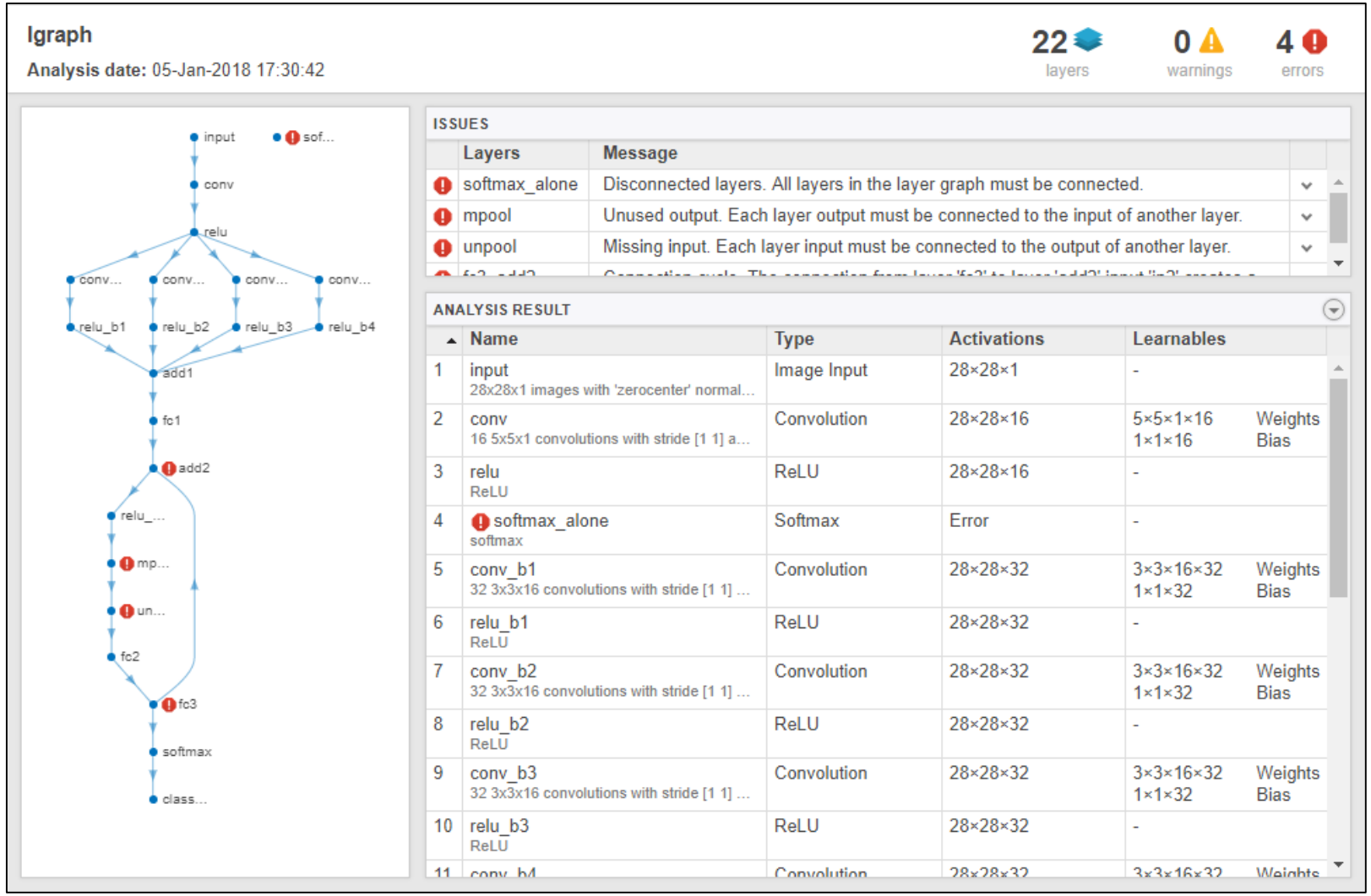
	~ 2016	2017	2018
Train 	• Multi-CPUs and clusters (2012) • GPU support (2012)	• Multi-GPUs and clusters • Bayesian optimization for hyper-parameters	• ADAM & RMSProp • Gradient clipping
Deploy & Share 	• C-code generation (2013) • Deploy neural network training model (2016)	• Generate CUDA code for NVIDIA® GPU	• Deploy deep network onto Intel® MKL-DNN, ARM® and NVIDIA TensorRT™ • DAG ResNet / GoogLeNet / SegNet

Network Editor App makes it easier to describe & visualize DAG networks

Model



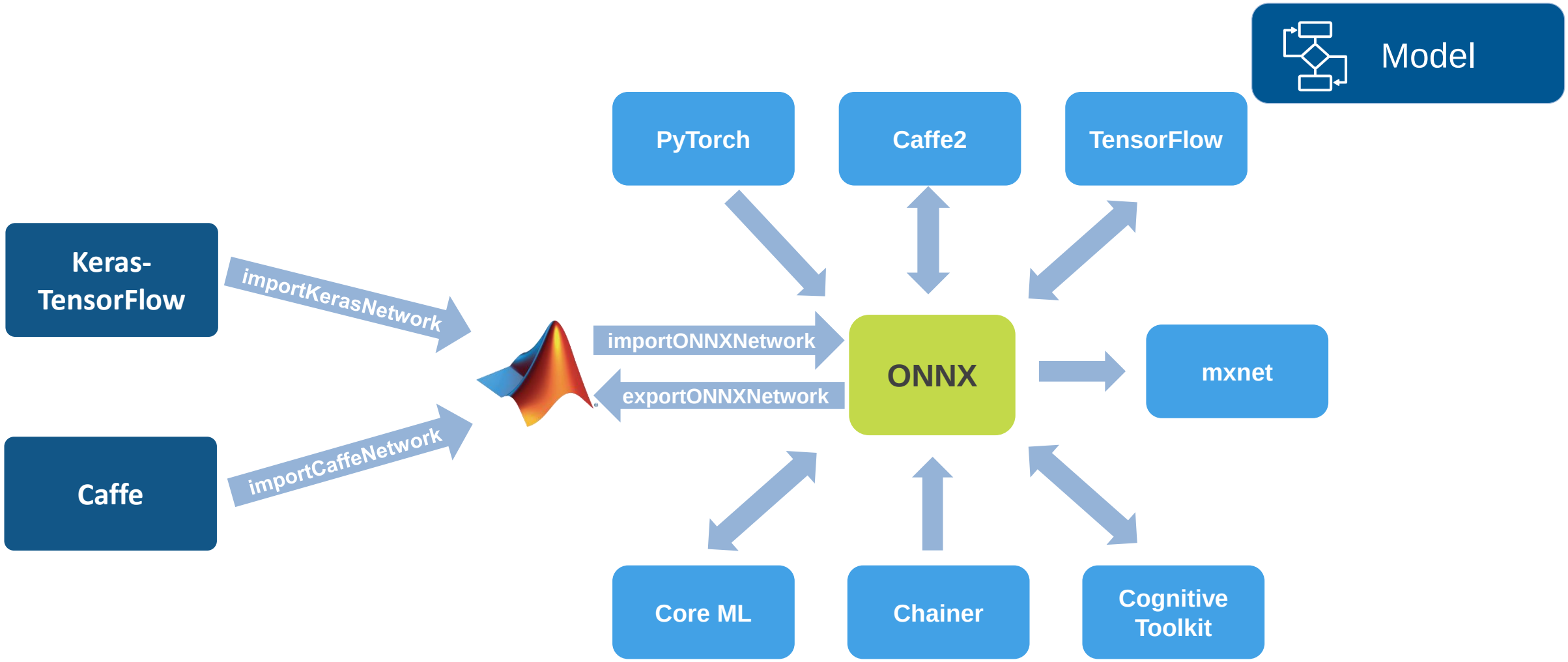
Network Analyzer: gives more information about your network



Model

Support Package

Interoperate With Deep Learning Frameworks

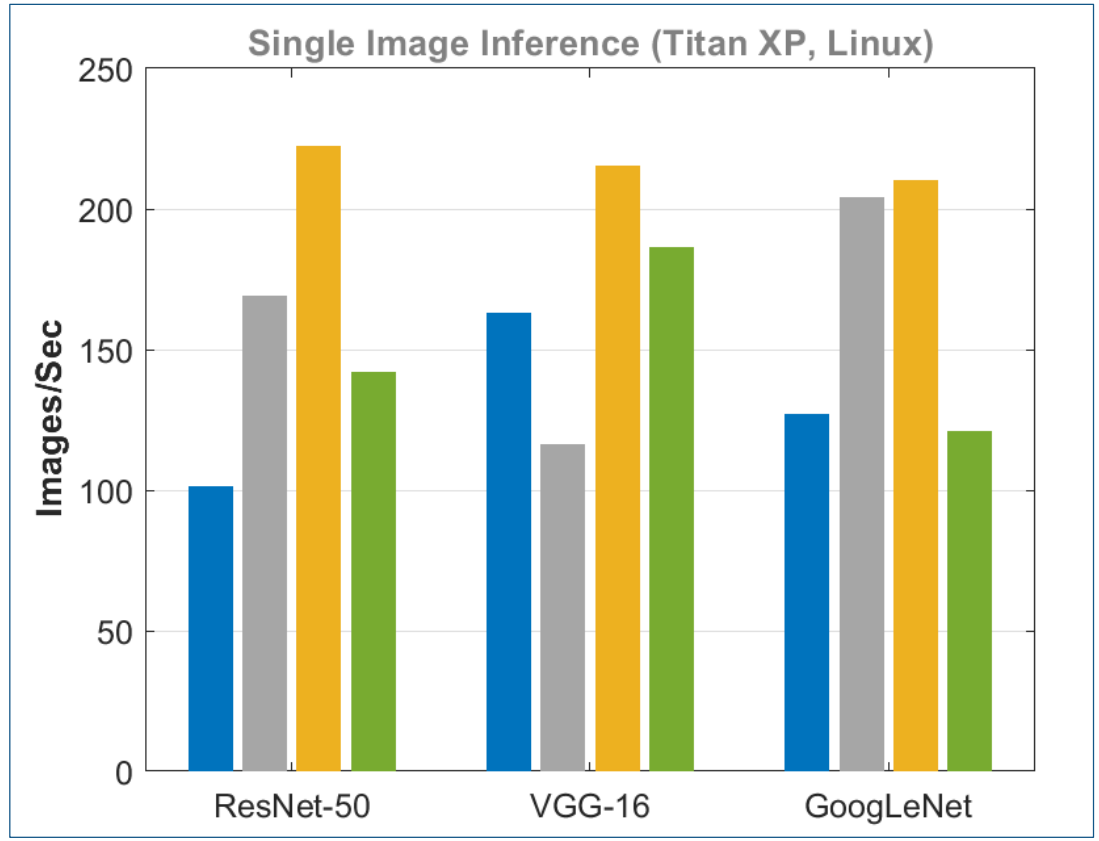


ONNX = Open Neural Network Exchange Format

Deep Learning

Design, build, and visualize convolutional neural networks

- Access the latest models
- Import pretrained models and use transfer learning
- Automate ground-truth labeling using apps
- Design and build your own models
- Use NVIDIA GPUs to train your models
- Automatically generate high-performance CUDA code for embedded deployment

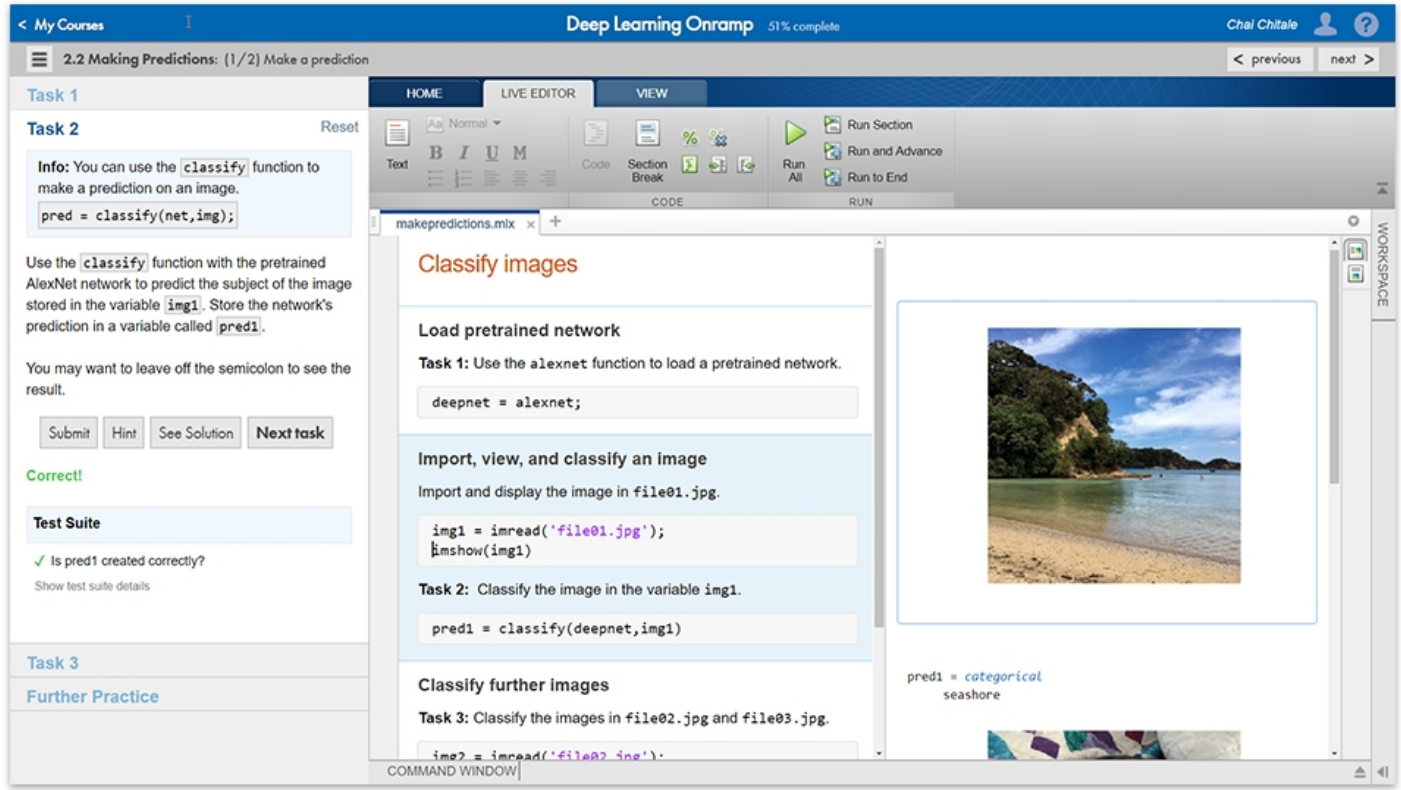


Deep Learning Toolbox
Computer Vision System Toolbox
GPU Coder

FREE

Learn to Use MATLAB for Deep Learning in 2 Hours

Launch Deep Learning Onramp

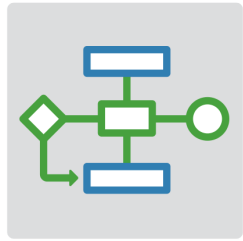


What's New in MATLAB and Simulink?

Platform Productivity

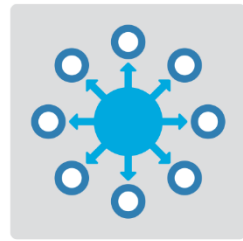
- Design Creation
- Analysis
- Simulation, Scaling

Workflow Depth



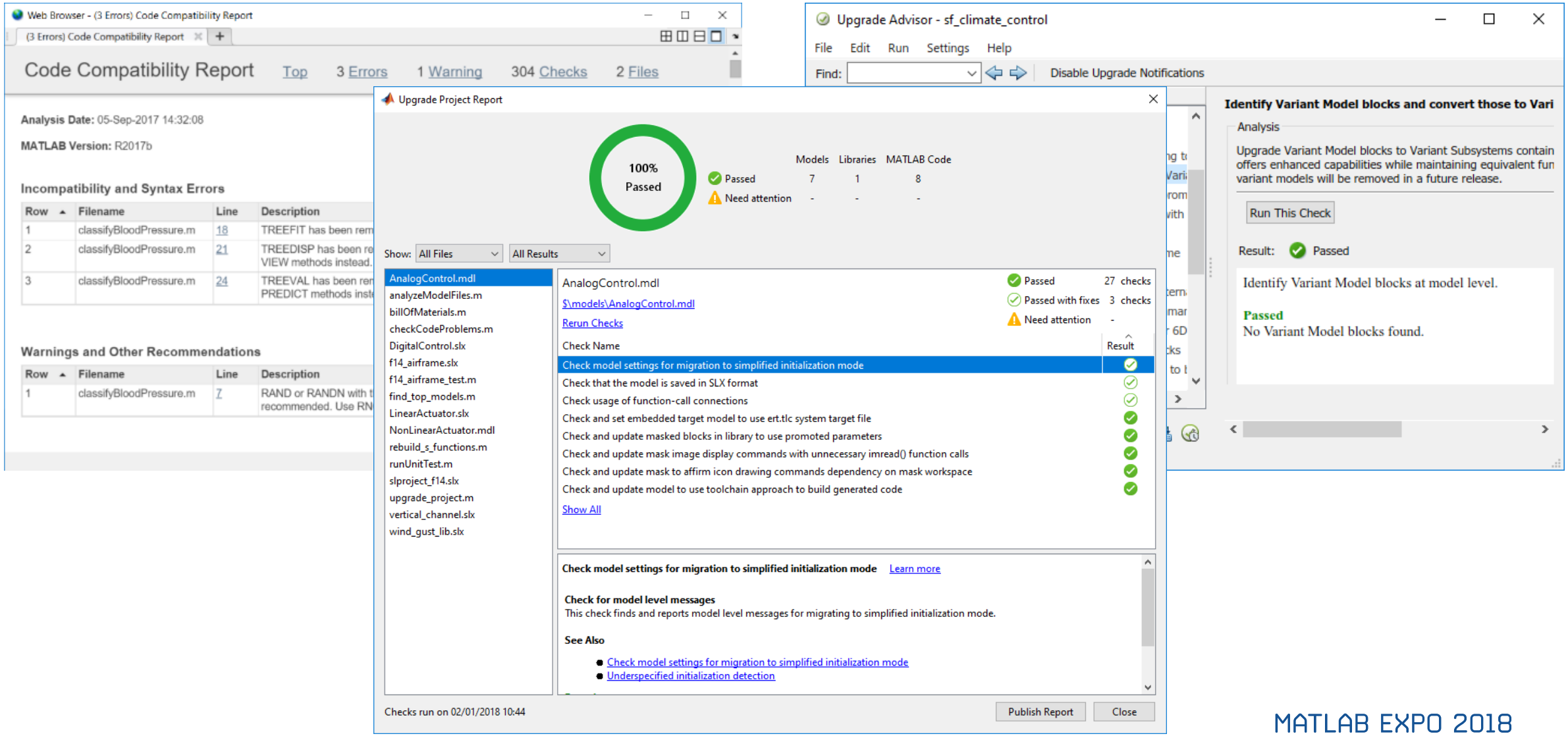
- Deployment
- Code Generation
- Verification and Validation

Application Breadth



- Physical Modeling
- Autonomous Systems
- Artificial Intelligence (AI)

Upgrade your MATLAB Code and Simulink Models



MATLAB EXPO 2018