MATLAB EXPO 2019

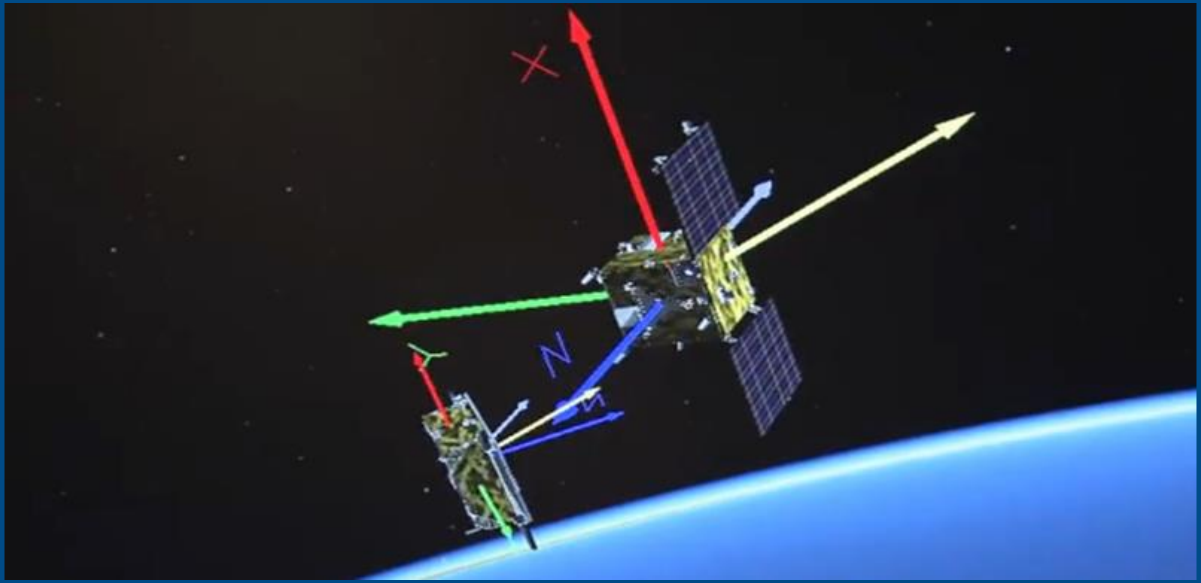
What’s New in MATLAB and Simulink

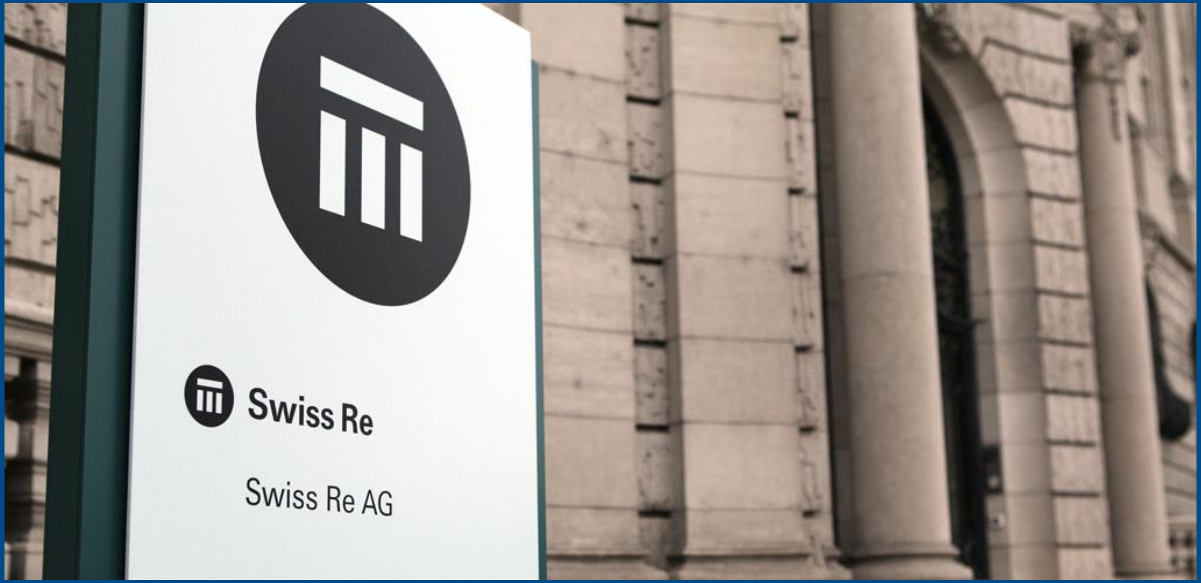
Maurizio Dalbard
Giuseppe Ridinò

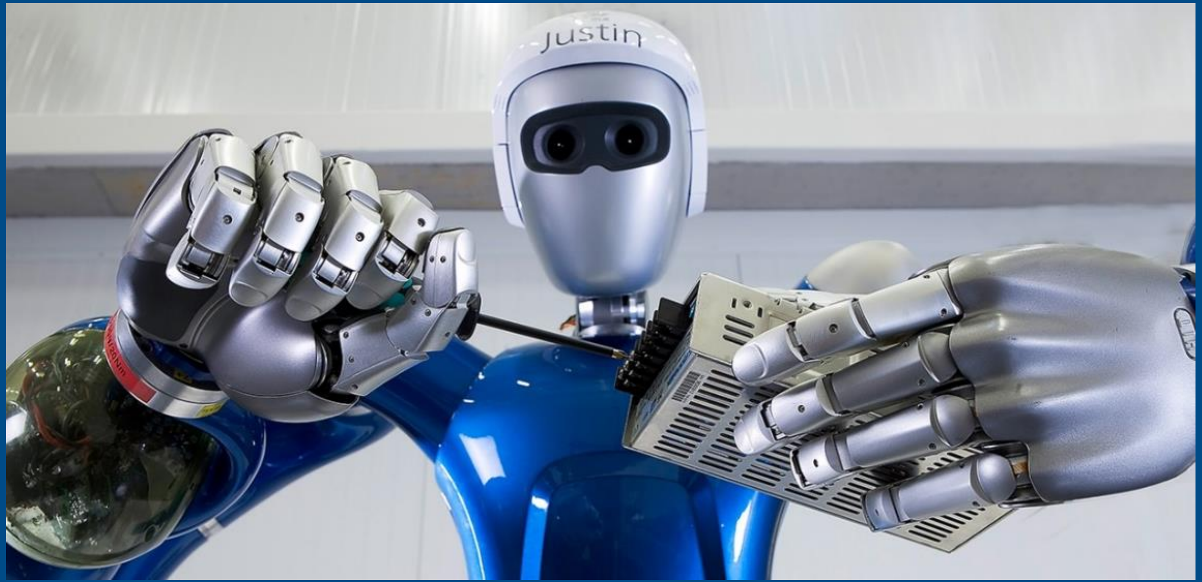
R2018a

Software in everything

Algorithms in everything … in Engineering and Science







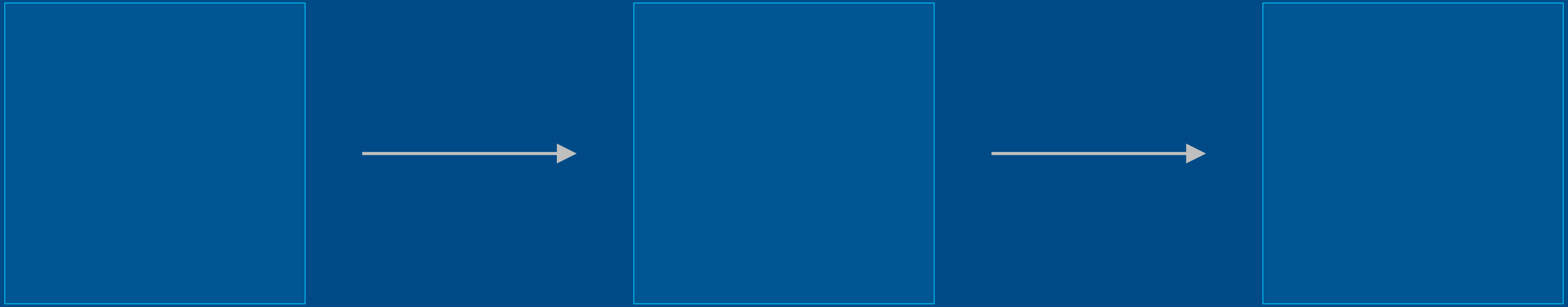
Using MATLAB & Simulink to Build Algorithms in Everything

Simplifying your work…

…often at higher levels of abstraction.

MATLAB®&SIMULINK®

Using MATLAB & Simulink to Build Algorithms in Everything



Inputs

Design

Outputs

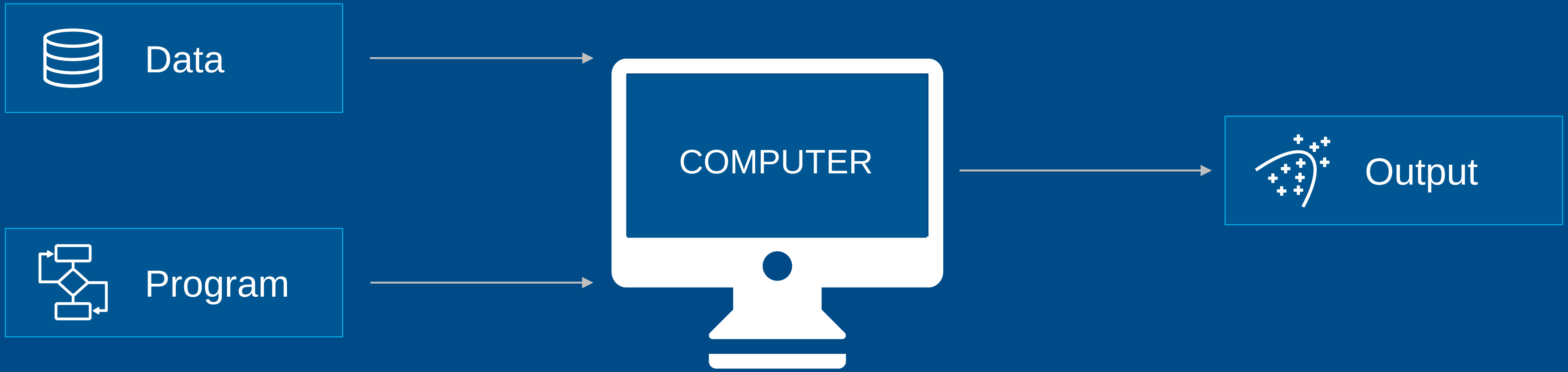
MATLAB®&SIMULINK®

Artificial Intelligence

The capability of a machine to
match or exceed intelligent human behavior by
training a machine
to learn the desired behavior

There are two ways to get a computer to do what you want

Traditional Programming



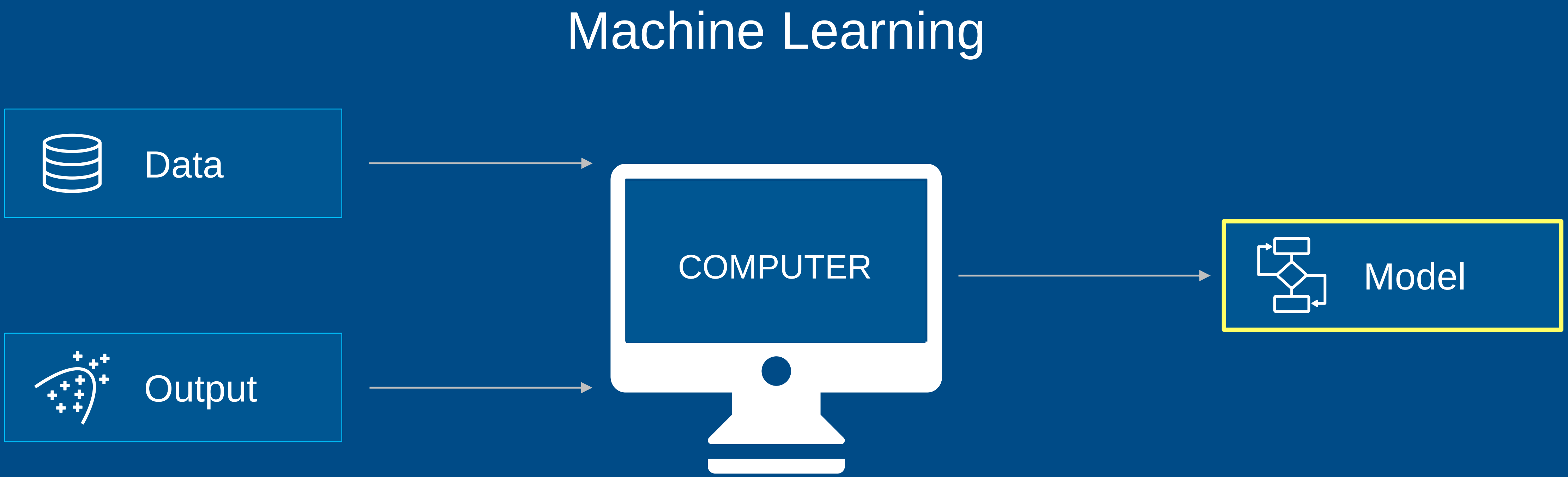
Data

Program

COMPUTER

Output

There are two ways to get a computer to do what you want



Machine Learning

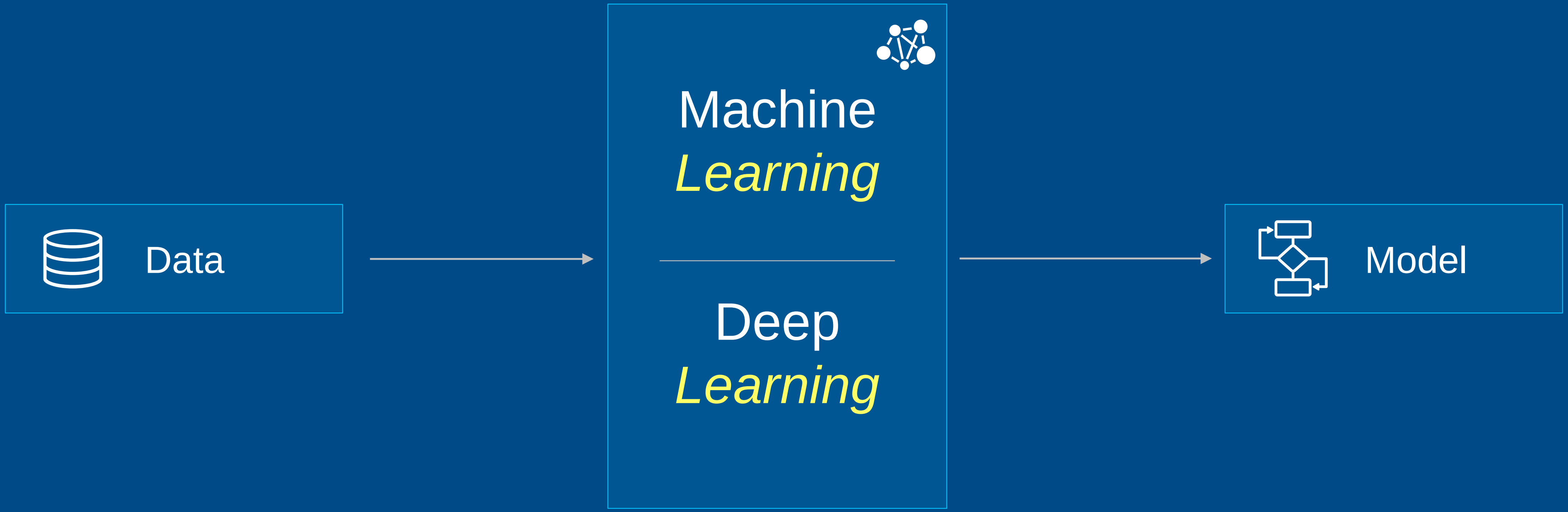
Data

Output

COMPUTER

Model

Artificial Intelligence



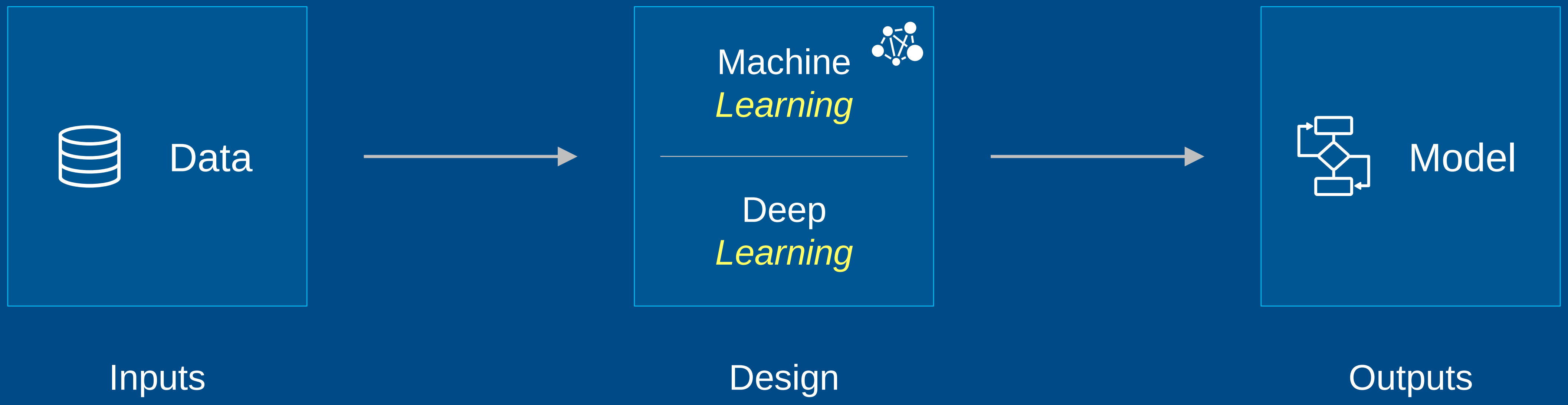
Data

Machine *Learning*

Deep *Learning*

Model

Using MATLAB and Simulink to Build Deep Learning Models



Data

Machine Learning

Deep Learning

Model

Inputs

Design

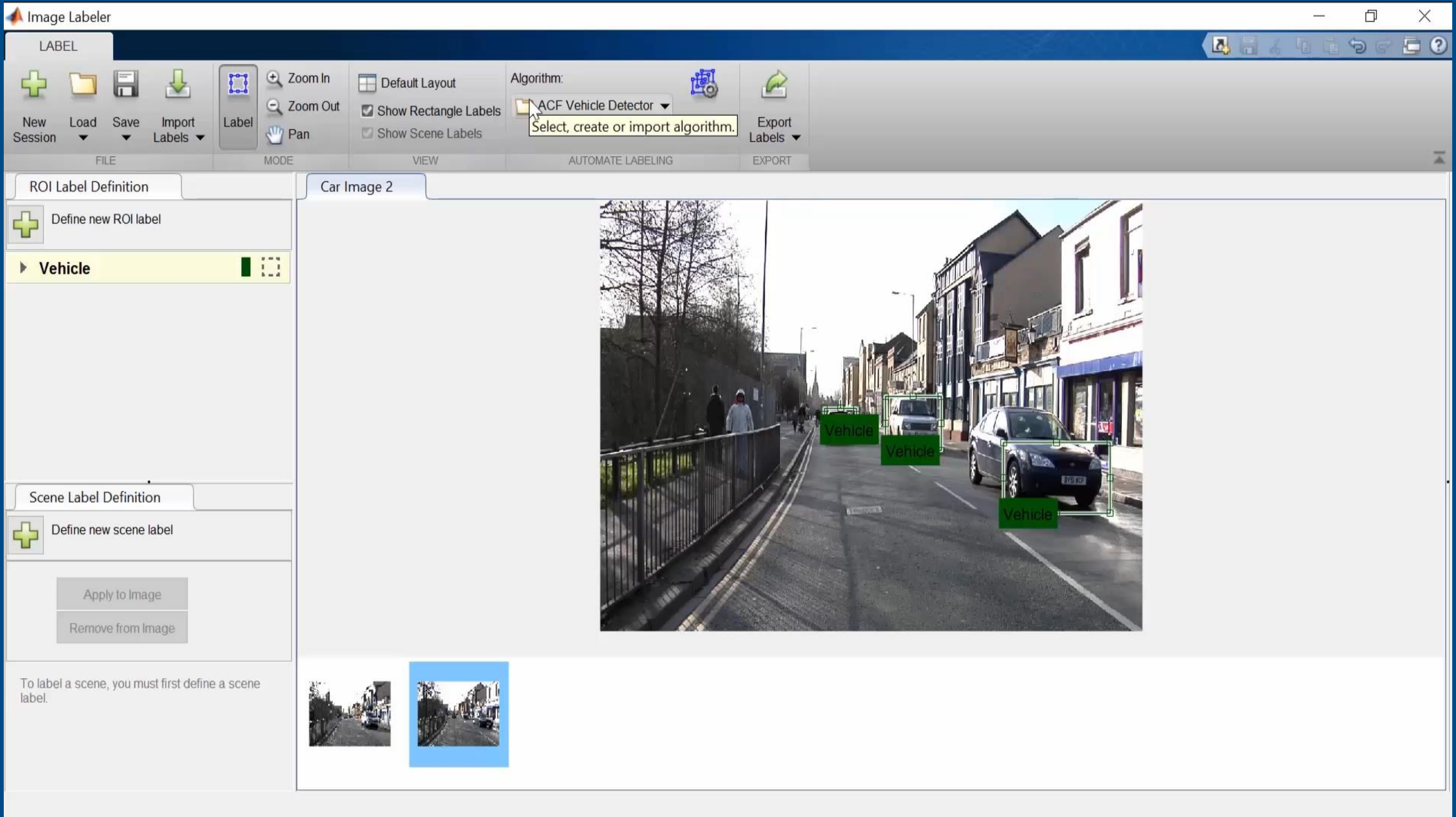
Outputs

MATLAB®&SIMULINK®

Input

Using Apps for Ground Truth Labeling

Image and Video Data



☑ Show Rectangle Labels

☑ Show Scene Labels

Algorithm: ACF Vehicle Detector

Select, create or import algorithm.

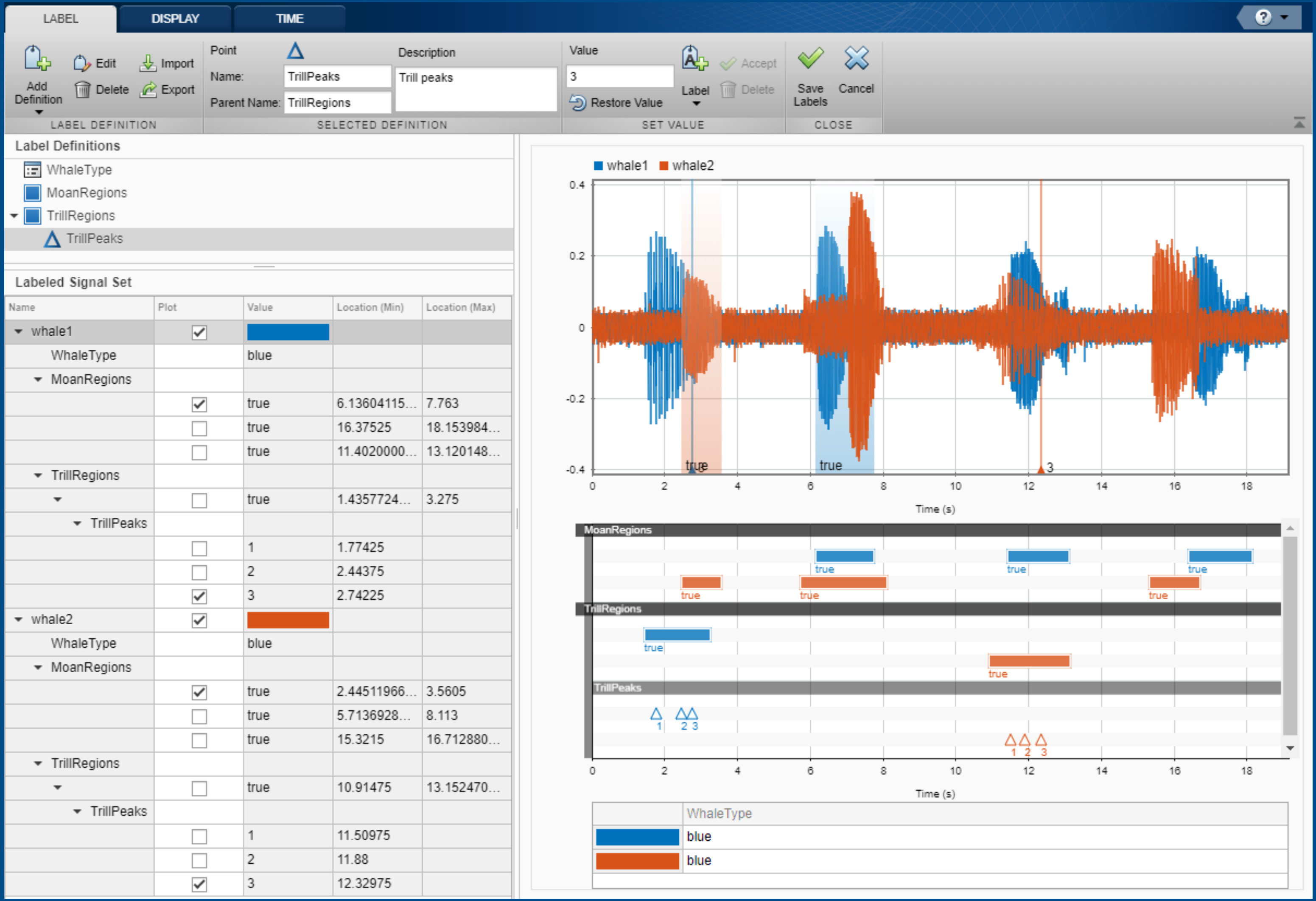
To label a scene, you must first define a scene label.

Computer Vision Toolbox

Input

Using Apps for Ground Truth Labeling

Signal Data



Point

Name: TrillPeaks

Parent Name: TrillRegions

Description: Trill peaks

Value: 3

Labeled Signal Set

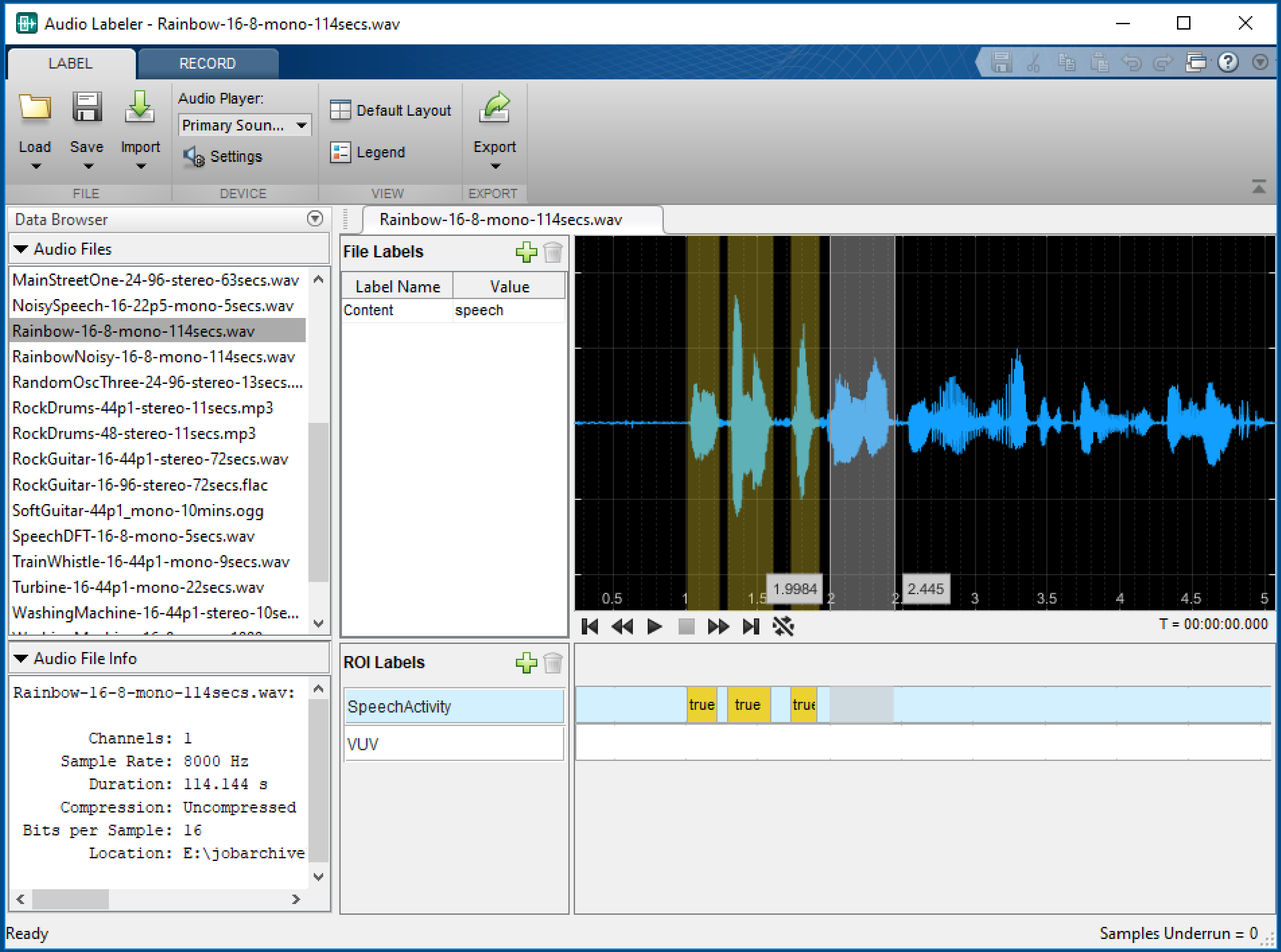
Name	Plot	Value	Location (Min)	Location (Max)
whale1	☑	🟦		
WhaleType		blue		
MoanRegions				
	☑	true	6.13604115…	7.763
	□	true	16.37525	18.153984…
	□	true	11.4020000…	13.120148…
TrillRegions				
	□	true	1.4357724…	3.275
TrillPeaks				
	□	1	1.77425	
	□	2	2.44375	
	☑	3	2.74225	
whale2	☑	🟧		
WhaleType		blue		
MoanRegions				
	☑	true	2.44511966…	3.5605
	□	true	5.7136928…	8.113
	□	true	15.3215	16.712880…
TrillRegions				
	□	true	10.91475	13.152470…
TrillPeaks				
	□	1	11.50975	
	□	2	11.88	
	☑	3	12.32975	

	WhaleType
🟦	blue
🟧	blue

Using Apps for Ground Truth Labeling

Audio Data

Input



Audio Files

- MainStreetOne-24-96-stereo-63secs.wav
- NoisySpeech-16-22p5-mono-5secs.wav
- Rainbow-16-8-mono-114secs.wav
- RainbowNoisy-16-8-mono-114secs.wav
- RandomOscThree-24-96-stereo-13secs....
- RockDrums-44p1-stereo-11secs.mp3
- RockDrums-48-stereo-11secs.mp3
- RockGuitar-16-44p1-stereo-72secs.wav
- RockGuitar-16-96-stereo-72secs.flac
- SoftGuitar-44p1_mono-10mins.ogg
- SpeechDFT-16-8-mono-5secs.wav
- TrainWhistle-16-44p1-mono-9secs.wav
- Turbine-16-44p1-mono-22secs.wav
- WashingMachine-16-44p1-stereo-10se....

File Labels

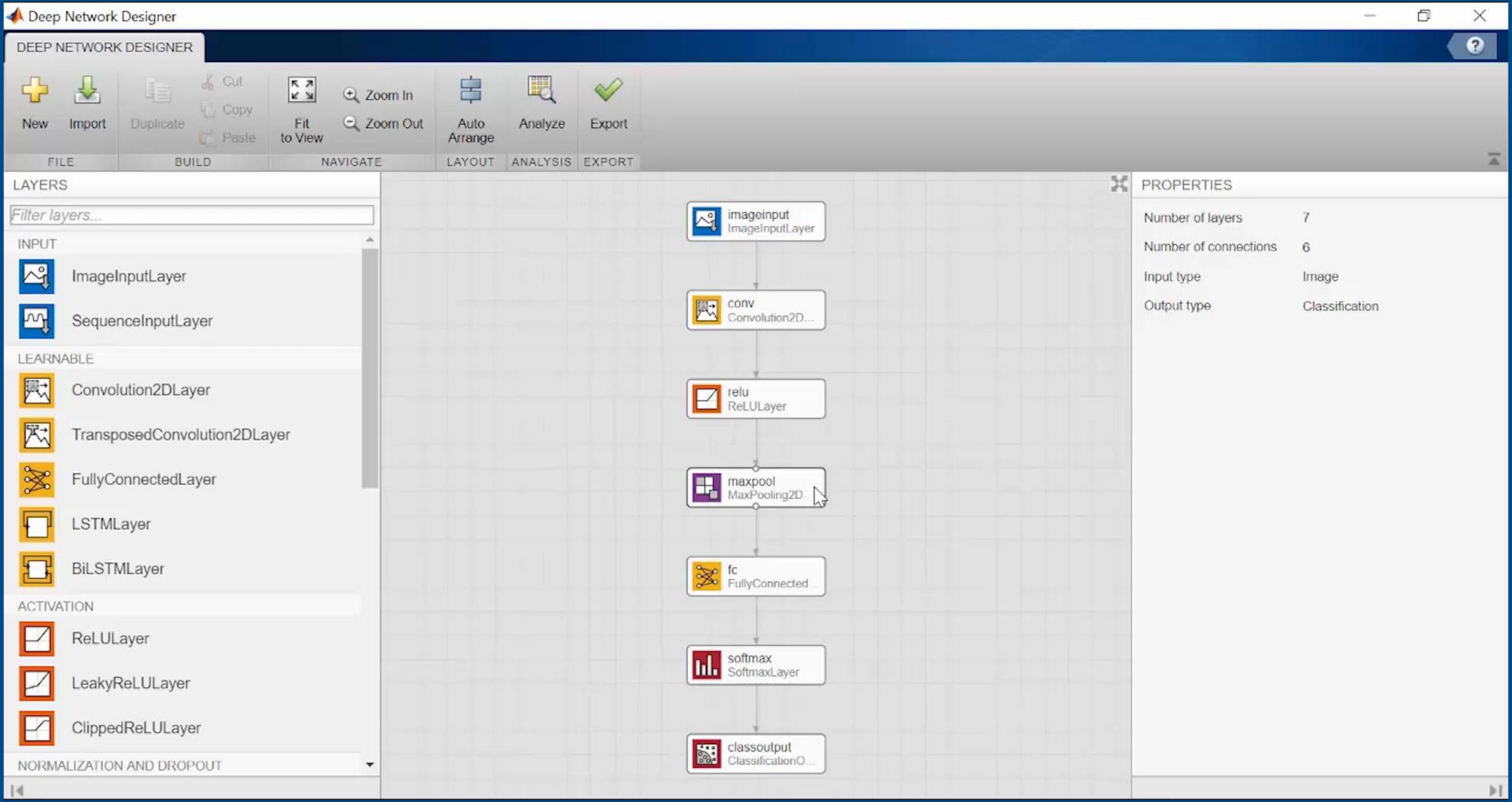
Label Name	Value
Content	speech

```
Rainbow-16-8-mono-114secs.wav:

        Channels: 1
     Sample Rate: 8000 Hz
        Duration: 114.144 s
     Compression: Uncompressed
 Bits per Sample: 16
        Location: E:\jobarchive
```

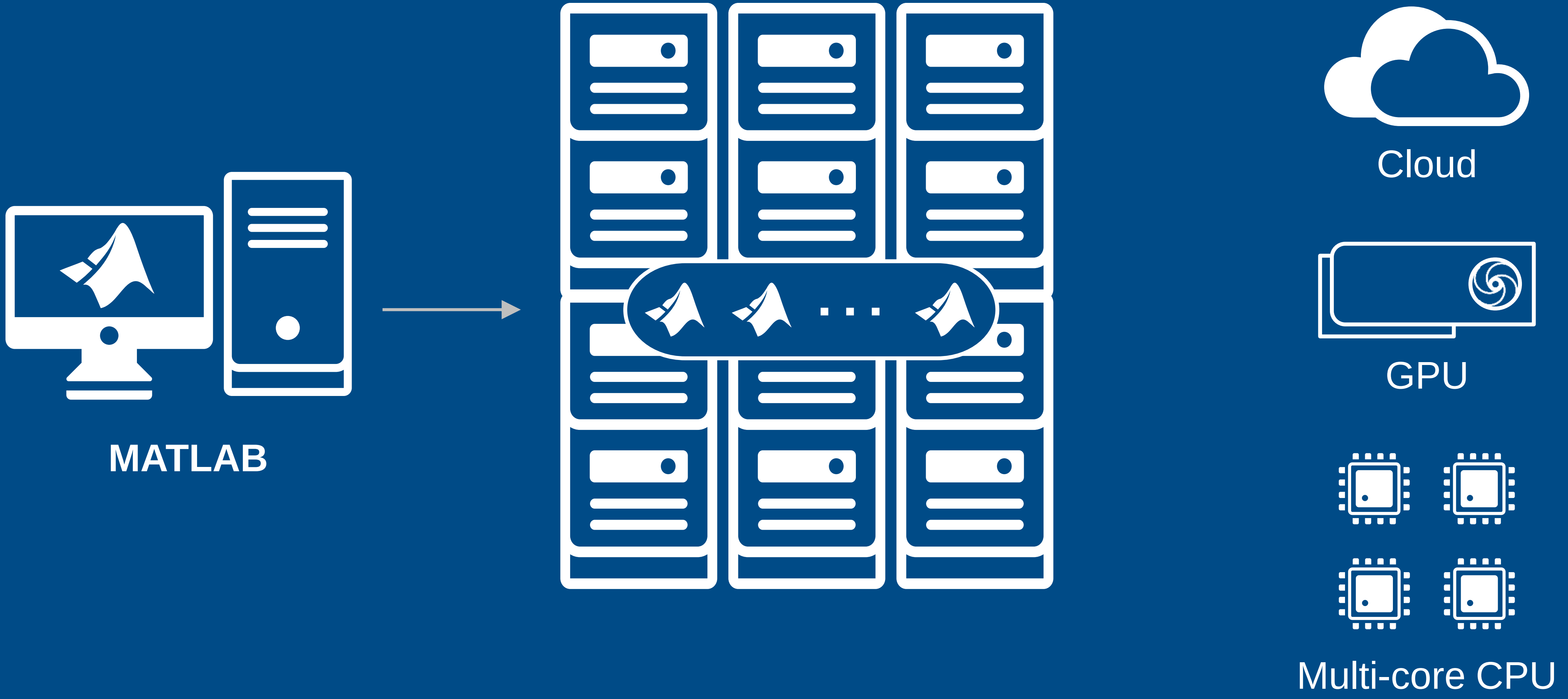
Using Apps for Designing Deep Learning Networks

Design

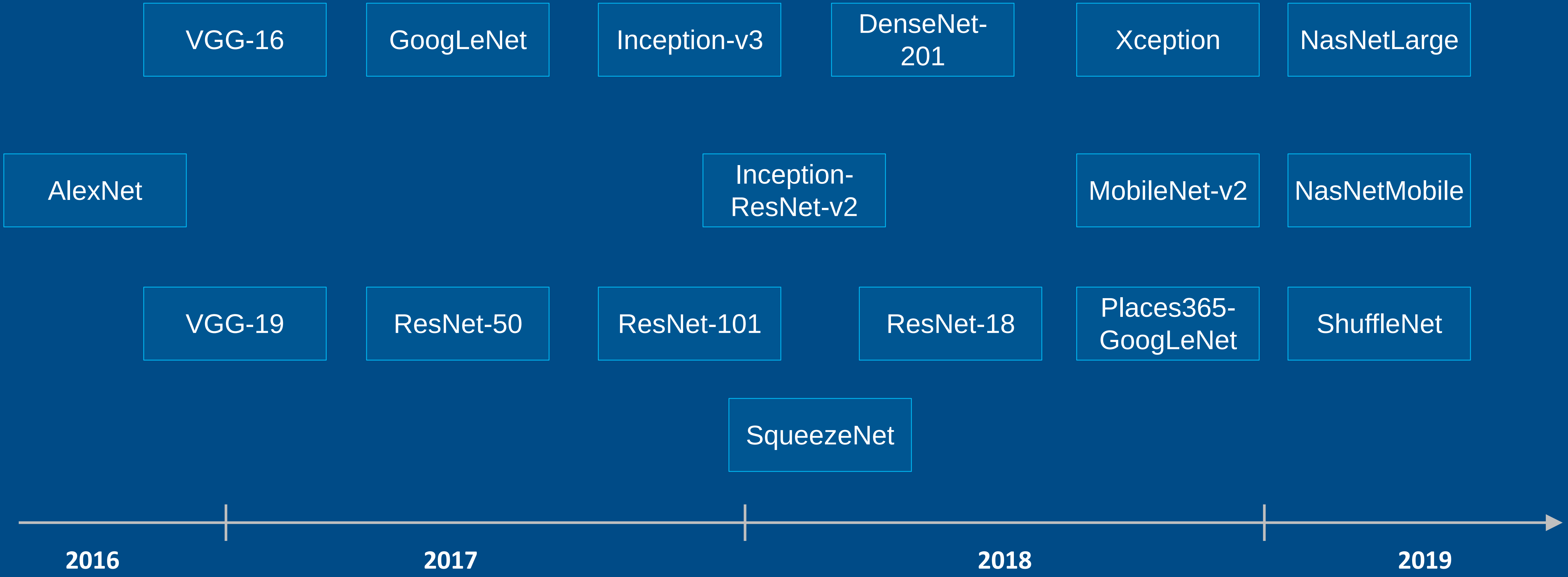


Number of layers	7
Number of connections	6
Input type	Image
Output type	Classification

Scaling Computation for Training Deep Learning



Using Transfer Learning with Pre-trained Models



AlexNet

VGG-16

VGG-19

GoogLeNet

ResNet-50

Inception-v3

ResNet-101

Inception-ResNet-v2

SqueezeNet

DenseNet-201

ResNet-18

Xception

MobileNet-v2

Places365-GoogLeNet

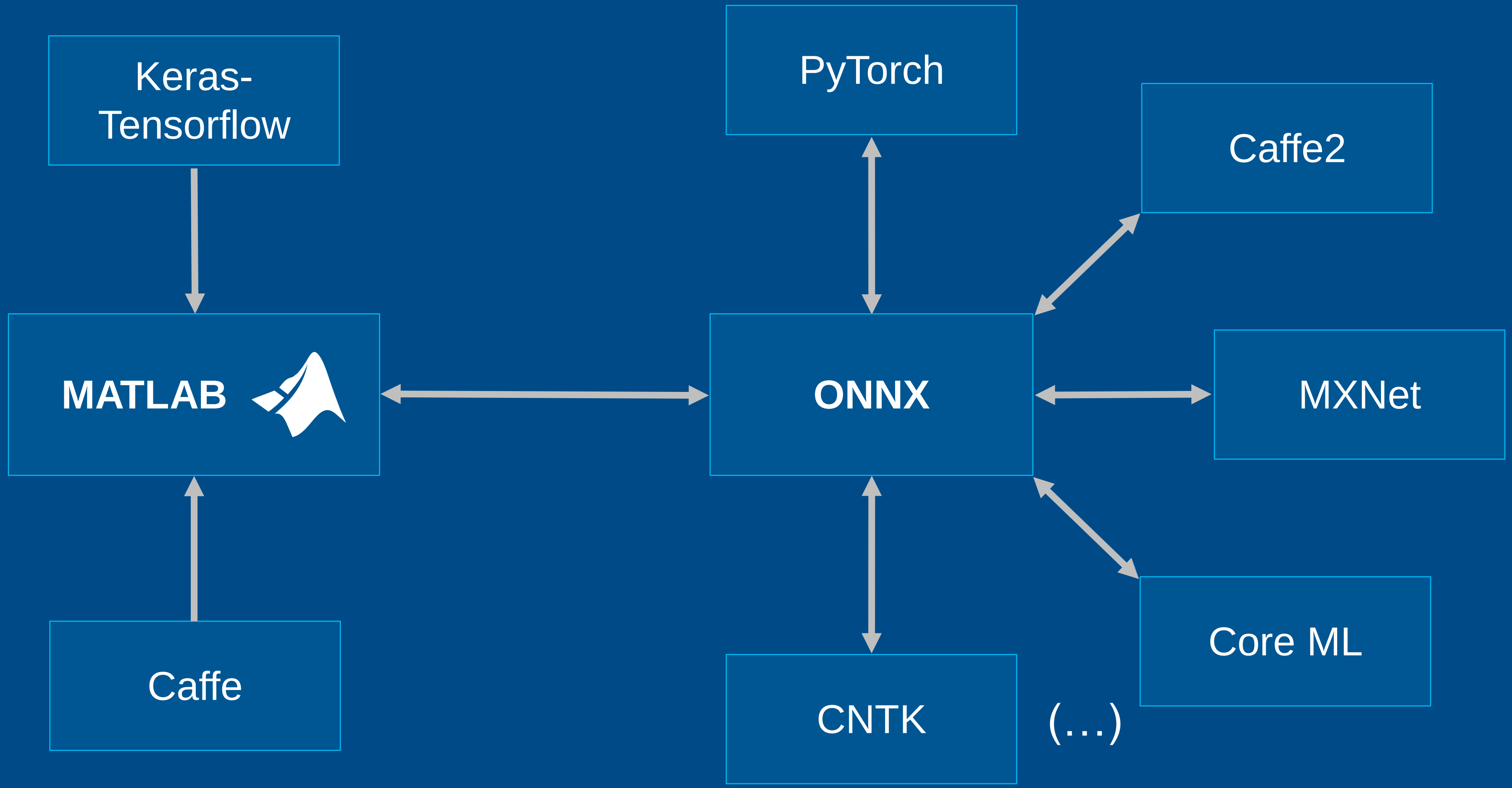
NasNetLarge

NasNetMobile

ShuffleNet

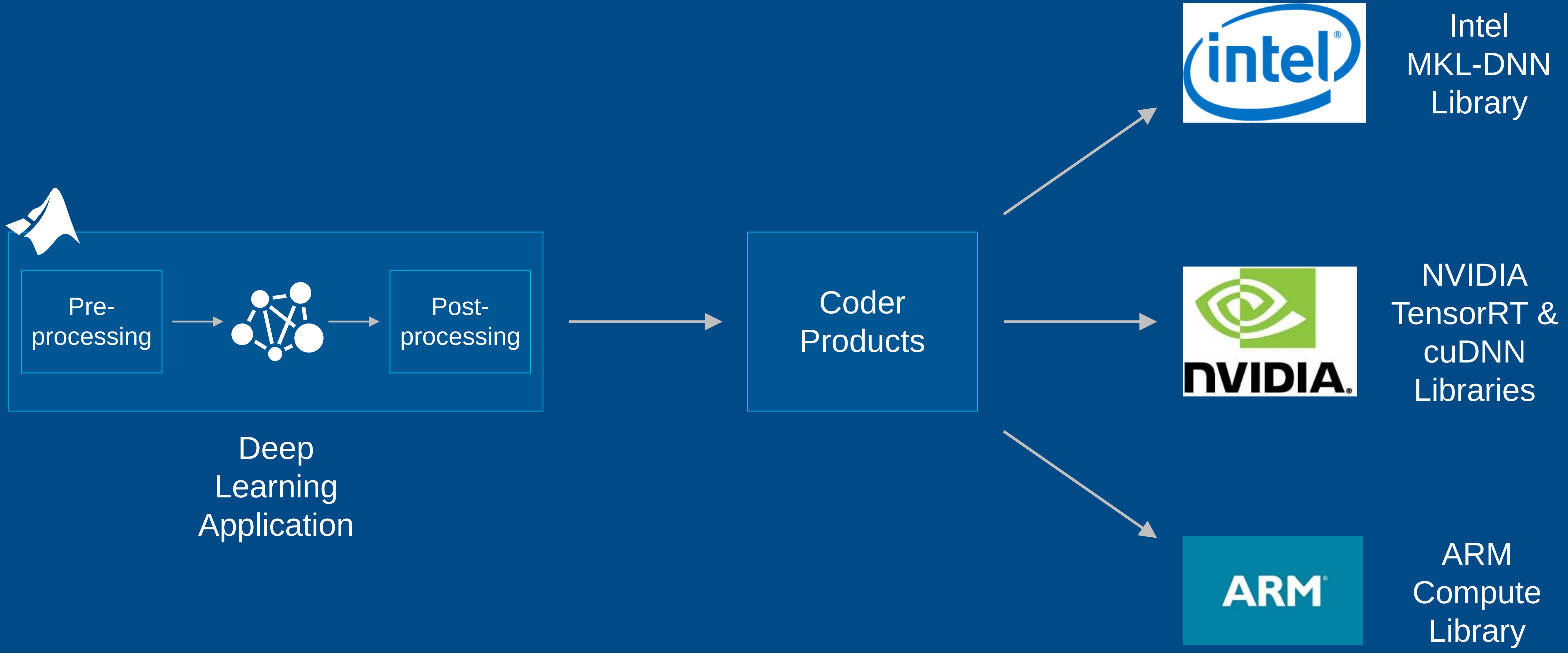
Design

Using Models from Other Frameworks



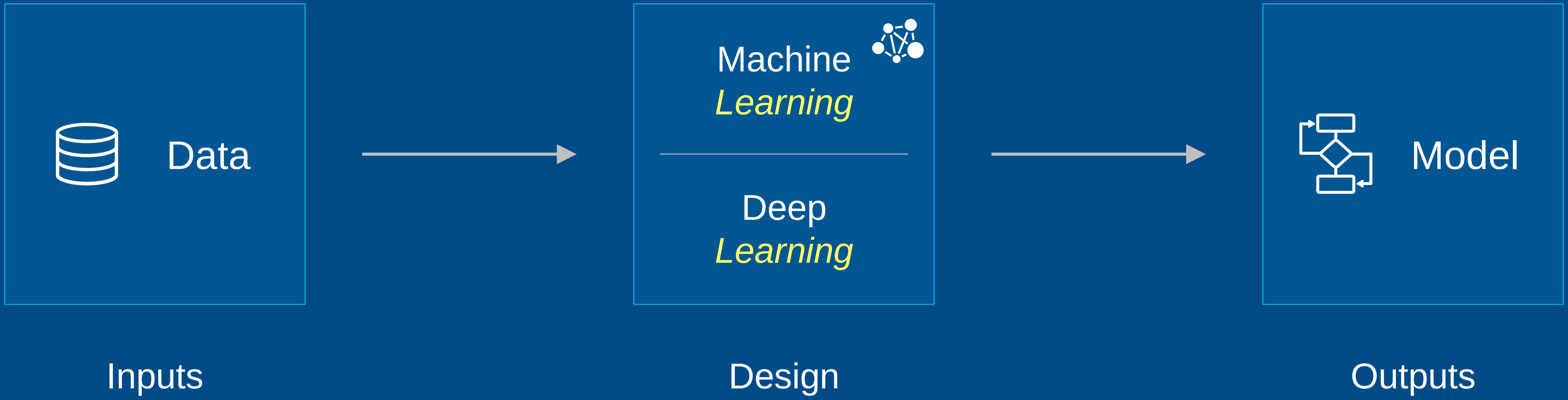
Deep Learning Toolbox

Deploying Deep Learning Applications



MATLAB Coder
GPU Coder

Using MATLAB and Simulink for Reinforcement Learning


Data

Machine *Learning*

Deep *Learning*

Model

Inputs

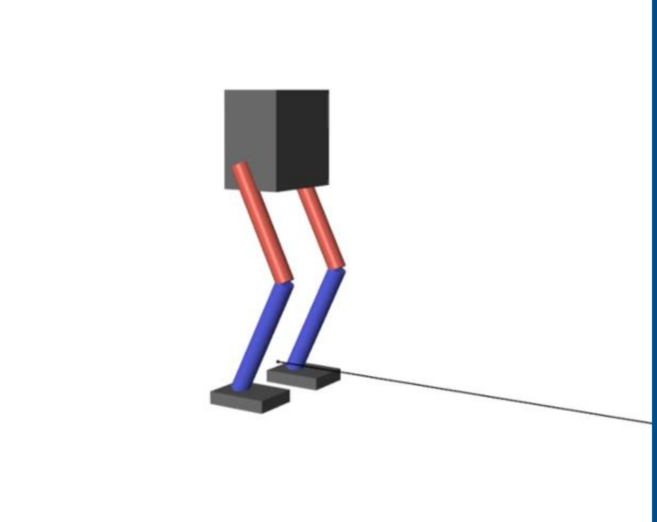
Design

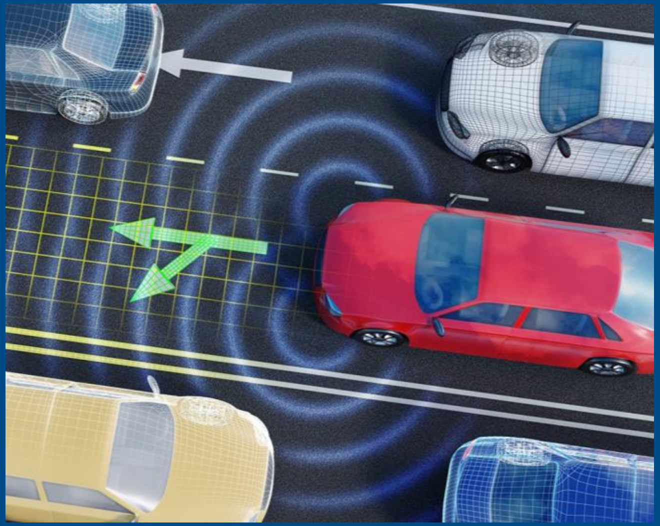
Outputs

MATLAB® & SIMULINK®

Reinforcement Learning Toolbox

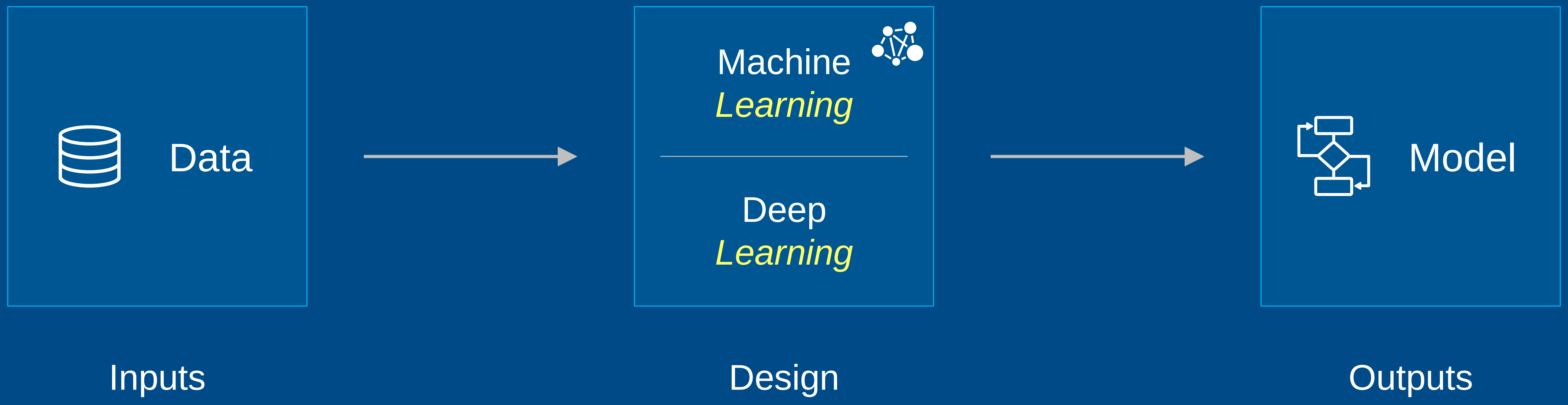
Using MATLAB and Simulink for Reinforcement Learning





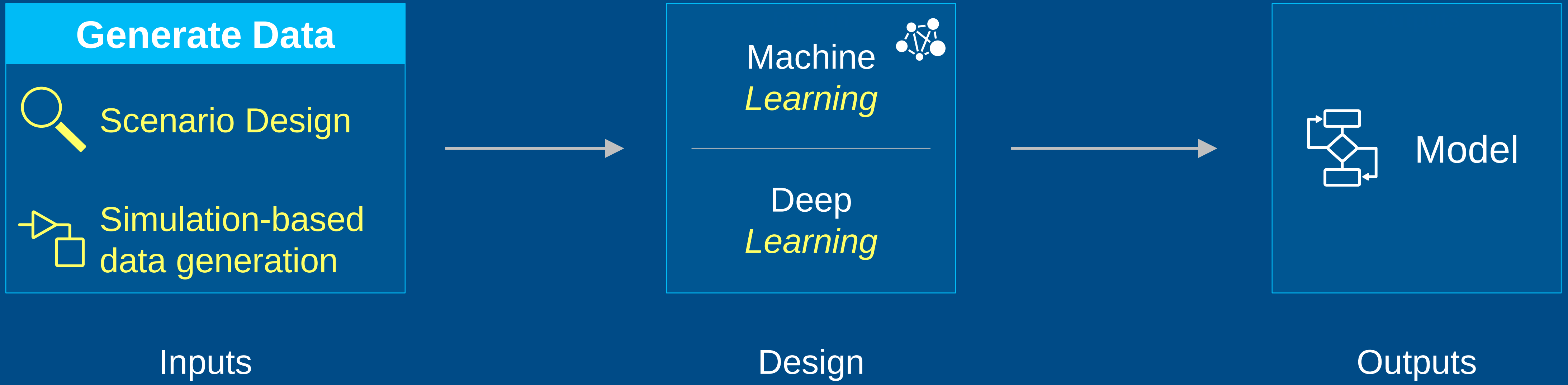
Reinforcement Learning Toolbox

Using MATLAB and Simulink for Reinforcement Learning



MATLAB®&SIMULINK®

Using MATLAB and Simulink for Reinforcement Learning



Generate Data

Scenario Design

Simulation-based data generation

Machine *Learning*

Deep *Learning*

Model

Inputs

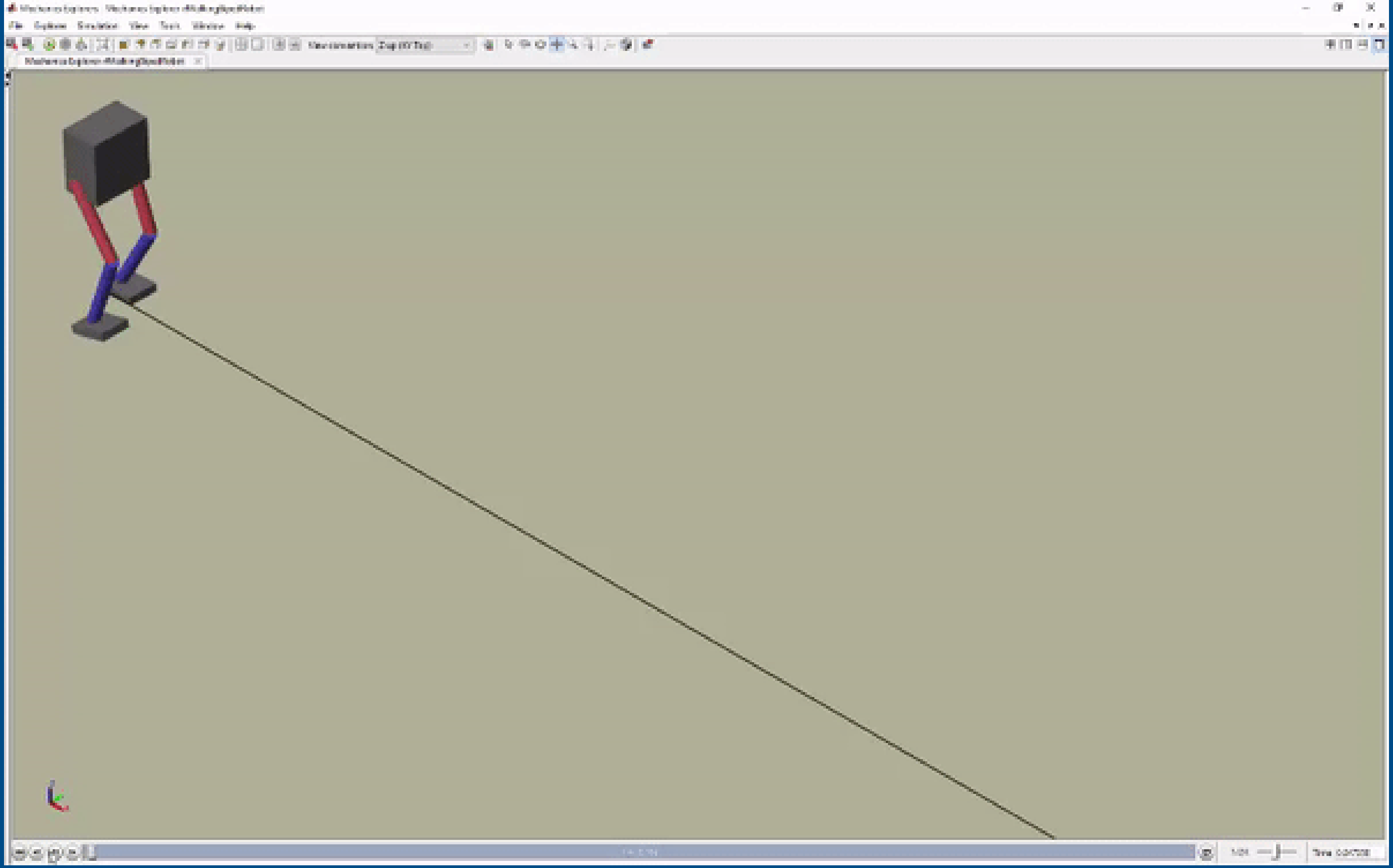
Design

Outputs

MATLAB & SIMULINK

Simulink
Reinforcement Learning Toolbox

Using MATLAB and Simulink for Reinforcement Learning


Mechanics Explorers - Mechanics Explorer - WalkingBipedRobot
File
Explorer
Simulation
View
Tools
Window
Help
View convention: Z up (XY Top)

Reinforcement Learning Toolbox

Using MATLAB and Simulink for Reinforcement Learning

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Model

utputs

MATLAB&SIMULINK

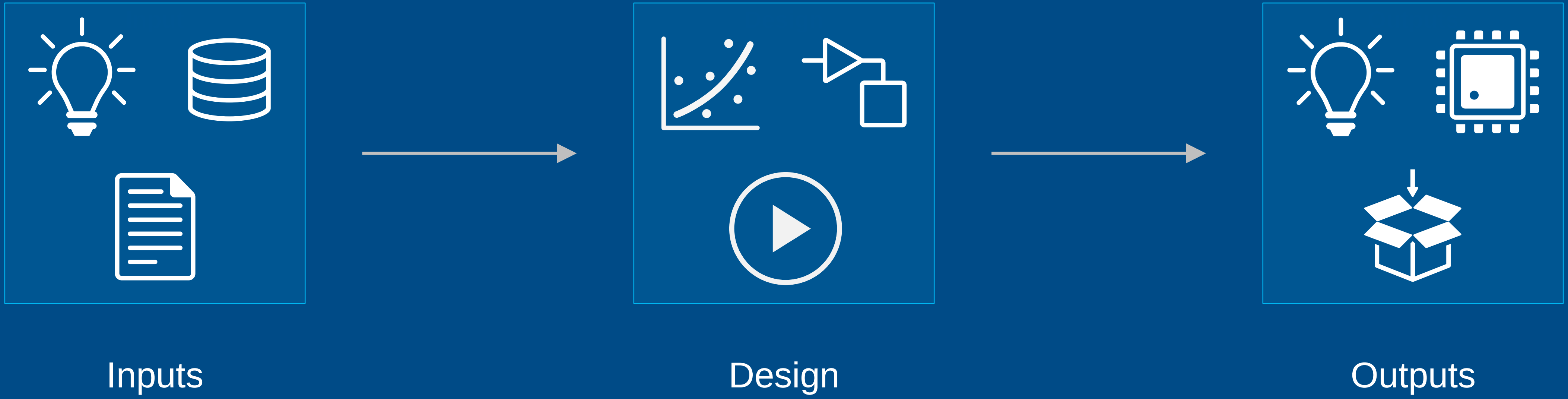
Find out more:

Deep Learning e Reinforcement Learning per l’intelligenza artificiale

Giuseppe Ridinò

Traccia A – 13:30

Using MATLAB & Simulink to Build Algorithms in Everything



Inputs

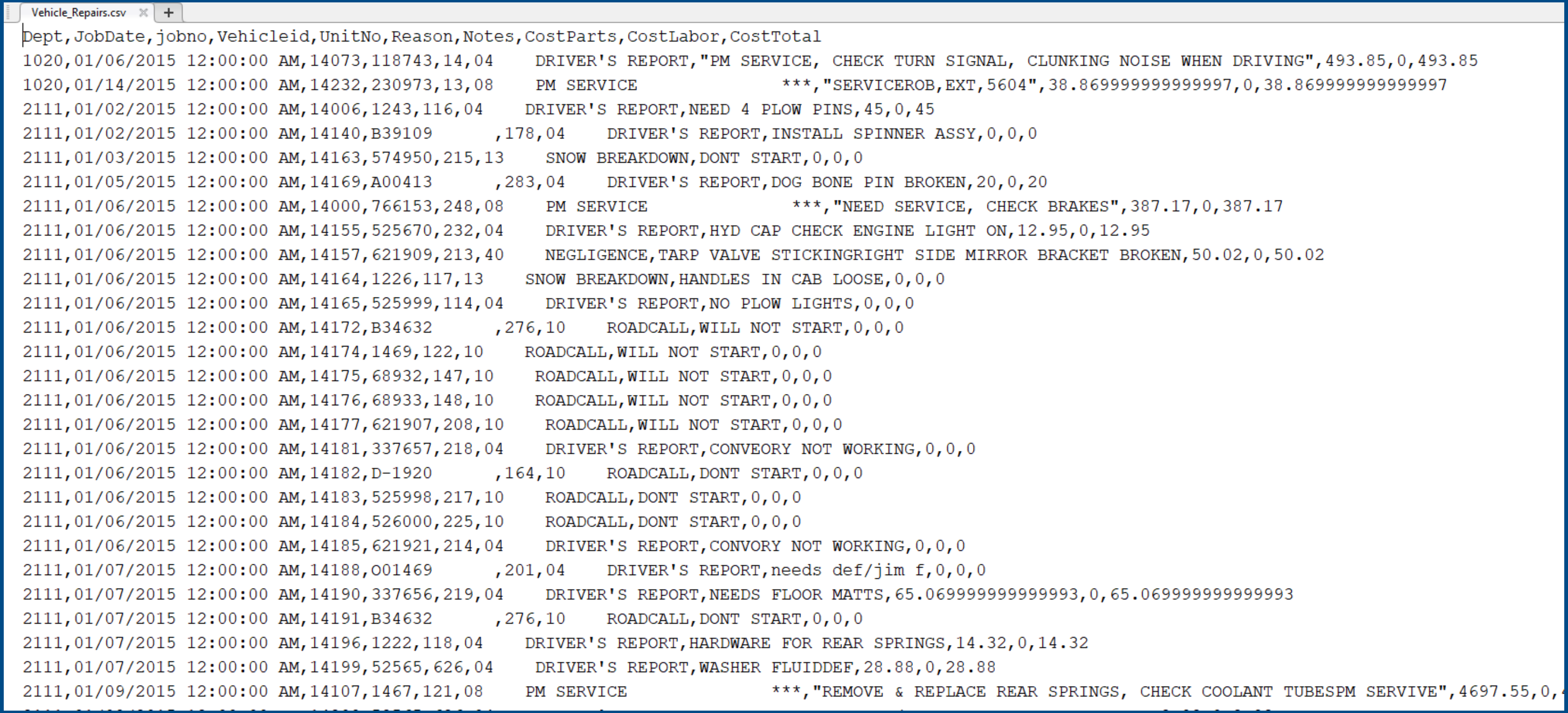
Design

Outputs

MATLAB®&SIMULINK®

Working with Text Data

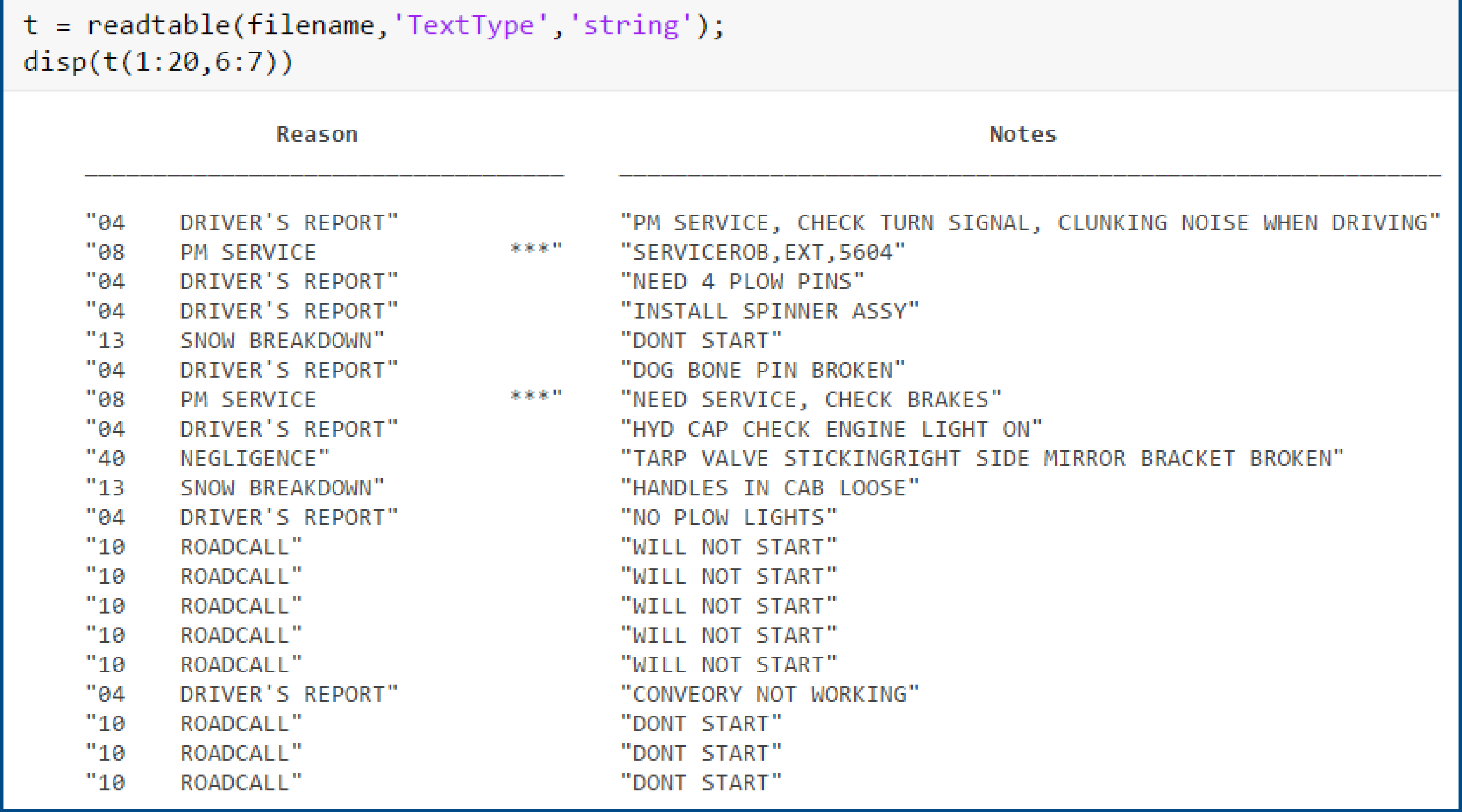
Input



```
Dept,JobDate,jobno,Vehicleid,UnitNo,Reason,Notes,CostParts,CostLabor,CostTotal
1020,01/06/2015 12:00:00 AM,14073,118743,14,04    DRIVER'S REPORT,"PM SERVICE, CHECK TURN SIGNAL, CLUNKING NOISE WHEN DRIVING",493.85,0,493.85
1020,01/14/2015 12:00:00 AM,14232,230973,13,08    PM SERVICE              ***,"SERVICEROB,EXT,5604",38.869999999999997,0,38.869999999999997
2111,01/02/2015 12:00:00 AM,14006,1243,116,04    DRIVER'S REPORT,NEED 4 PLOW PINS,45,0,45
2111,01/02/2015 12:00:00 AM,14140,B39109      ,178,04    DRIVER'S REPORT,INSTALL SPINNER ASSY,0,0,0
2111,01/03/2015 12:00:00 AM,14163,574950,215,13    SNOW BREAKDOWN,DONT START,0,0,0
2111,01/05/2015 12:00:00 AM,14169,A00413      ,283,04    DRIVER'S REPORT,DOG BONE PIN BROKEN,20,0,20
2111,01/06/2015 12:00:00 AM,14000,766153,248,08    PM SERVICE              ***,"NEED SERVICE, CHECK BRAKES",387.17,0,387.17
2111,01/06/2015 12:00:00 AM,14155,525670,232,04    DRIVER'S REPORT,HYD CAP CHECK ENGINE LIGHT ON,12.95,0,12.95
2111,01/06/2015 12:00:00 AM,14157,621909,213,40    NEGLIGENCE,TARP VALVE STICKINGRIGHT SIDE MIRROR BRACKET BROKEN,50.02,0,50.02
2111,01/06/2015 12:00:00 AM,14164,1226,117,13    SNOW BREAKDOWN,HANDLES IN CAB LOOSE,0,0,0
2111,01/06/2015 12:00:00 AM,14165,525999,114,04    DRIVER'S REPORT,NO PLOW LIGHTS,0,0,0
2111,01/06/2015 12:00:00 AM,14172,B34632      ,276,10    ROADCALL,WILL NOT START,0,0,0
2111,01/06/2015 12:00:00 AM,14174,1469,122,10    ROADCALL,WILL NOT START,0,0,0
2111,01/06/2015 12:00:00 AM,14175,68932,147,10    ROADCALL,WILL NOT START,0,0,0
2111,01/06/2015 12:00:00 AM,14176,68933,148,10    ROADCALL,WILL NOT START,0,0,0
2111,01/06/2015 12:00:00 AM,14177,621907,208,10    ROADCALL,WILL NOT START,0,0,0
2111,01/06/2015 12:00:00 AM,14181,337657,218,04    DRIVER'S REPORT,CONVEORY NOT WORKING,0,0,0
2111,01/06/2015 12:00:00 AM,14182,D-1920      ,164,10    ROADCALL,DONT START,0,0,0
2111,01/06/2015 12:00:00 AM,14183,525998,217,10    ROADCALL,DONT START,0,0,0
2111,01/06/2015 12:00:00 AM,14184,526000,225,10    ROADCALL,DONT START,0,0,0
2111,01/06/2015 12:00:00 AM,14185,621921,214,04    DRIVER'S REPORT,CONVORY NOT WORKING,0,0,0
2111,01/07/2015 12:00:00 AM,14188,001469      ,201,04    DRIVER'S REPORT,needs def/jim f,0,0,0
2111,01/07/2015 12:00:00 AM,14190,337656,219,04    DRIVER'S REPORT,NEEDS FLOOR MATTS,65.069999999999993,0,65.069999999999993
2111,01/07/2015 12:00:00 AM,14191,B34632      ,276,10    ROADCALL,DONT START,0,0,0
2111,01/07/2015 12:00:00 AM,14196,1222,118,04    DRIVER'S REPORT,HARDWARE FOR REAR SPRINGS,14.32,0,14.32
2111,01/07/2015 12:00:00 AM,14199,52565,626,04    DRIVER'S REPORT,WASHER FLUIDDEF,28.88,0,28.88
2111,01/09/2015 12:00:00 AM,14107,1467,121,08    PM SERVICE              ***,"REMOVE & REPLACE REAR SPRINGS, CHECK COOLANT TUBESPM SERVIVE",4697.55,0,
```

Working with Text Data

Input

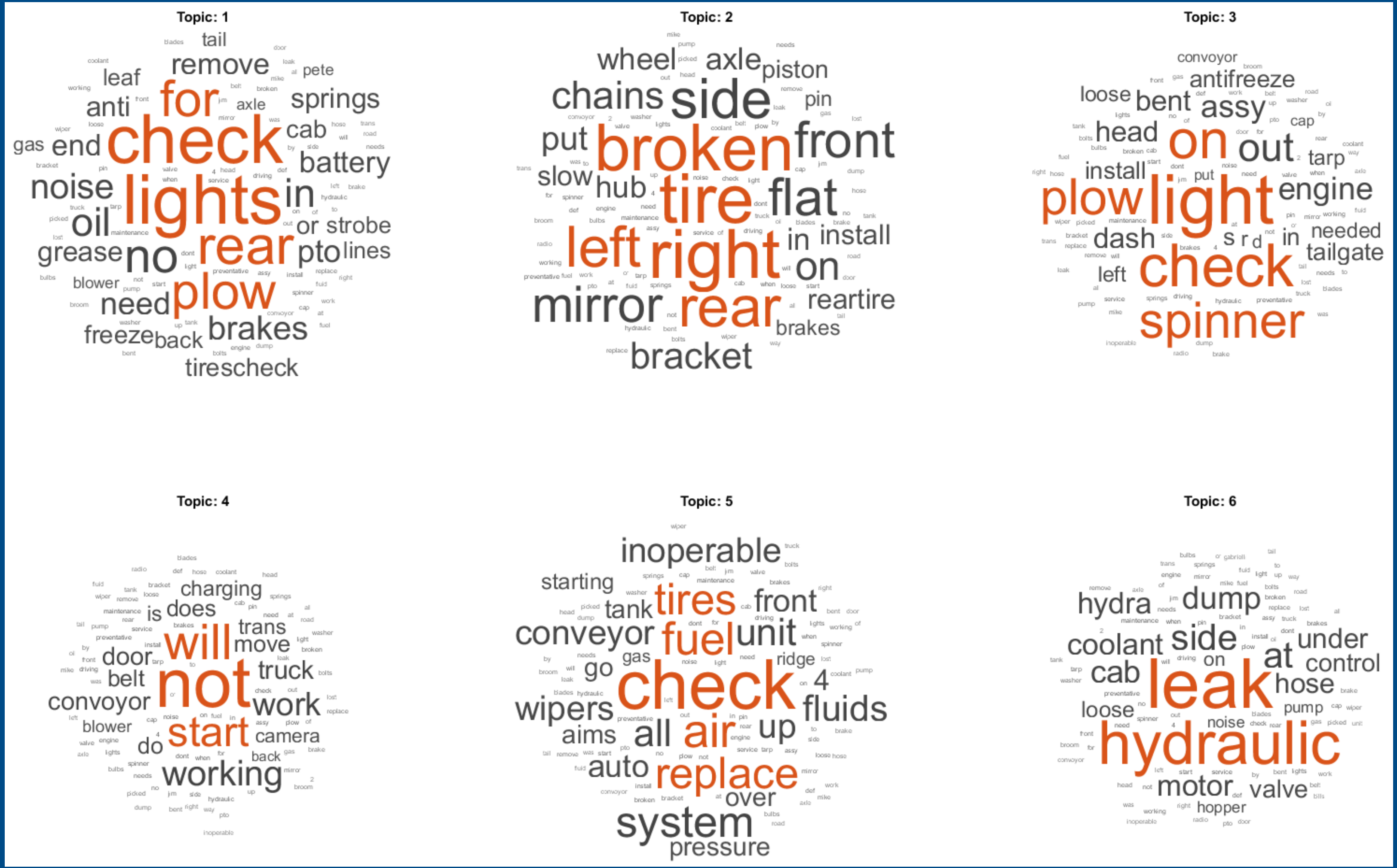


```
t = readtable(filename,'TextType','string');
disp(t(1:20,6:7))
```

```
                  Reason                                                Notes                          
    ___________________________________    ____________________________________________________________

    "04    DRIVER'S REPORT"                    "PM SERVICE, CHECK TURN SIGNAL, CLUNKING NOISE WHEN DRIVING"
    "08    PM SERVICE              ***"    "SERVICEROB,EXT,5604"                                       
    "04    DRIVER'S REPORT"                "NEED 4 PLOW PINS"                                          
    "04    DRIVER'S REPORT"                "INSTALL SPINNER ASSY"                                      
    "13    SNOW BREAKDOWN"                 "DONT START"                                                
    "04    DRIVER'S REPORT"                "DOG BONE PIN BROKEN"                                       
    "08    PM SERVICE              ***"    "NEED SERVICE, CHECK BRAKES"                                
    "04    DRIVER'S REPORT"                "HYD CAP CHECK ENGINE LIGHT ON"                             
    "40    NEGLIGENCE"                     "TARP VALVE STICKINGRIGHT SIDE MIRROR BRACKET BROKEN"       
    "13    SNOW BREAKDOWN"                 "HANDLES IN CAB LOOSE"                                      
    "04    DRIVER'S REPORT"                "NO PLOW LIGHTS"                                            
    "10    ROADCALL"                       "WILL NOT START"                                            
    "10    ROADCALL"                       "WILL NOT START"                                            
    "10    ROADCALL"                       "WILL NOT START"                                            
    "10    ROADCALL"                       "WILL NOT START"                                            
    "10    ROADCALL"                       "WILL NOT START"                                            
    "04    DRIVER'S REPORT"                "CONVEORY NOT WORKING"                                      
    "10    ROADCALL"                       "DONT START"                                                
    "10    ROADCALL"                       "DONT START"                                                
    "10    ROADCALL"                       "DONT START"                                                
```

Input

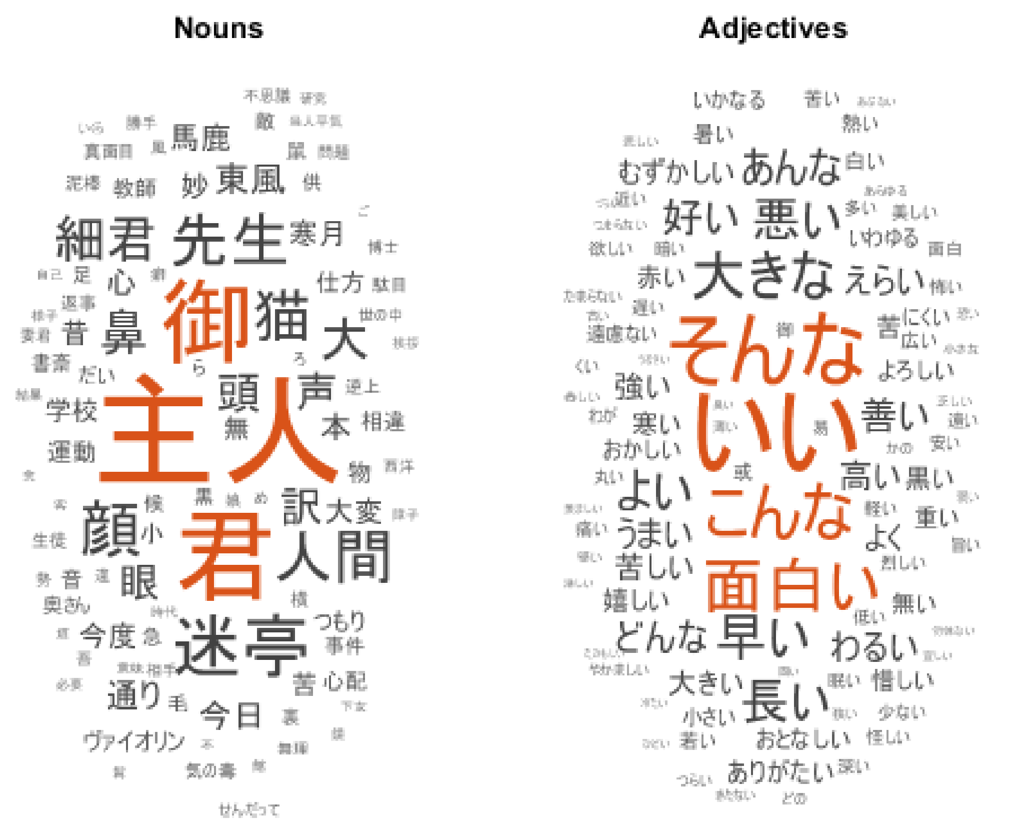
Working with Text Data

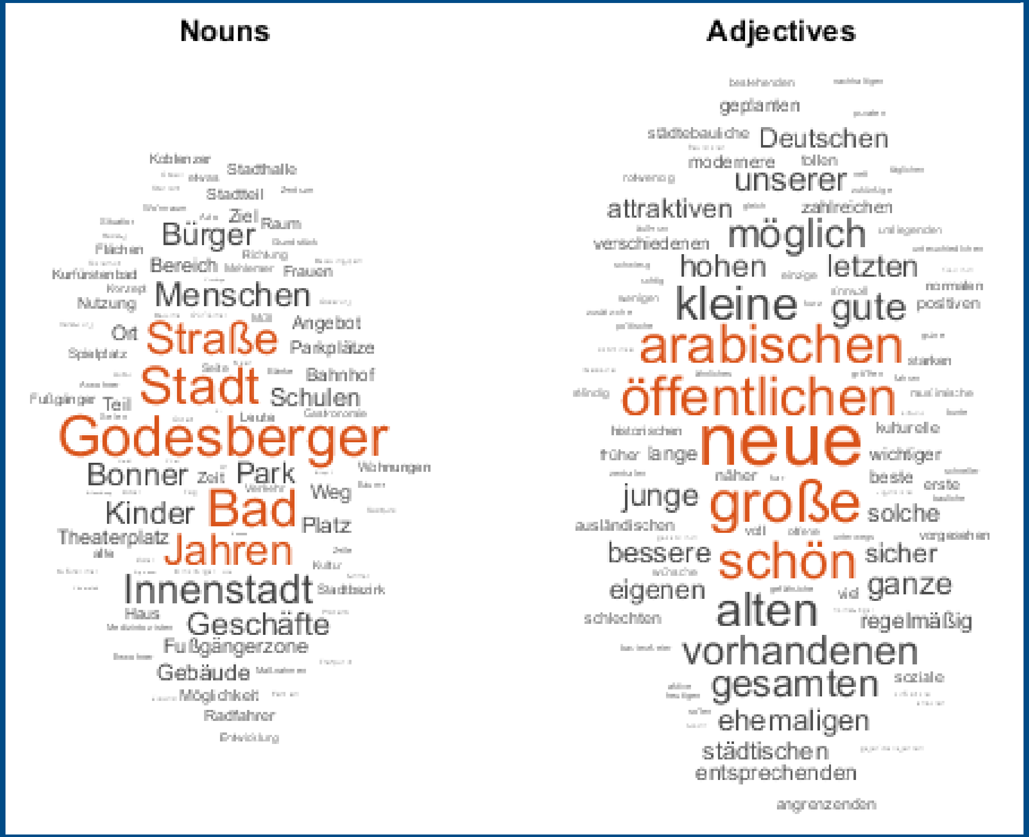


Deep Learning Toolbox
Statistics and Machine Learning Toolbox
Text Analytics Toolbox
MATLAB

Input

Working with Text Data

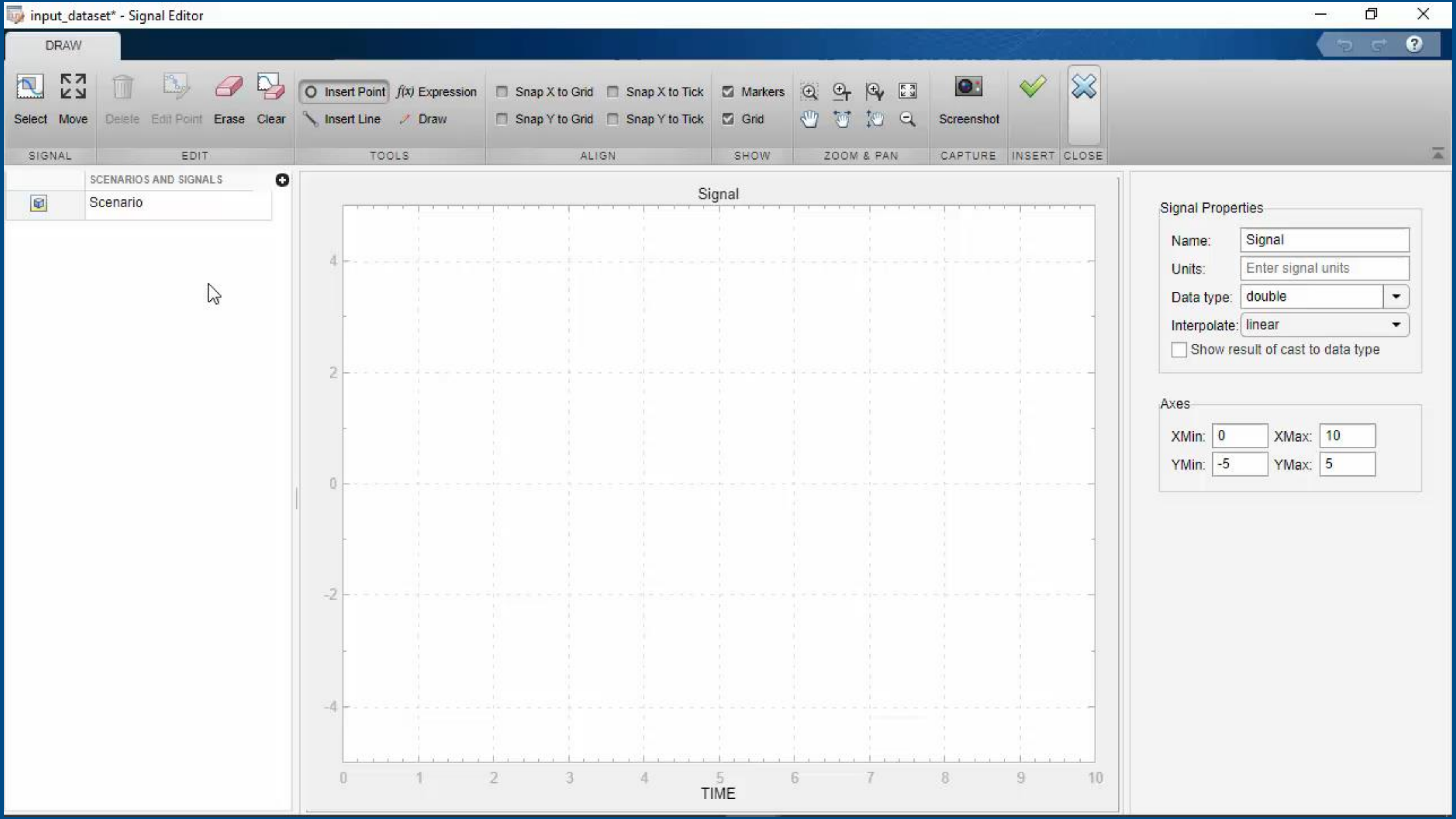




Text Analytics Toolbox
MATLAB

Input

Creating Your Own Data



Signal Properties

Name: Signal

Units: Enter signal units

Data type: double

Interpolate: linear

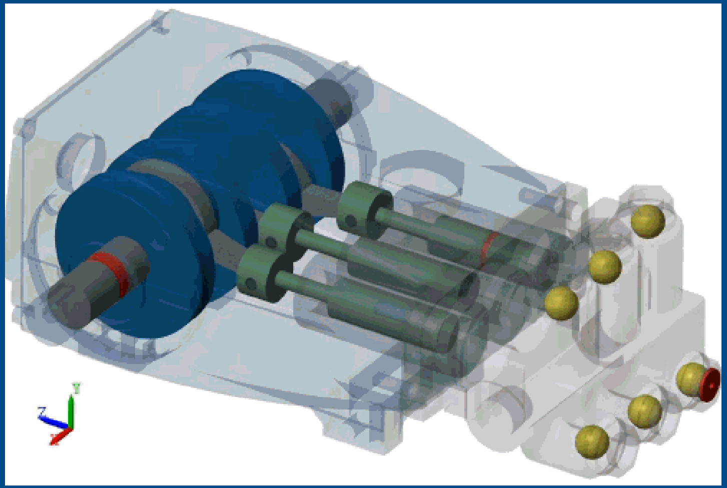
☐ Show result of cast to data type

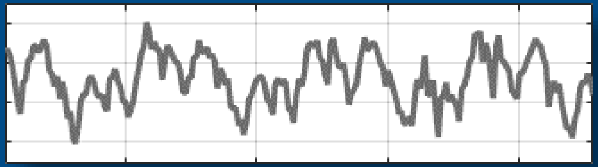
Axes

XMin: 0 XMax: 10

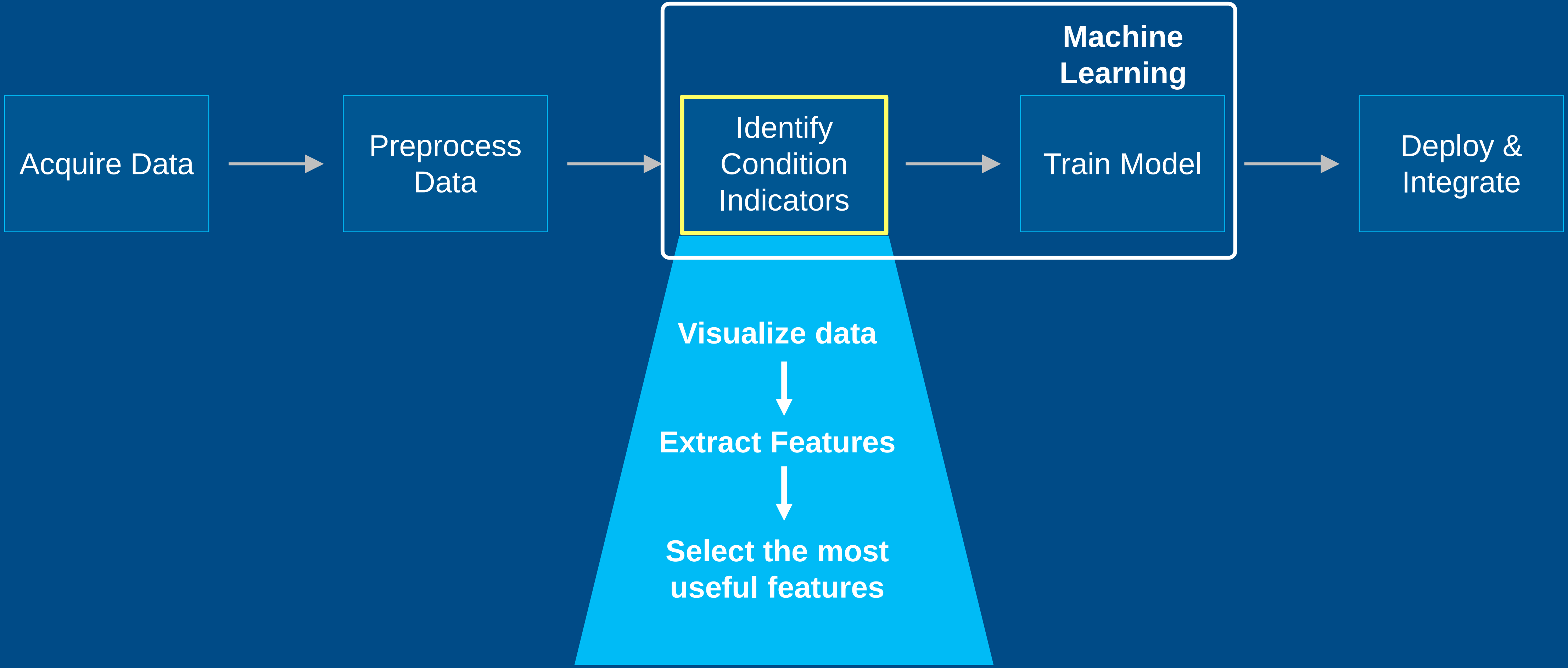
YMin: -5 YMax: 5

Input

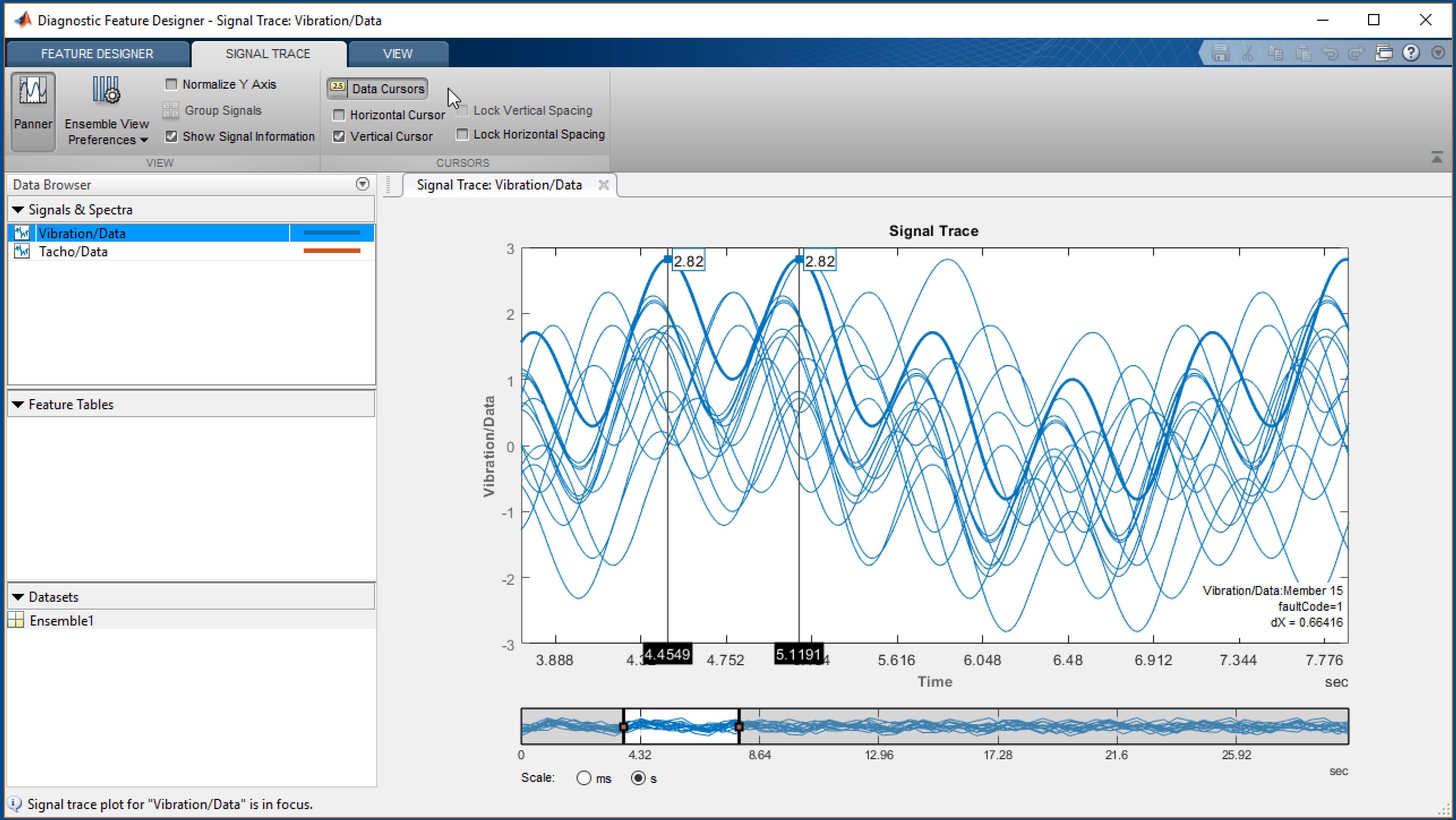




Identifying the Useful Data



Identifying the Useful Data



Diagnostic Feature Designer - Signal Trace: Vibration/Data

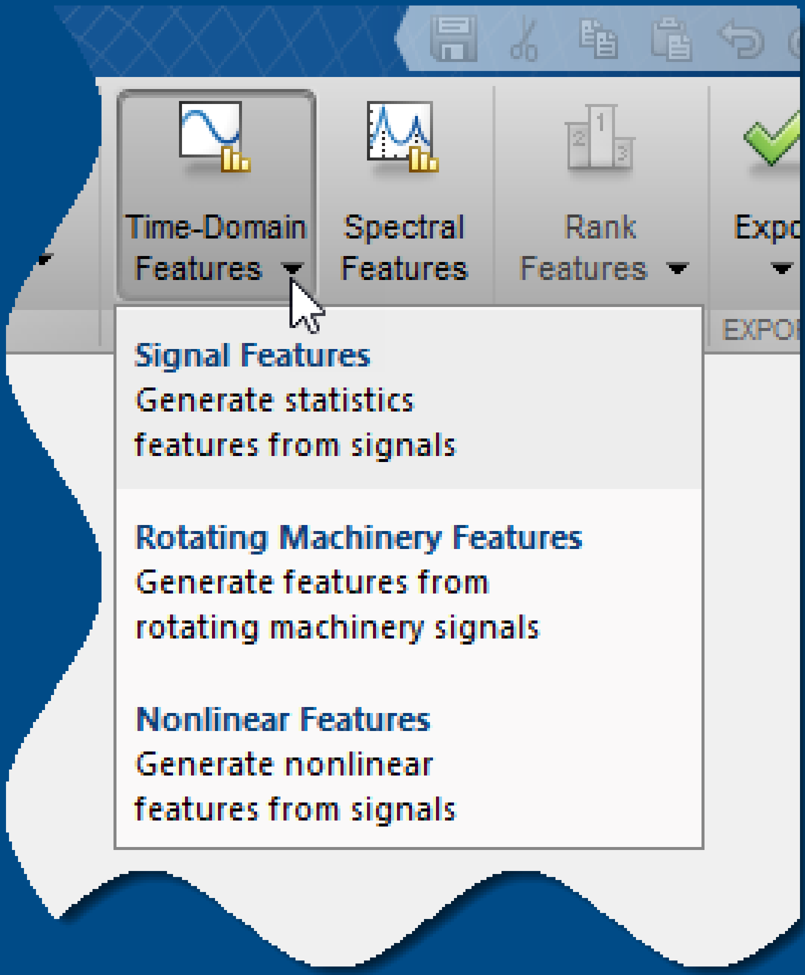
☐ Normalize Y Axis
☐ Group Signals
☑ Show Signal Information
☐ Horizontal Cursor
☑ Vertical Cursor
☐ Lock Vertical Spacing
☐ Lock Horizontal Spacing

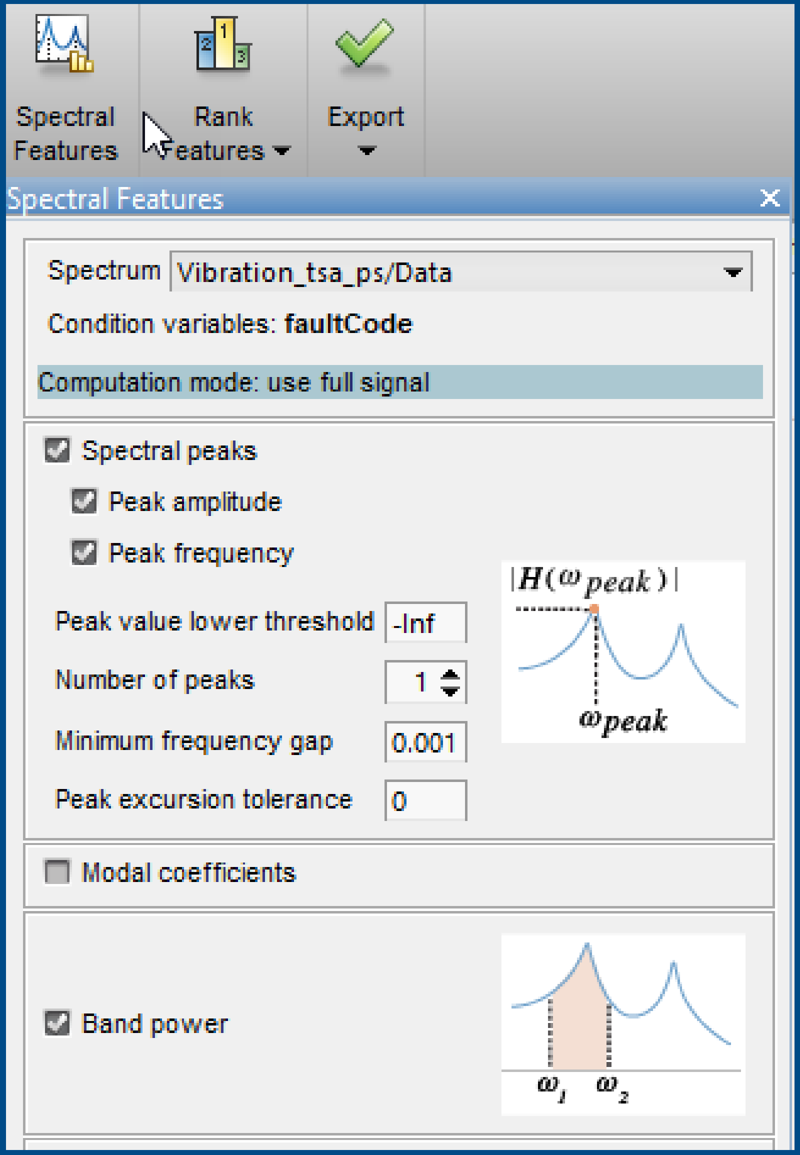
Vibration/Data:Member 15
faultCode=1
dX = 0.66416

Scale: ○ ms ● s

Signal trace plot for "Vibration/Data" is in focus.

Identifying the Useful Data


Time-Domain Features
Spectral Features
Rank Features
Expo
EXPOI
Signal Features
Generate statistics features from signals
Rotating Machinery Features
Generate features from rotating machinery signals
Nonlinear Features
Generate nonlinear features from signals



Spectral Features

Spectrum Vibration_tsa_ps/Data

Condition variables: **faultCode**

Computation mode: use full signal

☑ Spectral peaks

☑ Peak amplitude

☑ Peak frequency

Peak value lower threshold -Inf

Number of peaks 1

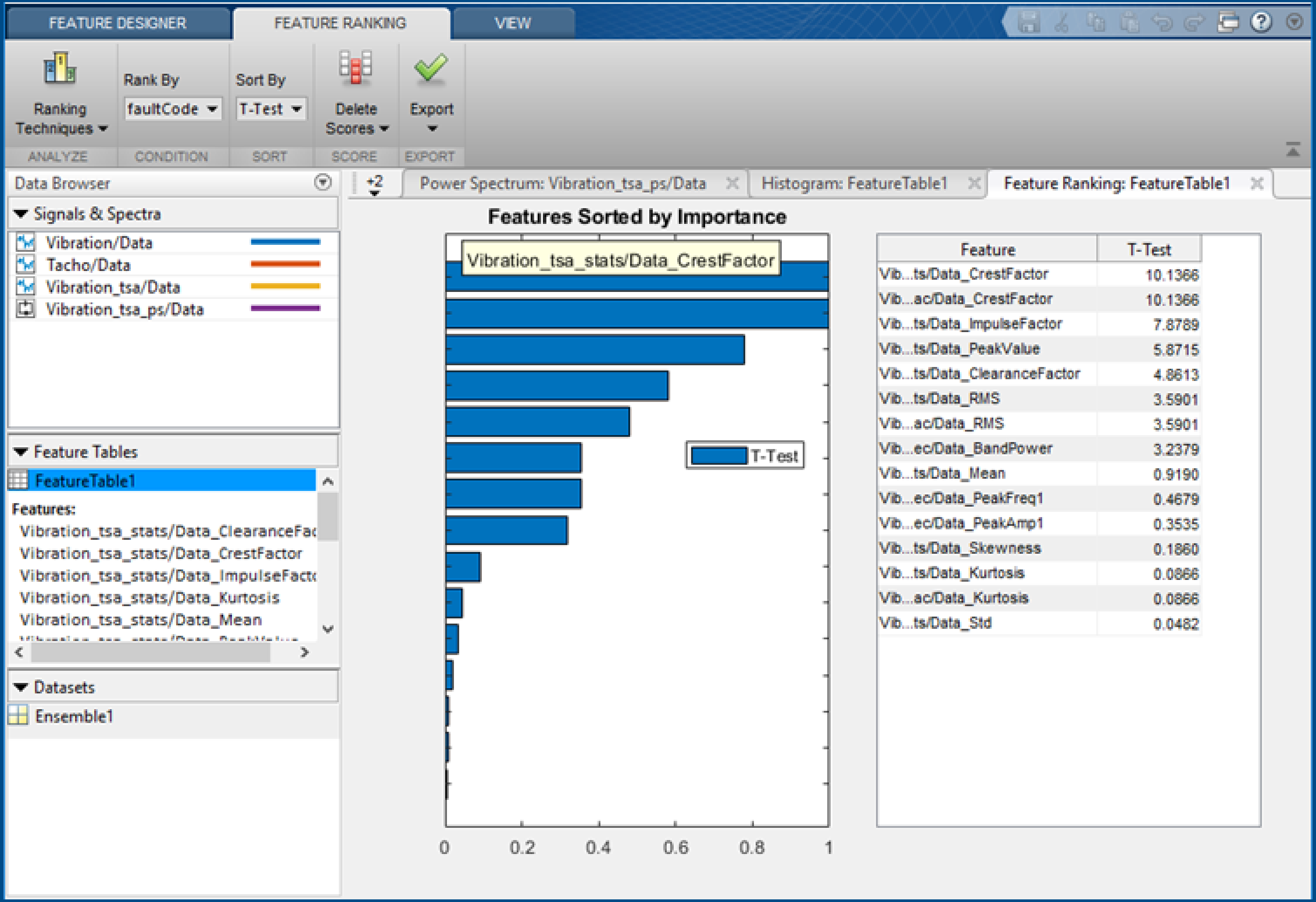
Minimum frequency gap 0.001

Peak excursion tolerance 0

☐ Modal coefficients

☑ Band power

Identifying the Useful Data



Features:
Vibration_tsa_stats/Data_ClearanceFac
Vibration_tsa_stats/Data_CrestFactor
Vibration_tsa_stats/Data_ImpulseFact
Vibration_tsa_stats/Data_Kurtosis
Vibration_tsa_stats/Data_Mean

Feature	T-Test
Vib...ts/Data_CrestFactor	10.1366
Vib...ac/Data_CrestFactor	10.1366
Vib...ts/Data_ImpulseFactor	7.8789
Vib...ts/Data_PeakValue	5.8715
Vib...ts/Data_ClearanceFactor	4.8613
Vib...ts/Data_RMS	3.5901
Vib...ac/Data_RMS	3.5901
Vib...ec/Data_BandPower	3.2379
Vib...ts/Data_Mean	0.9190
Vib...ec/Data_PeakFreq1	0.4679
Vib...ec/Data_PeakAmp1	0.3535
Vib...ts/Data_Skewness	0.1860
Vib...ts/Data_Kurtosis	0.0866
Vib...ac/Data_Kurtosis	0.0866
Vib...ts/Data_Std	0.0482

Acquire

Deploy & Integrate

Find out more:

Manutenzione Predittiva con MATLAB

Francesco Alderisio

Traccia A – 14:30

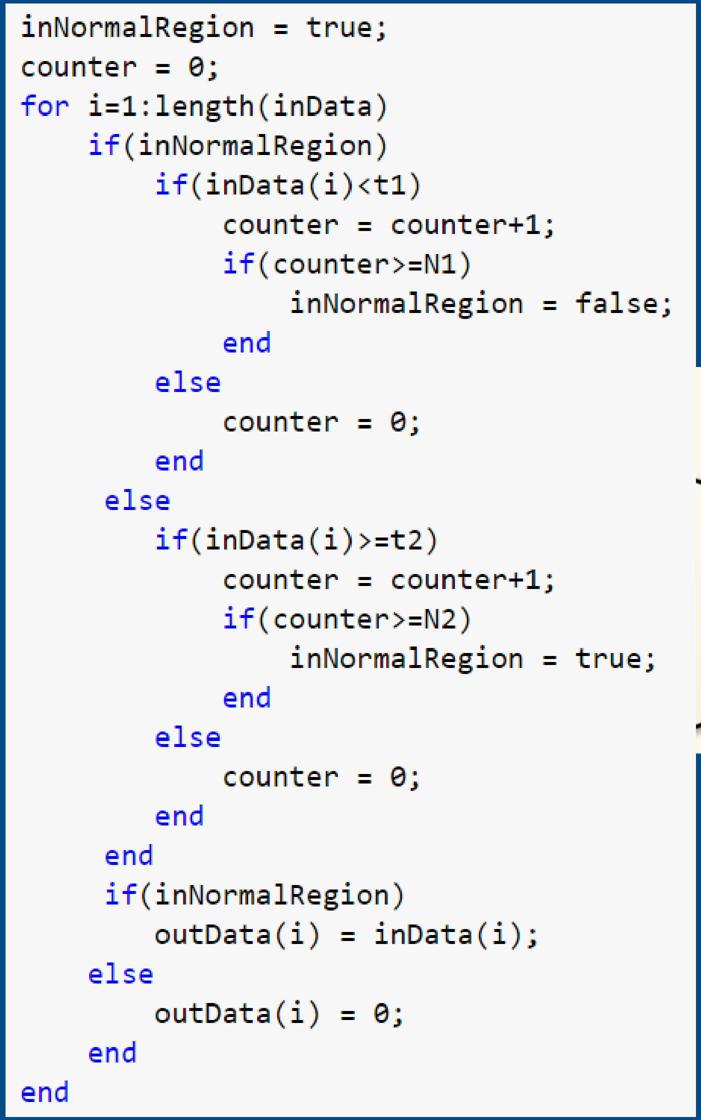
Data Science e Predictive Analytics

Francesco Alderisio

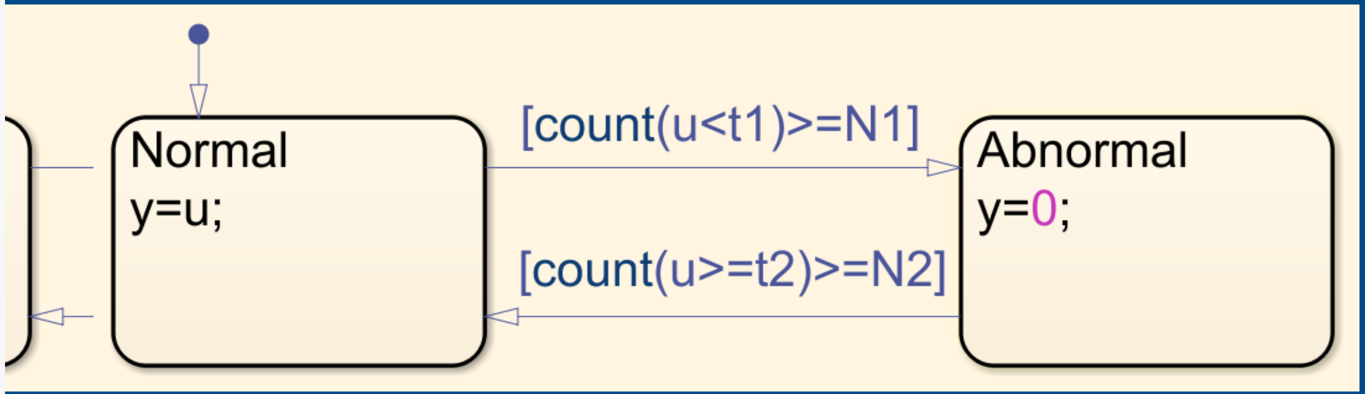
Postazione Demo

Designing Decision Logic with Stateflow

Design

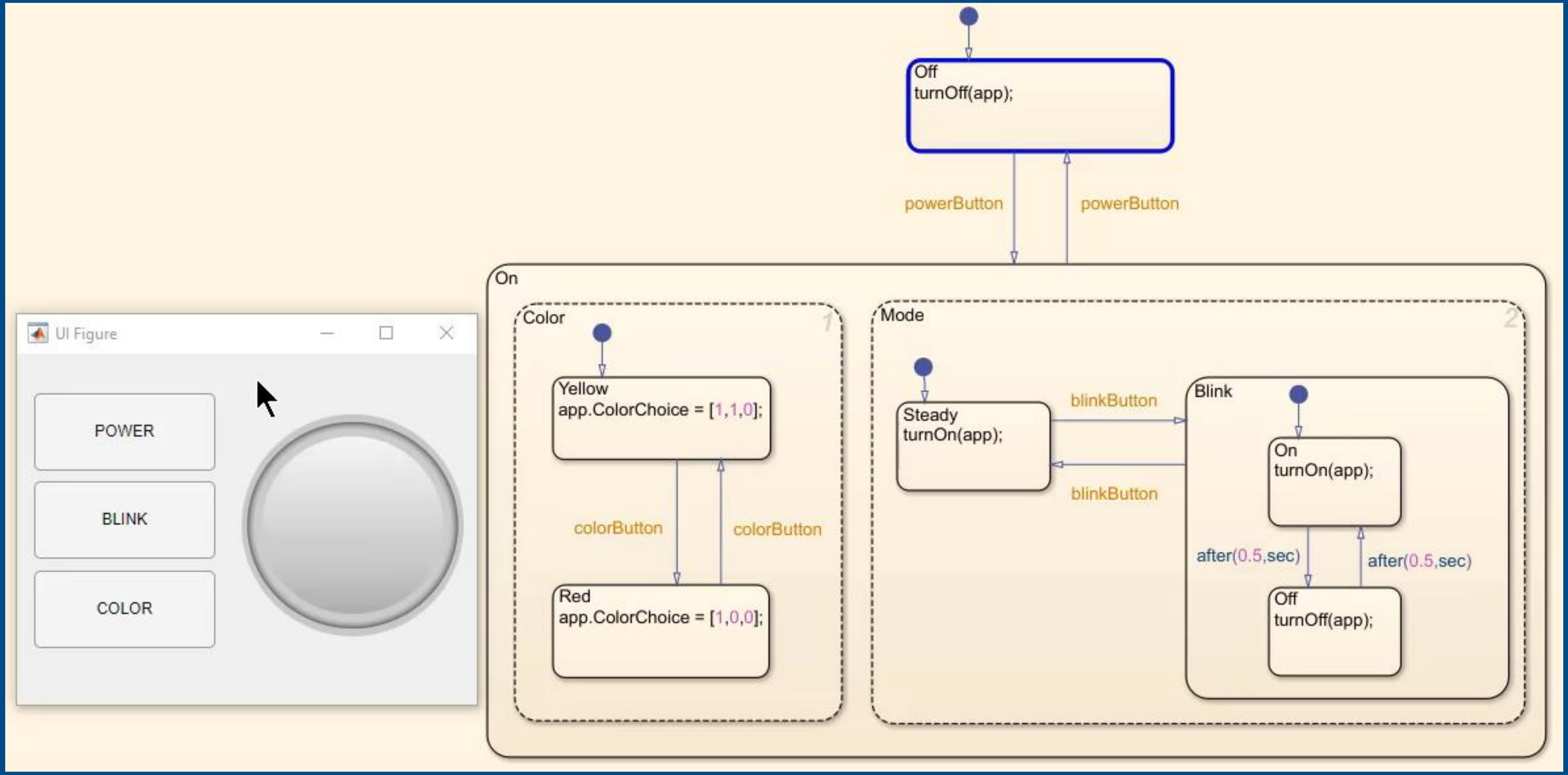


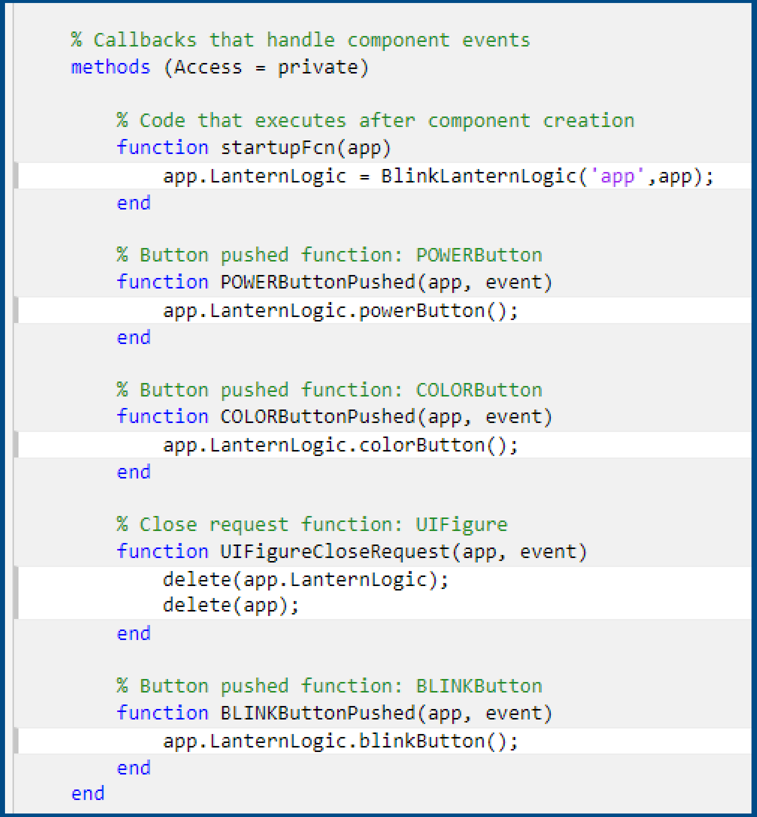
```
inNormalRegion = true;
counter = 0;
for i=1:length(inData)
    if(inNormalRegion)
        if(inData(i)<t1)
            counter = counter+1;
            if(counter>=N1)
                inNormalRegion = false;
            end
        else
            counter = 0;
        end
     else
        if(inData(i)>=t2)
            counter = counter+1;
            if(counter>=N2)
                inNormalRegion = true;
            end
        else
            counter = 0;
        end
     end
     if(inNormalRegion)
        outData(i) = inData(i);
    else
        outData(i) = 0;
    end
end
```



Stateflow
MATLAB

Using Stateflow in MATLAB



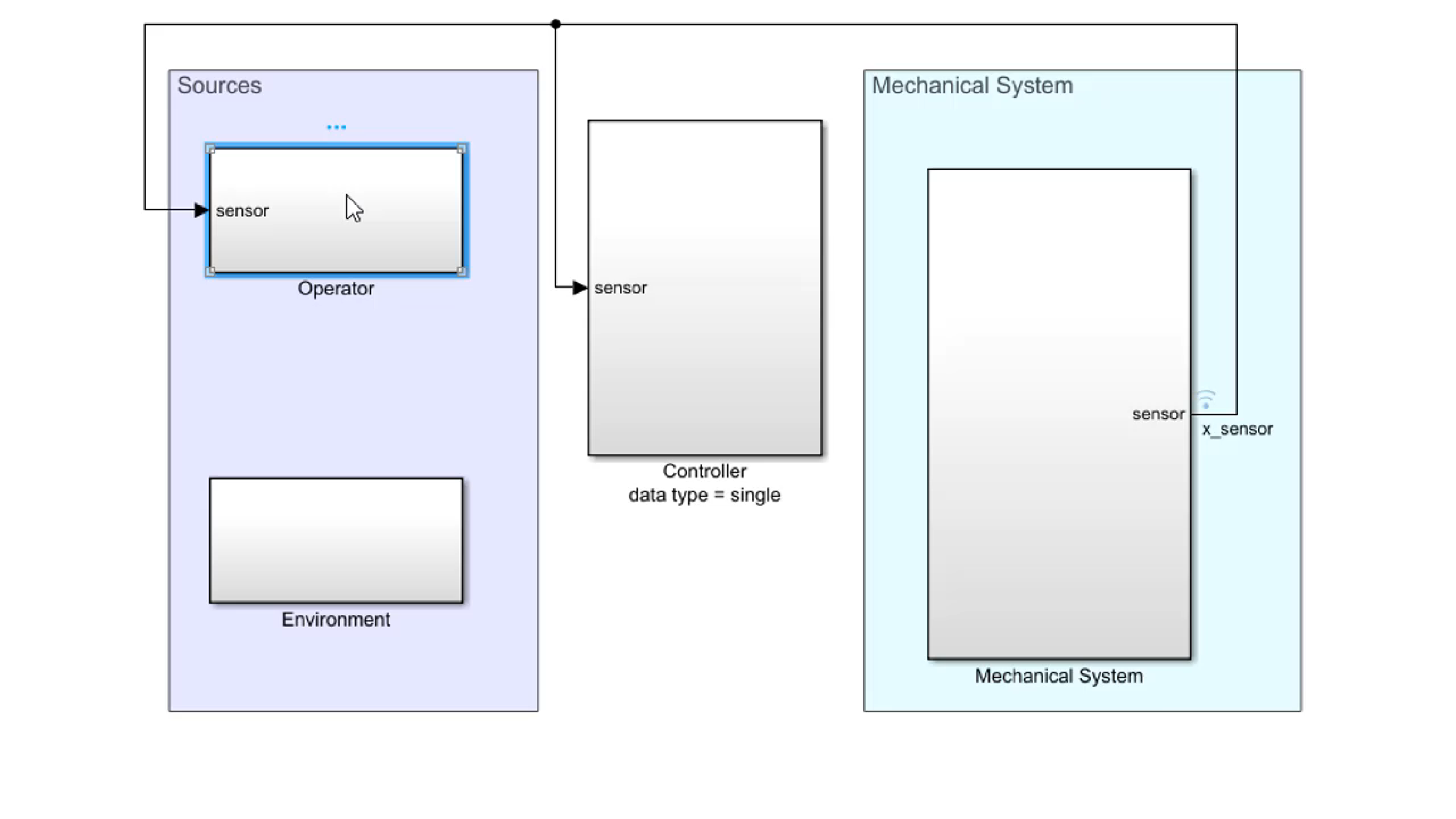


```
% Callbacks that handle component events
methods (Access = private)

    % Code that executes after component creation
    function startupFcn(app)
        app.LanternLogic = BlinkLanternLogic('app',app);
    end

    % Button pushed function: POWERButton
    function POWERButtonPushed(app, event)
        app.LanternLogic.powerButton();
    end

    % Button pushed function: COLORButton
    function COLORButtonPushed(app, event)
        app.LanternLogic.colorButton();
    end

    % Close request function: UIFigure
    function UIFigureCloseRequest(app, event)
        delete(app.LanternLogic);
        delete(app);
    end

    % Button pushed function: BLINKButton
    function BLINKButtonPushed(app, event)
        app.LanternLogic.blinkButton();
    end
end
```

Stateflow
MATLAB

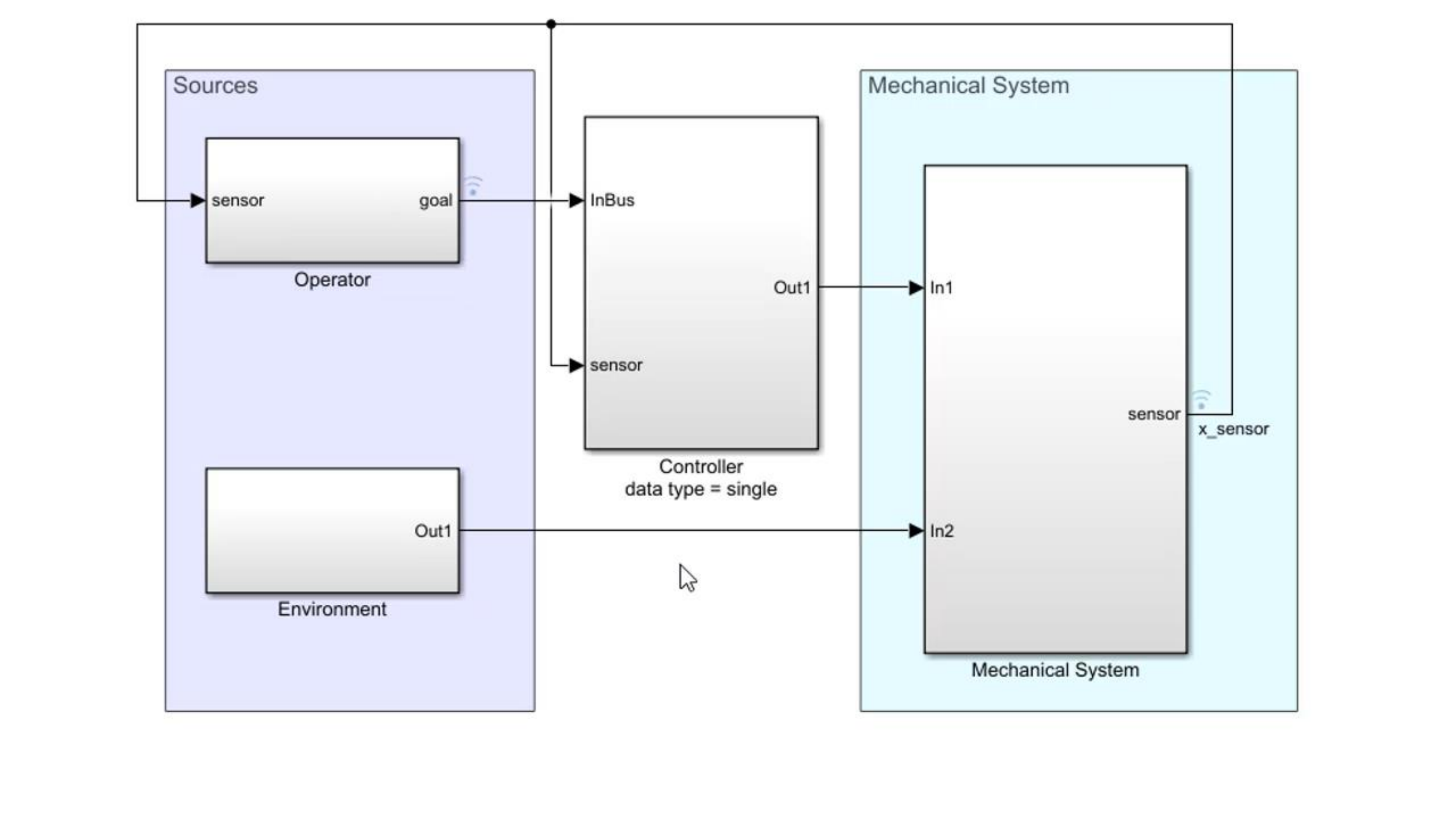
Editing at the Speed of Thought

Design



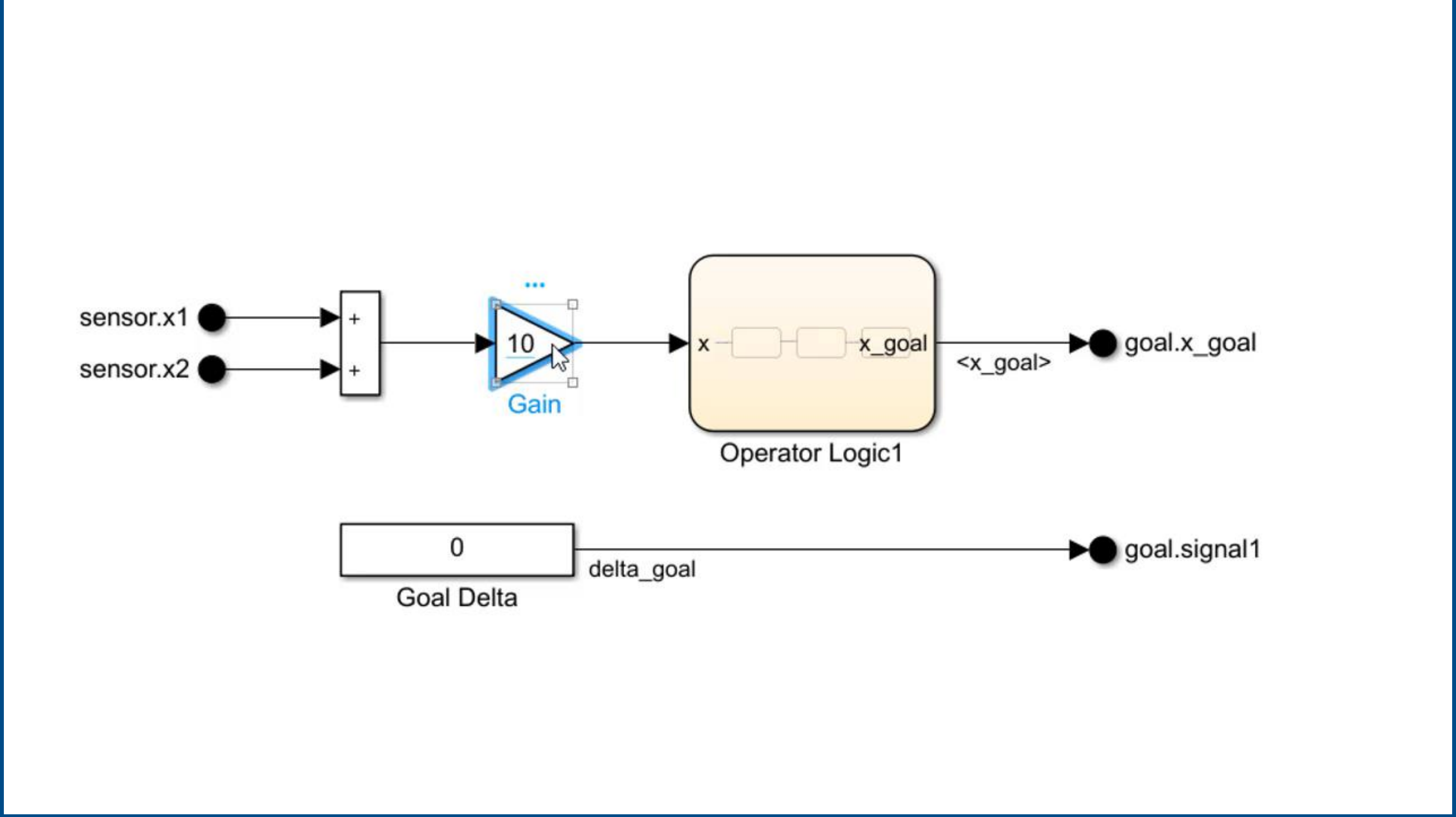
Editing at the Speed of Thought

Design



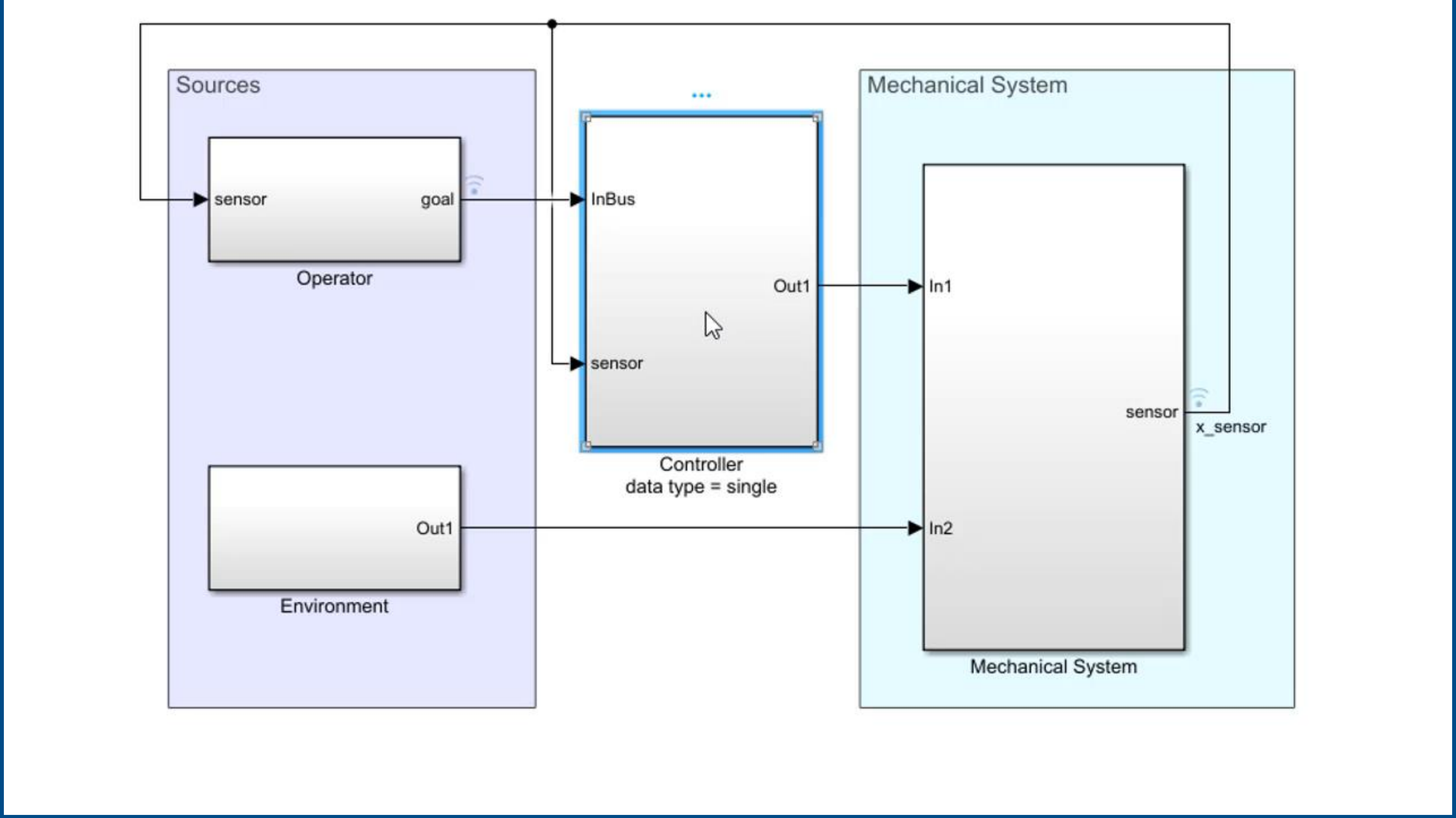
Editing at the Speed of Thought

Design



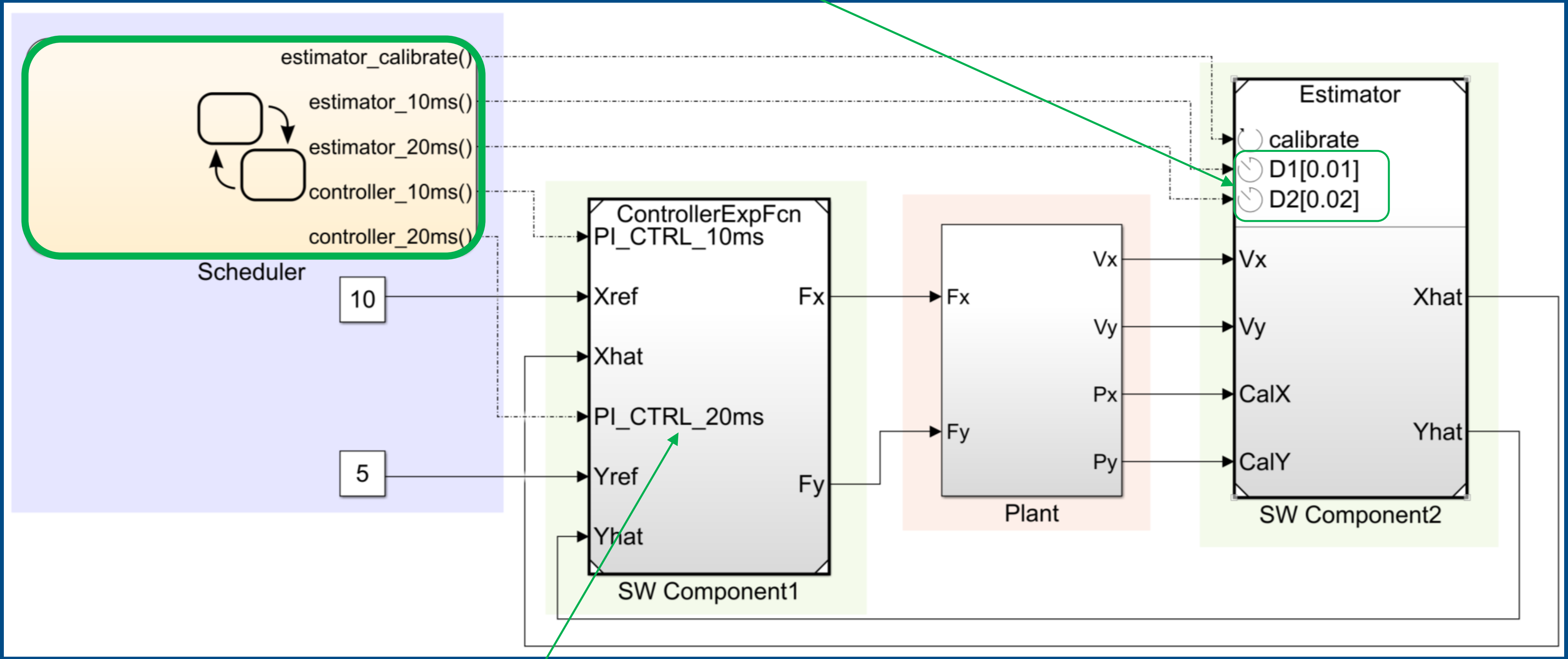
Editing at the Speed of Thought

Design



Controlling the Execution of Model Components

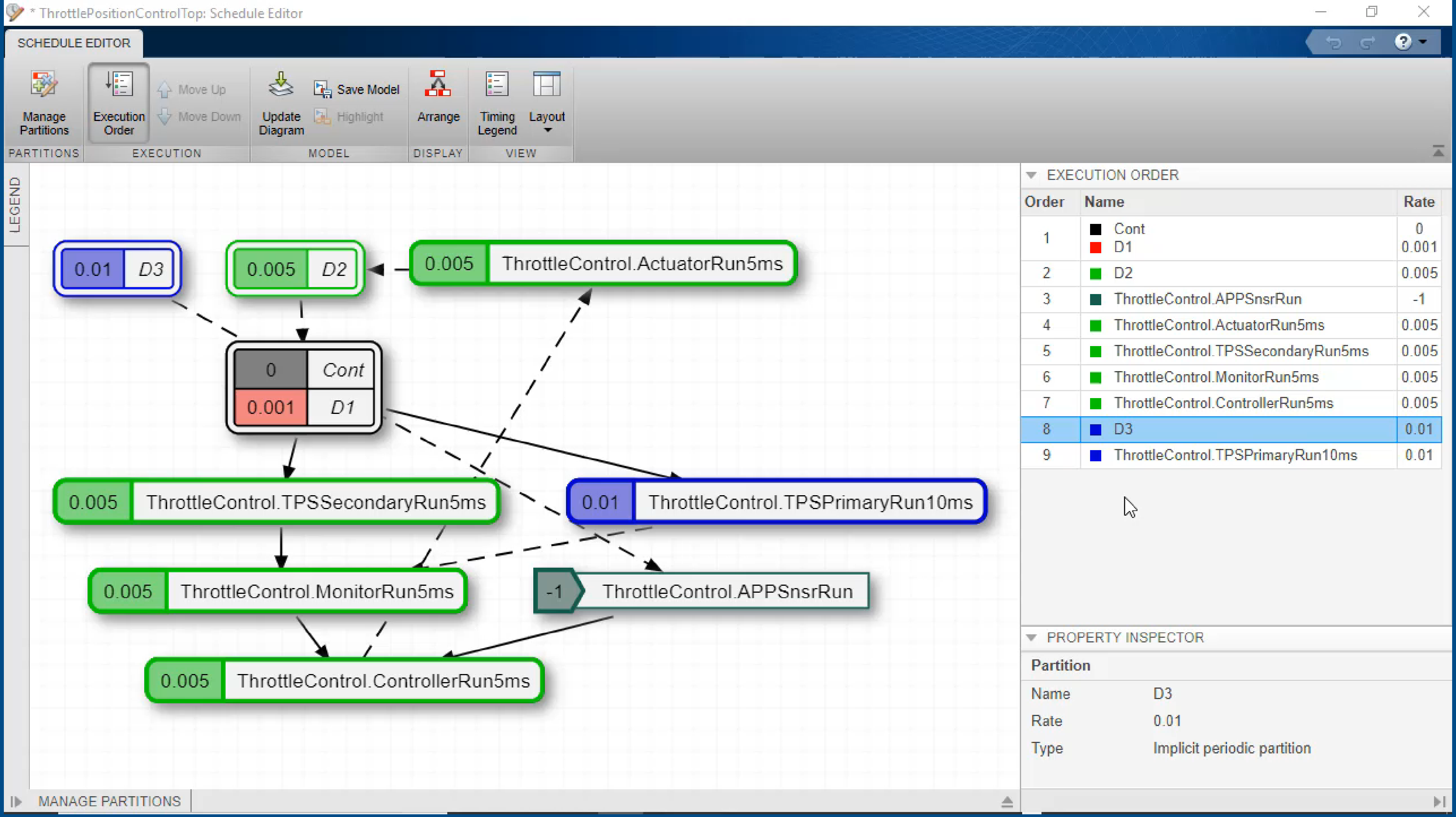
Schedulable Rate-Based Model



Export Function Model

Controlling the Execution of Model Components

Design


* ThrottlePositionControlTop: Schedule Editor
SCHEDULE EDITOR
Manage Partitions
Execution Order
Move Up
Move Down
Update Diagram
Save Model
Highlight
Arrange
Timing Legend
Layout
PARTITIONS
EXECUTION
MODEL
DISPLAY
VIEW
LEGEND
0.01 D3
0.005 D2
0.005 ThrottleControl.ActuatorRun5ms
0 Cont
0.001 D1
0.005 ThrottleControl.TPSSecondaryRun5ms
0.01 ThrottleControl.TPSPrimaryRun10ms
0.005 ThrottleControl.MonitorRun5ms
-1 ThrottleControl.APPSnsrRun
0.005 ThrottleControl.ControllerRun5ms
MANAGE PARTITIONS

EXECUTION ORDER

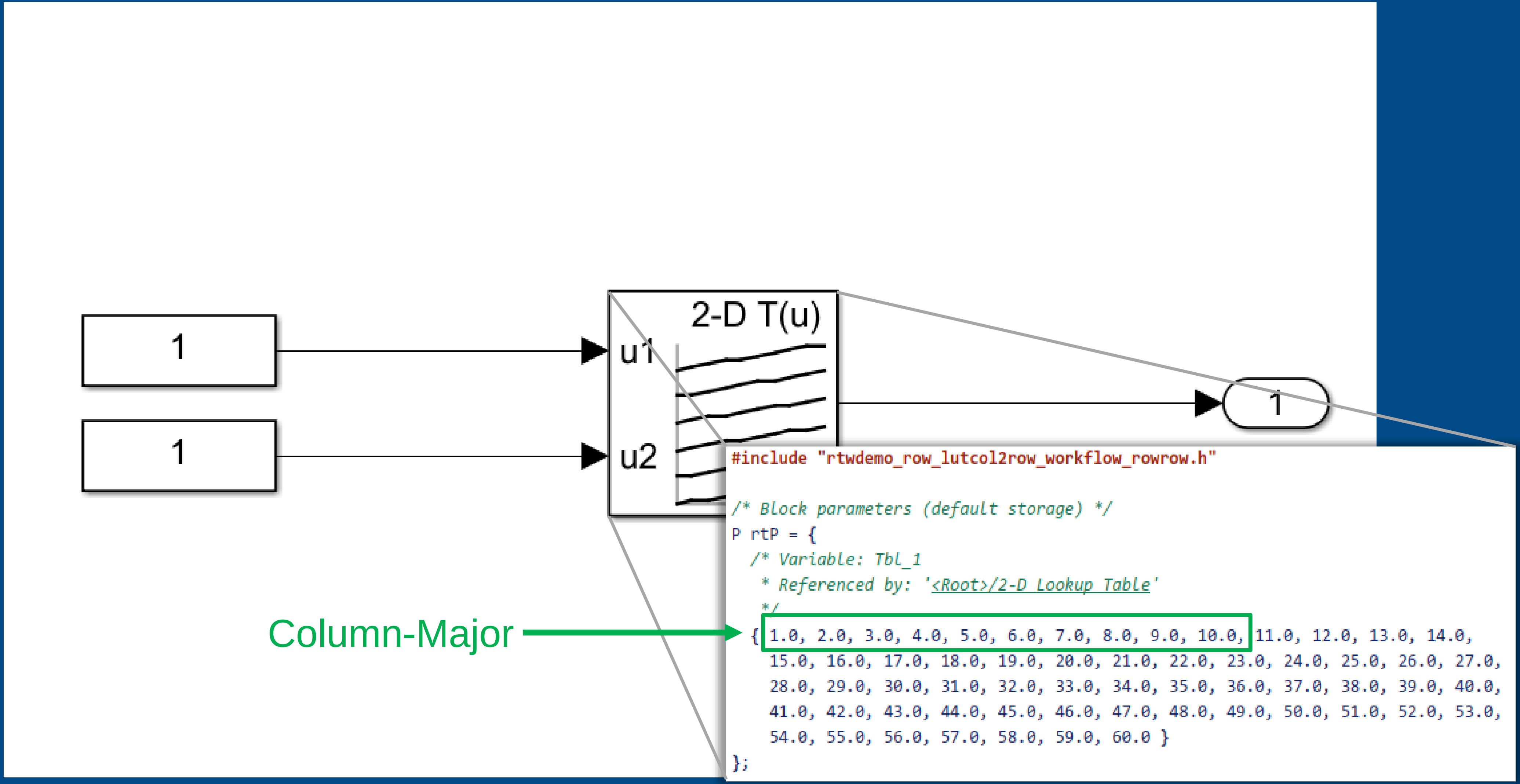
Order	Name	Rate
1	■ Cont 🟥 D1	0 0.001
2	🟩 D2	0.005
3	■ ThrottleControl.APPSnsrRun	-1
4	🟩 ThrottleControl.ActuatorRun5ms	0.005
5	🟩 ThrottleControl.TPSSecondaryRun5ms	0.005
6	🟩 ThrottleControl.MonitorRun5ms	0.005
7	🟩 ThrottleControl.ControllerRun5ms	0.005
8	🟦 D3	0.01
9	🟦 ThrottleControl.TPSPrimaryRun10ms	0.01

PROPERTY INSPECTOR

Partition

Name	D3
Rate	0.01
Type	Implicit periodic partition

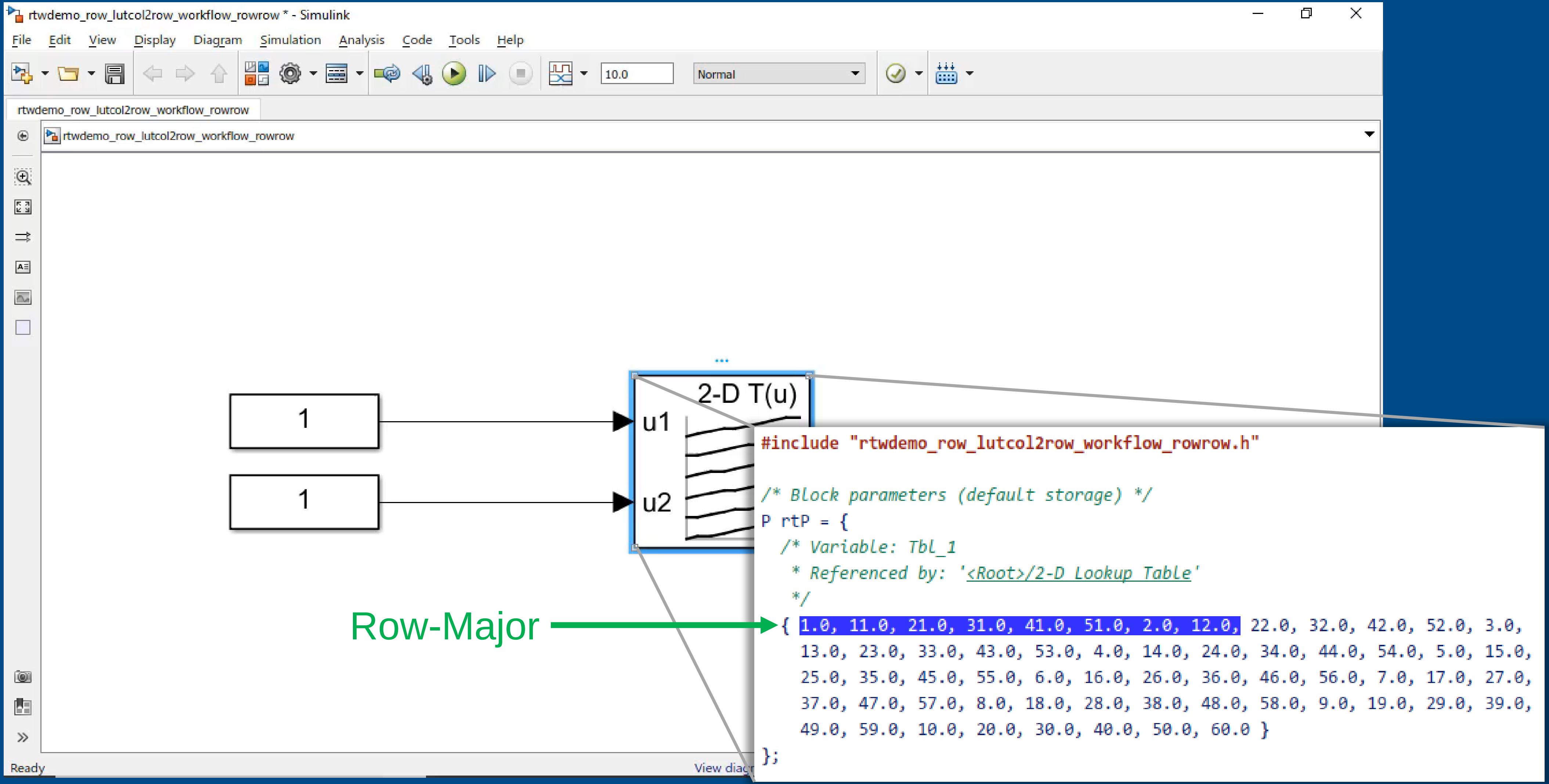
Simplifying Integration with External C/C++ Code



```
#include "rtwdemo_row_lutcol2row_workflow_rowrow.h"

/* Block parameters (default storage) */
P rtP = {
  /* Variable: Tbl_1
   * Referenced by: '<Root>/2-D Lookup Table'
   */
  { 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0,
    15.0, 16.0, 17.0, 18.0, 19.0, 20.0, 21.0, 22.0, 23.0, 24.0, 25.0, 26.0, 27.0,
    28.0, 29.0, 30.0, 31.0, 32.0, 33.0, 34.0, 35.0, 36.0, 37.0, 38.0, 39.0, 40.0,
    41.0, 42.0, 43.0, 44.0, 45.0, 46.0, 47.0, 48.0, 49.0, 50.0, 51.0, 52.0, 53.0,
    54.0, 55.0, 56.0, 57.0, 58.0, 59.0, 60.0 }
};
```

Simplifying Integration with External C/C++ Code

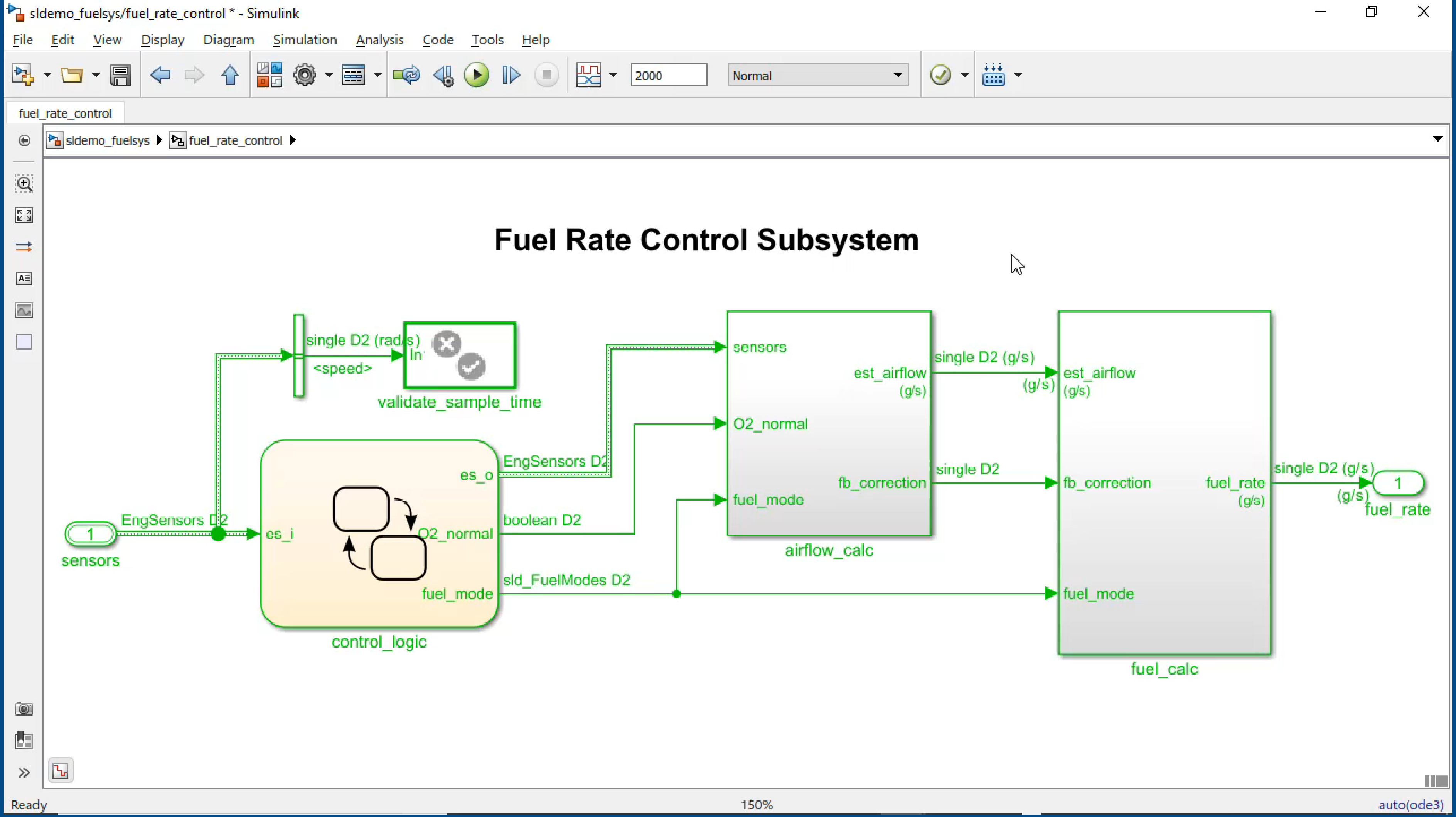
Output


rtwdemo_row_lutcol2row_workflow_rowrow * - Simulink
File Edit View Display Diagram Simulation Analysis Code Tools Help
10.0
Normal
rtwdemo_row_lutcol2row_workflow_rowrow
rtwdemo_row_lutcol2row_workflow_rowrow
1
1
u1
u2
2-D T(u)
Ready
View diag

```
#include "rtwdemo_row_lutcol2row_workflow_rowrow.h"

/* Block parameters (default storage) */
P rtP = {
  /* Variable: Tbl_1
   * Referenced by: '<Root>/2-D Lookup Table'
   */
  { 1.0, 11.0, 21.0, 31.0, 41.0, 51.0, 2.0, 12.0, 22.0, 32.0, 42.0, 52.0, 3.0,
    13.0, 23.0, 33.0, 43.0, 53.0, 4.0, 14.0, 24.0, 34.0, 44.0, 54.0, 5.0, 15.0,
    25.0, 35.0, 45.0, 55.0, 6.0, 16.0, 26.0, 36.0, 46.0, 56.0, 7.0, 17.0, 27.0,
    37.0, 47.0, 57.0, 8.0, 18.0, 28.0, 38.0, 48.0, 58.0, 9.0, 19.0, 29.0, 39.0,
    49.0, 59.0, 10.0, 20.0, 30.0, 40.0, 50.0, 60.0 }
};
```

Row-Major

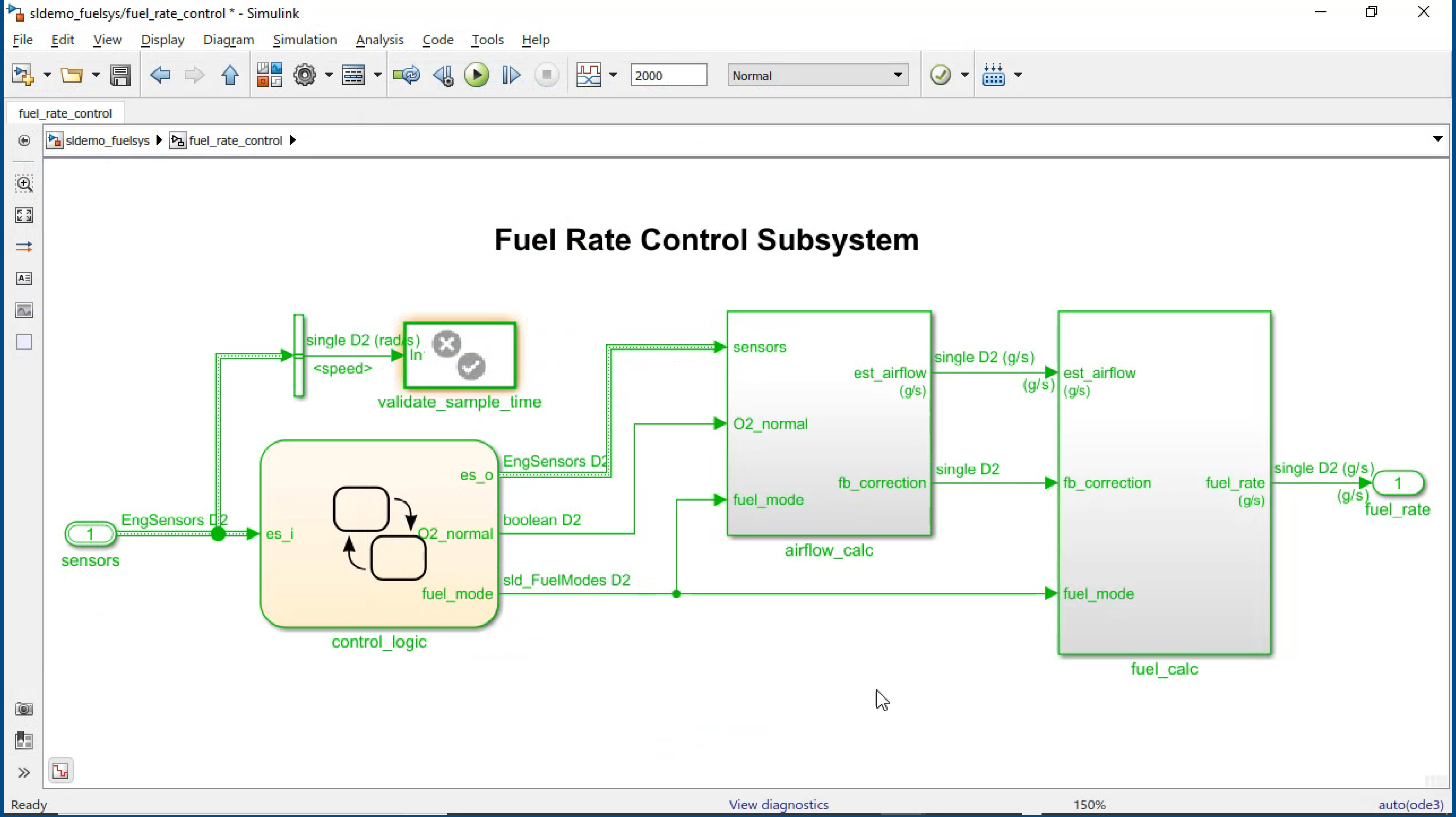
Viewing Generated Code Alongside the Model



Embedded Coder

Viewing Generated Code Alongside the Model

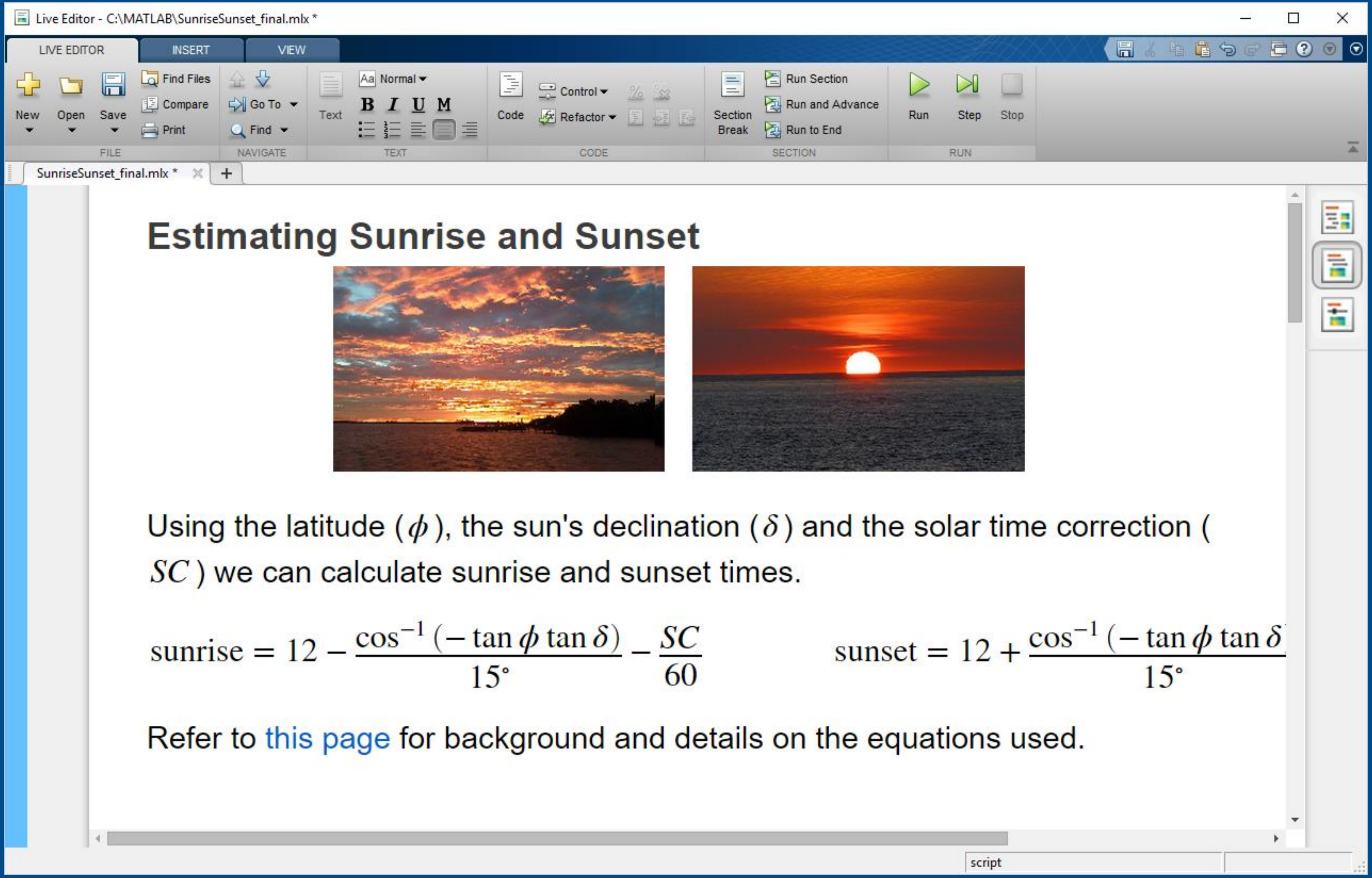
Output



Embedded Coder

Sharing Live Scripts

Output



Estimating Sunrise and Sunset

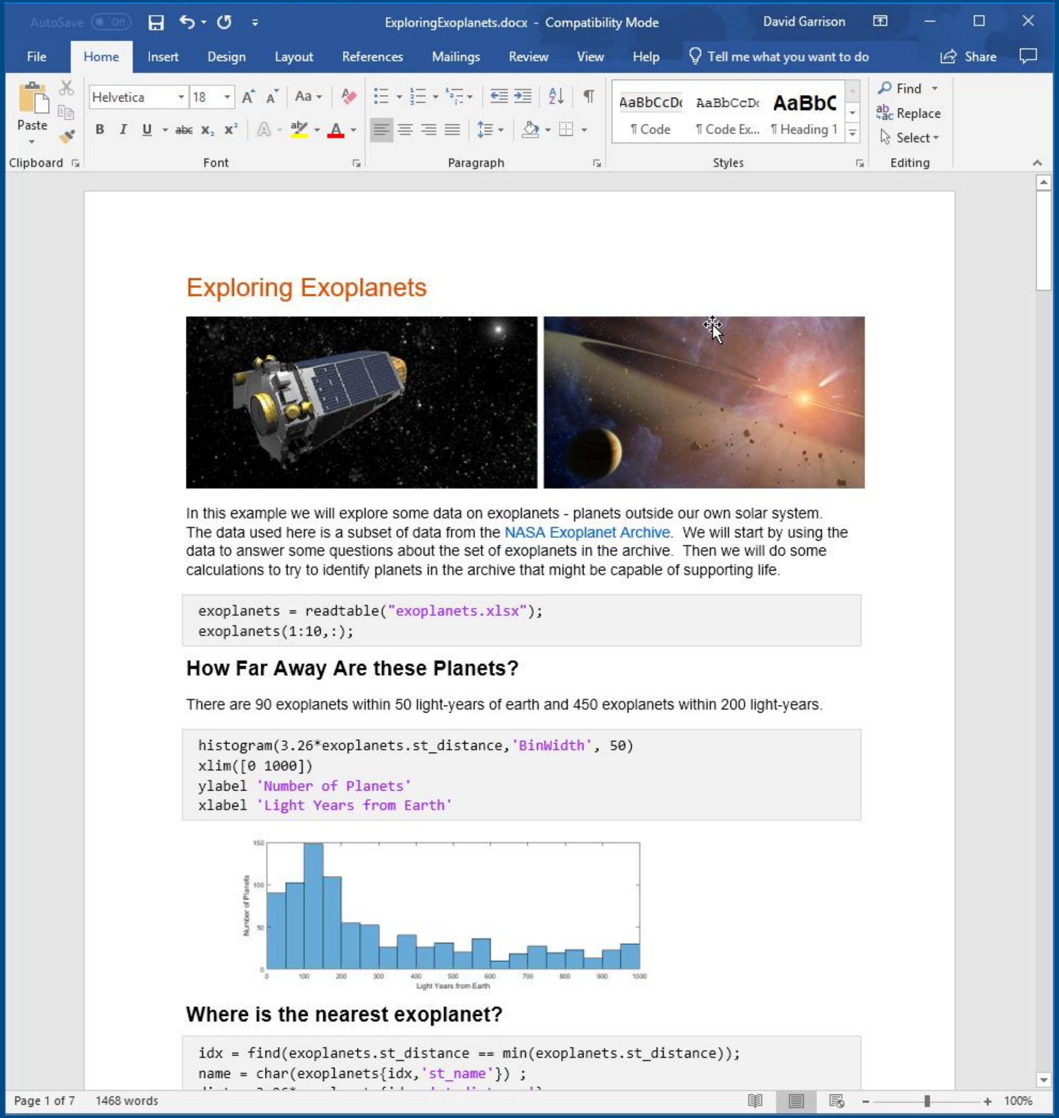
Using the latitude (ϕ), the sun's declination (δ) and the solar time correction (SC) we can calculate sunrise and sunset times.

$$\text{sunrise} = 12 - \frac{\cos^{-1}(-\tan\phi\tan\delta)}{15^\circ} - \frac{SC}{60} \qquad \text{sunset} = 12 + \frac{\cos^{-1}(-\tan\phi\tan\delta}{15^\circ}$$

Refer to this page for background and details on the equations used.

Sharing Live Scripts

Output



Exploring Exoplanets

In this example we will explore some data on exoplanets - planets outside our own solar system. The data used here is a subset of data from the NASA Exoplanet Archive. We will start by using the data to answer some questions about the set of exoplanets in the archive. Then we will do some calculations to try to identify planets in the archive that might be capable of supporting life.

```
exoplanets = readtable("exoplanets.xlsx");
exoplanets(1:10,:);
```

How Far Away Are these Planets?

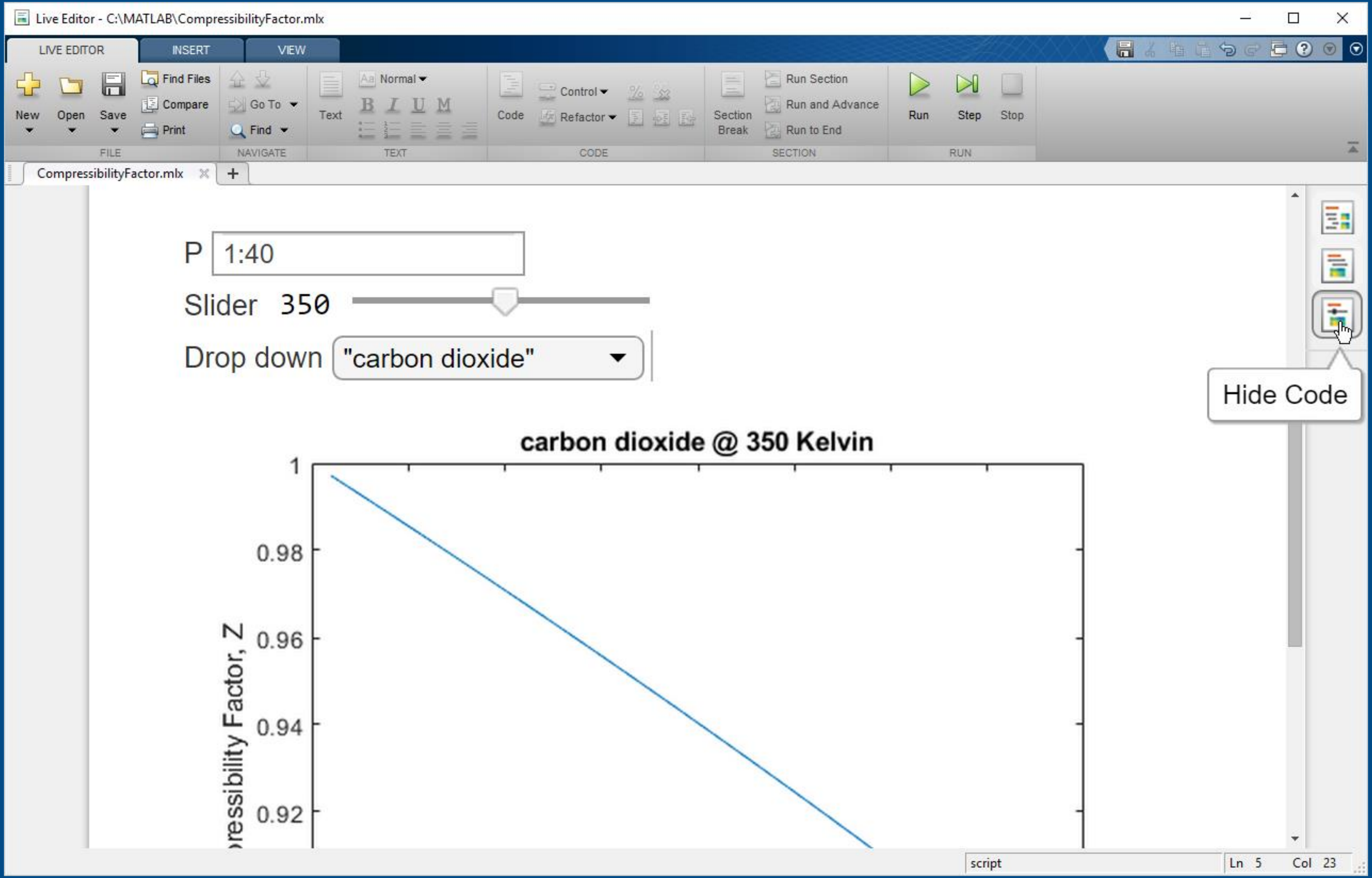
There are 90 exoplanets within 50 light-years of earth and 450 exoplanets within 200 light-years.

```
histogram(3.26*exoplanets.st_distance,'BinWidth', 50)
xlim([0 1000])
ylabel 'Number of Planets'
xlabel 'Light Years from Earth'
```

Where is the nearest exoplanet?

```
idx = find(exoplanets.st_distance == min(exoplanets.st_distance));
name = char(exoplanets{idx,'st_name'}) ;
```

Sharing Live Scripts



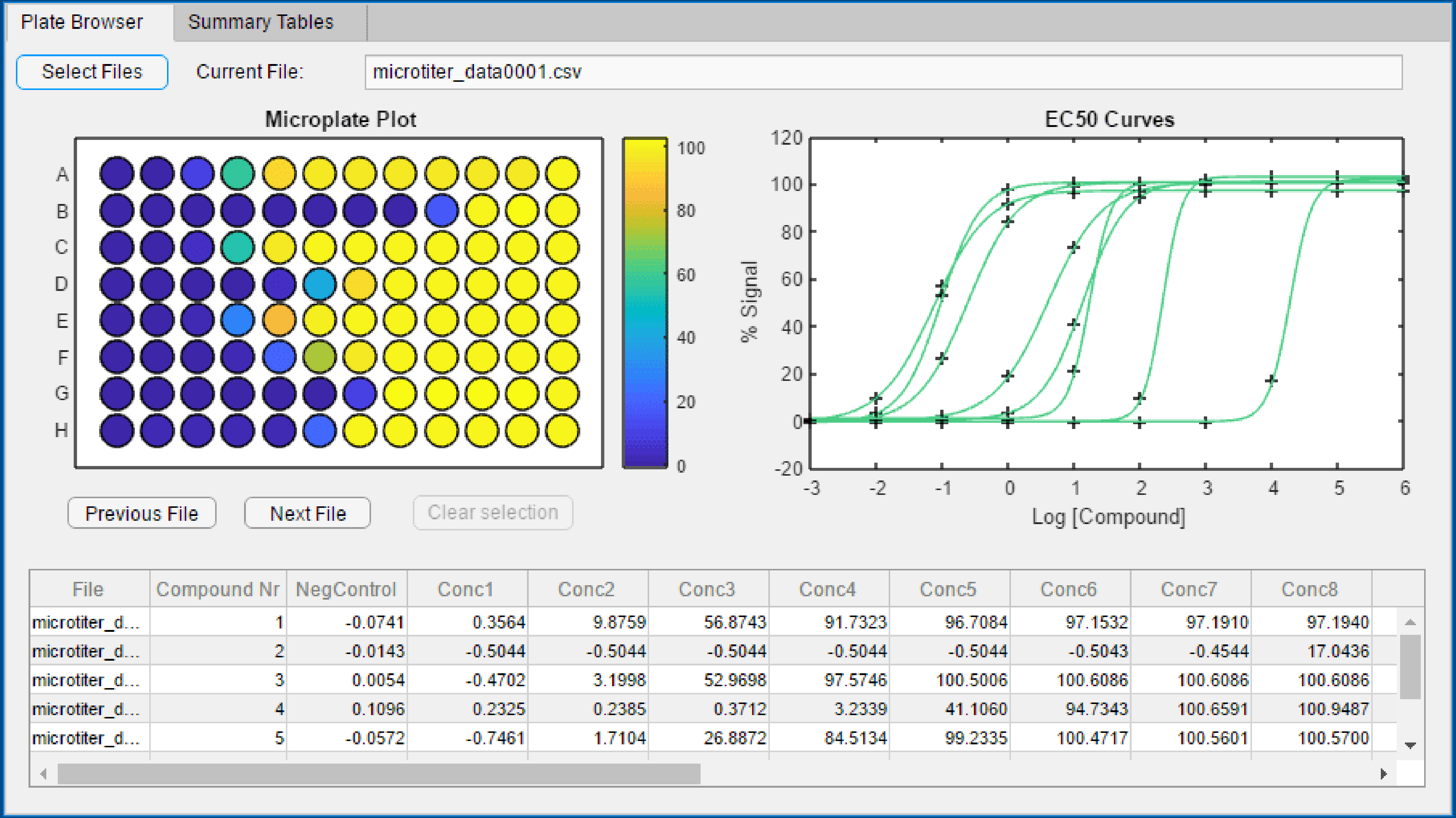
P 1:40

Slider 350

Drop down "carbon dioxide"

Creating Apps

Output



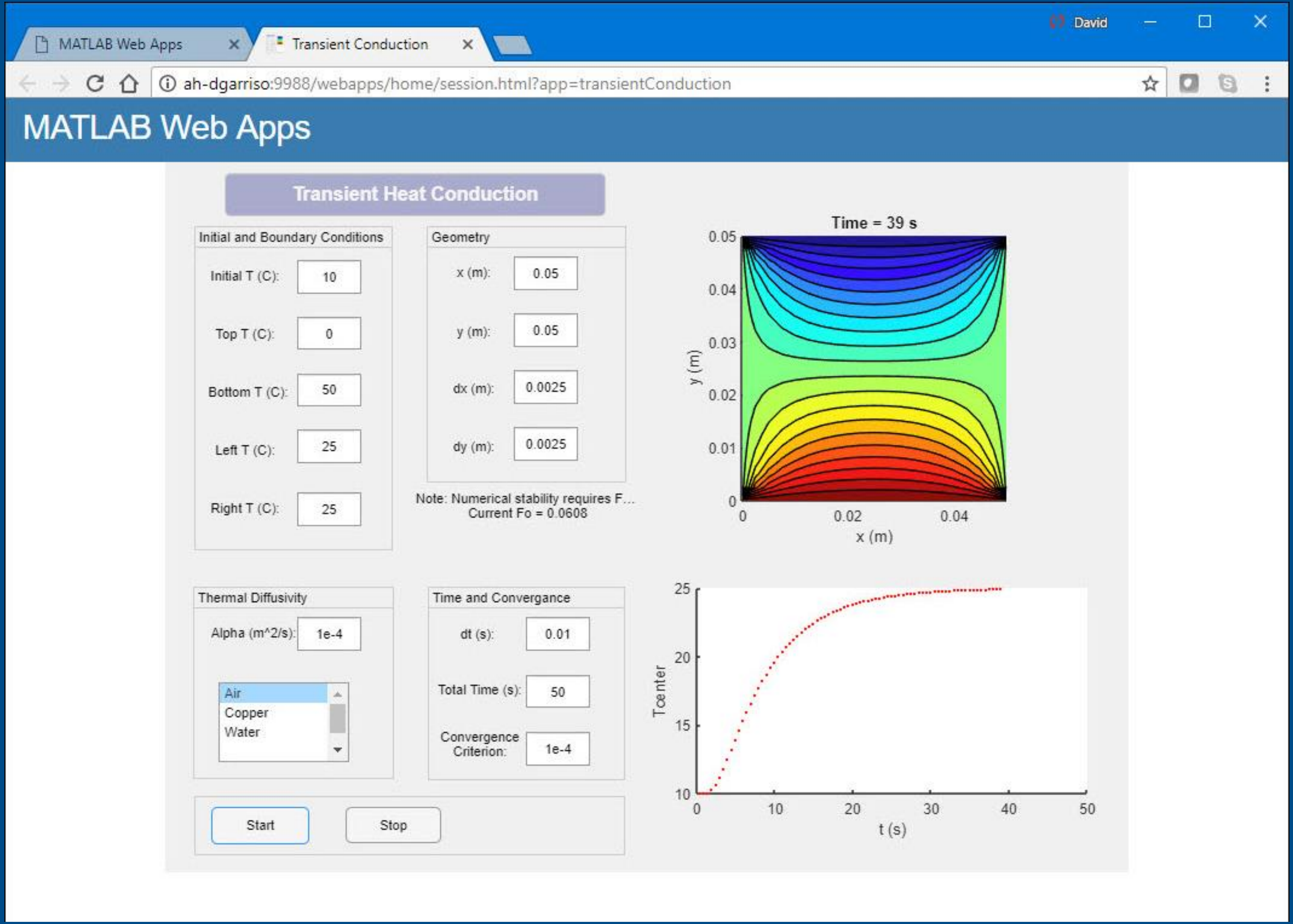
Current File: microtiter_data0001.csv

File	Compound Nr	NegControl	Conc1	Conc2	Conc3	Conc4	Conc5	Conc6	Conc7	Conc8
microtiter_d...	1	-0.0741	0.3564	9.8759	56.8743	91.7323	96.7084	97.1532	97.1910	97.1940
microtiter_d...	2	-0.0143	-0.5044	-0.5044	-0.5044	-0.5044	-0.5044	-0.5043	-0.4544	17.0436
microtiter_d...	3	0.0054	-0.4702	3.1998	52.9698	97.5746	100.5006	100.6086	100.6086	100.6086
microtiter_d...	4	0.1096	0.2325	0.2385	0.3712	3.2339	41.1060	94.7343	100.6591	100.9487
microtiter_d...	5	-0.0572	-0.7461	1.7104	26.8872	84.5134	99.2335	100.4717	100.5601	100.5700

MATLAB

Deploying Web Apps

Output



Initial and Boundary Conditions

Initial T (C): 10

Top T (C): 0

Bottom T (C): 50

Left T (C): 25

Right T (C): 25

Geometry

x (m): 0.05

y (m): 0.05

dx (m): 0.0025

dy (m): 0.0025

Note: Numerical stability requires F...
Current Fo = 0.0608

Thermal Diffusivity

Alpha (m^2/s): 1e-4

Air
Copper
Water

Time and Convergance

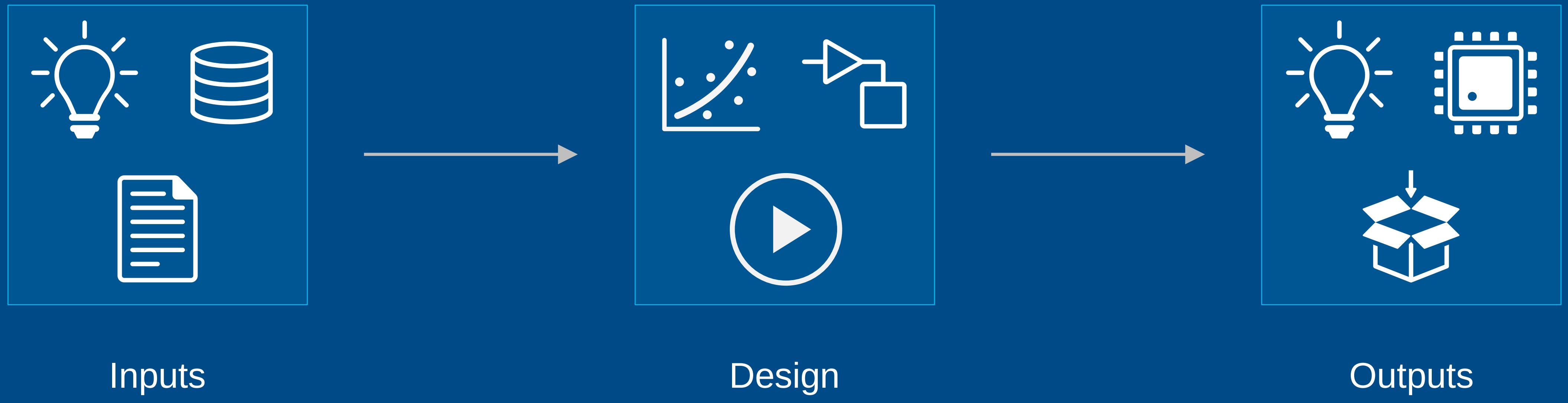
dt (s): 0.01

Total Time (s): 50

Convergence Criterion: 1e-4

MATLAB Compiler

Using MATLAB & Simulink to Build Algorithms in Everything



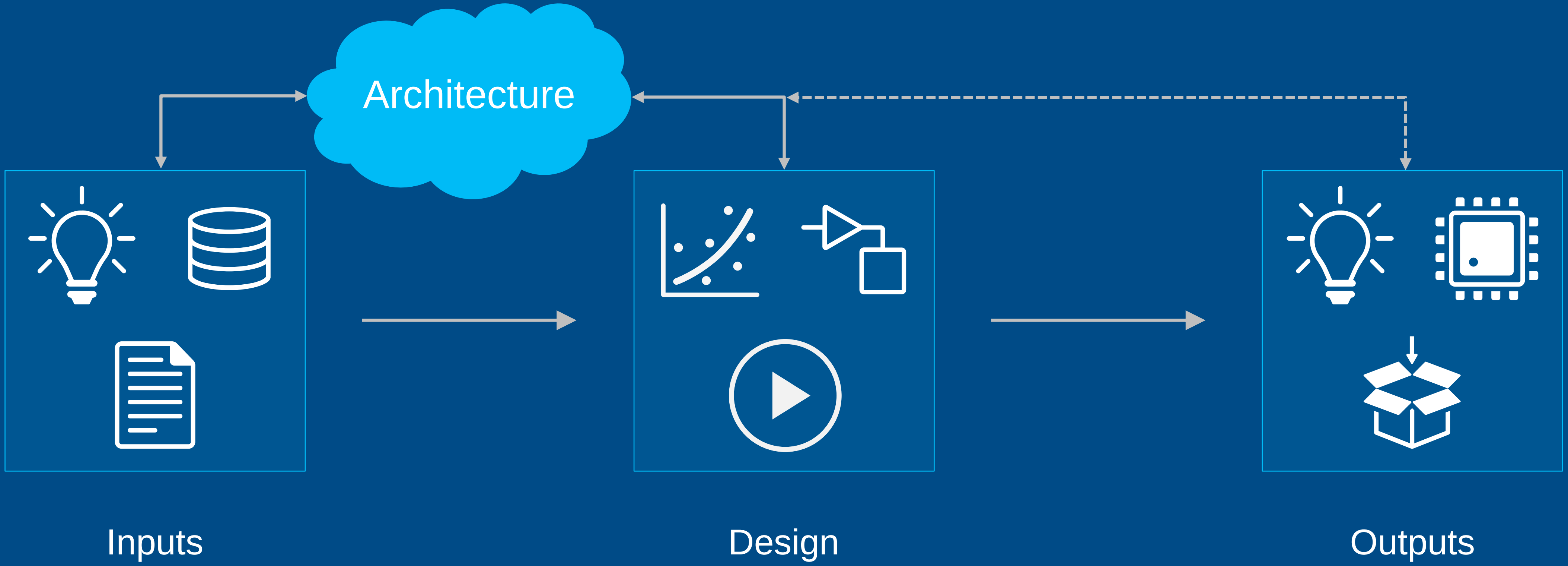
Inputs

Design

Outputs

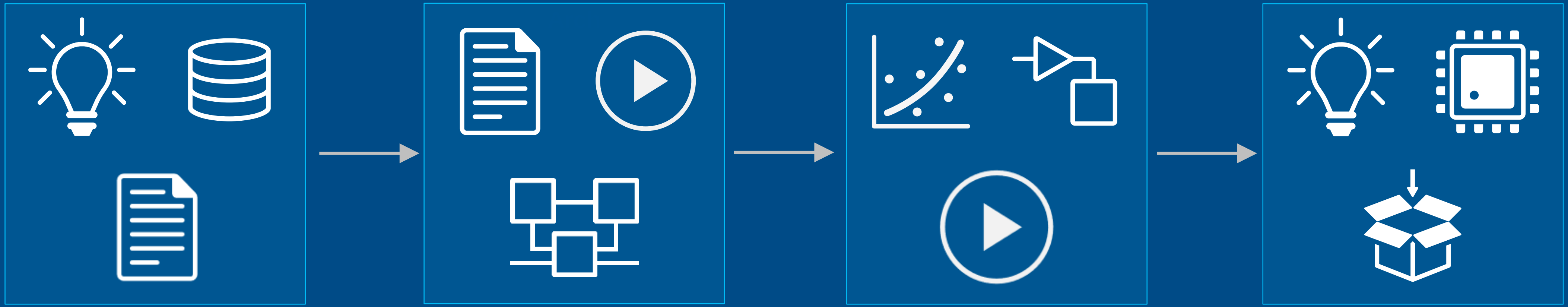
MATLAB®&SIMULINK®

Evaluating Architectures



MATLAB® & SIMULINK®

Evaluating Architectures



Inputs

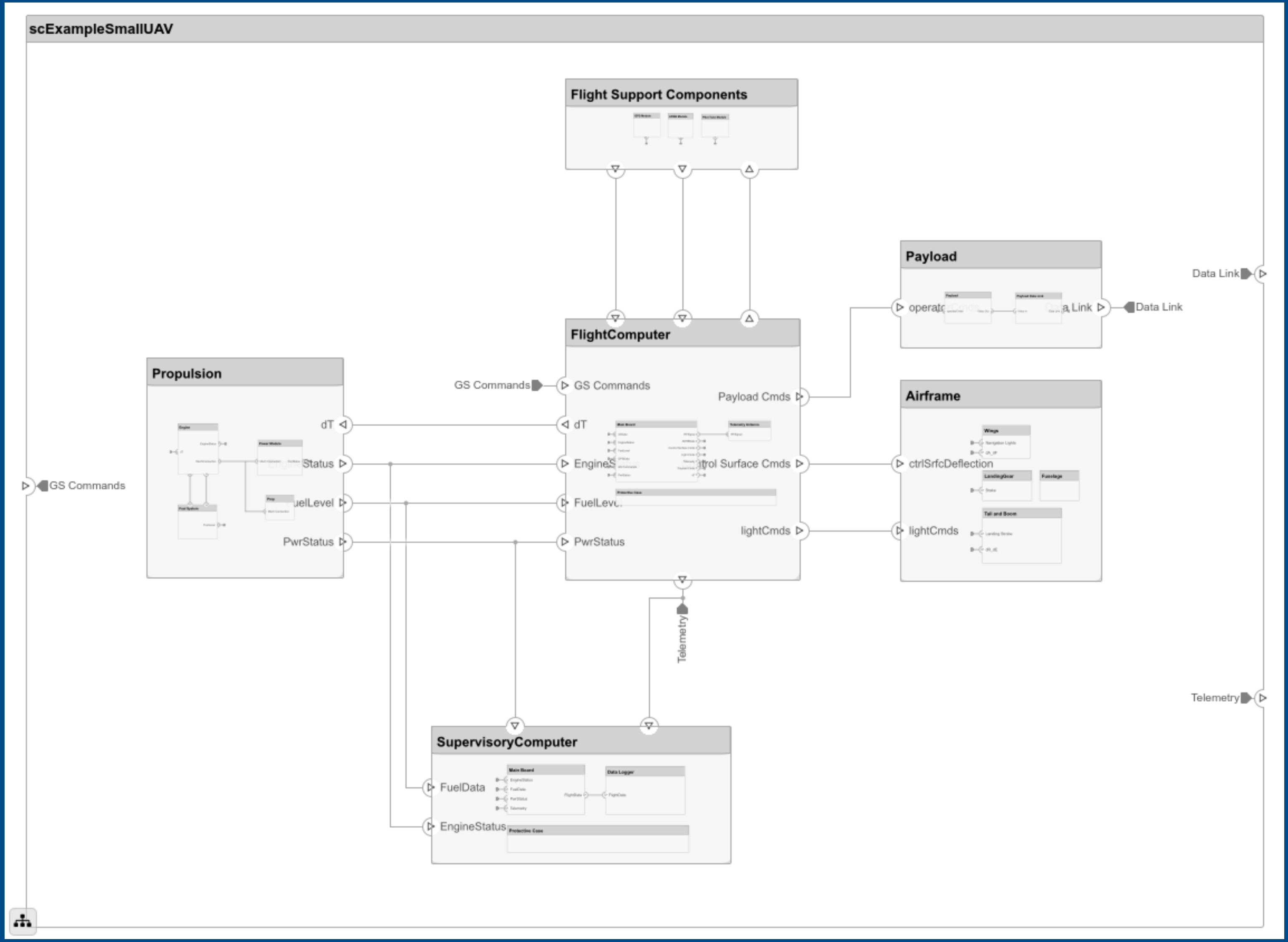
Architecture

Design

Outputs

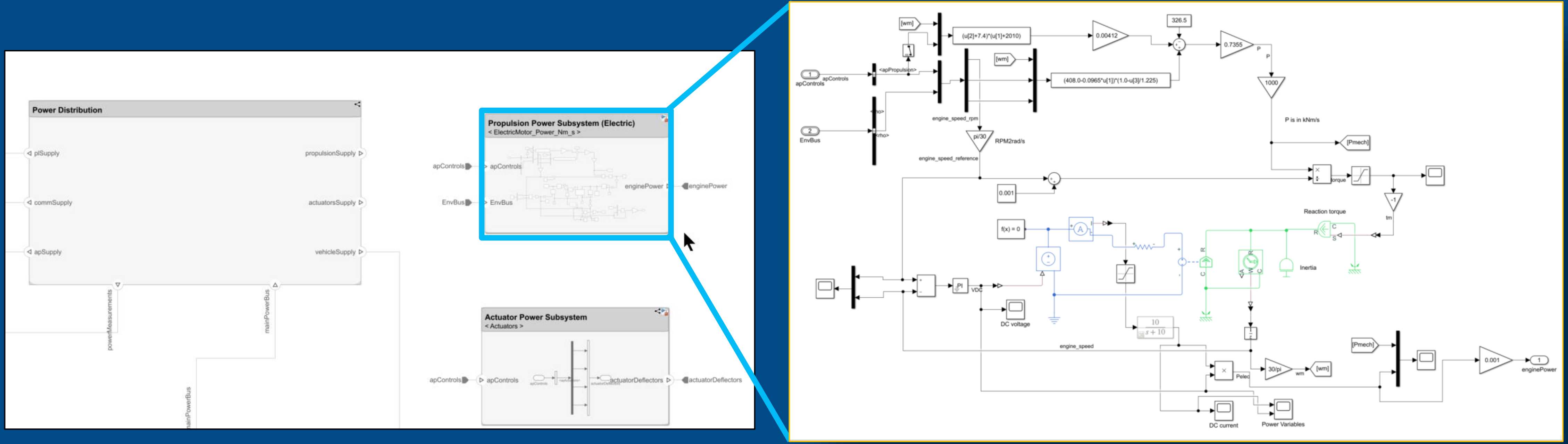
MATLAB® & SIMULINK®

Designing System and Software Architectures



System Composer

Designing System and Software Architectures



Designing System and Software Architectures

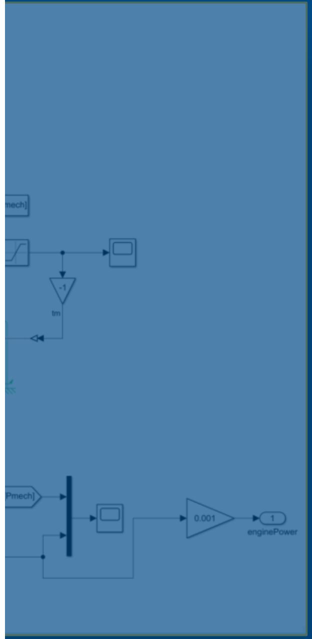
Arch

Find out more:

Ingegneria dei sistemi: dai requisiti all’architettura alla simulazione

Vincenzo Petrella

Traccia B – 14:30



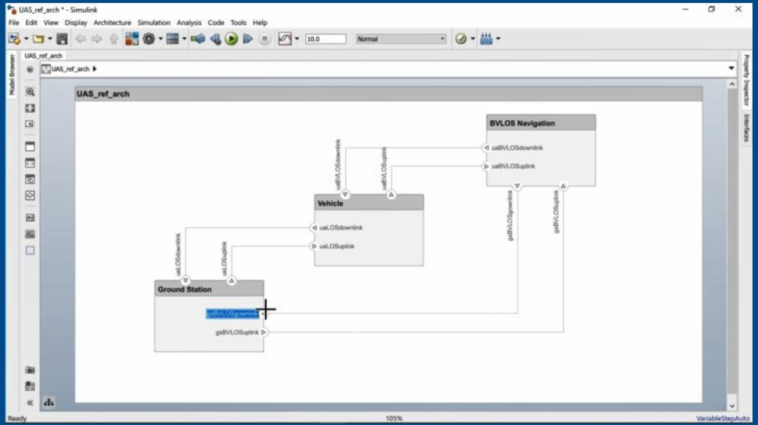
Designing Beyond System and Software Architectures

Arch

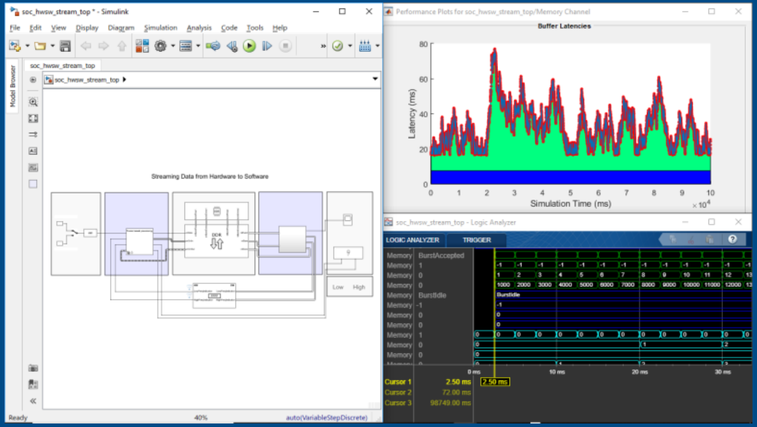
Systems and Software

SoC Hardware and Software

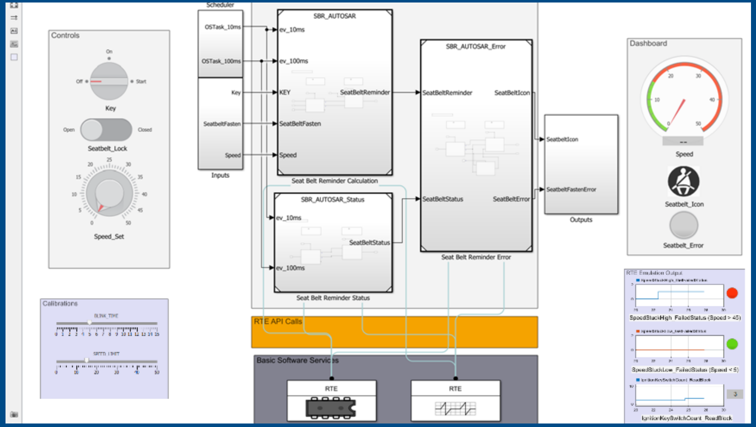
AUTOSAR Software



System Composer

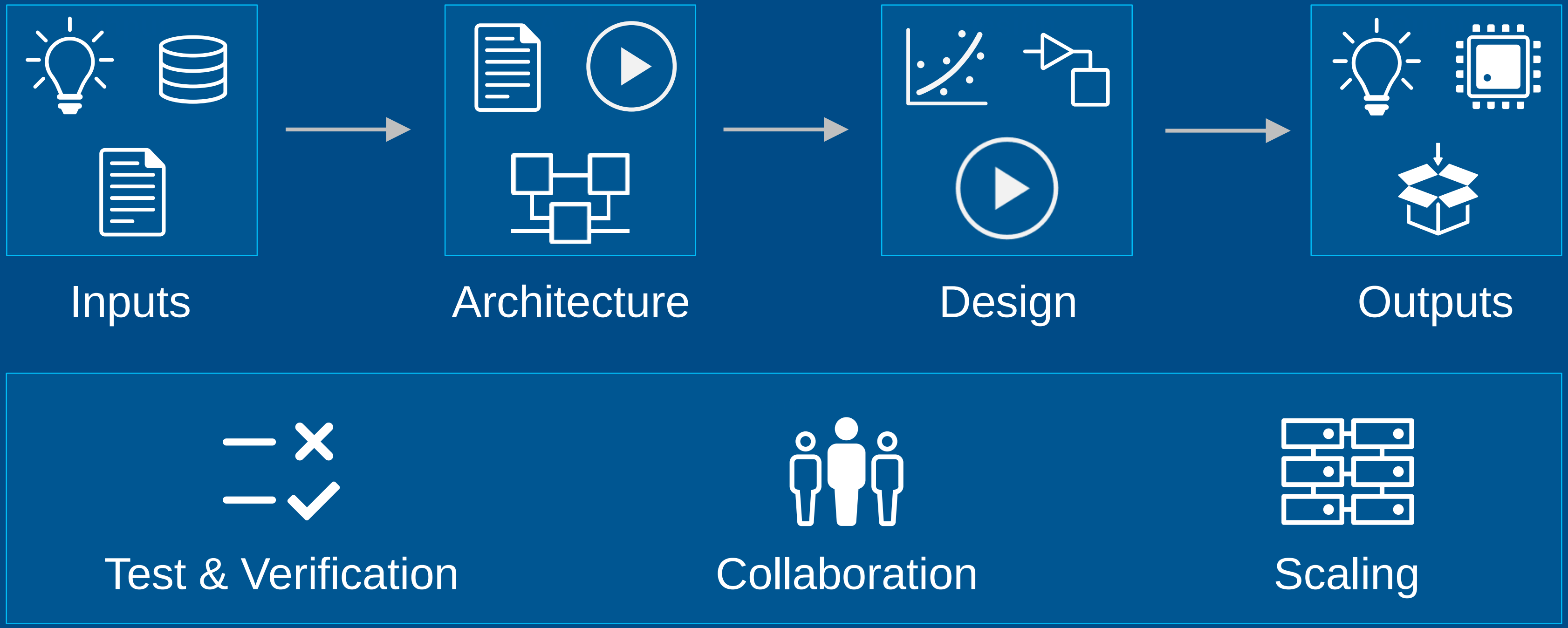


SoC Blockset



AUTOSAR Blockset

Using MATLAB & Simulink to Build Algorithms in Everything



Inputs

Architecture

Design

Outputs

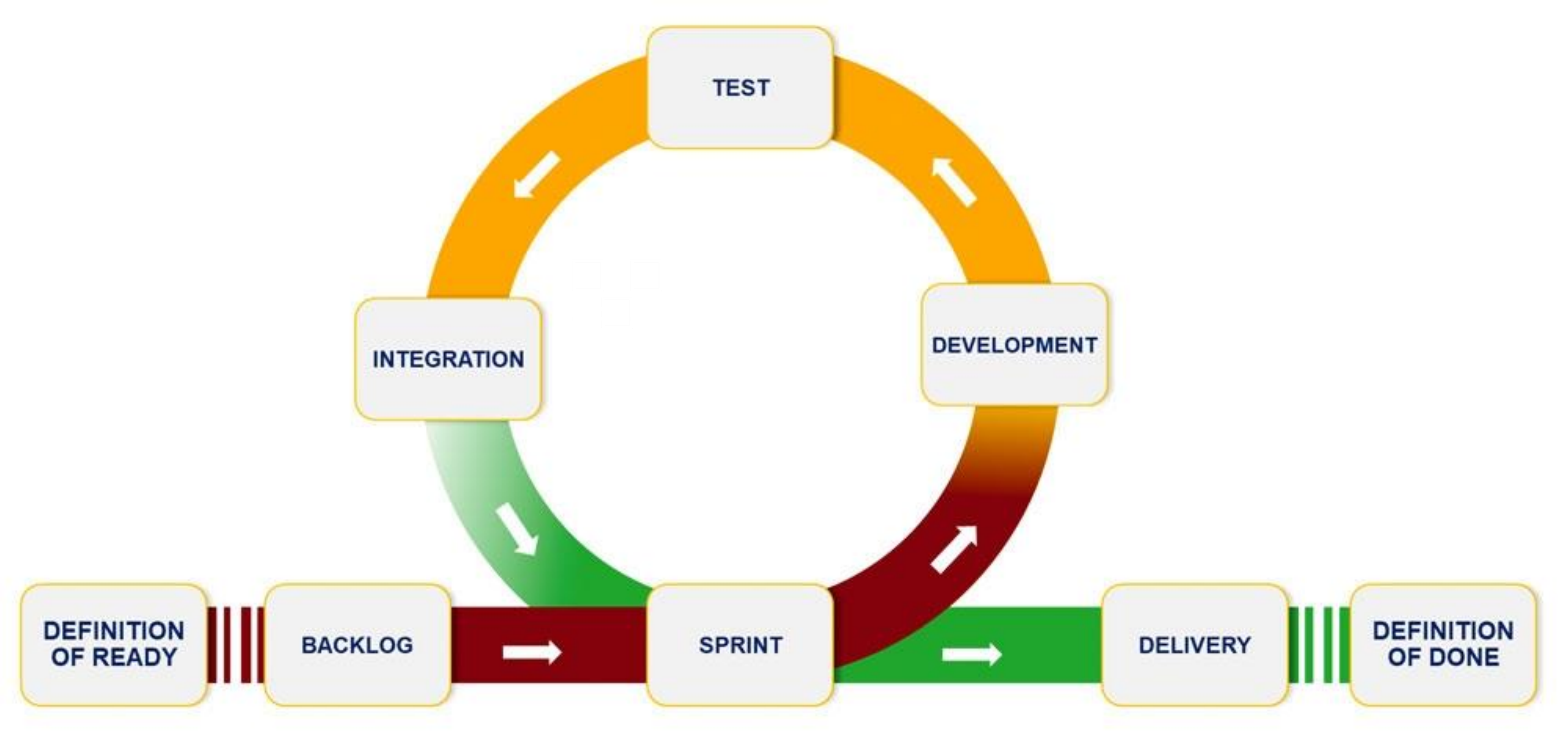
Test & Verification

Collaboration

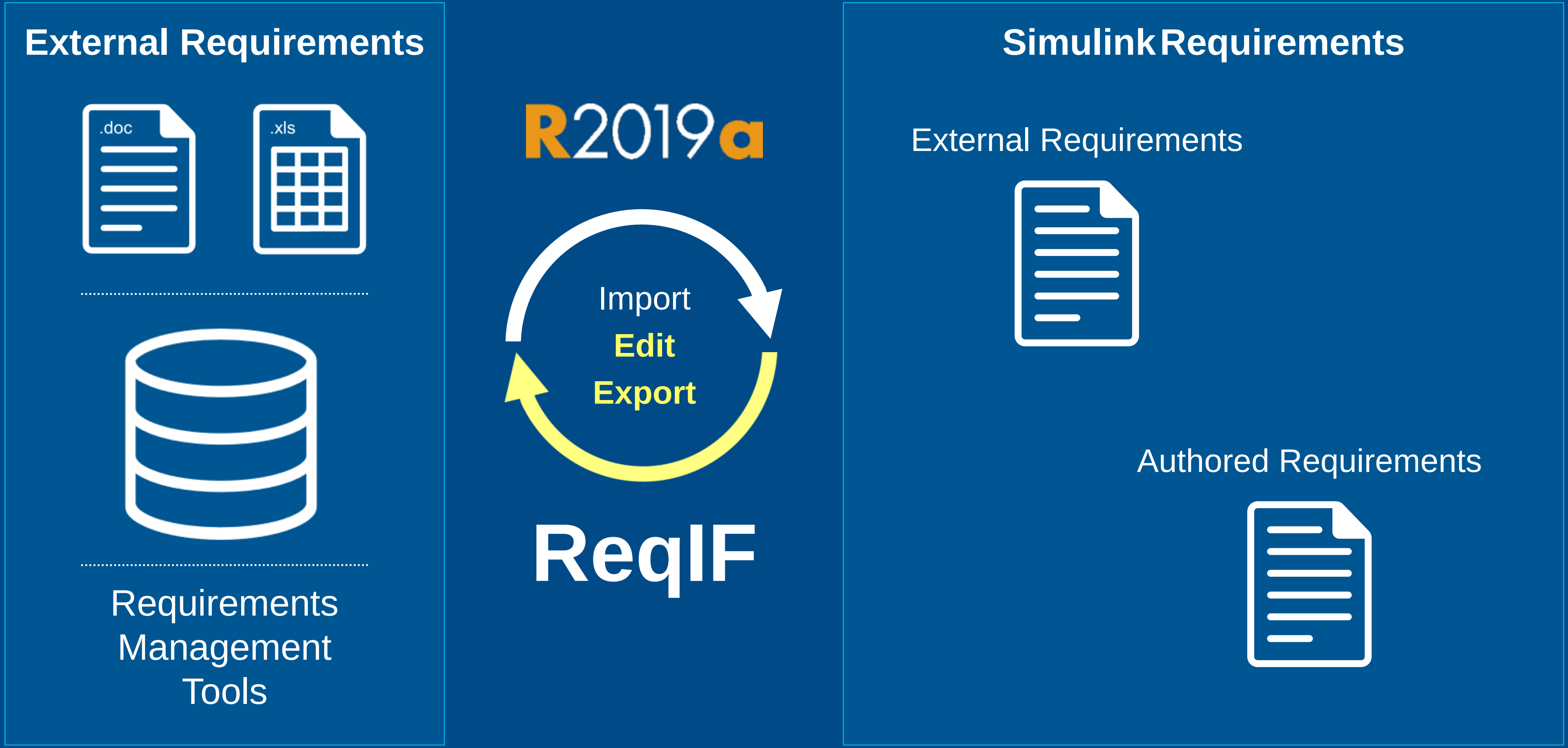
Scaling

MATLAB® & SIMULINK®

Using MATLAB & Simulink to Build Algorithms in Everything



Integrating with Third-party Requirements Tools



External Requirements

.doc

.xls

Requirements Management Tools

R2019a

Import

Edit

Export

ReqIF

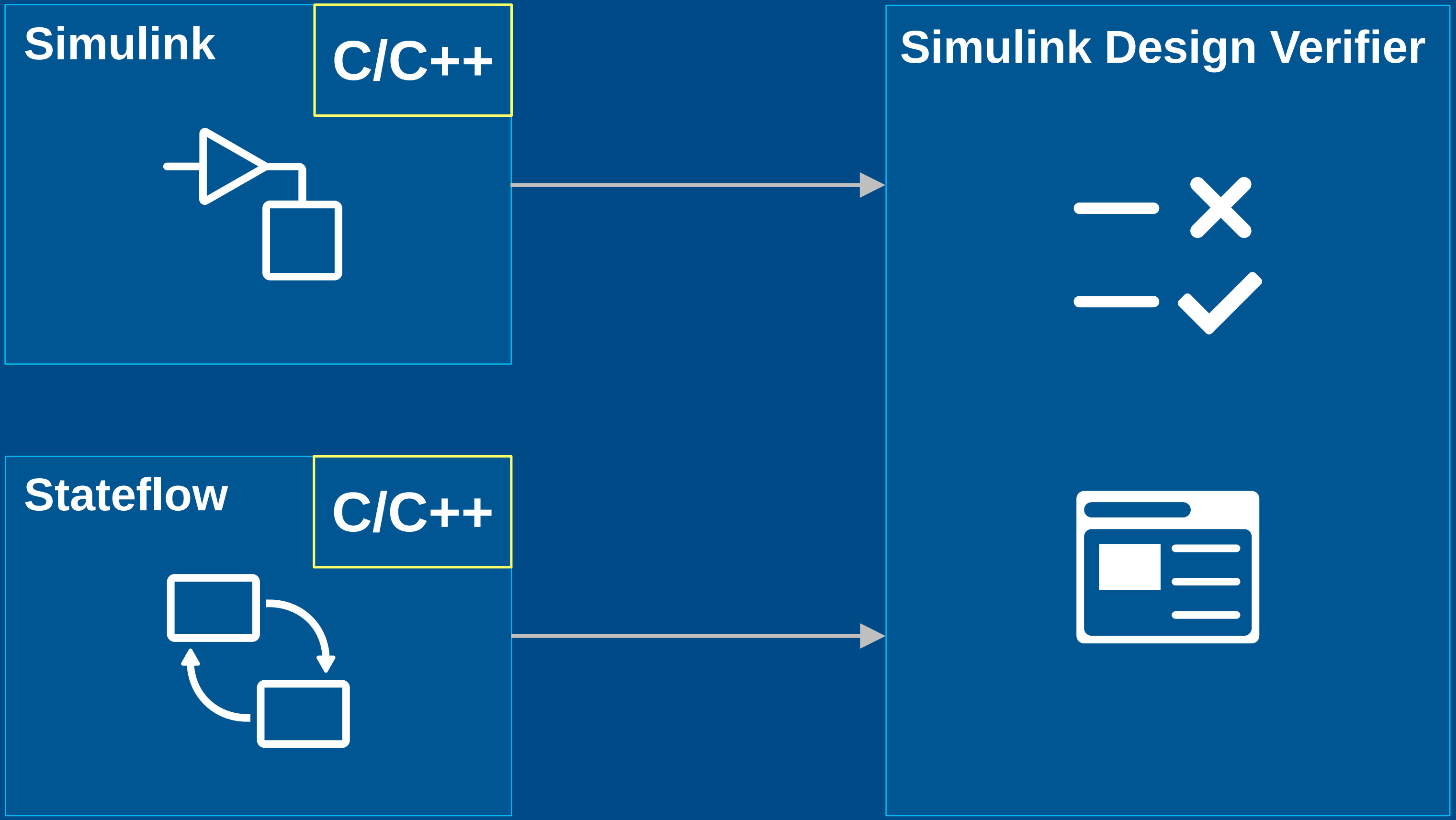
Simulink Requirements

External Requirements

Authored Requirements

Include Custom Code in Test & Verification

Test & Verification



Simulink Design Verifier

Include Custom Code in Test & Verification

Find out more:

Master Class:
Sviluppo di un sistema di gestione delle batterie con Simulink

Traccia B - 15:30

Maurizio Dalbard – Aldo Caraceto

Sviluppo Model-Based Design applicato ad un sistema di gestione delle batterie

Postazione Demo

Maurizio Dalbard – Vincenzo Petrella

Controls

Find out more:

Sviluppare controlli digitali per convertitori elettronici di potenza

Traccia B - 13:30

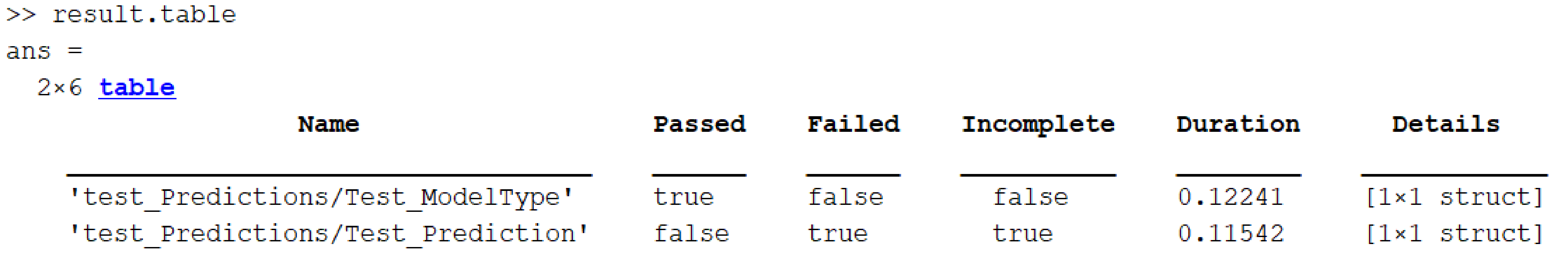
Aldo Caraceto

Industry 4.0: simulazione dinamica closed-loop e test virtuale

Postazione Demo

Aldo Caraceto

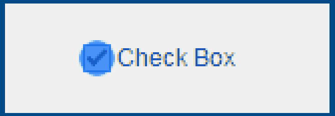
Using the MATLAB Unit Test Framework



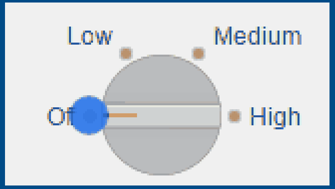
```
>> result.table
ans =
  2×6 table
                     Name                      Passed    Failed    Incomplete    Duration      Details   
    _________________________________    ______    ______    __________    ________    ____________
    'test_Predictions/Test_ModelType'     true      false       false       0.12241    [1×1 struct]
    'test_Predictions/Test_Prediction'    false     true        true        0.11542    [1×1 struct]
```

Using the MATLAB App Testing Framework

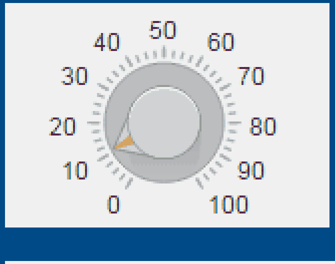
```
testCase.press(myApp.checkbox)
```



```
testCase.choose(myApp.discreteKnob, "Medium")
```



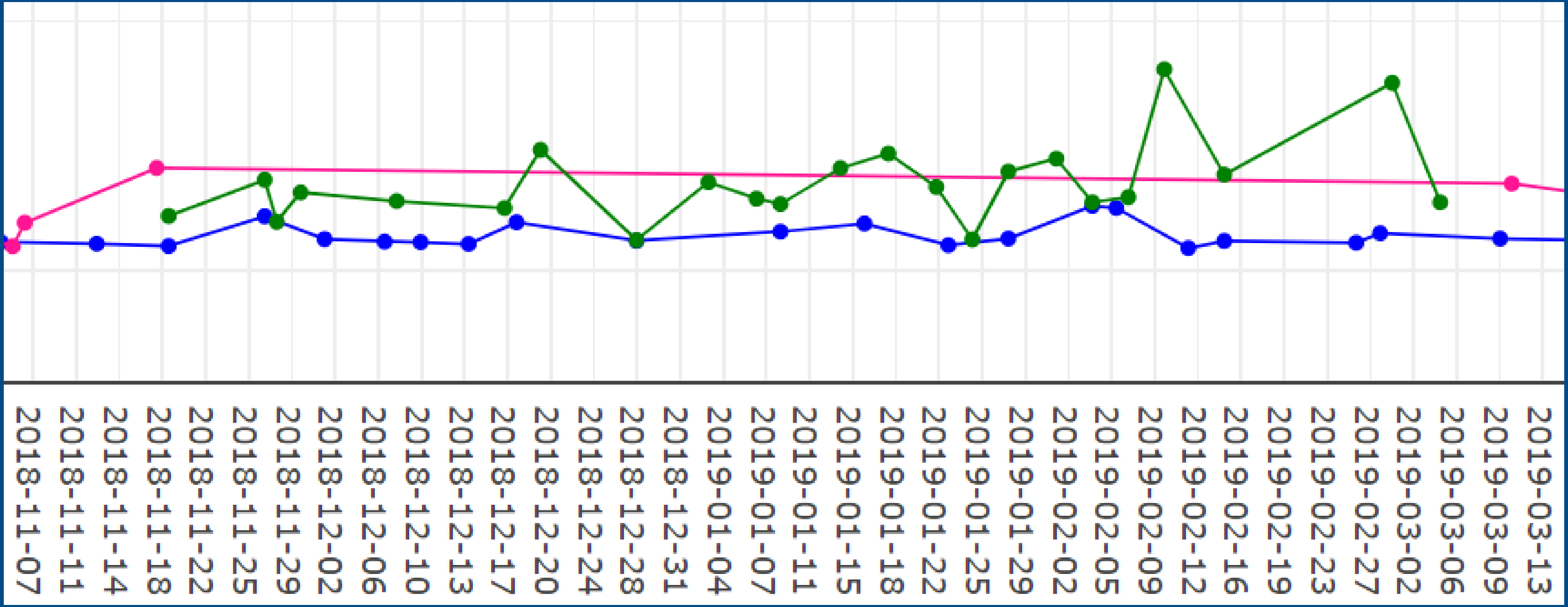
```
testCase.drag(myApp.continuousKnob, 10, 90)
```



```
testCase.type(myApp.editfield, myTextVar)
```

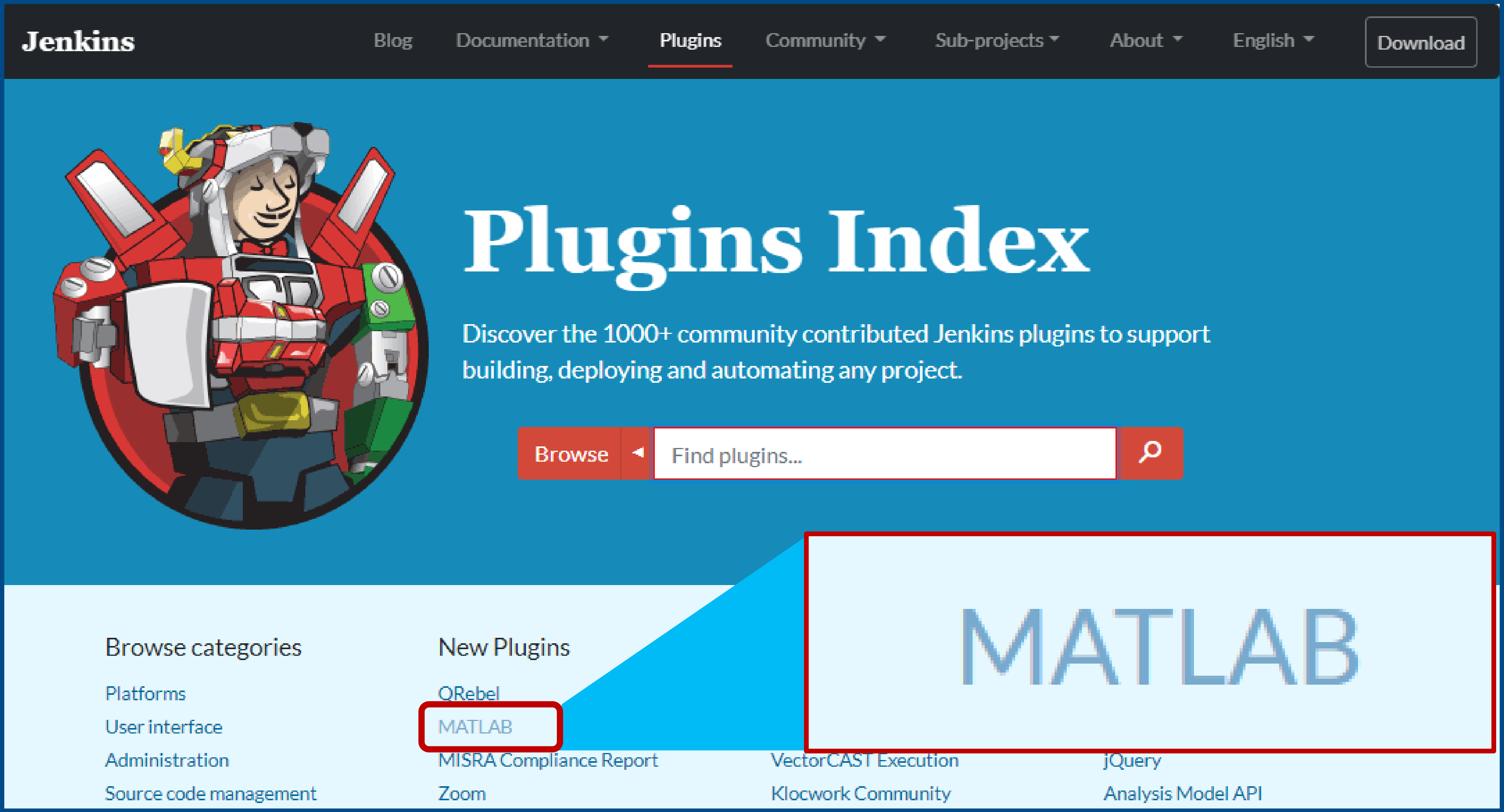
Test & Verification

Using the MATLAB Performance Testing Framework



Using Continuous Integration

Test & Verification



Plugins Index

Discover the 1000+ community contributed Jenkins plugins to support building, deploying and automating any project.

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- Administration
- Source code management

New Plugins

- QRebel
- MATLAB
- MISRA Compliance Report
- Zoom

- VectorCAST Execution
- Klocwork Community

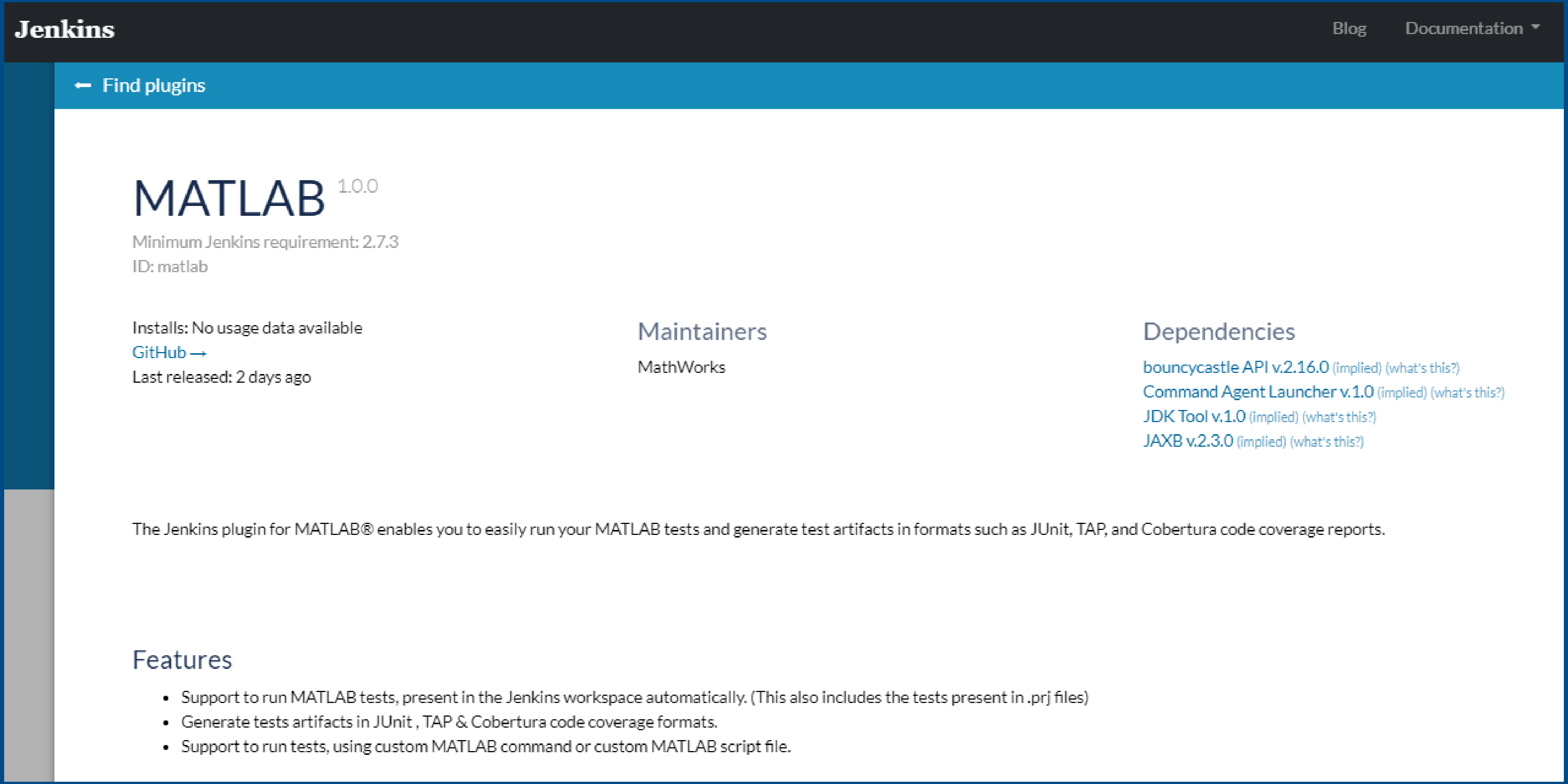
- jQuery
- Analysis Model API

MATLAB

https://plugins.jenkins.io/

Using Continuous Integration

Test & Verification



MATLAB 1.0.0

Minimum Jenkins requirement: 2.7.3
ID: matlab

Installs: No usage data available
GitHub →
Last released: 2 days ago

Maintainers

MathWorks

Dependencies

bouncycastle API v.2.16.0 (implied) (what's this?)
Command Agent Launcher v.1.0 (implied) (what's this?)
JDK Tool v.1.0 (implied) (what's this?)
JAXB v.2.3.0 (implied) (what's this?)

The Jenkins plugin for MATLAB® enables you to easily run your MATLAB tests and generate test artifacts in formats such as JUnit, TAP, and Cobertura code coverage reports.

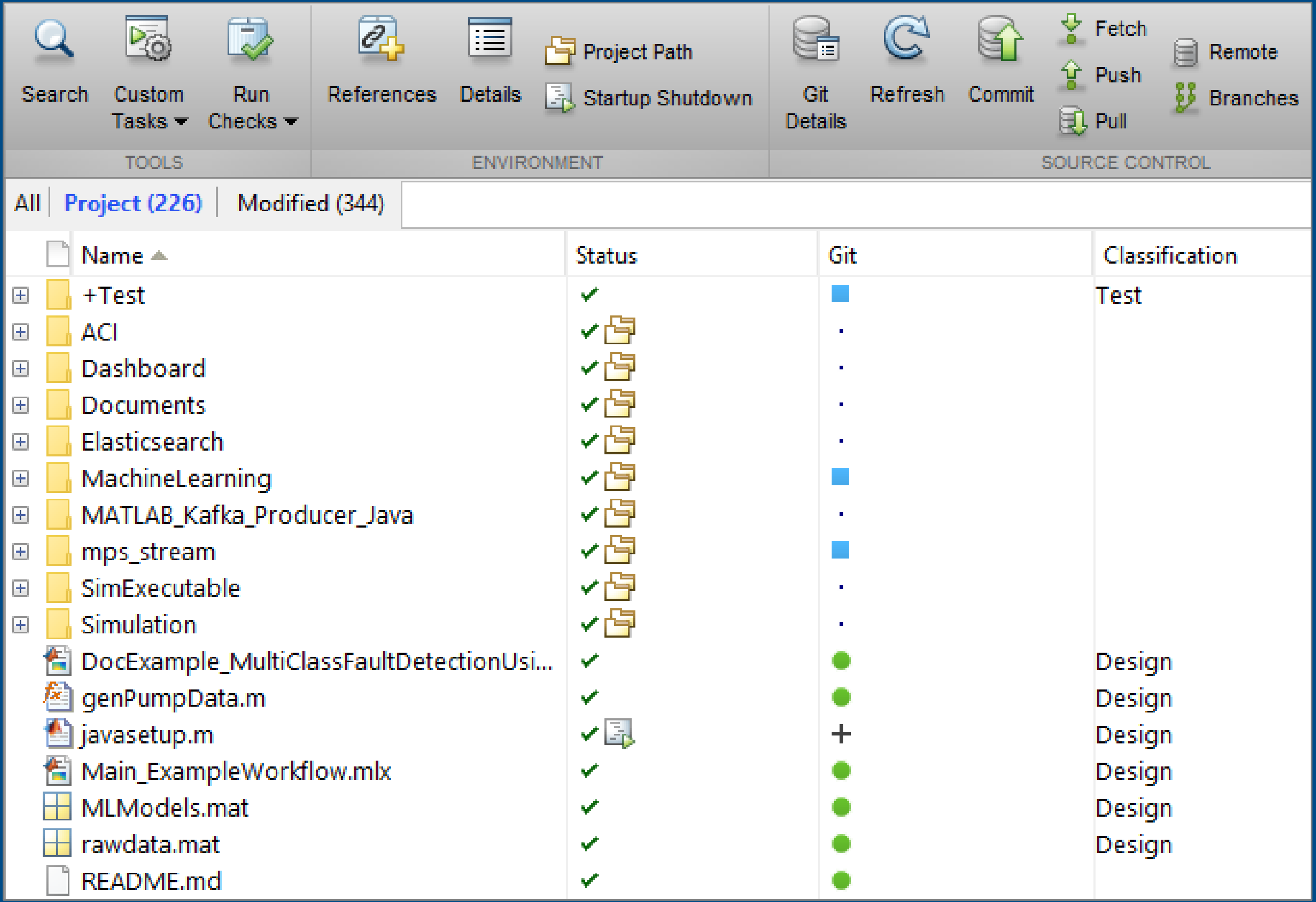
Features

- Support to run MATLAB tests, present in the Jenkins workspace automatically. (This also includes the tests present in .prj files)
- Generate tests artifacts in JUnit , TAP & Cobertura code coverage formats.
- Support to run tests, using custom MATLAB command or custom MATLAB script file.

MATLAB https://plugins.jenkins.io/matlab

Using Projects in MATLAB

Collaboration



Name	Status	Git	Classification
+Test	✓	🟦	Test
ACI	✓	·	
Dashboard	✓	·	
Documents	✓	·	
Elasticsearch	✓	·	
MachineLearning	✓	🟦	
MATLAB_Kafka_Producer_Java	✓	·	
mps_stream	✓	🟦	
SimExecutable	✓	·	
Simulation	✓	·	
DocExample_MultiClassFaultDetectionUsi...	✓	●	Design
genPumpData.m	✓	●	Design
javasetup.m	✓	+	Design
Main_ExampleWorkflow.mlx	✓	●	Design
MLModels.mat	✓	●	Design
rawdata.mat	✓	●	Design
README.md	✓	●	

Using Projects in MATLAB

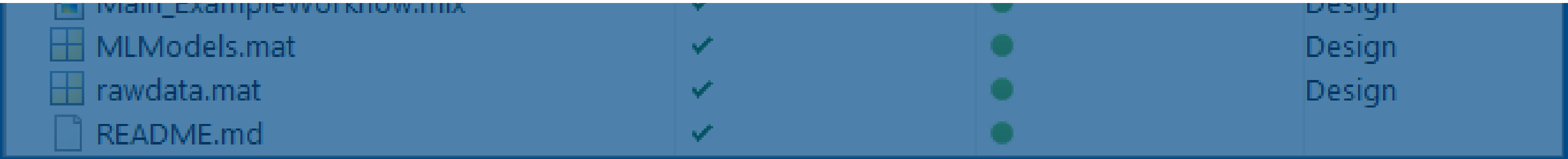
Collaboration

Find out more:

Master Class: Sviluppo software con MATLAB

Traccia A – 15:30

Francesco Alderisio - Giuseppe Ridinò

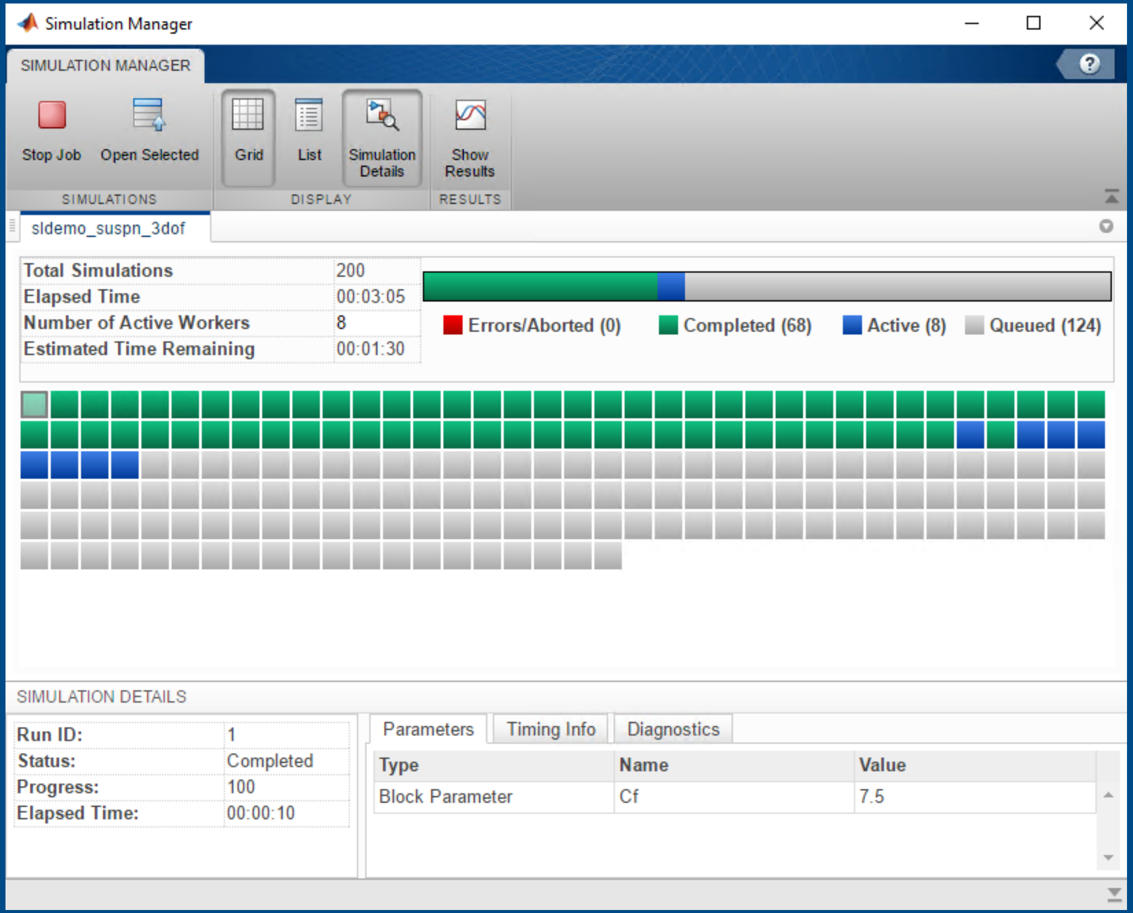


Main_ExampleWorkflow.mlx	✓	●	Design
MLModels.mat	✓	●	Design
rawdata.mat	✓	●	Design
README.md	✓	●	

Parallel Simulations in Simulink

Scaling

Simulation Manager



Simulation Manager

SIMULATION MANAGER

Stop Job | Open Selected | Grid | List | Simulation Details | Show Results

SIMULATIONS | DISPLAY | RESULTS

sldemo_suspn_3dof

Total Simulations	200
Elapsed Time	00:03:05
Number of Active Workers	8
Estimated Time Remaining	00:01:30

🟥 Errors/Aborted (0) 🟩 Completed (68) 🟦 Active (8) ⬜ Queued (124)

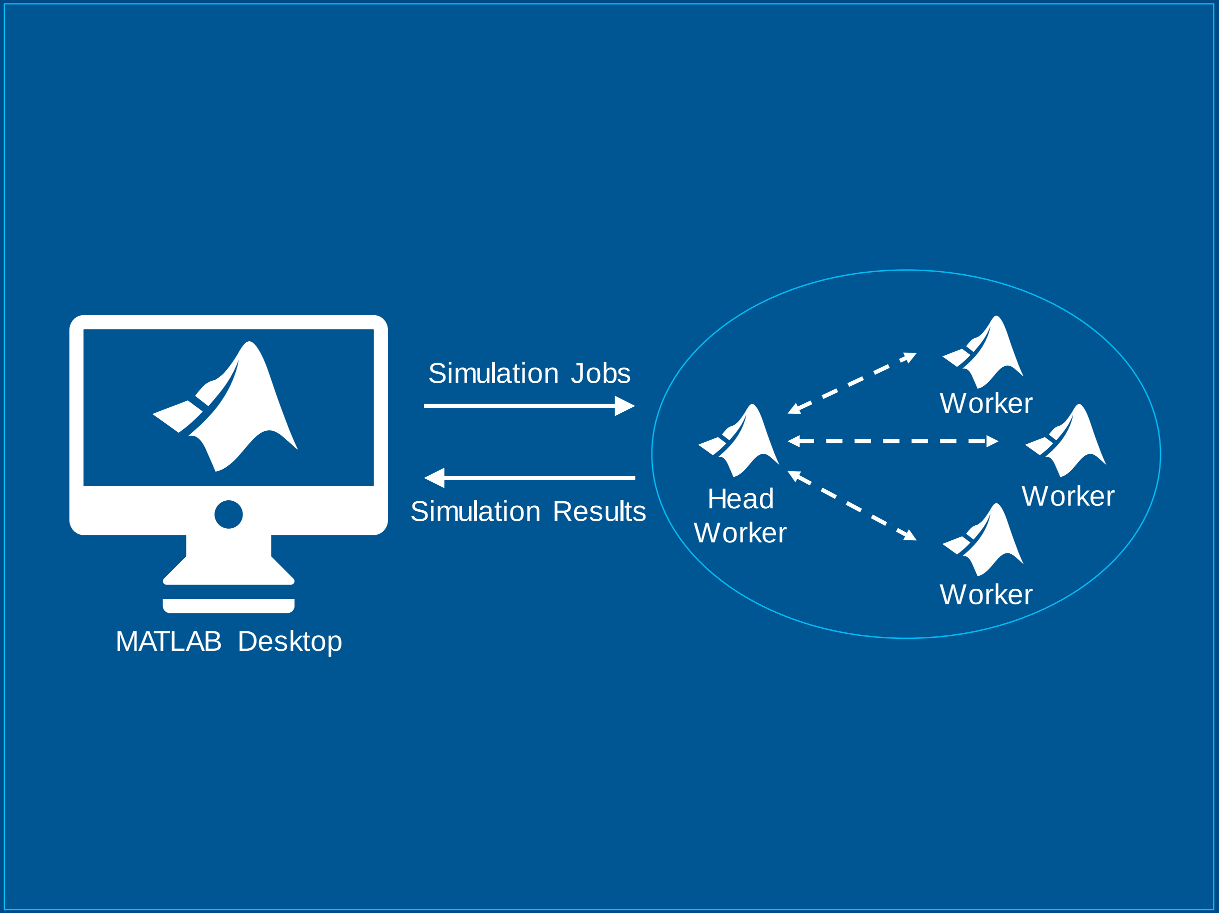
SIMULATION DETAILS

Run ID:	1
Status:	Completed
Progress:	100
Elapsed Time:	00:00:10

Parameters | Timing Info | Diagnostics

Type	Name	Value
Block Parameter	Cf	7.5

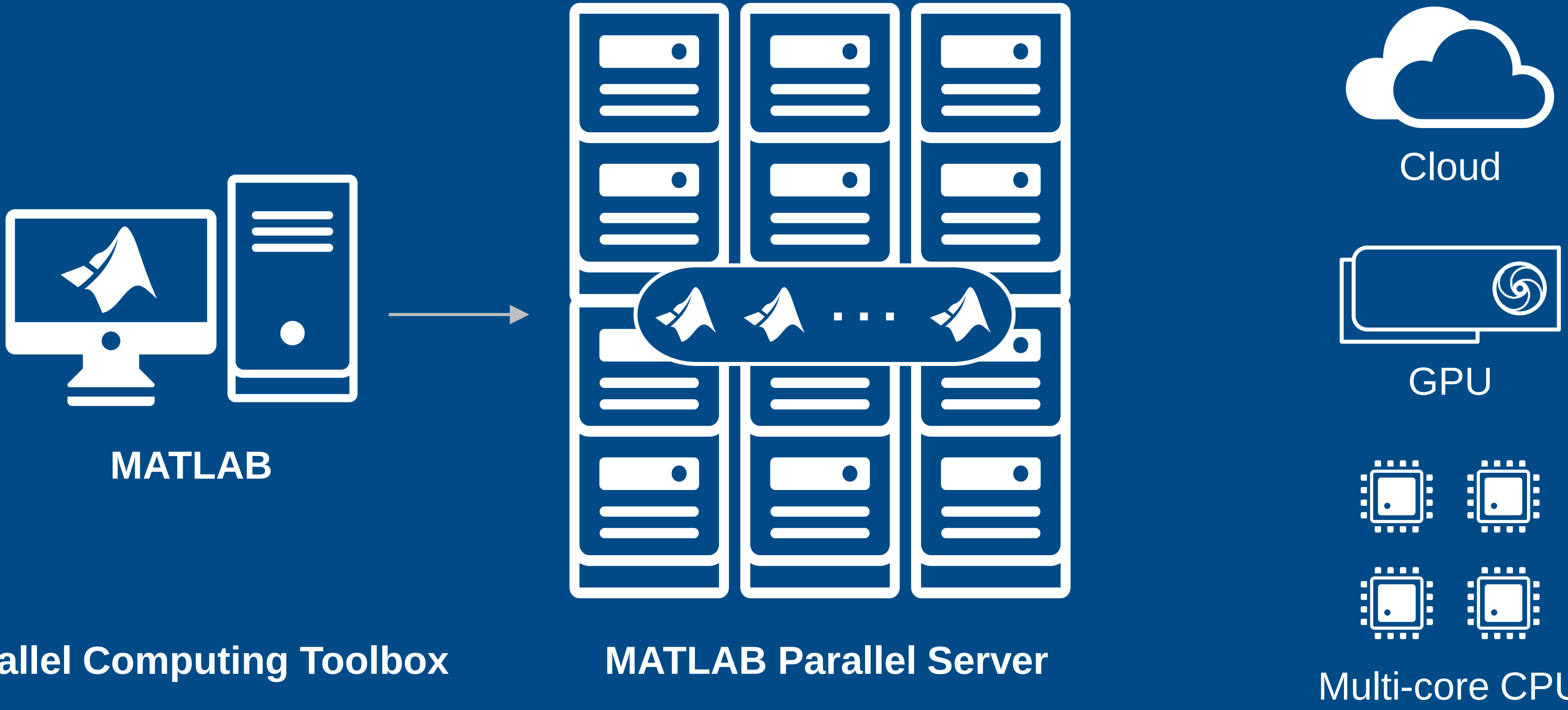
`batchsim`



Simulink

Parallel Computing Toolbox

Scaling Computations on Clusters and Clouds

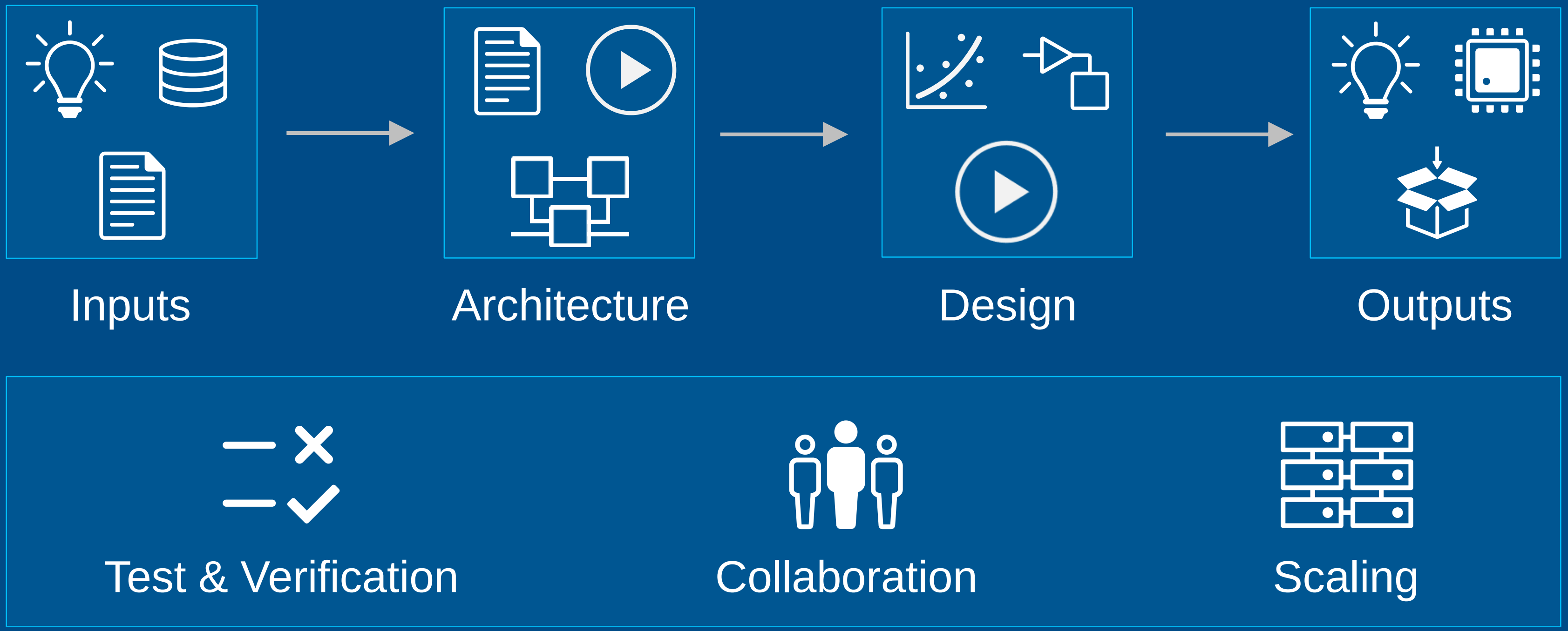


Parallel Computing Toolbox

MATLAB Parallel Server

MATLAB Parallel Server

Using MATLAB & Simulink to Build Algorithms in Everything



Inputs

Architecture

Design

Outputs

Test & Verification

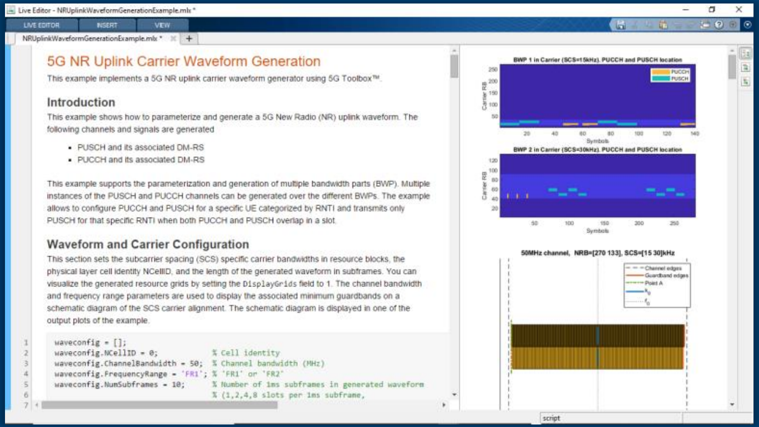
Collaboration

Scaling

MATLAB® & SIMULINK®

Specialized Tools for Building Algorithms in Everything

Communications


Live Editor - NRUplinkWaveformGenerationExample.mlx *
LIVE EDITOR
INSERT
VIEW
NRUplinkWaveformGenerationExample.mlx *
BWP 1 in Carrier (SCS=15kHz). PUCCH and PUSCH location
BWP 2 in Carrier (SCS=30kHz). PUCCH and PUSCH location
Carrier RB
Symbols
50MHz channel, NRB=[270 133], SCS=[15 30]kHz
script

5G NR Uplink Carrier Waveform Generation

This example implements a 5G NR uplink carrier waveform generator using 5G Toolbox™.

Introduction

This example shows how to parameterize and generate a 5G New Radio (NR) uplink waveform. The following channels and signals are generated

- PUSCH and its associated DM-RS
- PUCCH and its associated DM-RS

This example supports the parameterization and generation of multiple bandwidth parts (BWP). Multiple instances of the PUSCH and PUCCH channels can be generated over the different BWPs. The example allows to configure PUCCH and PUSCH for a specific UE categorized by RNTI and transmits only PUSCH for that specific RNTI when both PUCCH and PUSCH overlap in a slot.

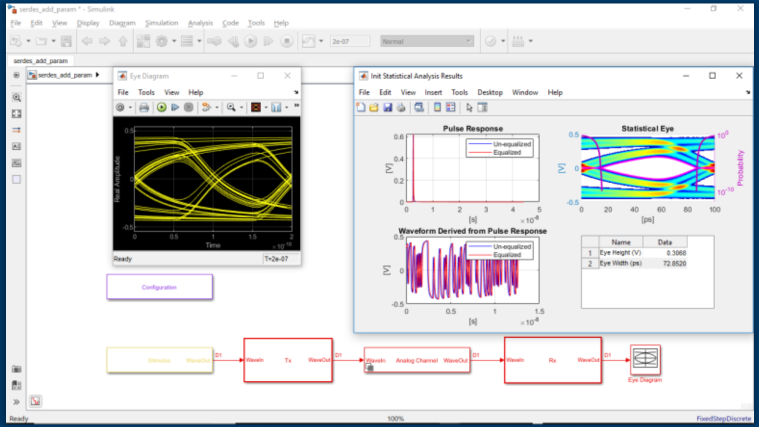
Waveform and Carrier Configuration

This section sets the subcarrier spacing (SCS) specific carrier bandwidths in resource blocks, the physical layer cell identity NCellID, and the length of the generated waveform in subframes. You can visualize the generated resource grids by setting the DisplayGrids field to 1. The channel bandwidth and frequency range parameters are used to display the associated minimum guardbands on a schematic diagram of the SCS carrier alignment. The schematic diagram is displayed in one of the output plots of the example.

```
waveconfig = [];
waveconfig.NCellID = 0;             % Cell identity
waveconfig.ChannelBandwidth = 50;   % Channel bandwidth (MHz)
waveconfig.FrequencyRange = 'FR1';  % 'FR1' or 'FR2'
waveconfig.NumSubframes = 10;       % Number of 1ms subframes in generated waveform
                                    % (1,2,4,8 slots per 1ms subframe,
```

5G Toolbox

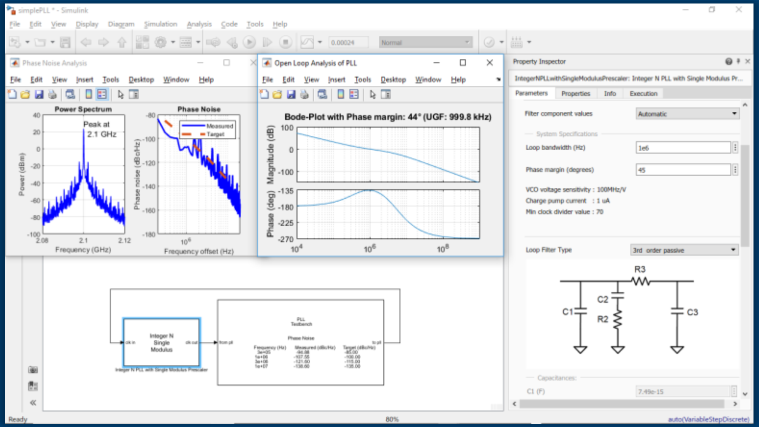
Physical interconnects



	Name	Data
1	Eye Height (V)	0.3066
2	Eye Width (ps)	72.8520

SerDes Toolbox

Analog Mixed-Signal



Filter component values: Automatic

Loop bandwidth (Hz): 1e6

Phase margin (degrees): 45

VCO voltage sensitivity : 100MHz/V

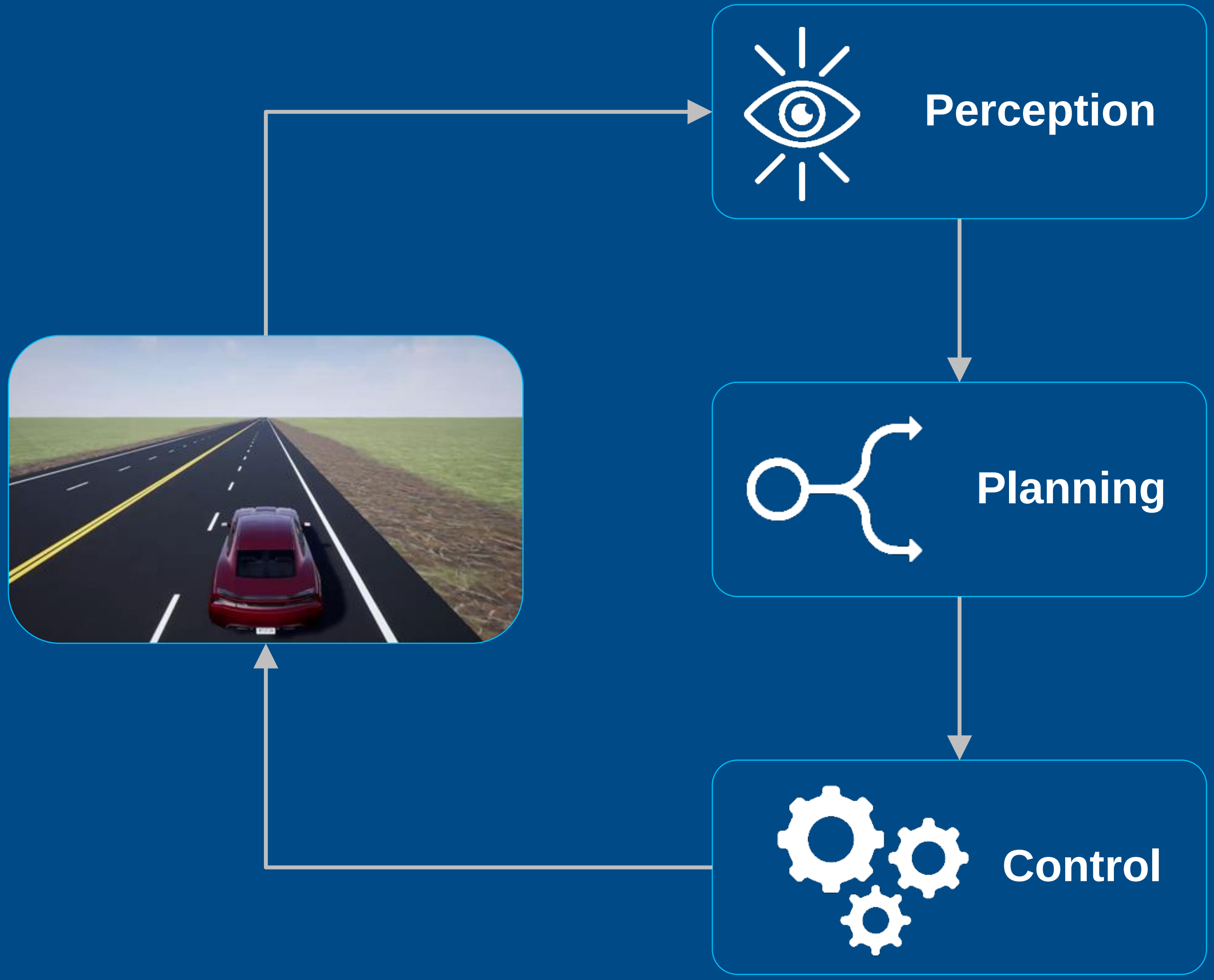
Charge pump current : 1 uA

Min clock divider value : 70

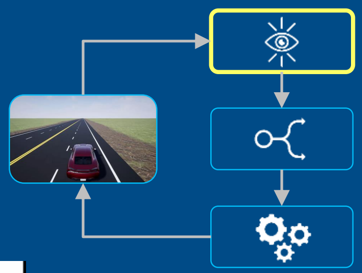
Loop Filter Type: 3rd order passive

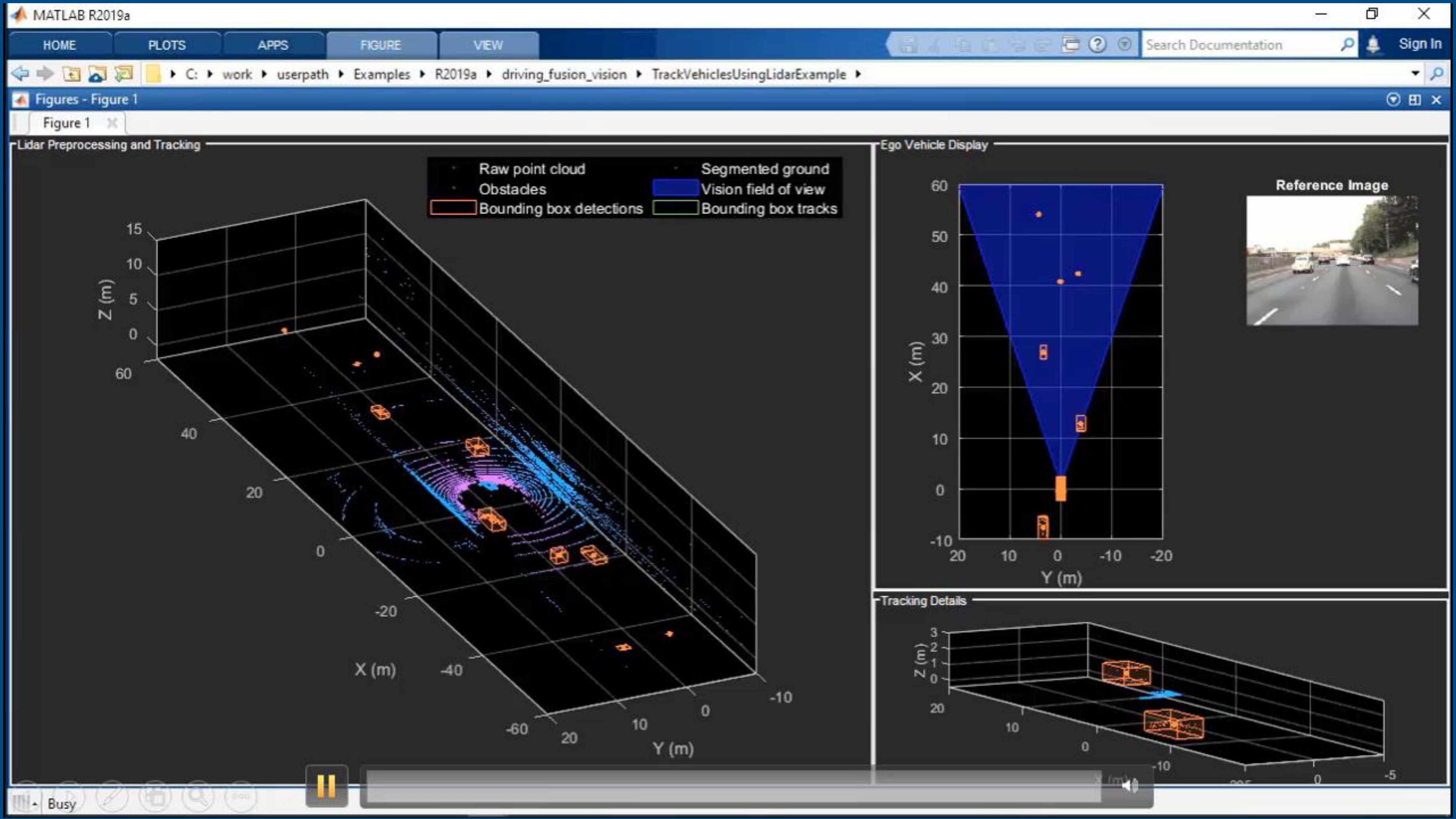
Mixed-Signal Blockset

Developing Autonomous Systems

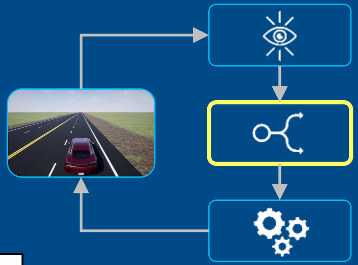


Evaluate Sensor Fusion Architectures

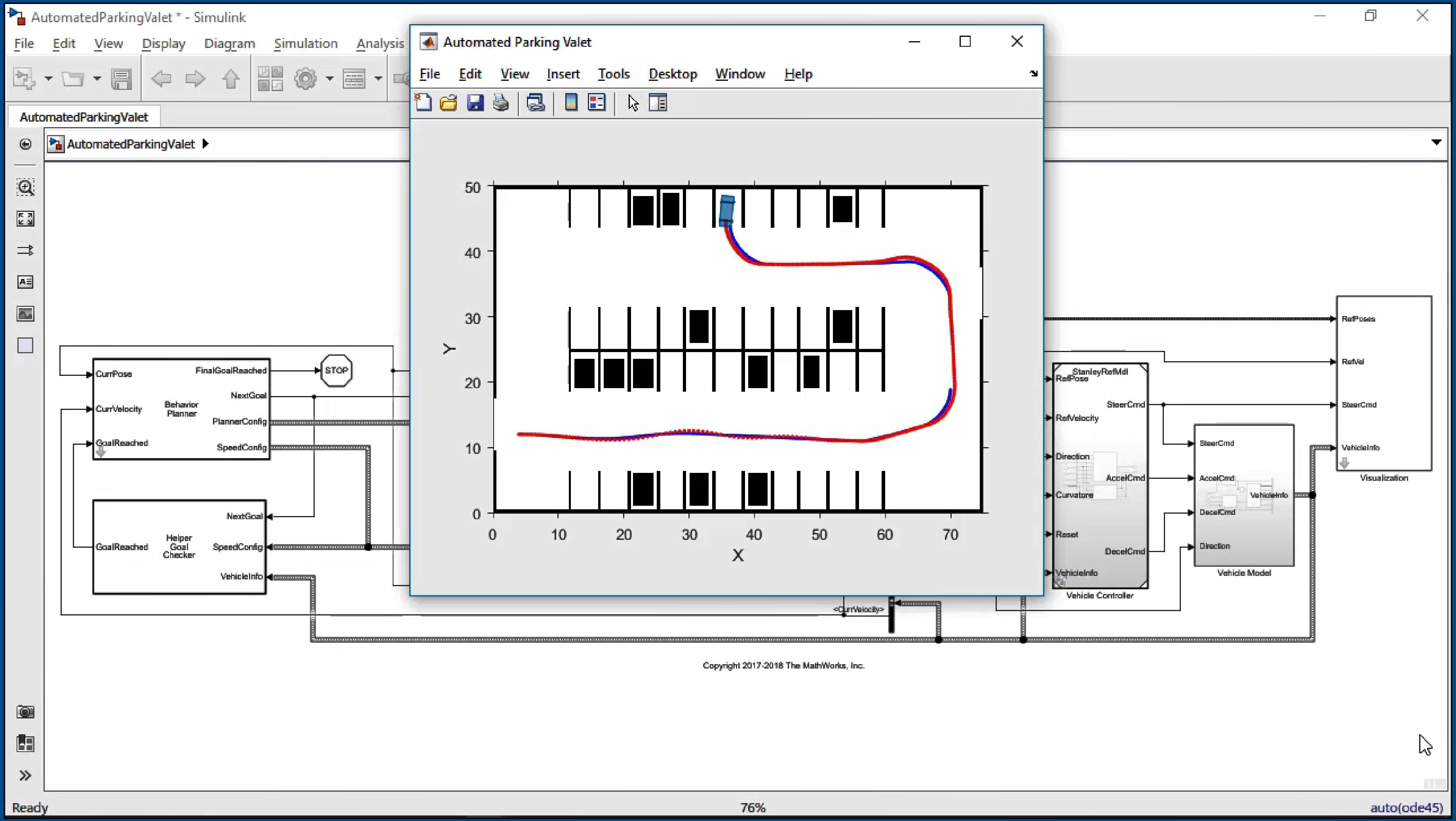


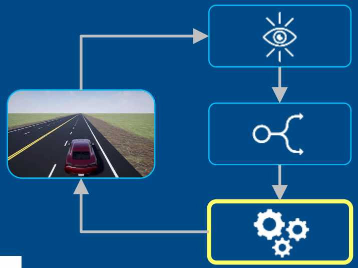


Sensor Fusion and Tracking Toolbox

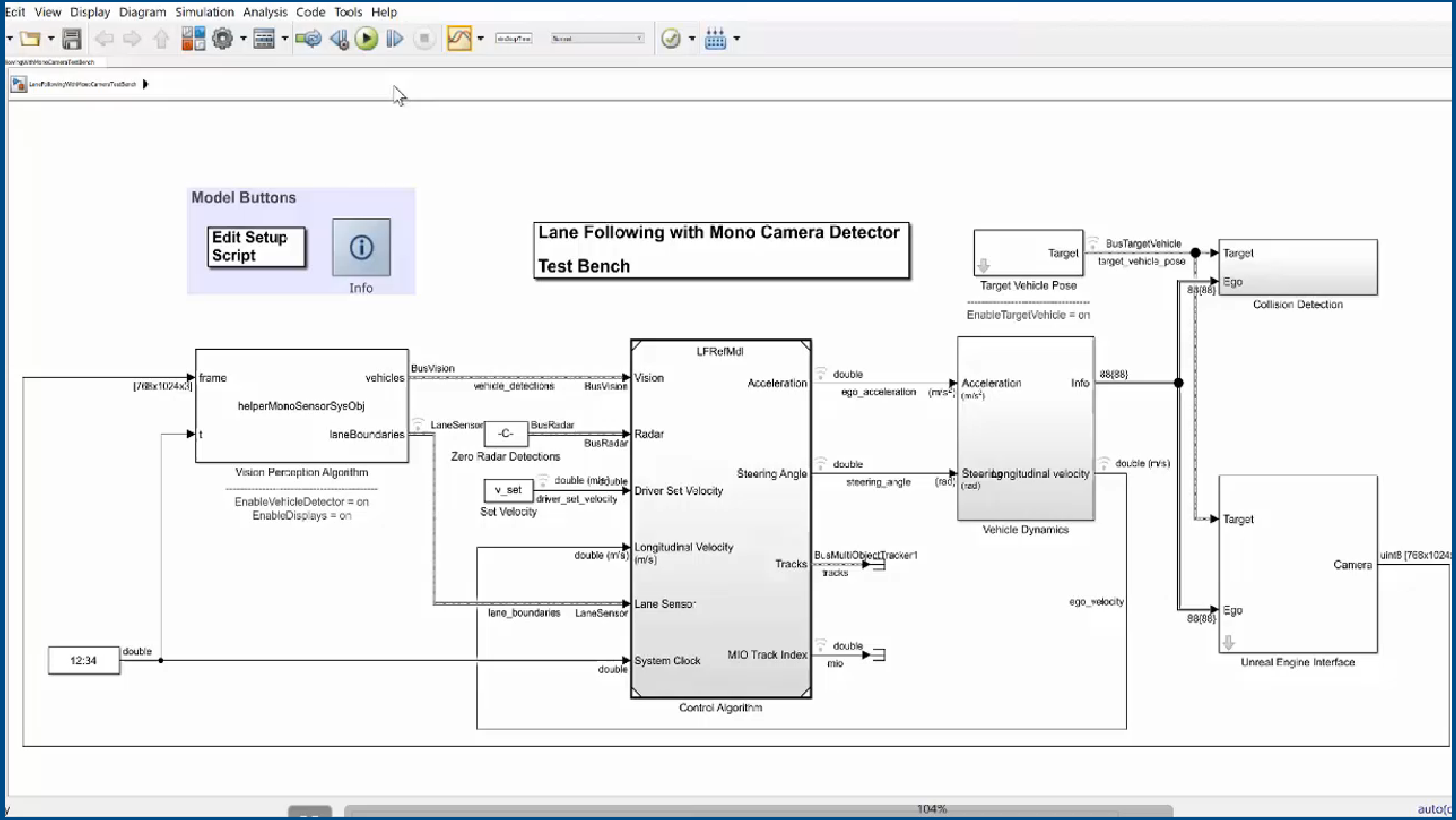


Simulate Path Planning Algorithms



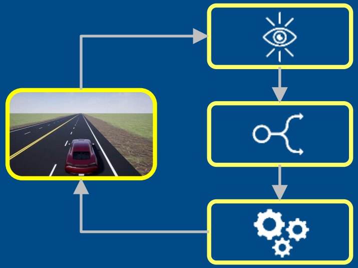


Design Lane-following and Spacing Control Algorithms

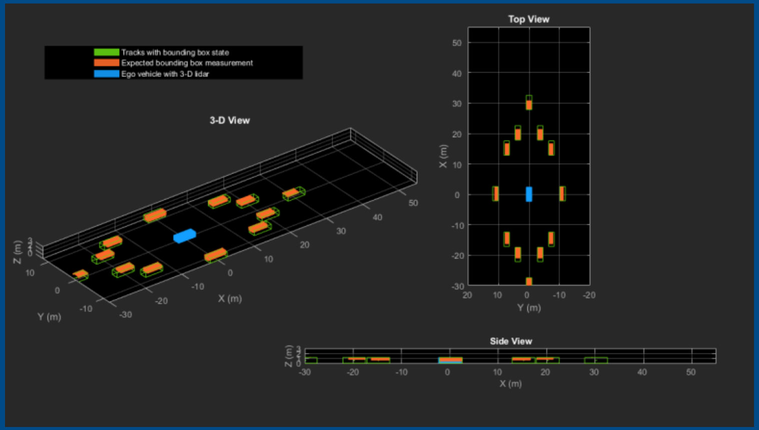


Model Predictive Control Toolbox

Developing Autonomous Systems

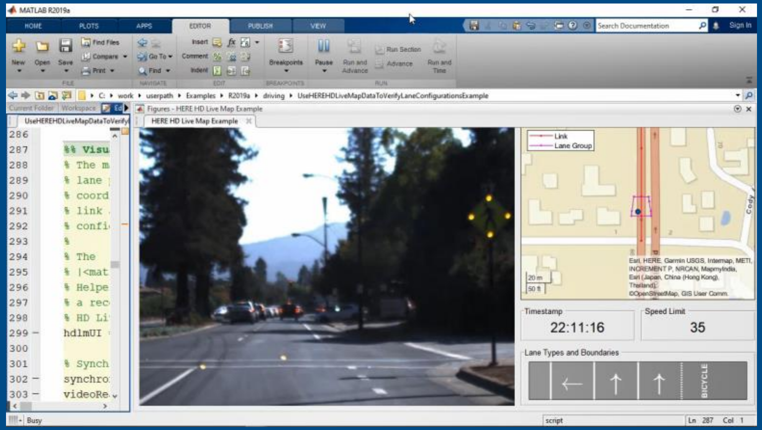


Lidar Processing & Tracking


Top View
Tracks with bounding box state
Expected bounding box measurement
Ego vehicle with 3-D lidar
3-D View
Side View
X (m)
Y (m)
Z (m)

Computer Vision Toolbox

HERE HD Maps & OpenDRIVE Roads



```
%% Visu
% The m
% lane
% coord
% link
% confi
%
% The
% |<mat
% Helpe
% a rec
% HD Li
hdlmUI

% Synch
synchro
videoRe
```

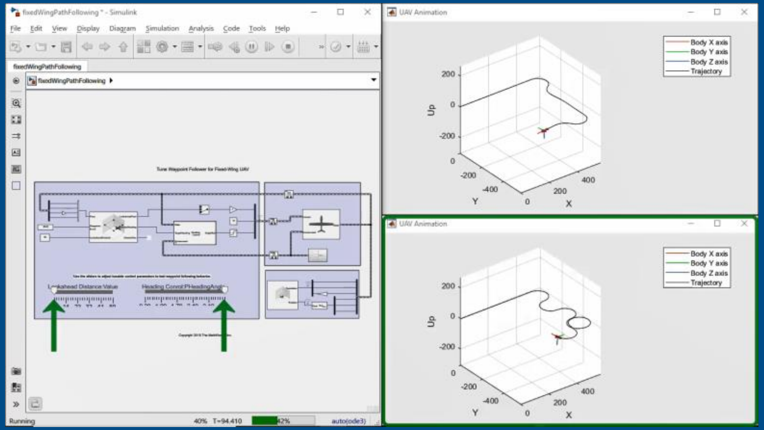
Timestamp 22:11:16

Speed Limit 35

Lane Types and Boundaries

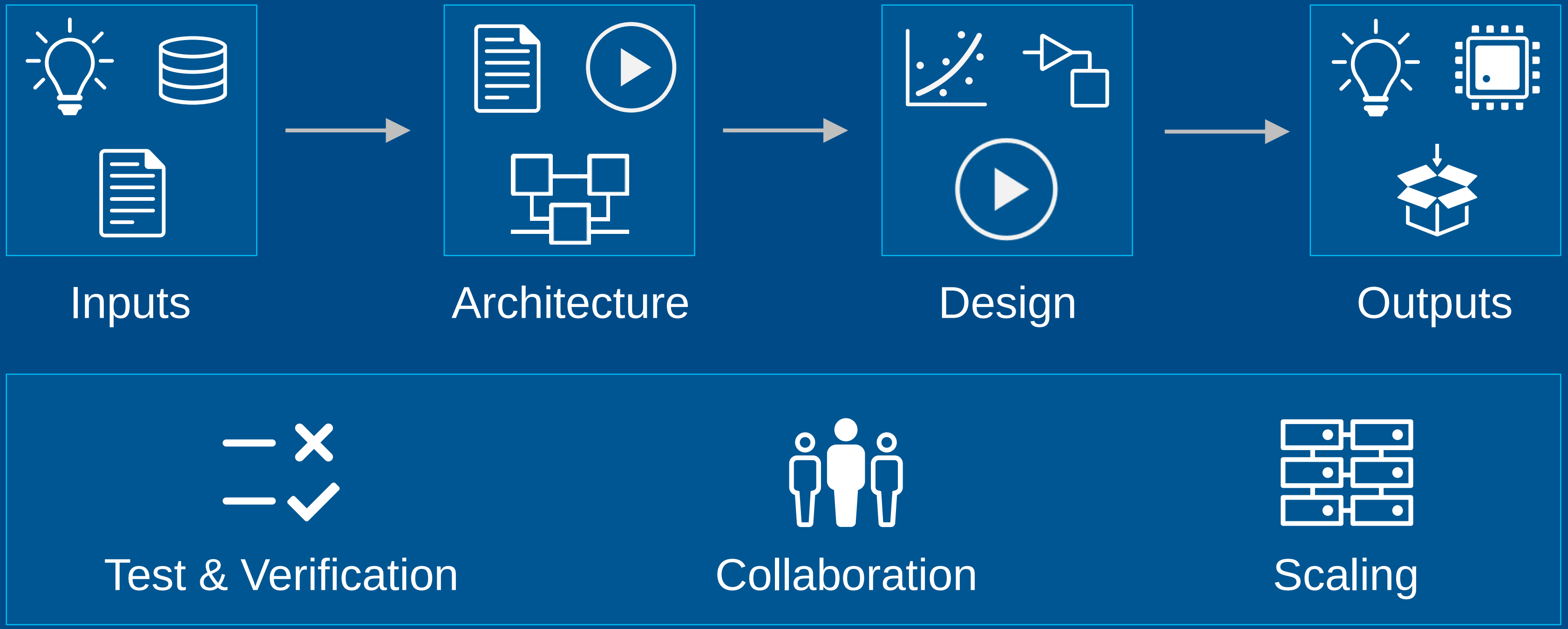
Automated Driving Toolbox

UAV Algorithms


fixedWingPathFollowing * - Simulink
UAV Animation
Tune Waypoint Follower for Fixed-Wing UAV
Lookahead Distance Value
Heading Control PHeadingAngle
Body X axis
Body Y axis
Body Z axis
Trajectory
Up
X
Y
Running

Robotics System Toolbox

Using MATLAB & Simulink to Build Algorithms in Everything



Inputs

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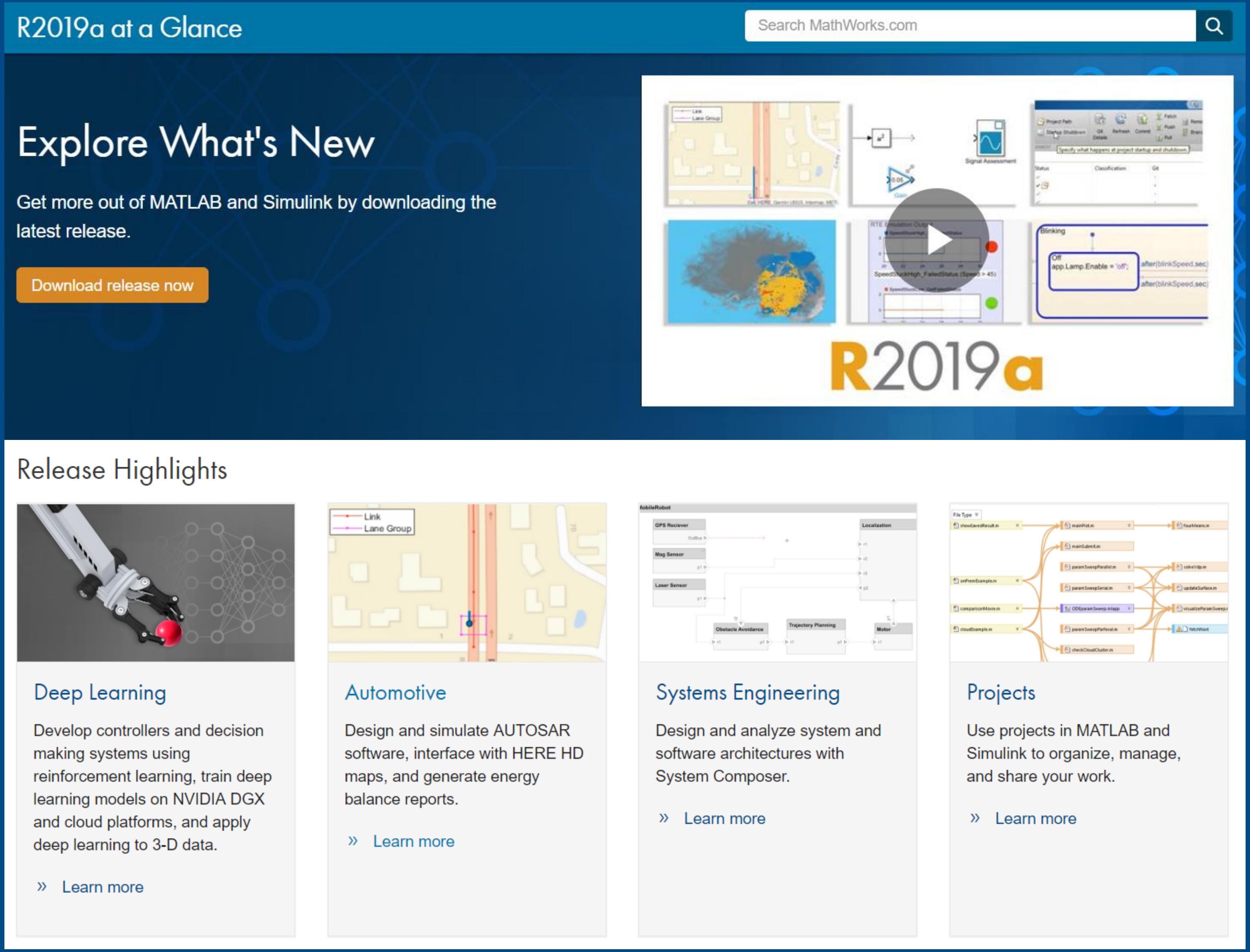
Scaling

MATLAB®&SIMULINK®

Read the Release Notes



R2019a at a Glance

Explore What's New

Get more out of MATLAB and Simulink by downloading the latest release.

Release Highlights

Deep Learning

Develop controllers and decision making systems using reinforcement learning, train deep learning models on NVIDIA DGX and cloud platforms, and apply deep learning to 3-D data.

» Learn more

Automotive

Design and simulate AUTOSAR software, interface with HERE HD maps, and generate energy balance reports.

» Learn more

Systems Engineering

Design and analyze system and software architectures with System Composer.

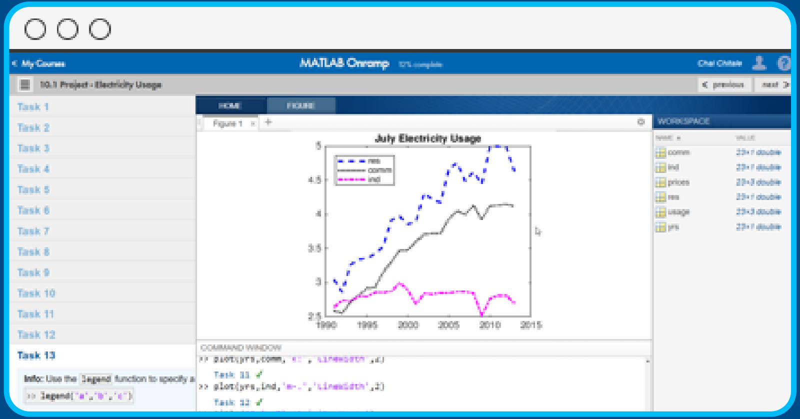
» Learn more

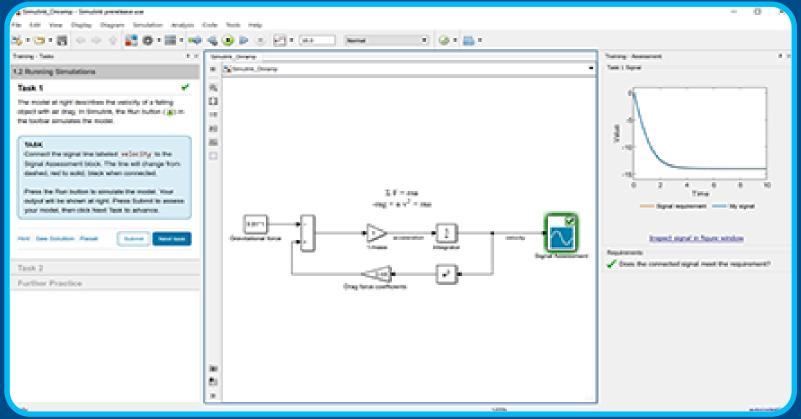
Projects

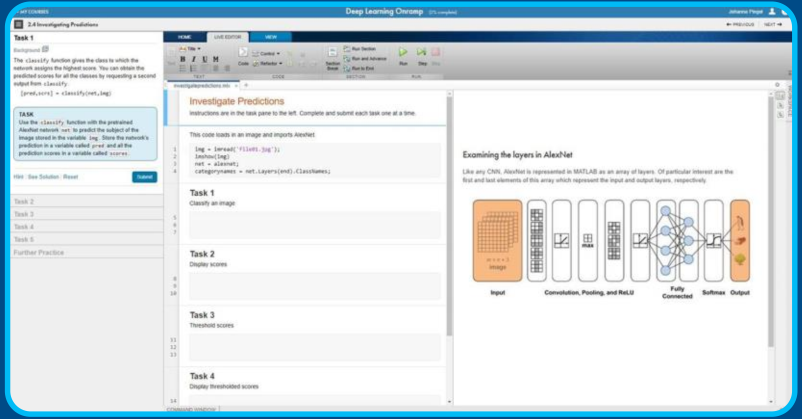
Use projects in MATLAB and Simulink to organize, manage, and share your work.

» Learn more

Get Started







MATLAB Onramp

Quickly learn the
essentials of MATLAB.

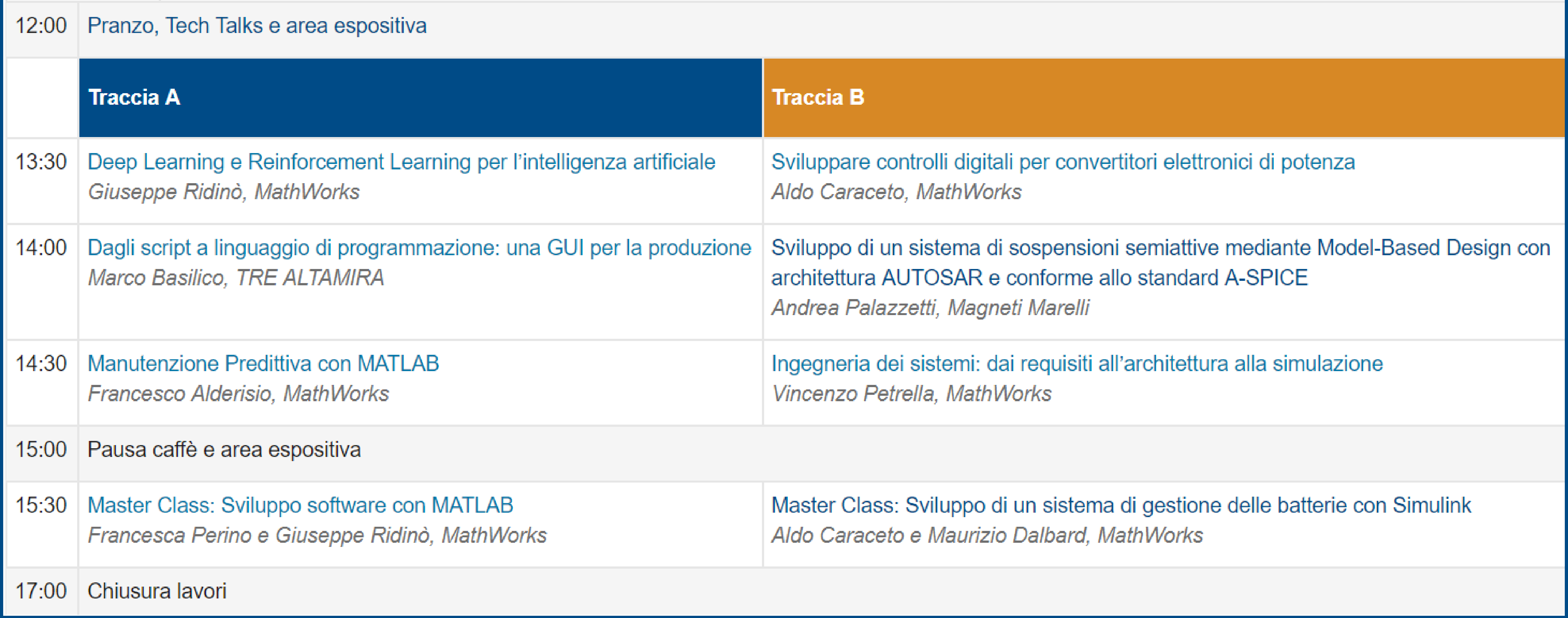
Simulink Onramp

Learn to create, edit, and
troubleshoot Simulink models.

Deep Learning Onramp

Learn to use deep learning techniques
in MATLAB for image recognition.

Attend Sessions this Afternoon



12:00	Pranzo, Tech Talks e area espositiva	
	Traccia A	**Traccia B**
13:30	Deep Learning e Reinforcement Learning per l'intelligenza artificiale *Giuseppe Ridinò, MathWorks*	Sviluppare controlli digitali per convertitori elettronici di potenza *Aldo Caraceto, MathWorks*
14:00	Dagli script a linguaggio di programmazione: una GUI per la produzione *Marco Basilico, TRE ALTAMIRA*	Sviluppo di un sistema di sospensioni semiattive mediante Model-Based Design con architettura AUTOSAR e conforme allo standard A-SPICE *Andrea Palazzetti, Magneti Marelli*
14:30	Manutenzione Predittiva con MATLAB *Francesco Alderisio, MathWorks*	Ingegneria dei sistemi: dai requisiti all'architettura alla simulazione *Vincenzo Petrella, MathWorks*
15:00	Pausa caffè e area espositiva	
15:30	Master Class: Sviluppo software con MATLAB *Francesca Perino e Giuseppe Ridinò, MathWorks*	Master Class: Sviluppo di un sistema di gestione delle batterie con Simulink *Aldo Caraceto e Maurizio Dalbard, MathWorks*
17:00	Chiusura lavori	

MATLAB EXPO 2019