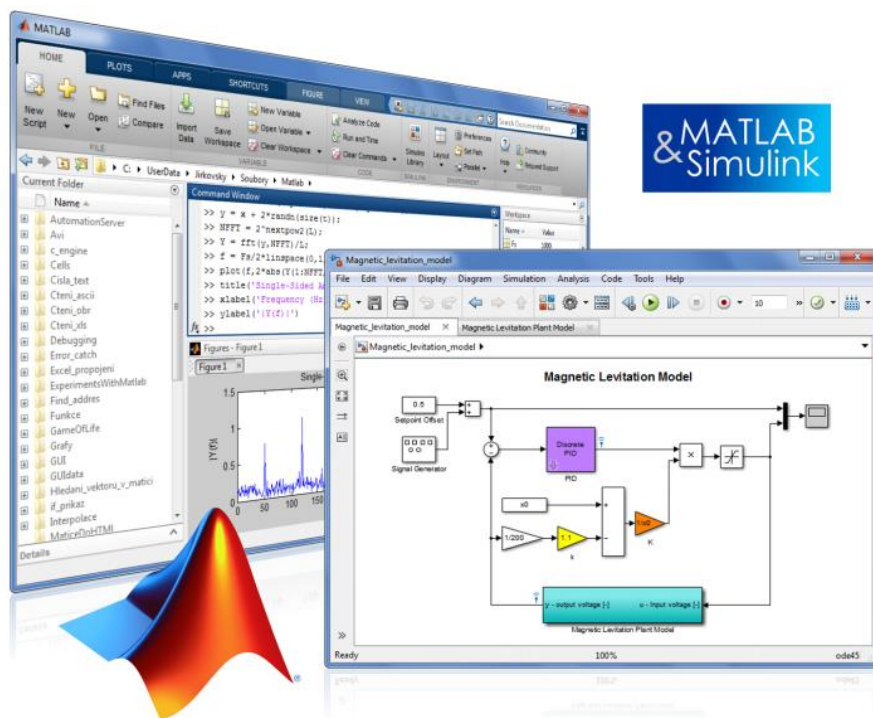


08.09.2022 Technical Computing Camp 2022

Novinky v prostředí MATLAB v roku 2022



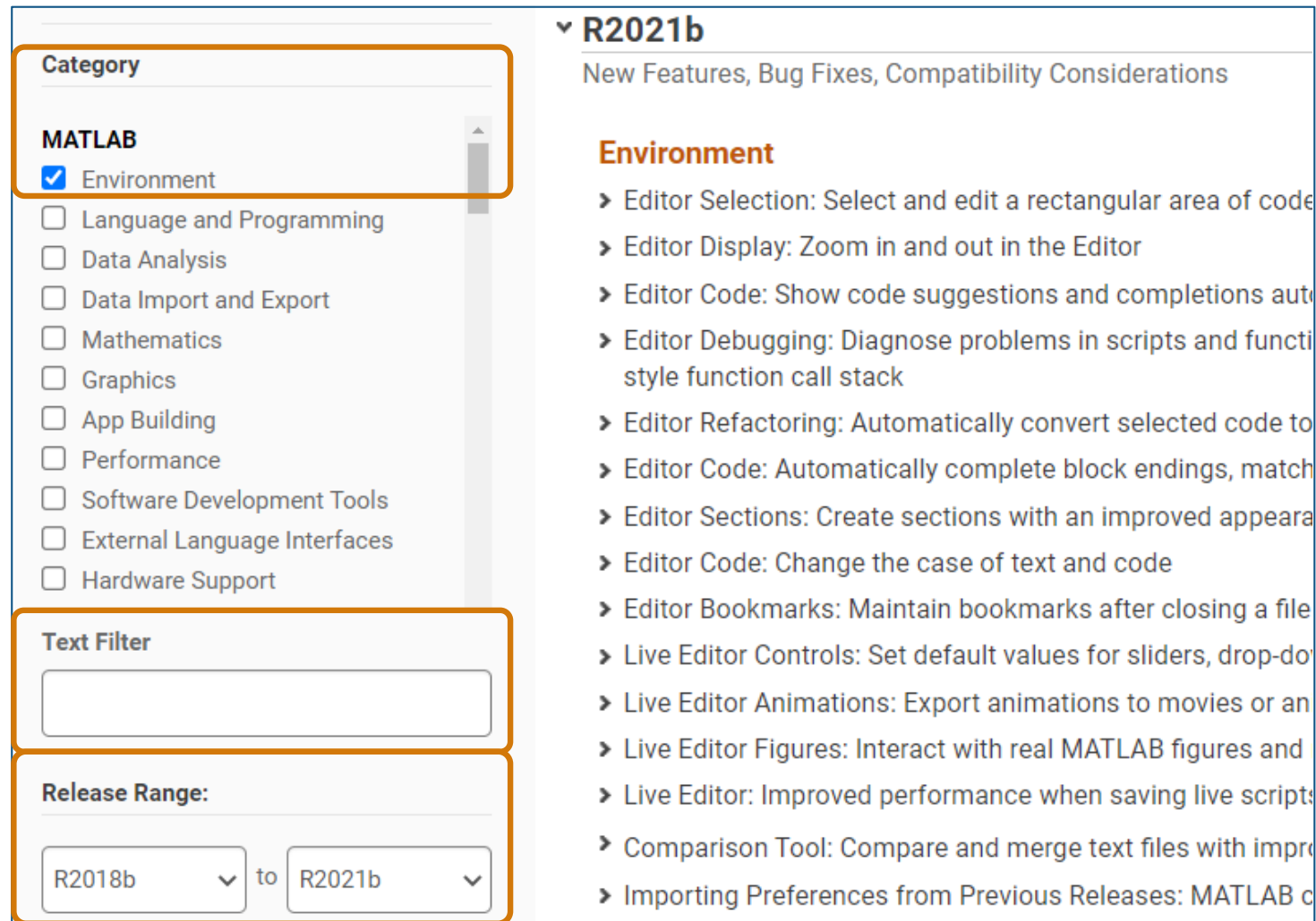
Michal Blaho
blaho@humusoft.sk

www.humusoft.cz
info@humusoft.cz

www.mathworks.com

Zoznam noviniek

- Release notes
- Filtrovanie výsledkov
 - Kategórie
 - Kľúčové slová
 - Rozsah verzií



The screenshot shows the MATLAB release notes filter interface. It is divided into two main sections: a left sidebar for filtering and a right pane for the selected release notes.

Filtering Section (Left):

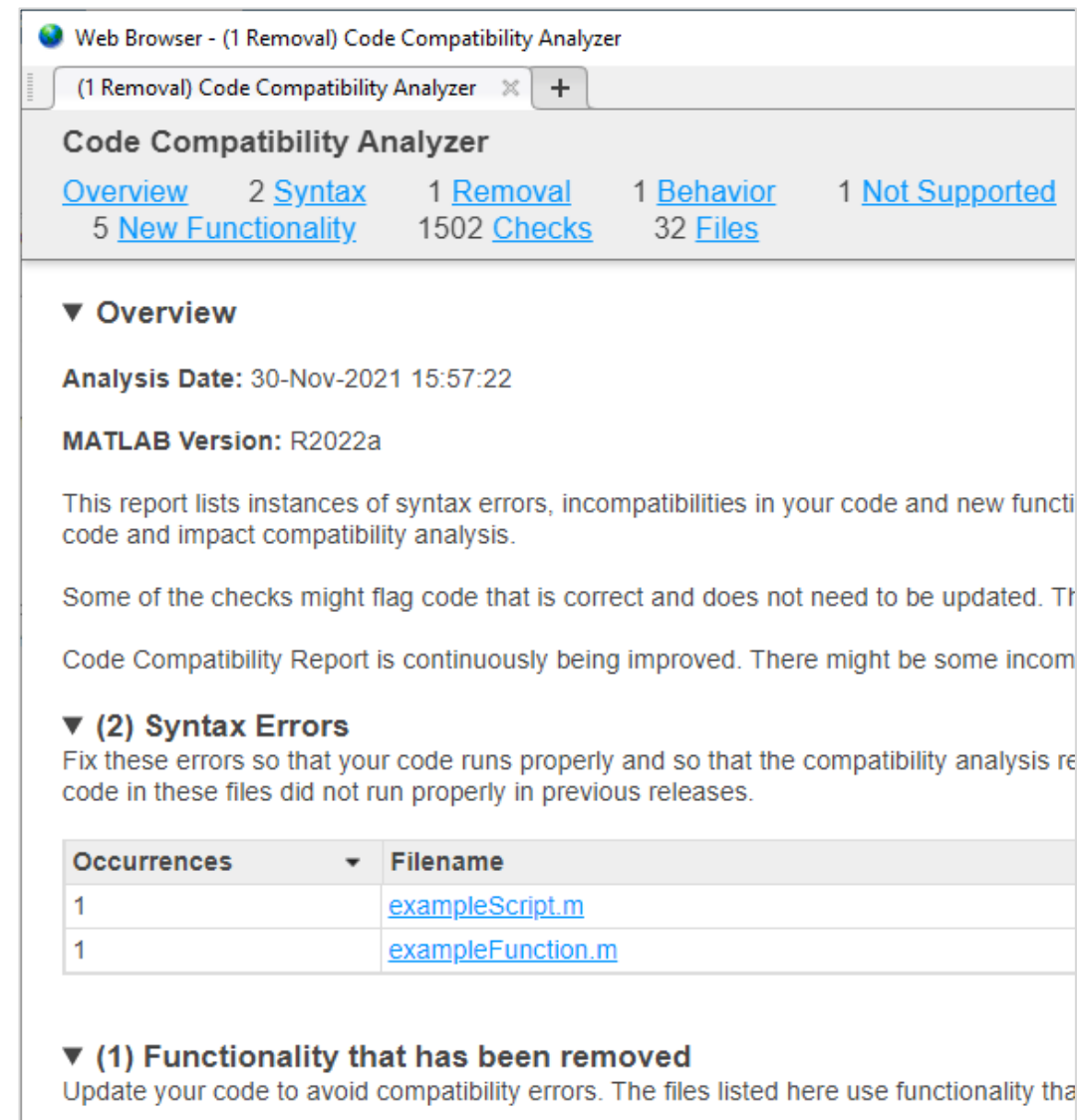
- Category:** A dropdown menu currently showing "MATLAB".
- Environment:** A checked checkbox.
- Other categories (unchecked):** Language and Programming, Data Analysis, Data Import and Export, Mathematics, Graphics, App Building, Performance, Software Development Tools, External Language Interfaces, Hardware Support.
- Text Filter:** An empty text input field.
- Release Range:** Two dropdown menus showing "R2018b" and "R2021b" with a "to" label between them.

Release Notes Section (Right):

- Release:** R2021b
- Summary:** New Features, Bug Fixes, Compatibility Considerations
- Environment:** A sub-section containing a list of new features:
 - Editor Selection: Select and edit a rectangular area of code
 - Editor Display: Zoom in and out in the Editor
 - Editor Code: Show code suggestions and completions auto
 - Editor Debugging: Diagnose problems in scripts and functi
 - Editor Refactoring: Automatically convert selected code to
 - Editor Code: Automatically complete block endings, match
 - Editor Sections: Create sections with an improved appeara
 - Editor Code: Change the case of text and code
 - Editor Bookmarks: Maintain bookmarks after closing a file
 - Live Editor Controls: Set default values for sliders, drop-do
 - Live Editor Animations: Export animations to movies or an
 - Live Editor Figures: Interact with real MATLAB figures and
 - Live Editor: Improved performance when saving live scripts
 - Comparison Tool: Compare and merge text files with impro
 - Importing Preferences from Previous Releases: MATLAB c

Prechod na najnovšiu verziu

- Code Compatibility Analyzer
- Pomáha aktualizovať kód
- Kontrola
 - nekompatibility, funkčnosť
 - chýb, warningov



Web Browser - (1 Removal) Code Compatibility Analyzer

(1 Removal) Code Compatibility Analyzer

Code Compatibility Analyzer

[Overview](#) 2 [Syntax](#) 1 [Removal](#) 1 [Behavior](#) 1 [Not Supported](#)
5 [New Functionality](#) 1502 [Checks](#) 32 [Files](#)

▼ **Overview**

Analysis Date: 30-Nov-2021 15:57:22

MATLAB Version: R2022a

This report lists instances of syntax errors, incompatibilities in your code and new functionality in your code and impact compatibility analysis.

Some of the checks might flag code that is correct and does not need to be updated. The Code Compatibility Report is continuously being improved. There might be some incompatibilities in your code that are not yet reported.

▼ **(2) Syntax Errors**

Fix these errors so that your code runs properly and so that the compatibility analysis report can be generated. The code in these files did not run properly in previous releases.

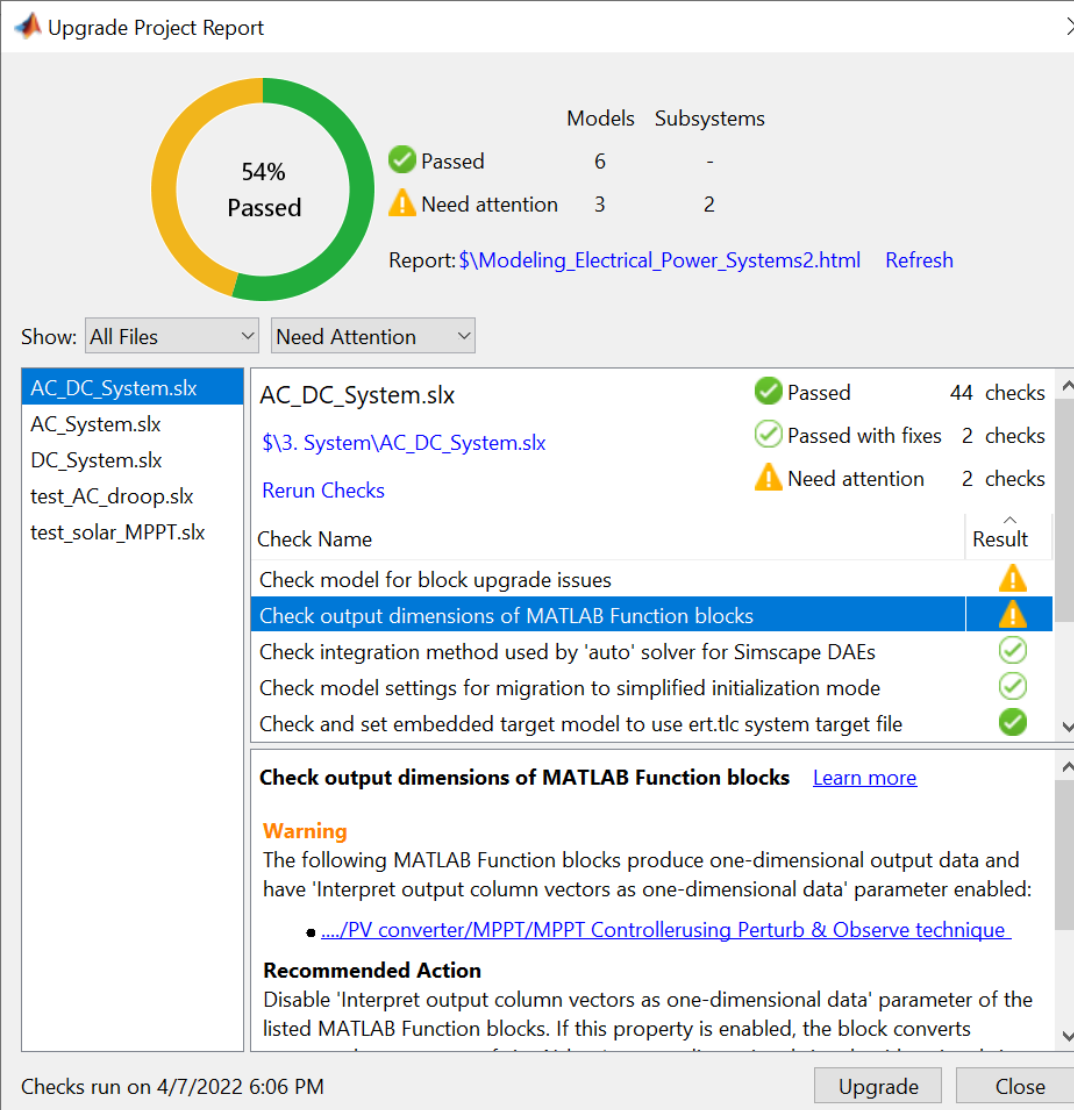
Occurrences	Filename
1	exampleScript.m
1	exampleFunction.m

▼ **(1) Functionality that has been removed**

Update your code to avoid compatibility errors. The files listed here use functionality that has been removed in this release.

Prechod na najnovšiu verziu

- Code Compatibility Analyzer
- Pomáha aktualizovať kód
- Kontrola
 - nekompatibility, funkčnosti
 - chýb, warningov
- Podpora v projektoch



Upgrade Project Report

54% Passed

	Models	Subsystems
Passed	6	-
Need attention	3	2

Report: [\\$\\Modeling_Electrical_Power_Systems2.html](#) Refresh

Show: All Files Need Attention

File	Status	Checks
AC_DC_System.slx	Passed	44 checks
AC_System.slx	Passed with fixes	2 checks
DC_System.slx	Need attention	2 checks
test_AC_droop.slx		
test_solar_MPPT.slx		

Rerun Checks

Check Name	Result
Check model for block upgrade issues	Warning
Check output dimensions of MATLAB Function blocks	Warning
Check integration method used by 'auto' solver for Simscape DAEs	Passed
Check model settings for migration to simplified initialization mode	Passed
Check and set embedded target model to use ert.tlc system target file	Passed

Check output dimensions of MATLAB Function blocks [Learn more](#)

Warning

The following MATLAB Function blocks produce one-dimensional output data and have 'Interpret output column vectors as one-dimensional data' parameter enabled:

- [../PV_converter/MPPT/MPPT_Controllerusing Perturb & Observe technique](#)

Recommended Action

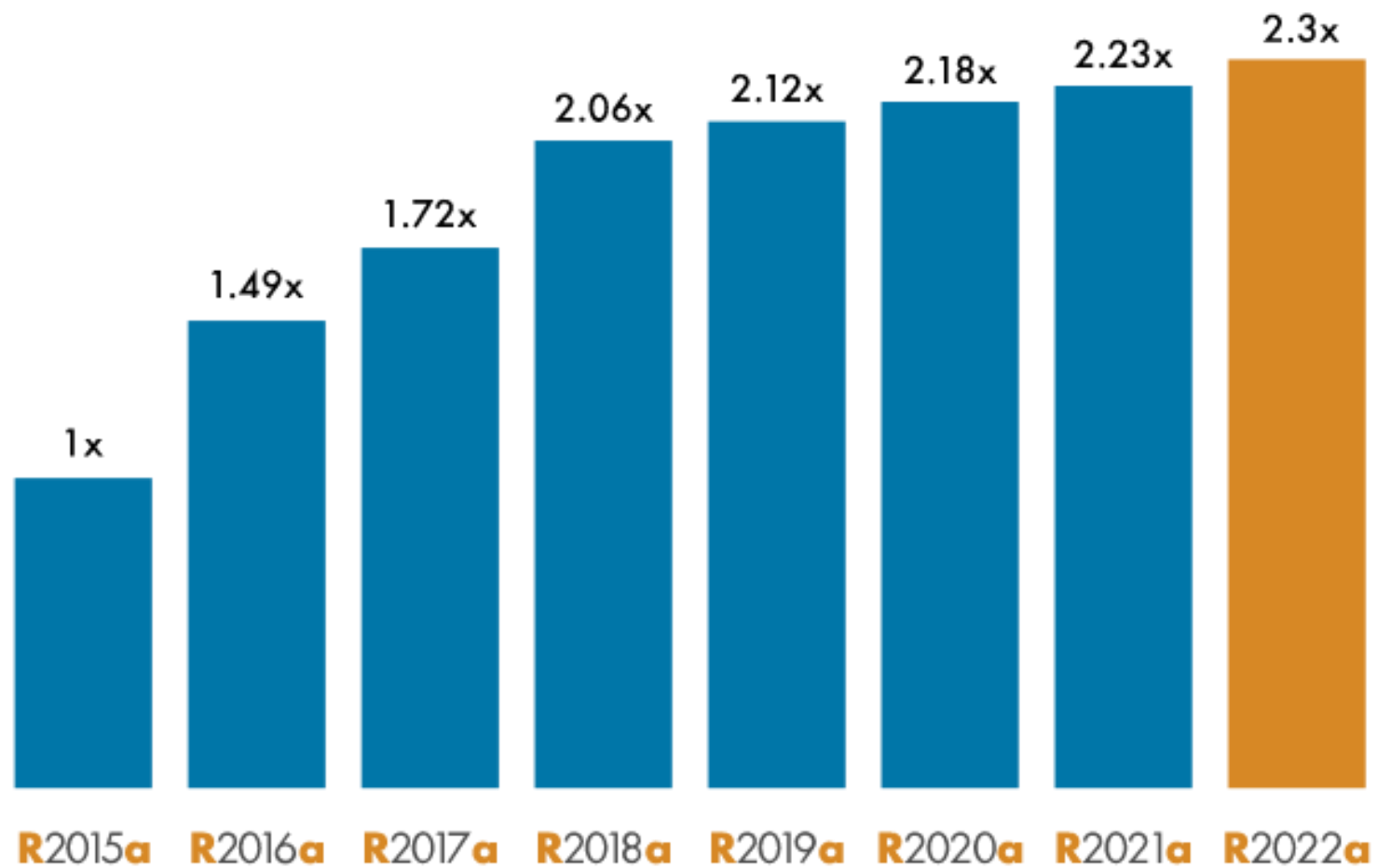
Disable 'Interpret output column vectors as one-dimensional data' parameter of the listed MATLAB Function blocks. If this property is enabled, the block converts

Checks run on 4/7/2022 6:06 PM

Upgrade Close

Zlepšovanie každou verziou

Average Speedup in Customer Workflows

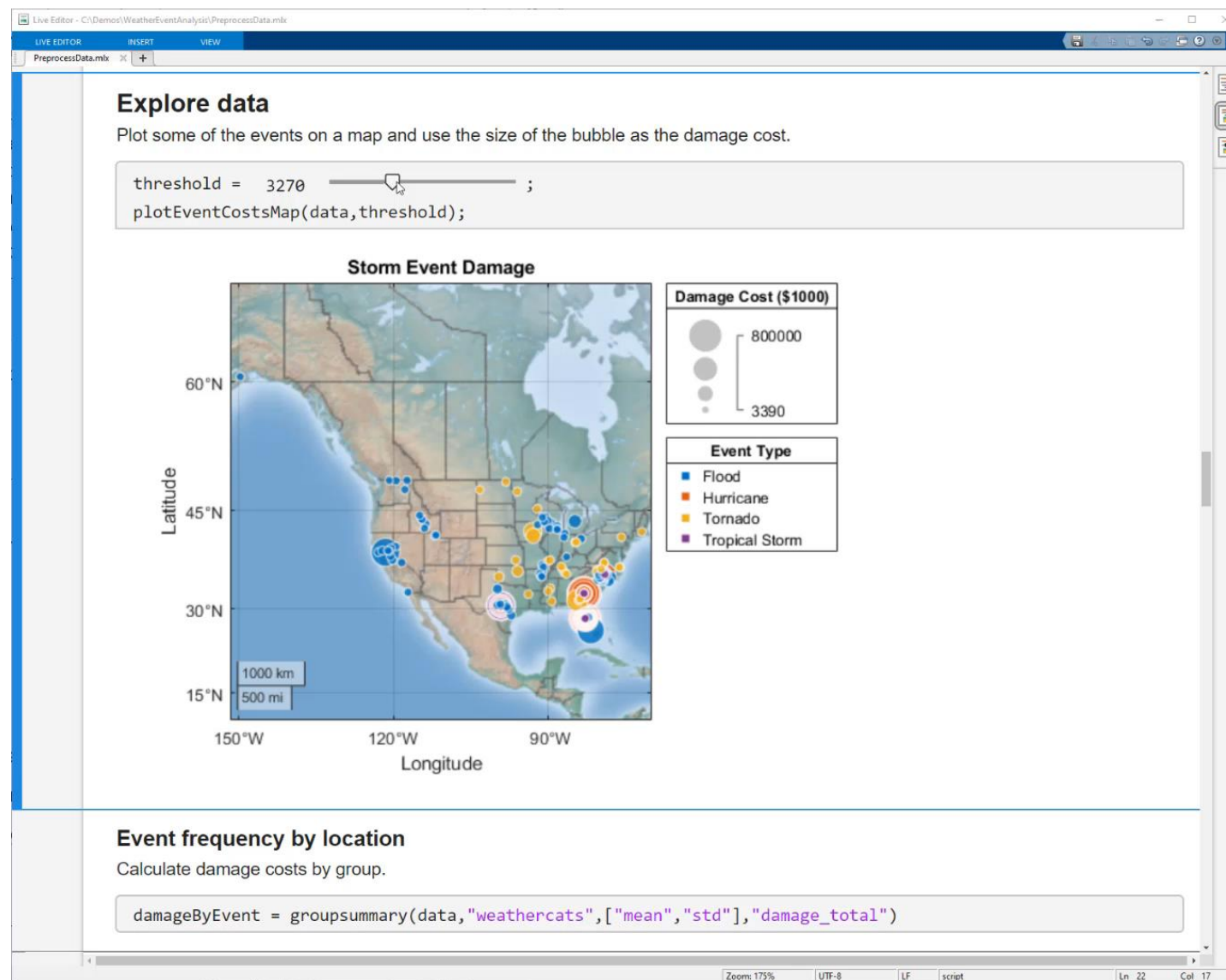






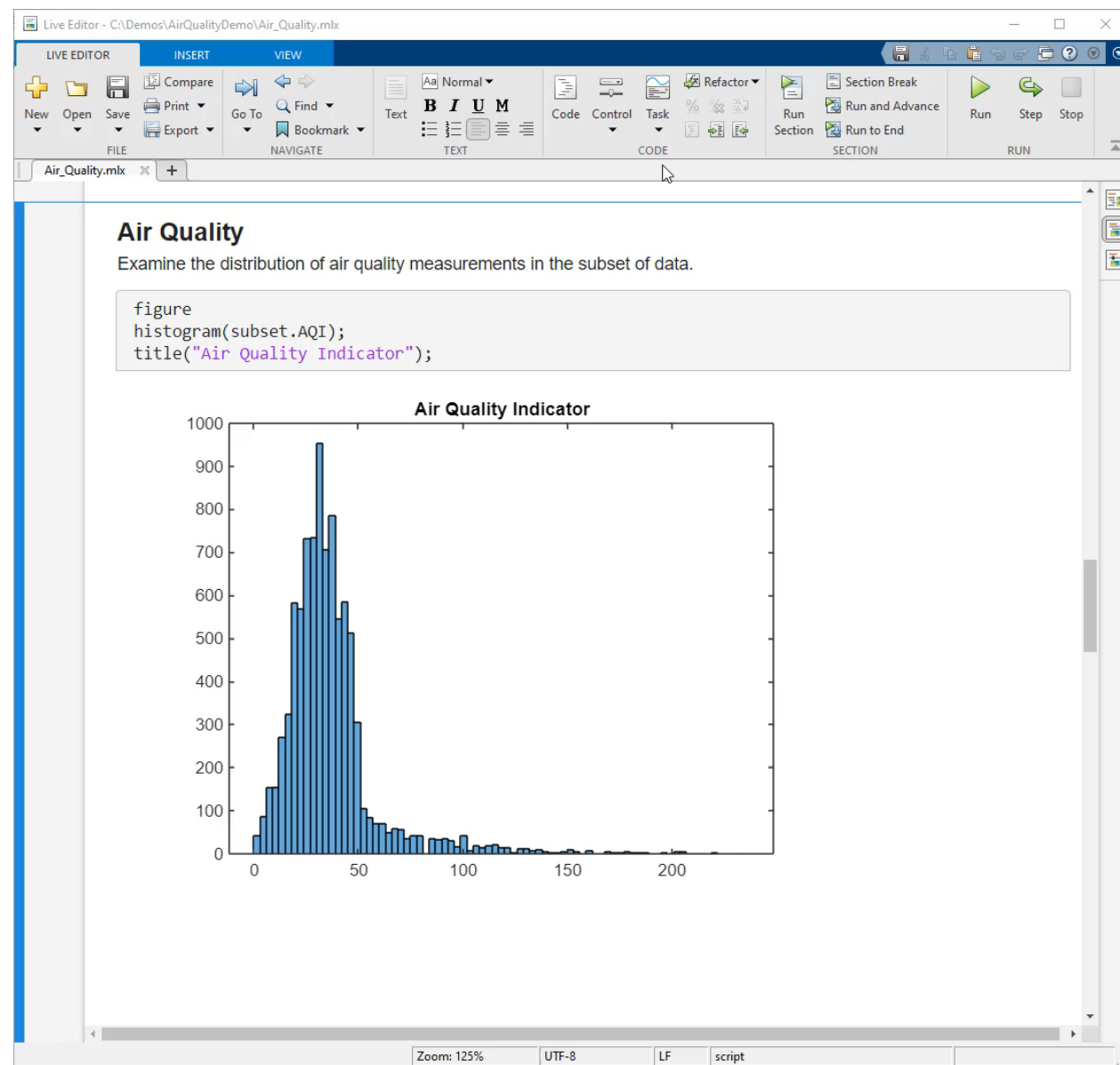
Live Editor

- Výstup popri kóde
- Formatovanie
 - Text
 - Vzorce
 - Obrázky
 - hyperlinky
- Interaktívne ovládanie
 - Slider, Drop downs, ...
- Export
 - PDF, LaTeX, Word, HTML



Programovanie bez programovania

- Live Editor Tasks
- Vnorené aplikácie
 - interaktívne skúšanie parametrov a nastavení
 - vizualizácie výsledkov
 - generovanie kódu
- Každou verziou pribúdajú nové
 - Compute by Group
 - Normalize Data



Live Editor Tasks

DATA PREPROCESSING



Clean Missing Data

Find, fill, or remove missing data



Clean Outlier Data

Find, fill, or remove outliers



Compute by Group

Summarize, transform, or filter by group



Find Change Points

Find abrupt changes in data

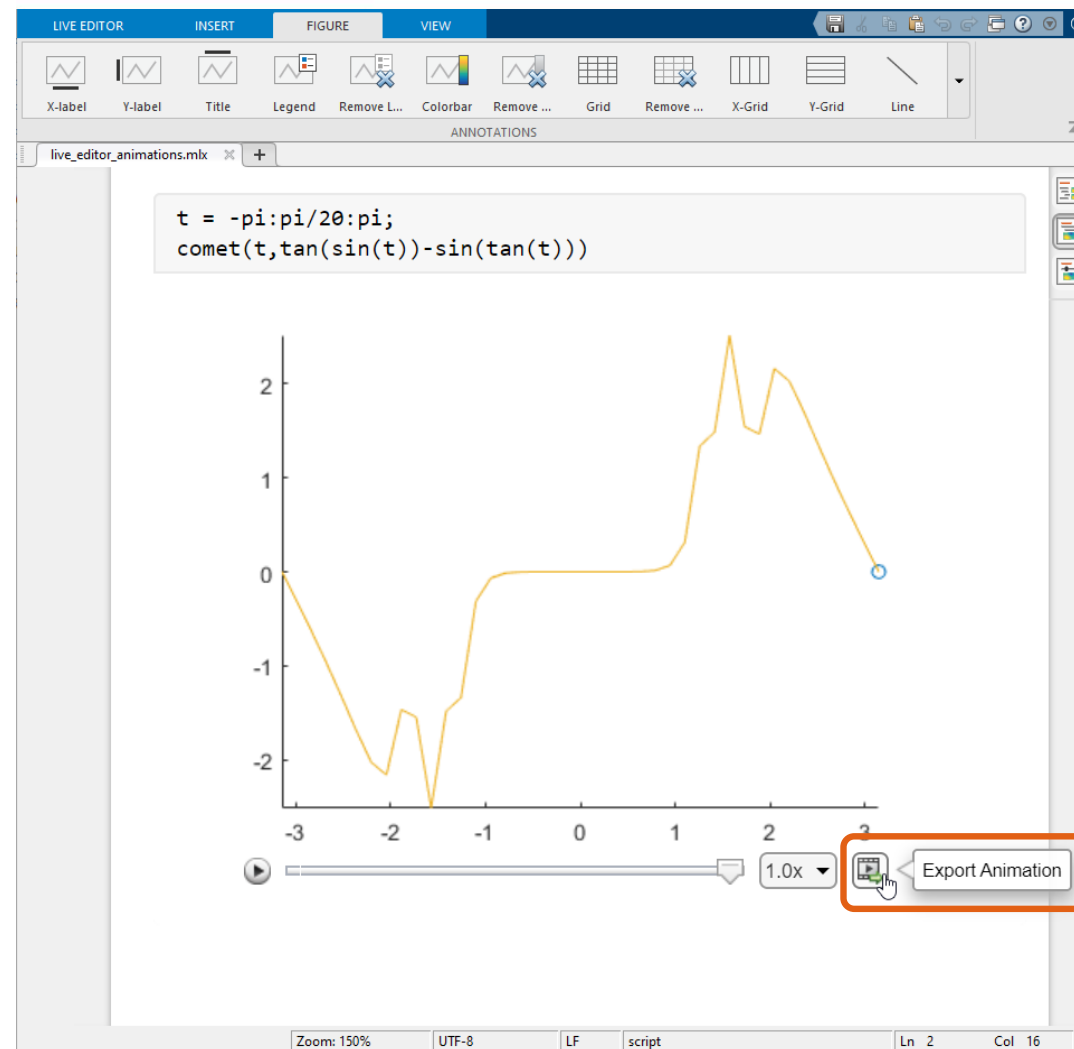


Find Local Extrema

Find local maxima and minima

Live Editor – interaktívne výstupy

- Animácie výstupov
- Prehrávanie
 - rýchle opakovanie animácie
 - slider pre pohyb v animácií
 - voľba rýchlosti
- Export animácie
 - GIF
 - mp4



Import

Clean Missing Data

Clean Outlier Data

Normalize Data

Smooth Data

Retime Timetable

FILE

CLEANING METHODS

- Show Legend
- Show Summary Statistics

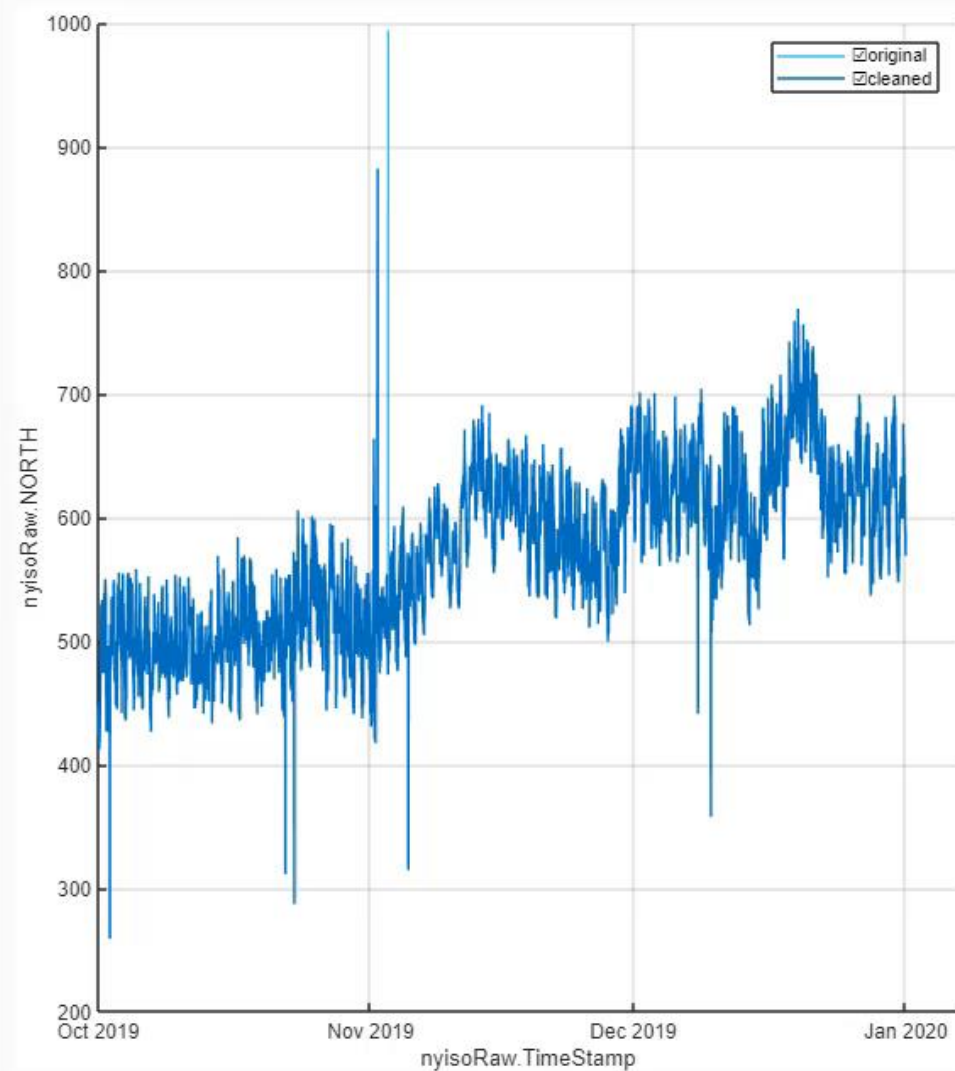
Export

EXPORT

Variables

- nyisoRaw
- Time Stamp
 - CAPITL
 - CENTRL
 - DUNWOD
 - GENESE
 - HUD VL
 - LONGIL
 - MHK VL
 - MILLWD
 - N.Y.C.
 - NORTH
 - WEST

Visualization Data Summary



NORTH

Type	double
Unique Values	2966
Has Duplicates	True
Is Sorted	False
Missing Count	0
Minimum	258.7
Maximum	881.8
Mean	571.6102
Median	574.7
Mode	611.2
Standard Deviation	65.1021

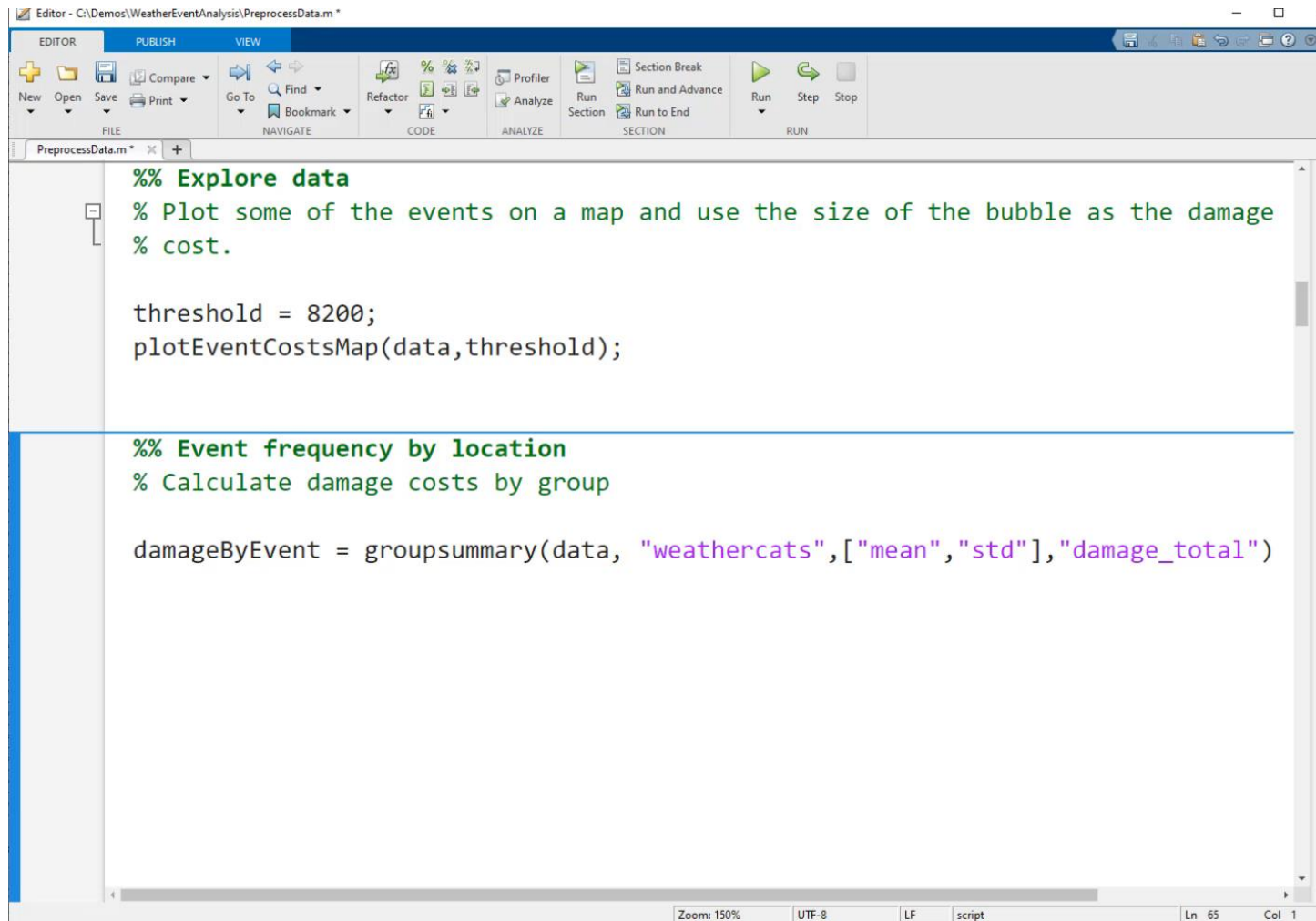
Cleaning Steps

- Unstack Table Variables: nyisoRaw
- Clean Missing Data: nyisoRaw.NORTH

Cleaning Parameters

Rýchla úprava a ladenie live skriptov

- Kontextová nápoveda
- Block editing
 - editovanie naprieč riadkami
- Code refactoring
 - rýchla konverzia na funkciu
- Debugging
 - inline ovládanie



The screenshot shows the MATLAB Editor window with the following code:

```

%% Explore data
% Plot some of the events on a map and use the size of the bubble as the damage
% cost.

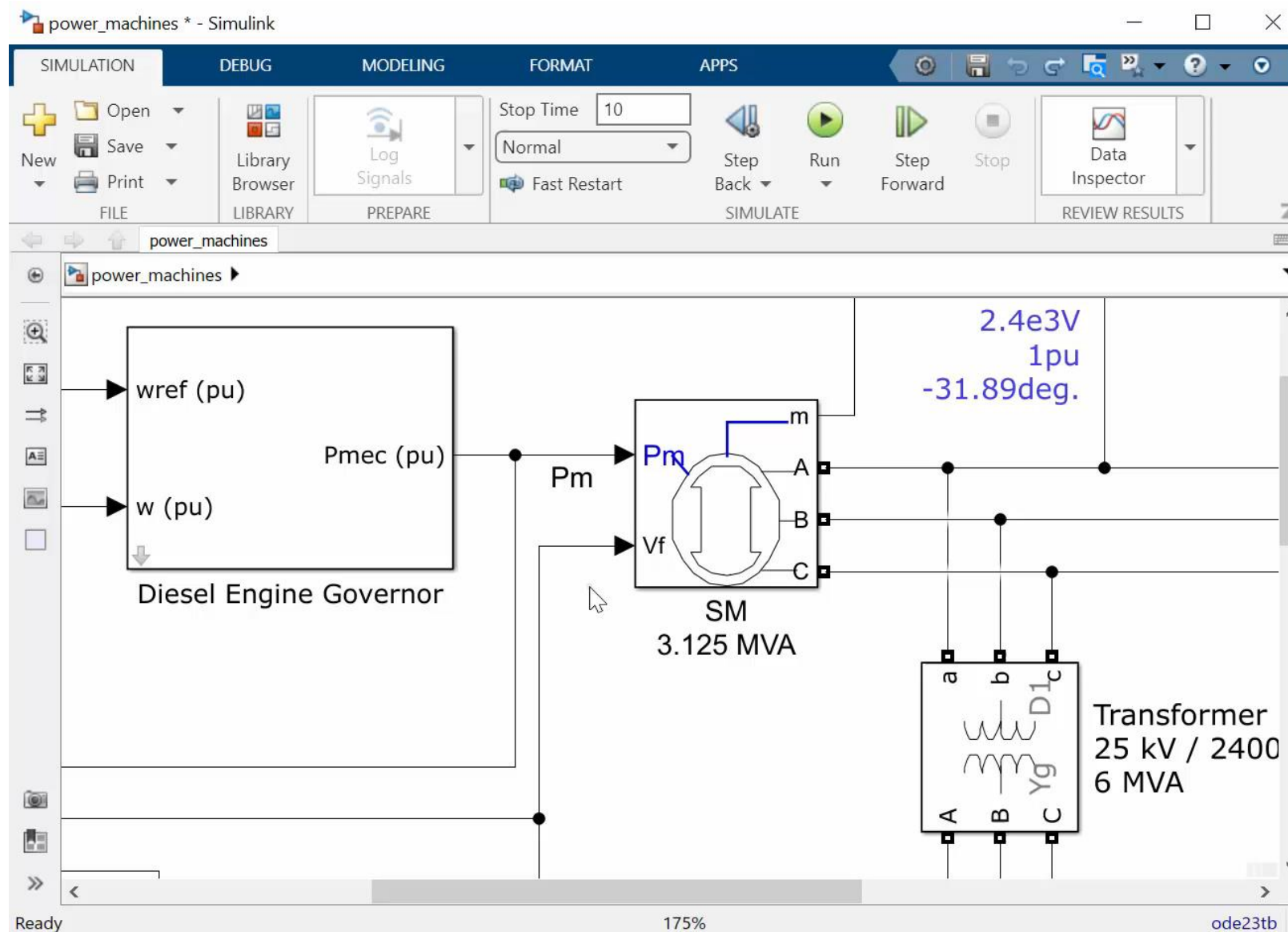
threshold = 8200;
plotEventCostsMap(data,threshold);

%% Event frequency by location
% Calculate damage costs by group

damageByEvent = groupsummary(data, "weathercats",["mean","std"],"damage_total")
  
```

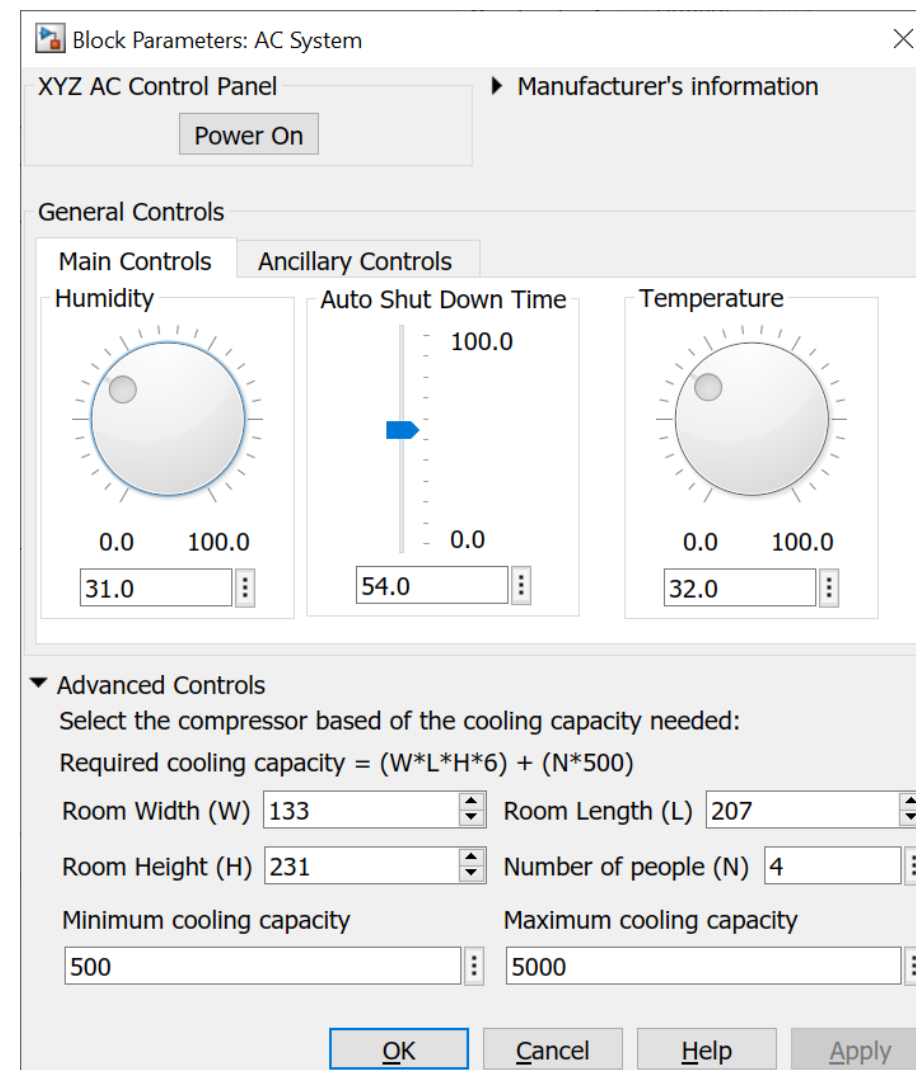
The interface includes a menu bar (EDITOR, PUBLISH, VIEW), a toolbar with icons for file operations, navigation, code refactoring, and execution, and a status bar at the bottom showing Zoom: 150%, UTF-8, LF, script, Ln 65, Col 1.

Simulink – navigácia



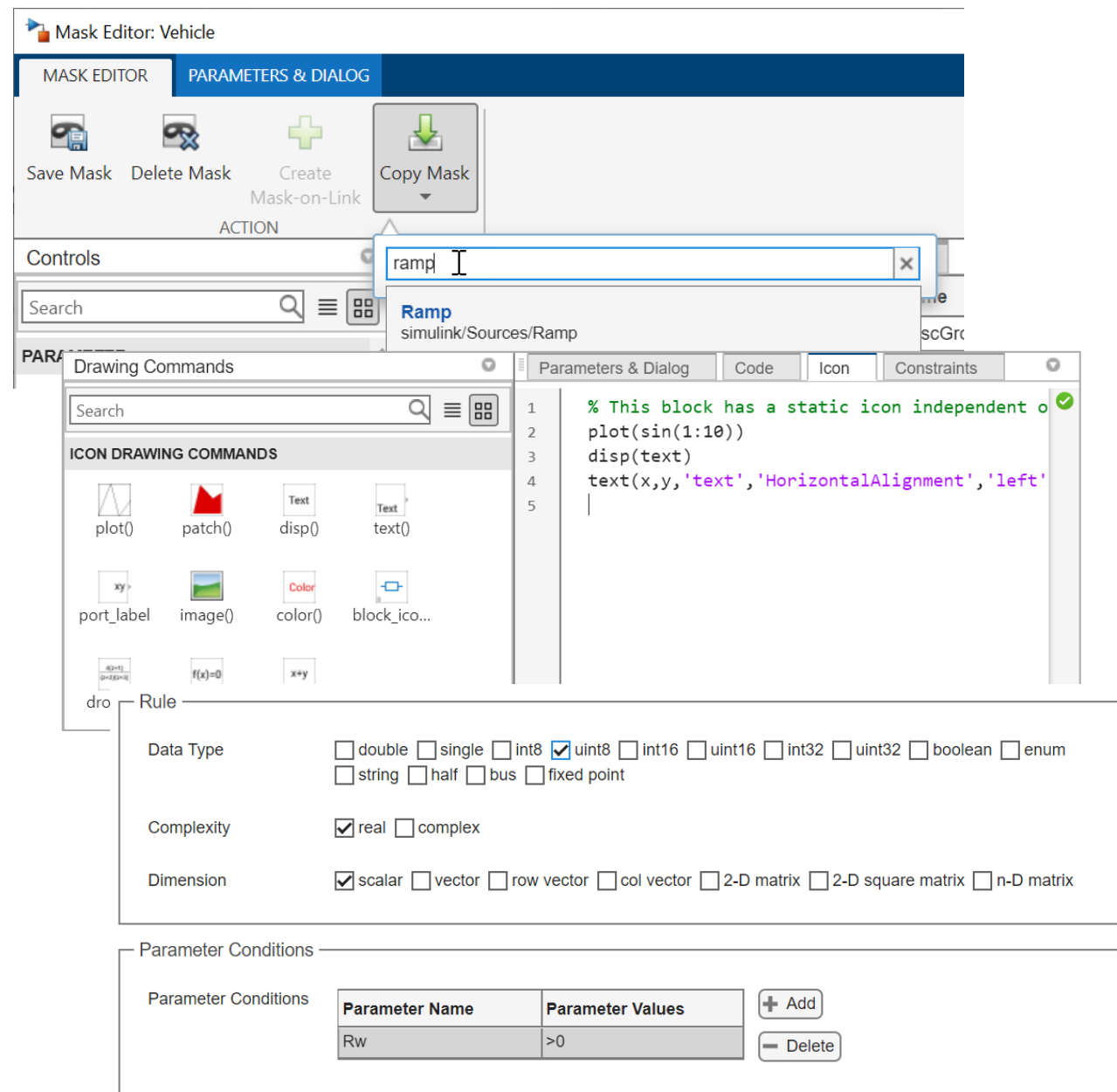
Simulink – tvorba masiek

- Vlastné masky
 - ľahký prístup k parametrom bloku
 - interaktívne ovládanie
- Mask Editor
 - vylepšená tvorba masiek



Simulink – tvorba masiek

- Kopírovanie masky
 - z existujúcich blokov
 - úprava namiesto od začiatku
- Ikonka masky
 - rýchly prístup k príkazom kreslenia
- Obmedzenia parametrov
 - dátový typ
 - hodnoty



Mask Editor: Vehicle

MASK EDITOR | PARAMETERS & DIALOG

Save Mask | Delete Mask | Create Mask-on-Link | Copy Mask

Controls

Search

Search: ramp

Ramp
simulink/Sources/Ramp

Drawing Commands

Search

ICON DRAWING COMMANDS

plot() patch() disp() text()

port_label image() color() block_ico...

Rule

Data Type double single int8 uint8 int16 uint16 int32 uint32 boolean enum
 string half bus fixed point

Complexity real complex

Dimension scalar vector row vector col vector 2-D matrix 2-D square matrix n-D matrix

Parameter Conditions

Parameter Name	Parameter Values
Rw	>0

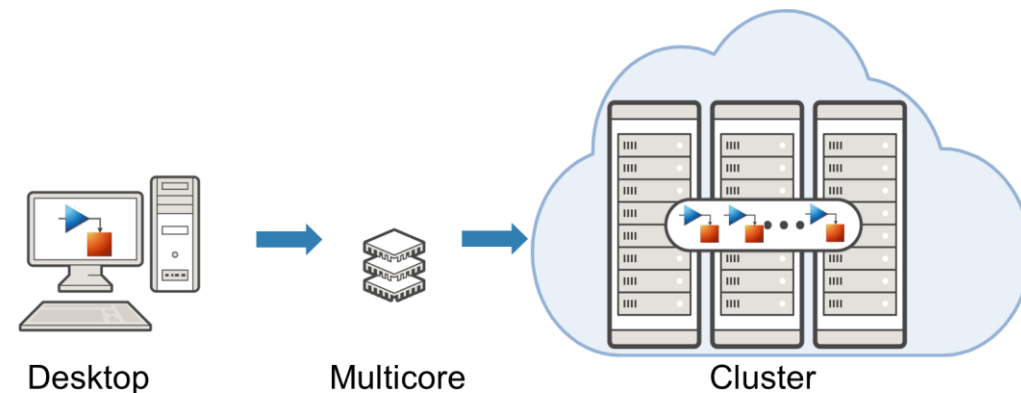
+ Add - Delete





Paralelizácia simulácií

- Využitie `parsim` na tvorbu paralelných simulácií na lokálnom počítači alebo cloude – rovnaký princíp

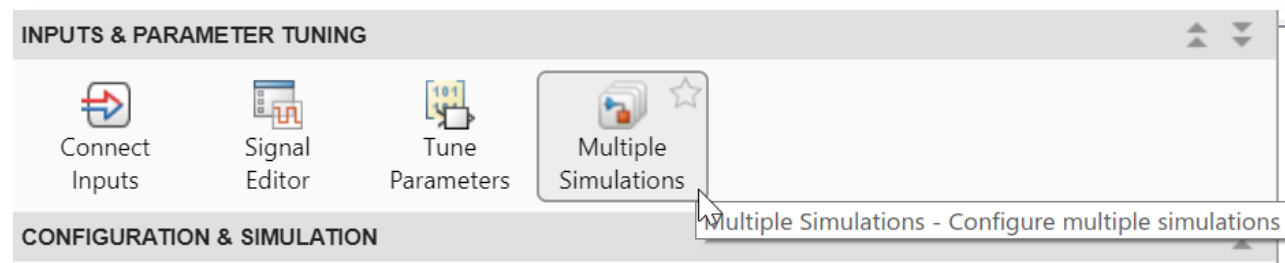


- Automaticky
 - Presunutie súborov na workerov
 - Získanie logovaných dát
 - Ovládanie adresárov

```

for i = 10000:-1:1
    in(i) = Simulink.SimulationInput(my_model);
    in(i) = in(i).setVariable(my_var, i);
end
out = parsim(in);
    
```

- Multiple Simulations Panel
 - konfigurácia viacerých simulácií



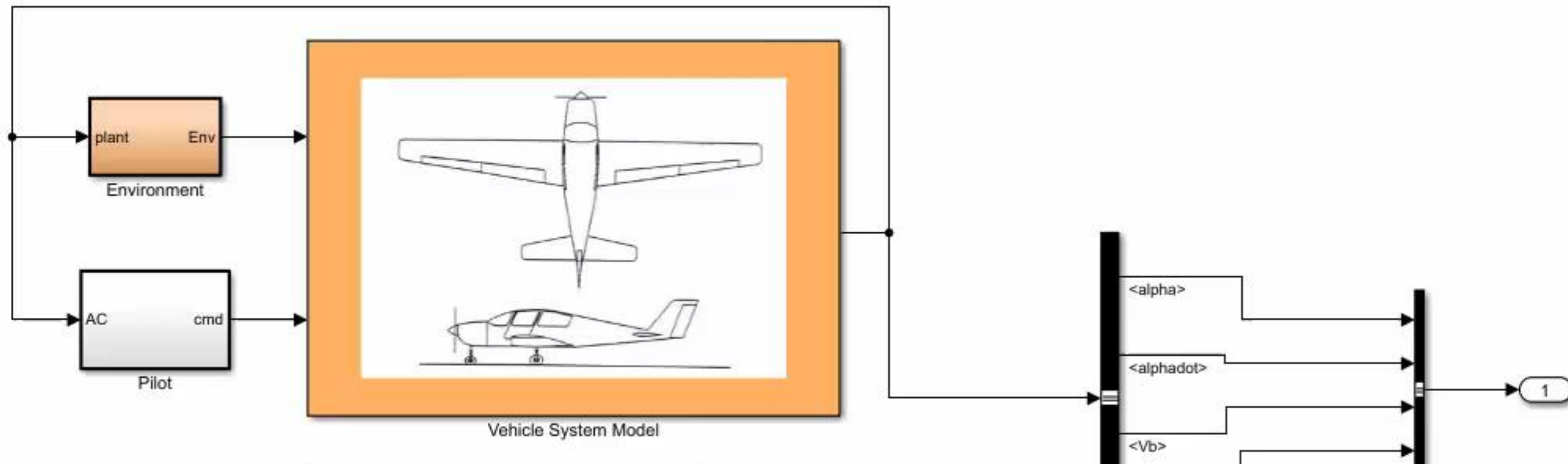
SIMULATION DEBUG MODELING FORMAT APPS

FILE LIBRARY PREPARE SIMULATE REVIEW RESULTS

Open, Save, Print, Library Browser, Log Signals, Add Viewer, Signal Table, Stop Time: 75, Normal, Fast Restart, Step Back, Run, Step Forward, Stop, Data Inspector, Logic Analyzer, Bird's-Eye Scope, Simulation Manager

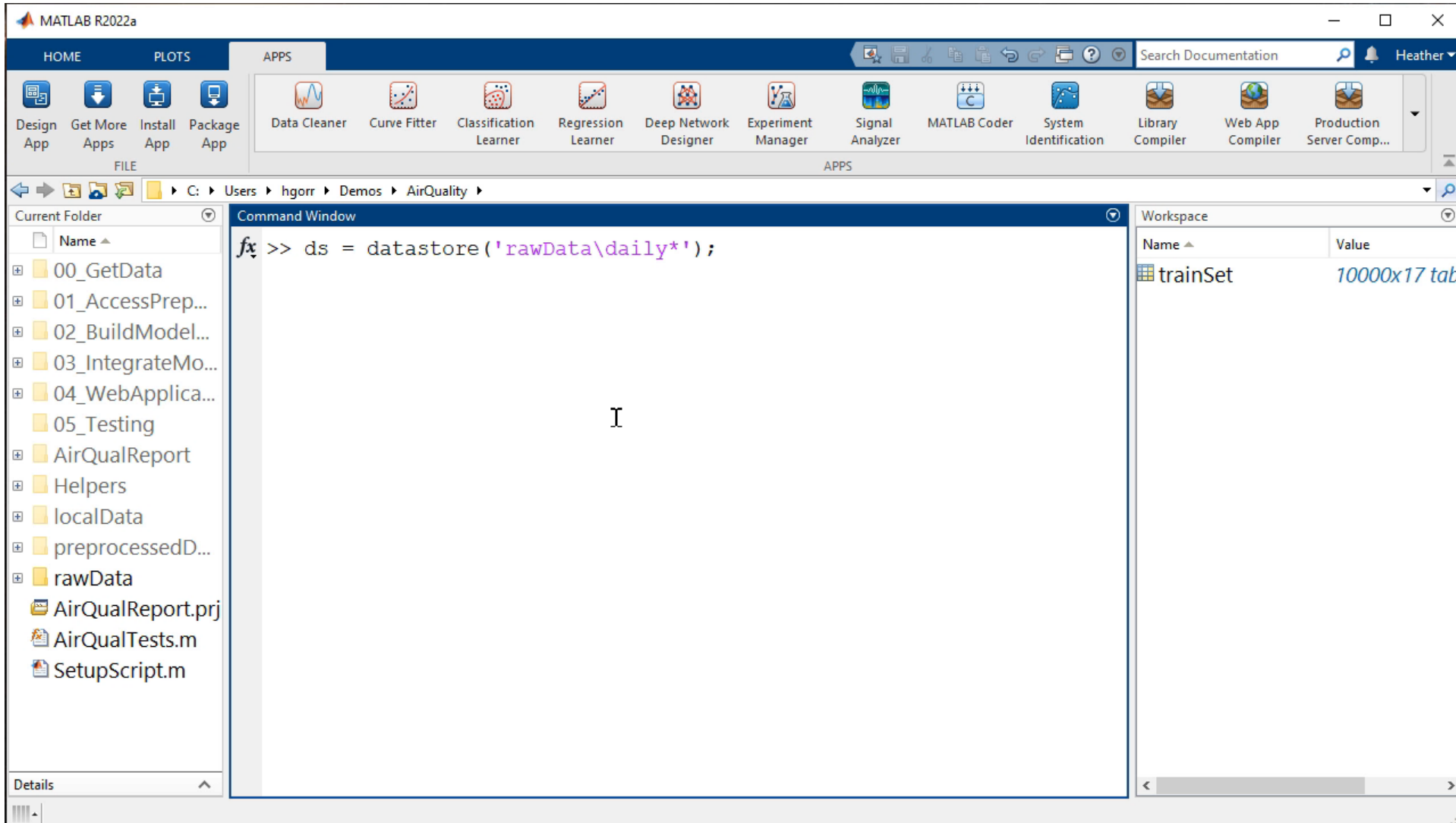
skyhogg

skyhogg



Sky Hogg Example,
Vehicle Geometry from
Cannon, M, Gabbard, M, Meyer, T, Morrison,
S, Skocik, M, Woods, D. "Swineworks D-200
Sky Hogg Design Proposal." AIAA/General
Dynamics Corporation Team Aircraft Design
Competition, 1991-1992

Paralelný beh kódu



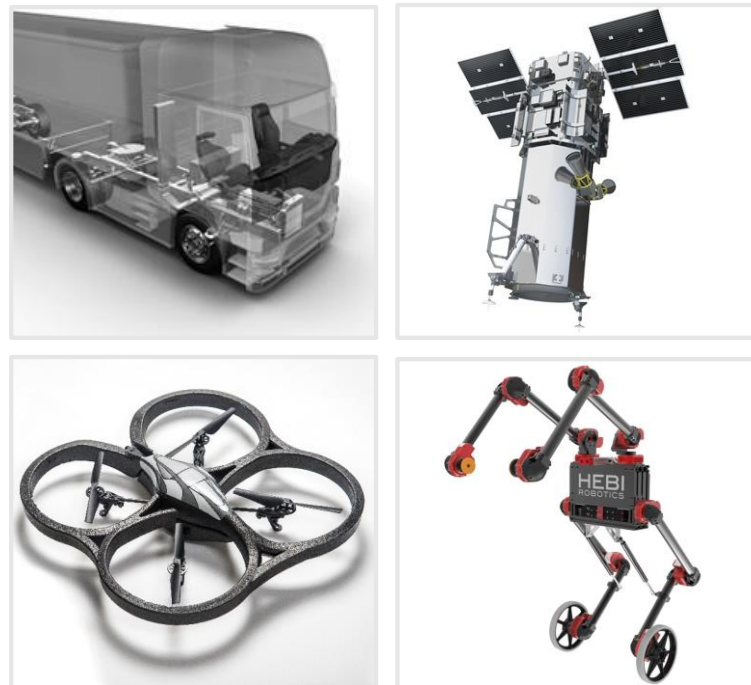
The screenshot shows the MATLAB R2022a environment. The Command Window contains the following code:

```
fx >> ds = datastore('rawData\daily*');
```

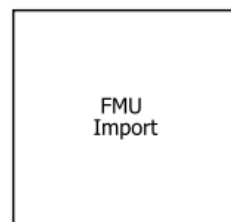
The Workspace window displays the following variable:

Name	Value
trainSet	10000x17 tab

Spolupráca s inými jazykmi

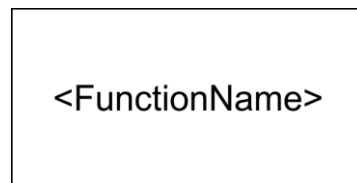


R2017b



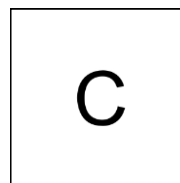
FMU Import

R2018b



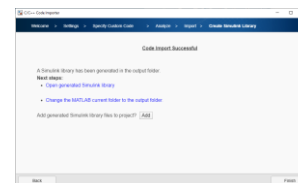
C Caller

R2020a



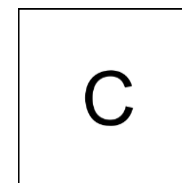
C Function

R2021a



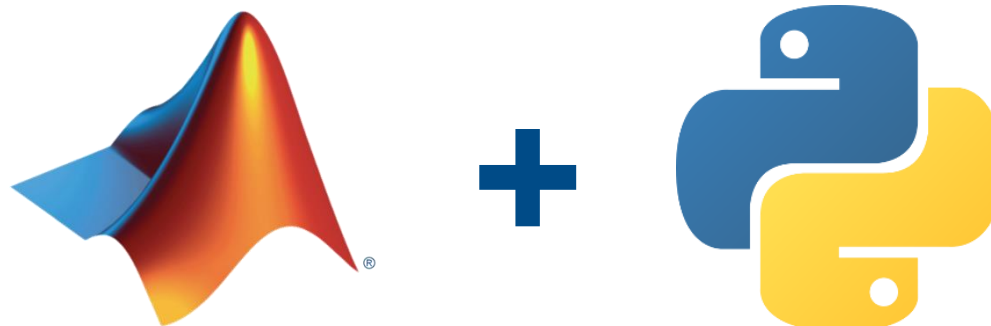
Code Importer

R2022a

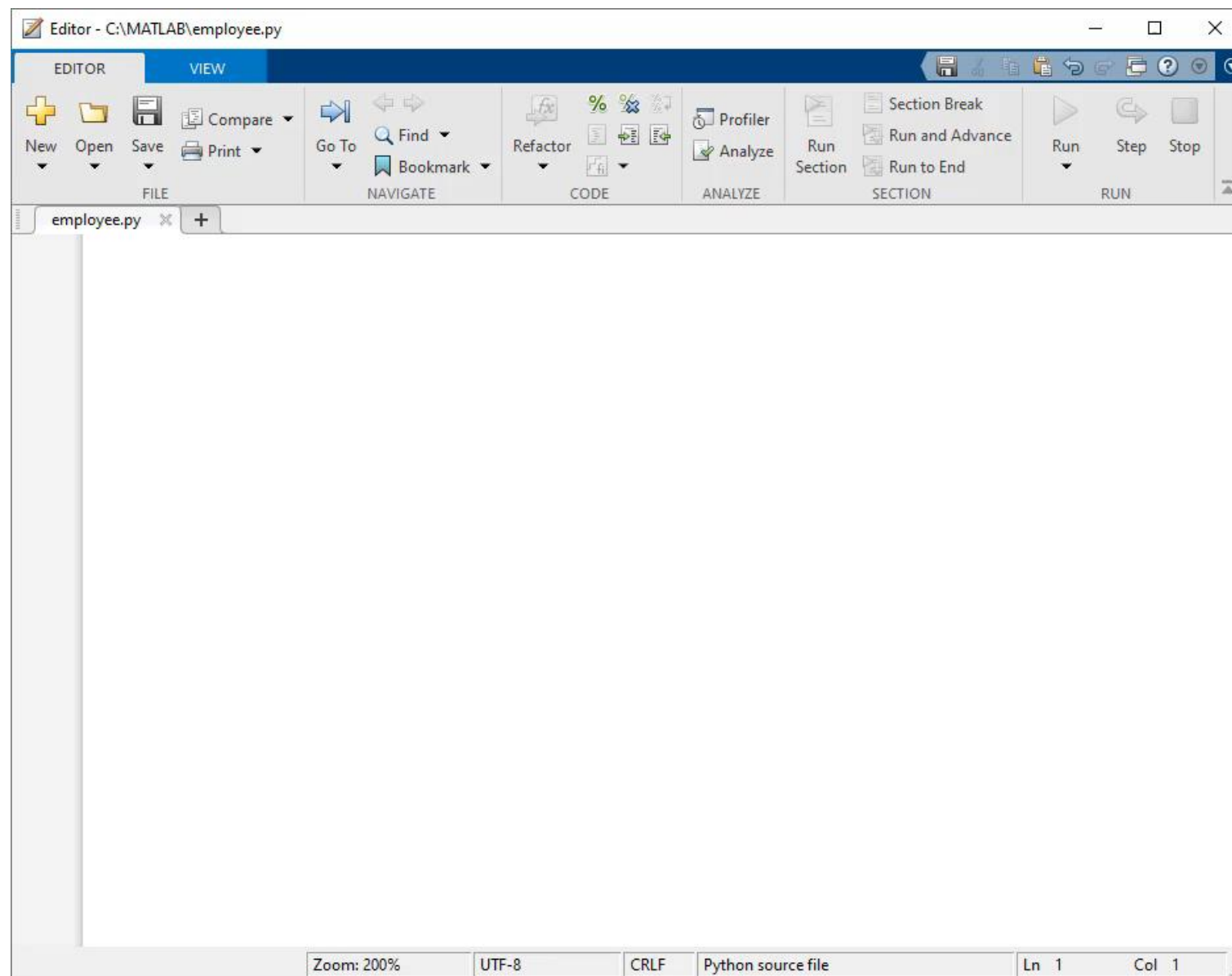


C Function supports C++

Spolupráca s inými jazykmi

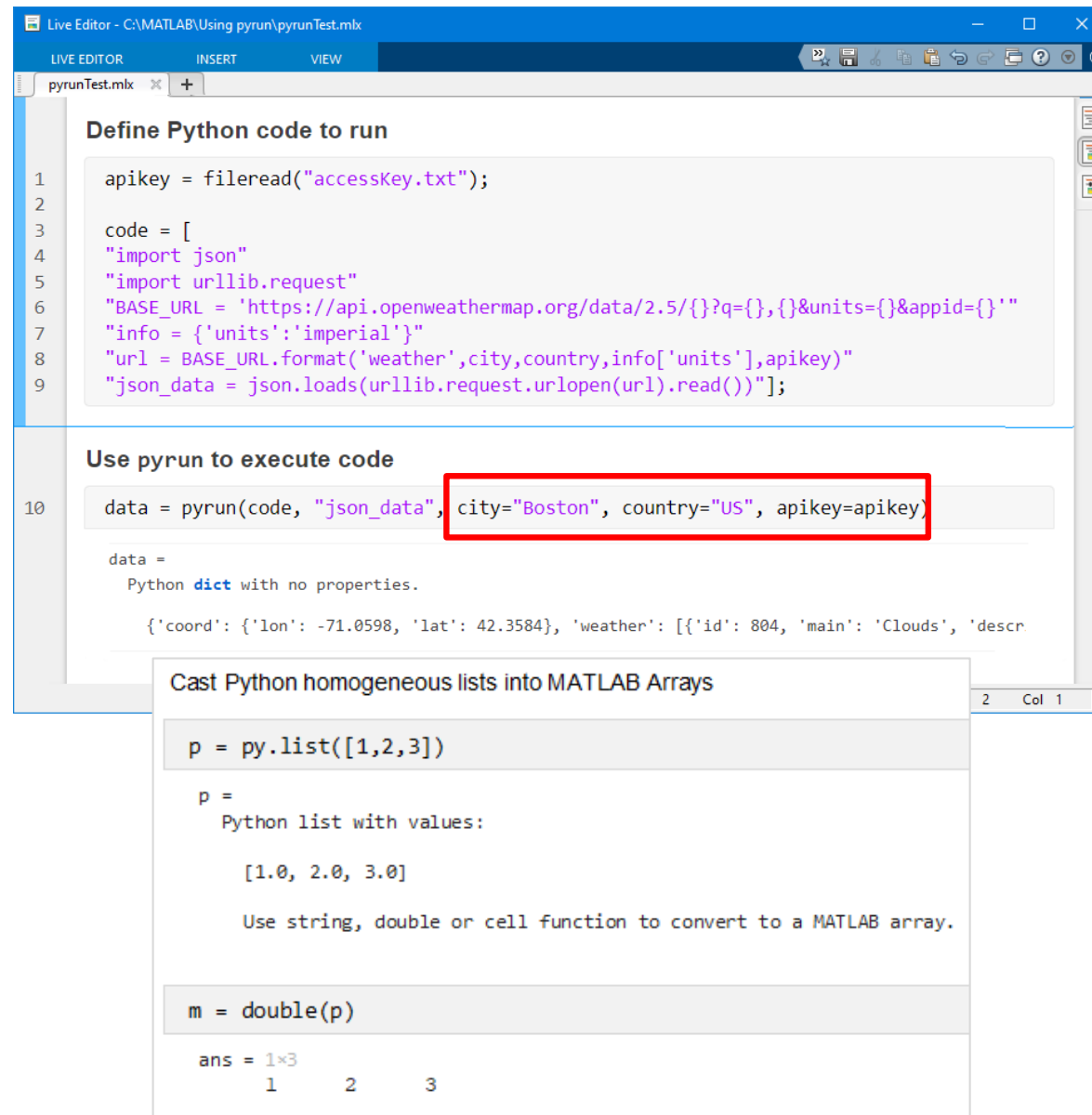


Spolupráca s inými jazykmi



Spolupráca s inými jazykmi

- Spúšťanie príkazov a skriptov
 - pyrun
 - pyrunfile
- Podpora syntaxe
 - Name = Value
- Reprezentácia dát
 - list
 - tuple



The screenshot shows the MATLAB Live Editor interface. The top section, titled "Define Python code to run", contains the following Python code:

```

1  apikey = fileread("accessKey.txt");
2
3  code = [
4  "import json"
5  "import urllib.request"
6  "BASE_URL = 'https://api.openweathermap.org/data/2.5/{q={}&units={}&appid={}'"
7  "info = {'units':'imperial'}"
8  "url = BASE_URL.format('weather',city,country,info['units'],apikey)"
9  "json_data = json.loads(urllib.request.urlopen(url).read())"];

```

The bottom section, titled "Use pyrun to execute code", shows the execution of the code:

```

10 data = pyrun(code, "json_data", city="Boston", country="US", apikey=apikey)

```

The output shows a Python dict with no properties and a nested dictionary for weather data:

```

data =
  Python dict with no properties.

  {'coord': {'lon': -71.0598, 'lat': 42.3584}, 'weather': [{'id': 804, 'main': 'Clouds', 'descr

```

A tooltip titled "Cast Python homogeneous lists into MATLAB Arrays" is visible, showing the following code and output:

```

p = py.list([1,2,3])

p =
  Python list with values:

  [1.0, 2.0, 3.0]

  Use string, double or cell function to convert to a MATLAB array.

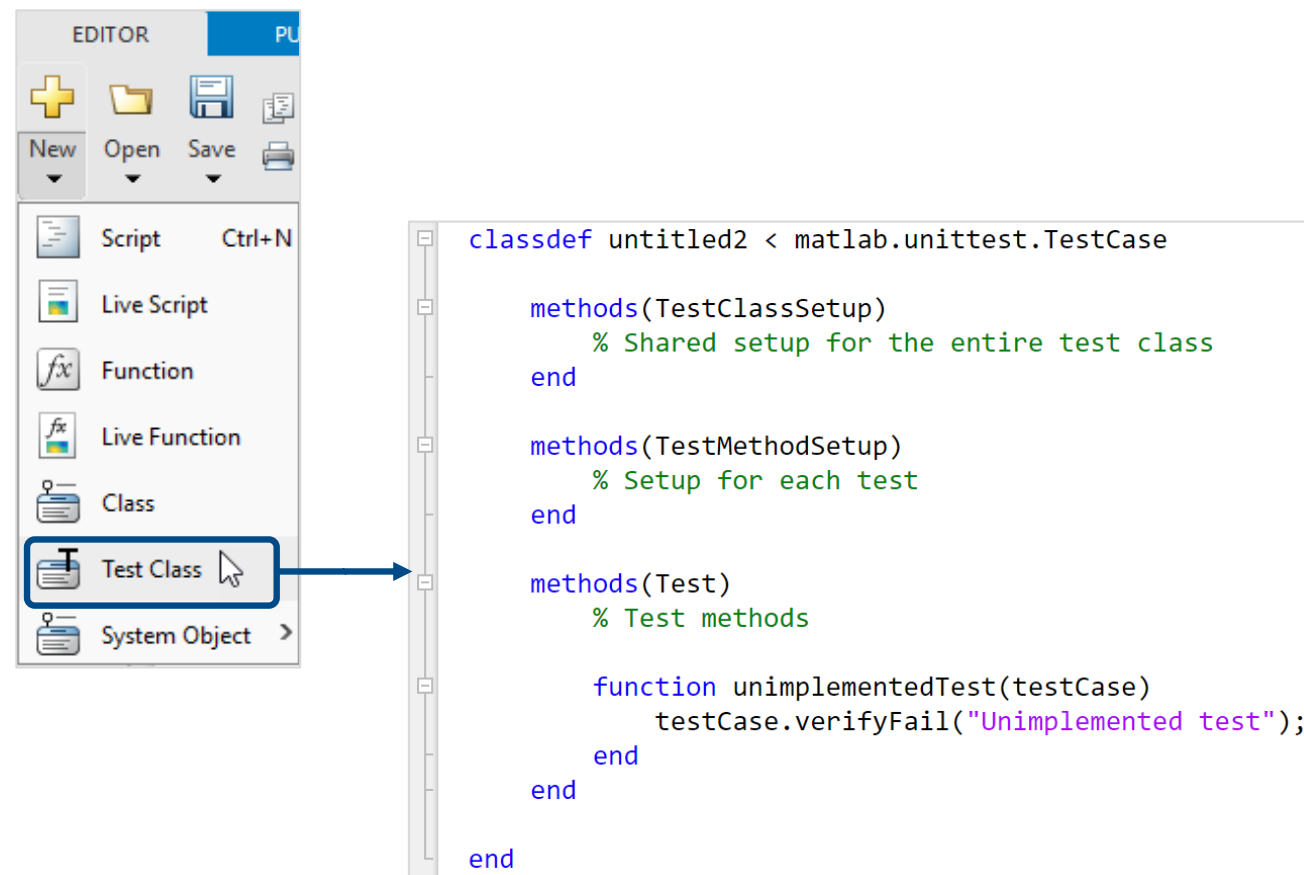
m = double(p)

ans = 1x3
      1      2      3

```

Testovanie kódu

- Unit Testovanie
 - dostupné z toolstripu
 - šablóna testovacej triedy



The image shows the MATLAB Editor interface. On the left, the 'New' dropdown menu is open, and the 'Test Class' option is highlighted with a blue box and a mouse cursor. A blue arrow points from this option to the right, where a code editor window displays the following MATLAB code template for a test class:

```

classdef untitled2 < matlab.unittest.TestCase

    methods(TestClassSetup)
        % Shared setup for the entire test class
    end

    methods(TestMethodSetup)
        % Setup for each test
    end

    methods(Test)
        % Test methods

        function unimplementedTest(testCase)
            testCase.verifyFail("Unimplemented test");
        end
    end
end
  
```

Testovanie kódu

- Unit Testovanie
 - dostupné z toolstripu
 - šablóna testovacej triedy



- Code coverage report
 - detailná analýza testu

MATLAB® Code Coverage Report

The MATLAB code coverage report provides a detailed analysis of the source code covered by the tests.

Overall Coverage Summary

Summary of the code coverage metrics for all source files.

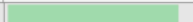
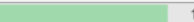
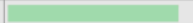
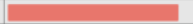
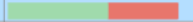



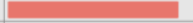










Total Files	29		
Coverage Metric	Executable	Code Coverage	
Statement Coverage	196		44.89%
Function Coverage	36		58.33%

Breakdown by Source

Code coverage metrics per source file.

[Summary View](#) [Detailed View](#)

Root Folder - L:\Troubleshoot\22a\CodeCoverage\CollectorForRepro\

File Name	Statement Coverage	Function Coverage
11 foo.m	 100%	 100%
12 liveSourceScript.mlx	 100%	N/A
13 perfTestCoverage.m	 0%	N/A
14 quadraticSolver.m	 58.82%	 50%
15 qux.m	 0%	 0%
16 reproCD.m	 0%	N/A
17 reproCobertura.m	 0%	N/A
18 reproCollector.m	 0%	 0%
19 reproCollectorMCDC.m	 0%	 0%
20 reproCollectorPFile.m	 0%	 0%
21 reproCollector_changesFileOrder.m	 0%	 0%
22 reproDecision.m	 0%	N/A

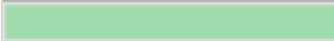
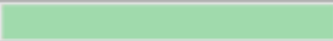
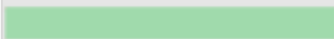
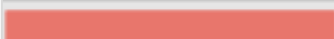
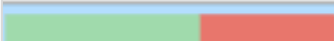
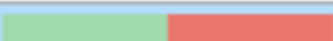
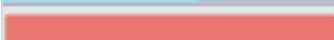
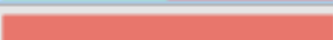



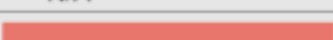







Source Details

Detailed analysis of code coverage for a source file.

Hit Count	Line Number	L:\Troubleshoot\22a\CodeCoverage\CollectorForRepro\quadraticSolver.m
1	1	<code>function roots = quadraticSolver(a, b, c, printBool)</code>
	2	<code>% quadraticSolver returns solutions to the</code>
	3	<code>% quadratic equation a*x^2 + b*x + c = 0.</code>
	4	<code></code>
	5	<code>arguments</code>
1,1,0	6	<code>a (mustBeNumeric, mustBeNonNaN) =</code>
1,0	7	<code>b (mustBeNumeric) =</code>

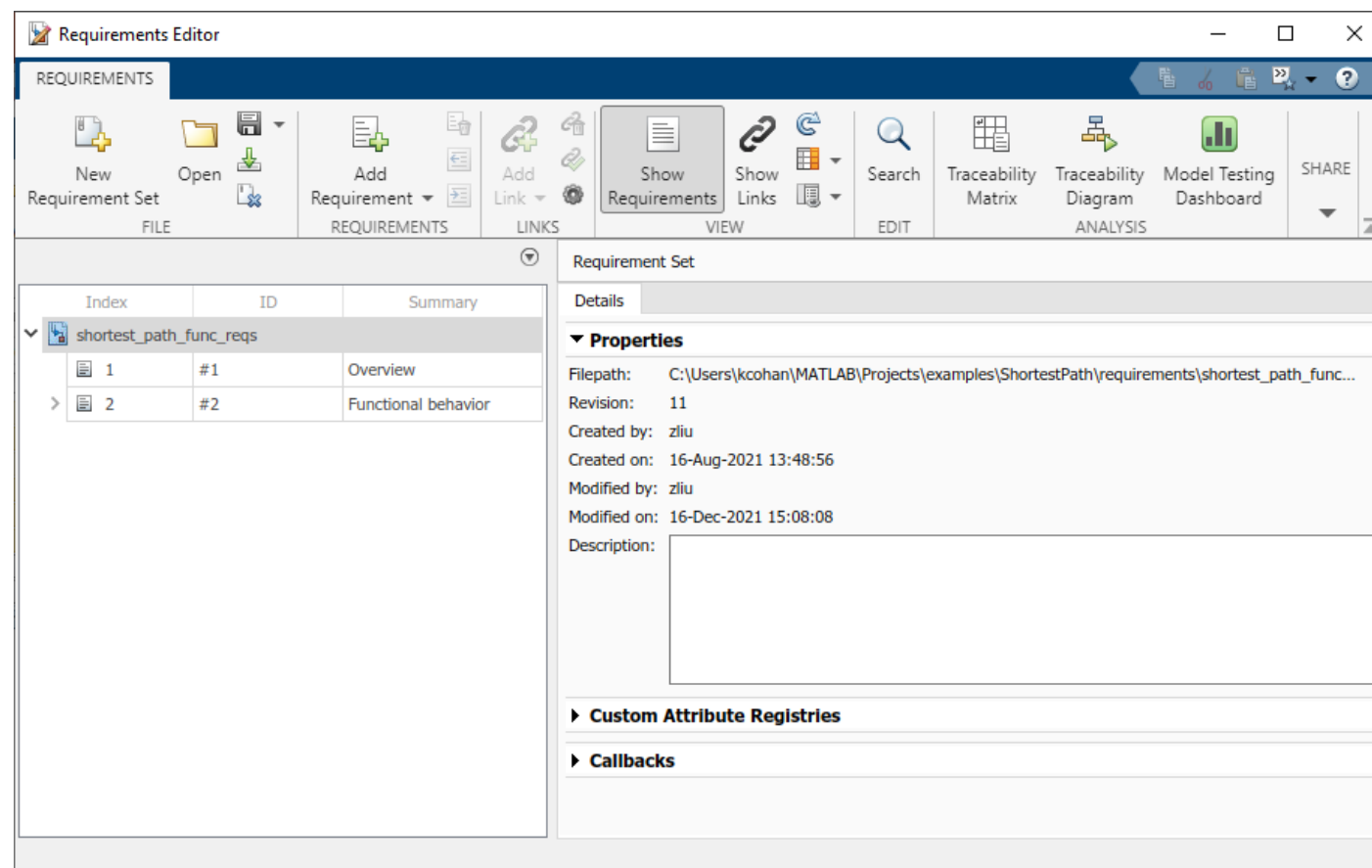
Testovanie kódu

- Unit Testovanie
 - dostupné z toolstripu
 - šablóna testovacej triedy
- Code coverage report
 - detailná analýza testu
- Metrika pokrytia
 - čo bolo volaná aspoň raz

Statement Coverage		Function Coverage	
	100%		100%
	100%	N/A	
	0%	N/A	
	58.82%		50%
	0%		0%
	0%	N/A	
	0%	N/A	
	0%		0%
	0%		0%
	0%		0%
	0%		0%
	0%	N/A	

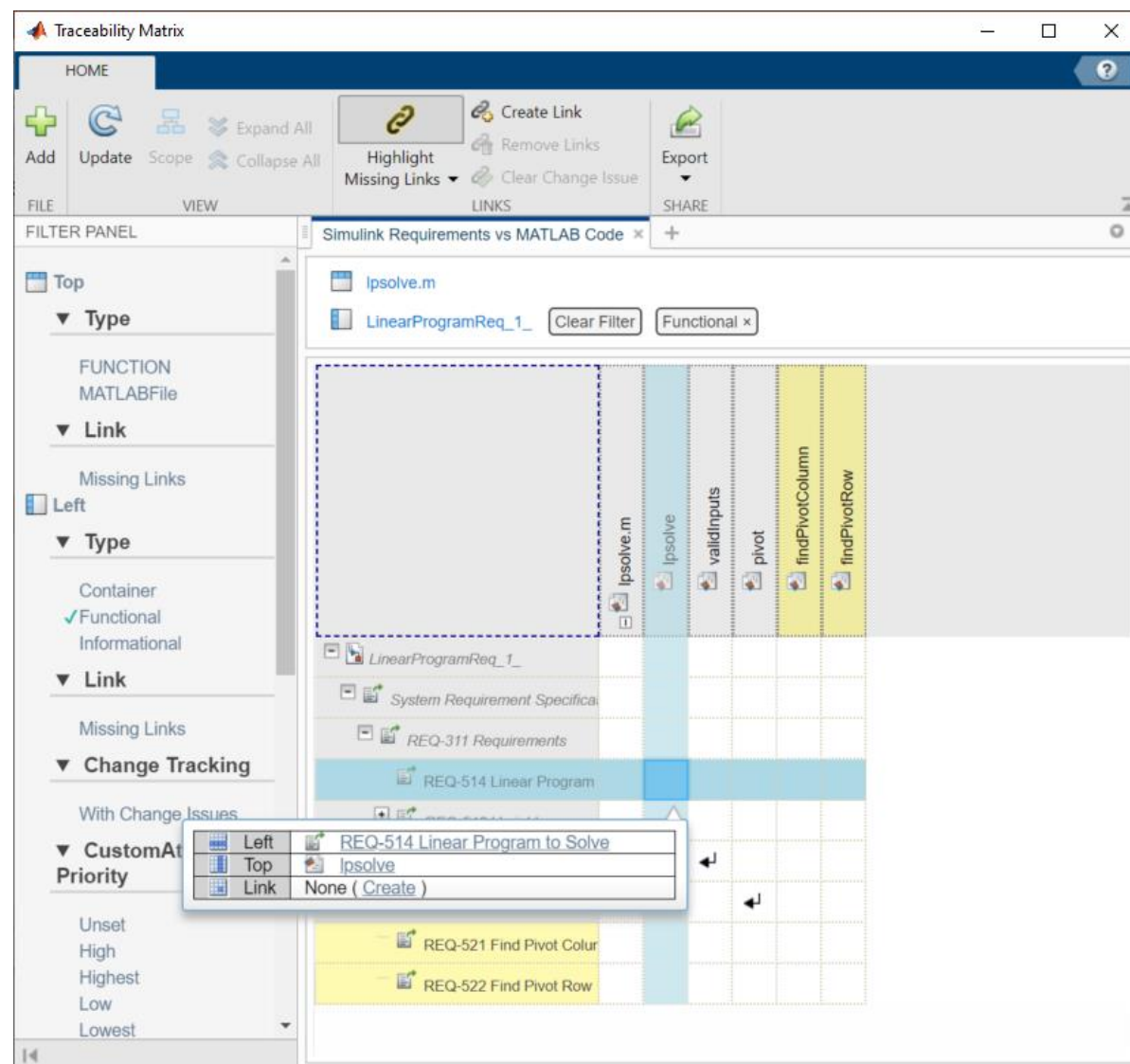
Požiadavky

- Tvorba požiadaviek
 - algoritmus v MATLABe
 - import z rôznych nástrojov
 - link na Unit Test



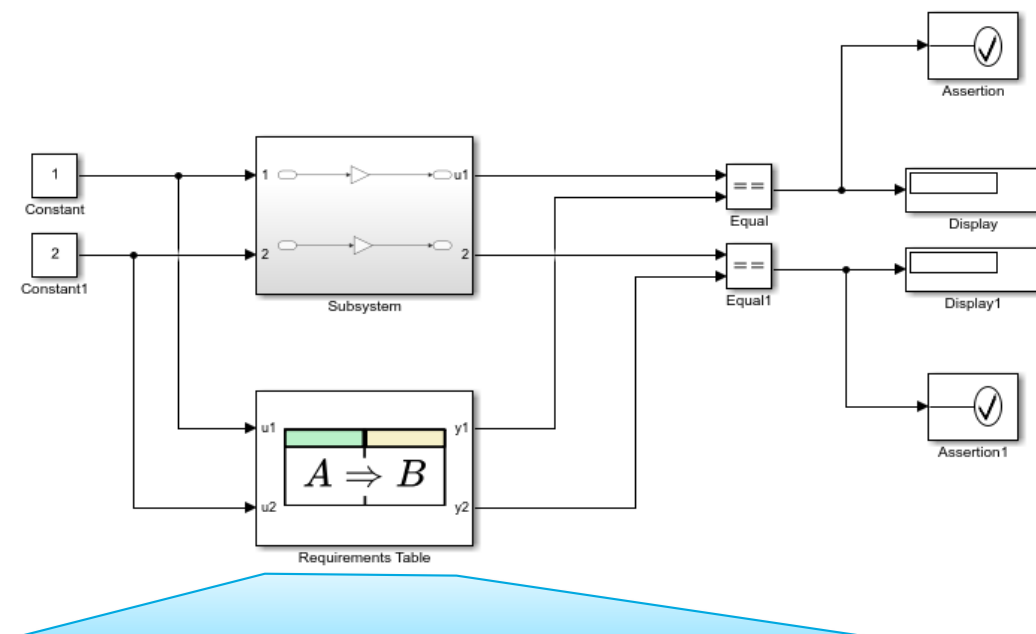
Požiadavky

- Tvorba požiadaviek
 - algoritmus v MATLABe
 - import z rôznych nástrojov
 - link na Unit Test
- Traceability matrix
 - ukazuje chýbajúce linky
 - možnosť doplnenia



Požiadavky

- Tvorba požiadaviek
 - algoritmus v MATLABe
 - import z rôznych nástrojov
 - link na Unit Test
- Traceability matrix
 - ukazuje chýbajúce linky
 - možnosť doplnenia
- Requirements Table blok
 - vyhodnotenie logiky, pred/po



Requirements		Assumptions	
Index	Summary	Precondition	Action
1	Requirement 1	$u1 > 0$	$y1 = 2*u1$
2	Requirement 2	$u2 > 0$	$y2 = 0.5*u2$





Tvorba Live Editor Taskov

Live Editor - C:\Demos\22a_demos\custom_tasks\CustomizeAxes\CustomizedAxesScript_Expo.mlx

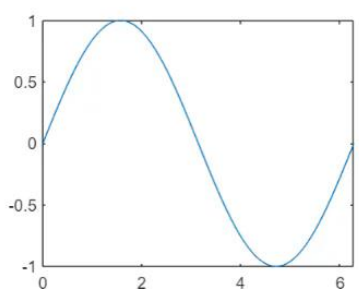
LIVE EDITOR INSERT VIEW

CustomizedAxesScript_Expo.mlx CustomizeAxes.m +

Create the initial figure

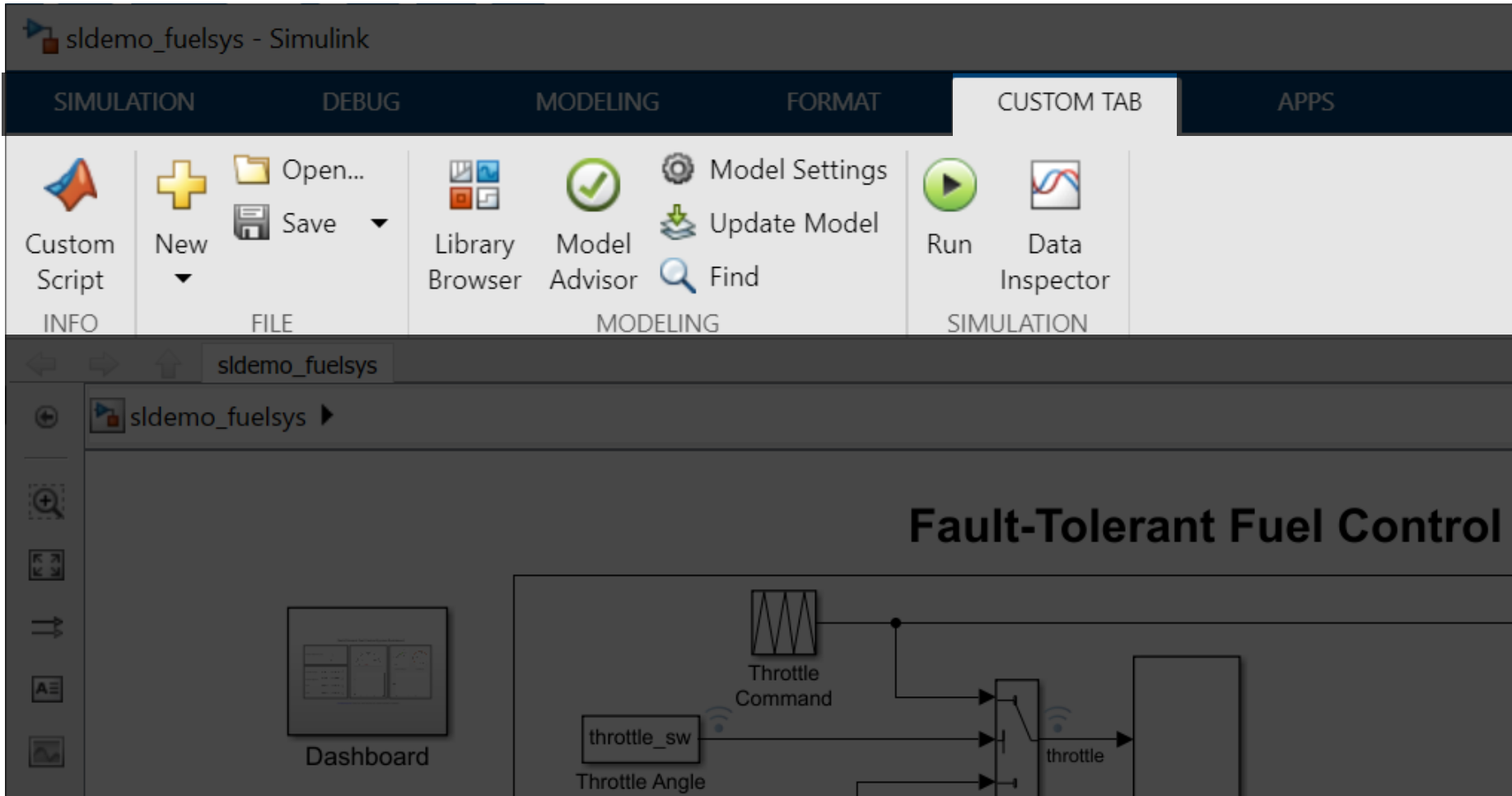
```
x = 0:pi/100:2*pi;
y = sin(x);
plot(x,y)
```

Customize the figure

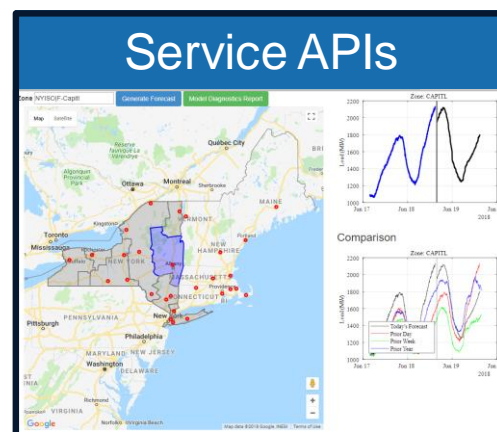
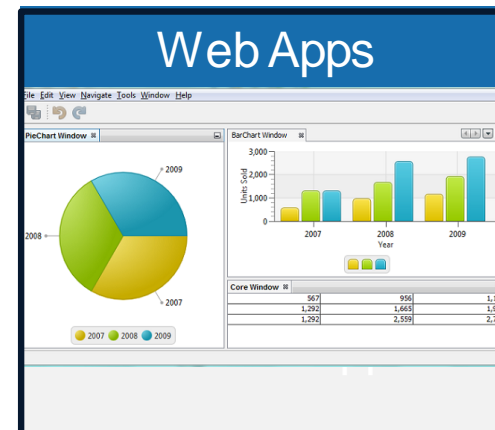
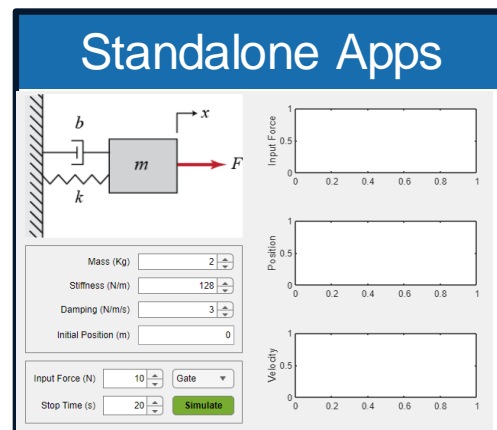


Zoom: 150% UTF-8 LF script Ln 4 Col 1

Vlastná záložka



Tvorba a zdieľanie aplikácií



Tvorba a zdieľanie aplikácií

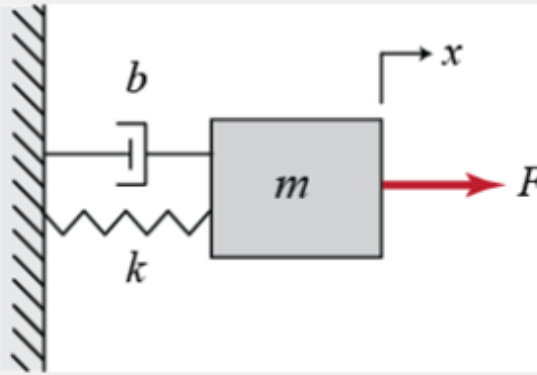
App Designer - C:\Users\mcarone\OneDrive - MathWorks\Documents\MATLAB\Examples\R2022a\simulinkcompiler\DeployingASimulationAppUsingSimulinkCompilerExample\MassSpringDamperApp.mlapp

DESIGNER CANVAS VIEW

```

% Code that executes after component creation
function startupFcn(app)
end
% Bu
func

```



end
% Bu
func

Mass (Kg)

Stiffness (N/m)

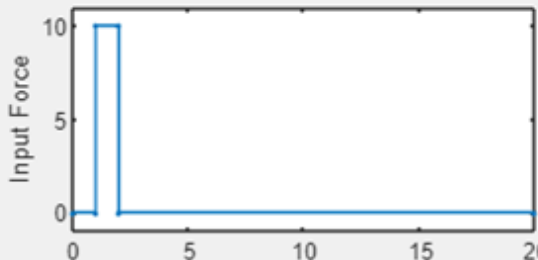
Damping (N/m/s)

Initial Position (m)

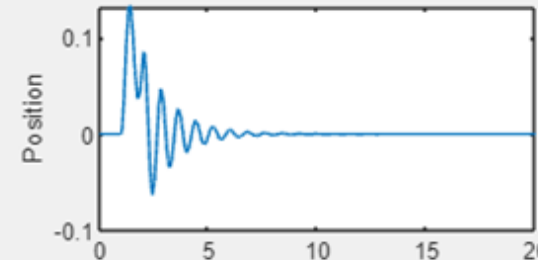
Input Force (N) Gate

Stop Time (s) **Simulate**

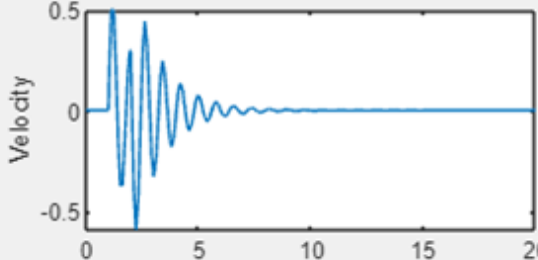
Input Force



Position



Velocity



HOME PLOTS APPS

Search Documentation Weiwu

New Script New Live Script New Open Compare Import Data Clean Data Variable SaveWorkspace Clear Workspace Favorites Analyze Code Run and Time Clear Commands Simulink Layout Preferences Set Path Parallel Add-Ons Help Community Request Support Learn MATLAB

FILE VARIABLE CODE SIMULINK ENVIRONMENT RESOURCES

C:\Work\MultiPaneSimApp

Current Folder

Name
NeonatalVentilatorModelParams.mat
NeonatalVentilatorModel.slx
archive

Details

Select a file to view details

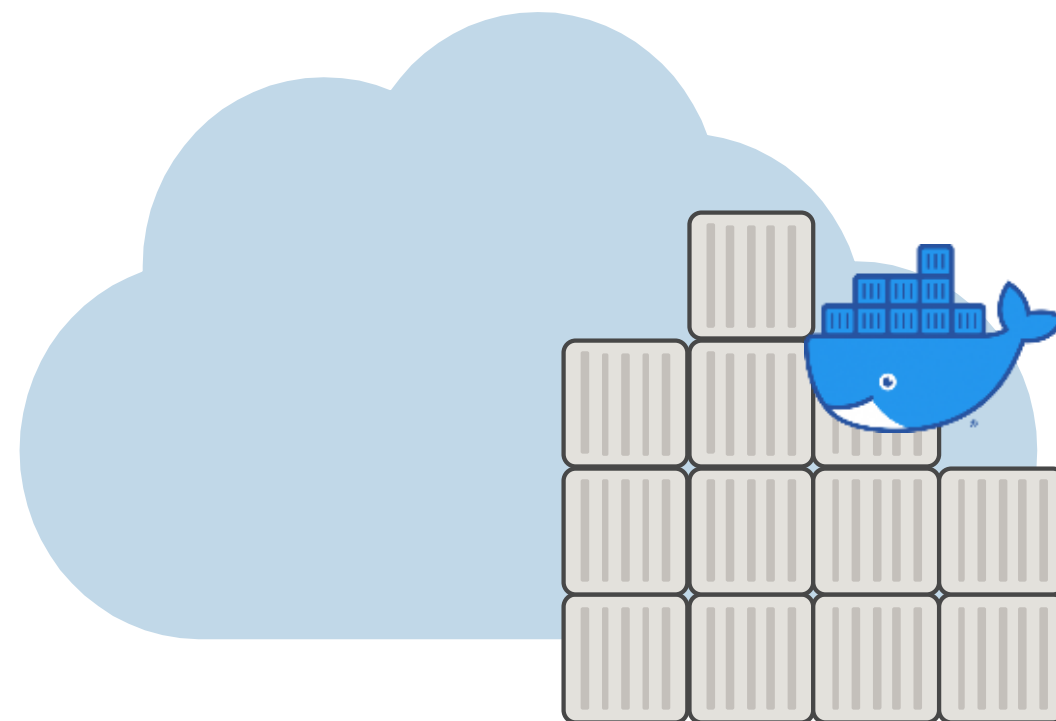
Command Window

```
fx >> simulink.compiler.genapp('NeonatalVentilatorModel');
```

Workspace

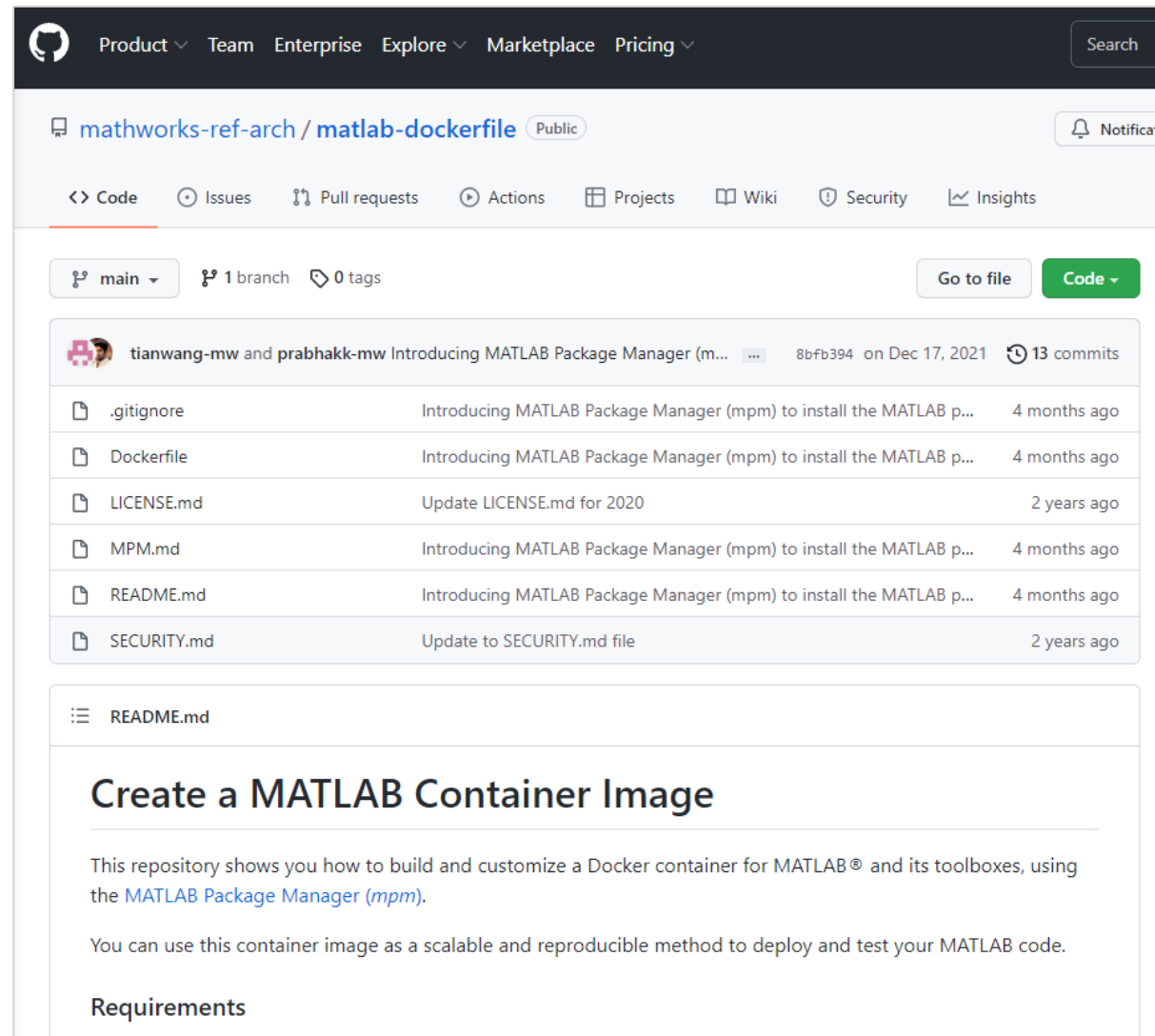
MATLAB v kontaineroch

- Čo je kontajner
 - izolovaná jednotka softvéru
 - zvyčajne pre cloud
 - integrácia s inými napr. CI/CD



MATLAB v kontajneroch

- Čo je kontajner
 - izolovaná jednotka softvéru
 - zvyčajne pre cloud, Docker
 - integrácia s inými napr. CI/CD
- Prístup ku kontajneru
 - Image na DockerHub
 - Postup krokov na GitHube



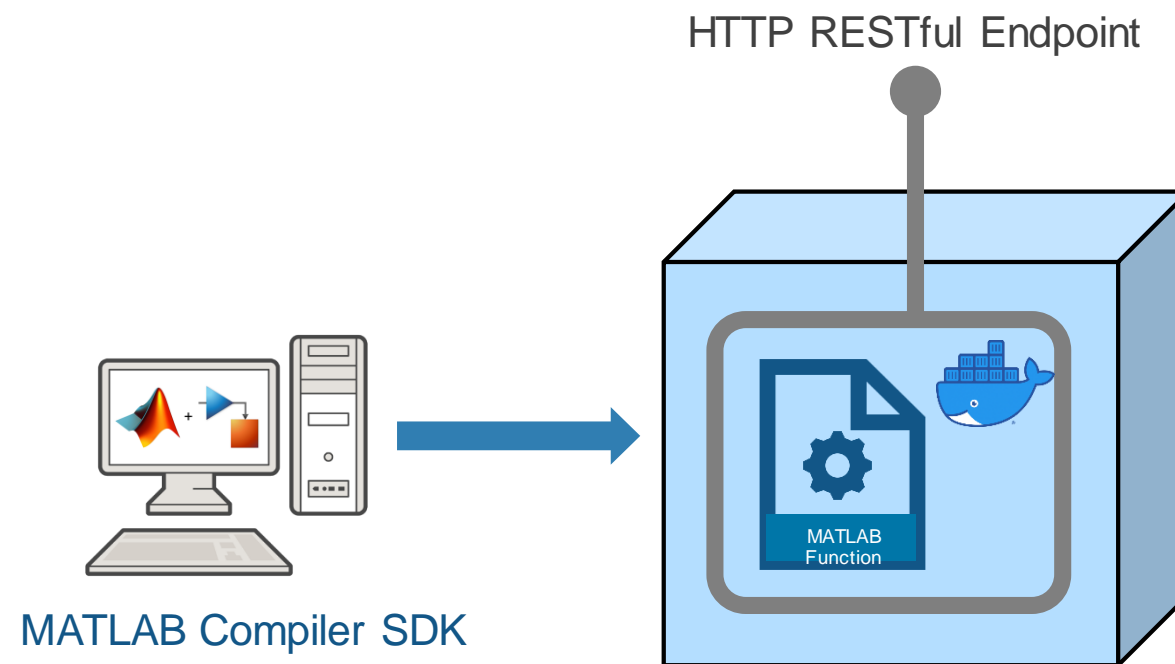
The screenshot shows the GitHub interface for the repository 'mathworks-ref-arch / matlab-dockerfile'. The repository is public and has 1 branch and 0 tags. The commit history shows a commit by 'tianwang-mw and prabhakk-mw' on Dec 17, 2021, with 13 commits. The file list includes .gitignore, Dockerfile, LICENSE.md, MPM.md, README.md, and SECURITY.md. The README.md file is selected, showing the title 'Create a MATLAB Container Image' and the text: 'This repository shows you how to build and customize a Docker container for MATLAB® and its toolboxes, using the MATLAB Package Manager (mpm). You can use this container image as a scalable and reproducible method to deploy and test your MATLAB code. Requirements'.

MATLAB v kontajneroch

- Čo je kontajner
 - izolovaná jednotka softvéru
 - zvyčajne pre cloud, Docker
 - integrácia s inými napr. CI/CD

- Prístup ku kontajneru
 - Image na DockerHub
 - Postup krokov na GitHub

- Microservices
 - služba, aplikácia



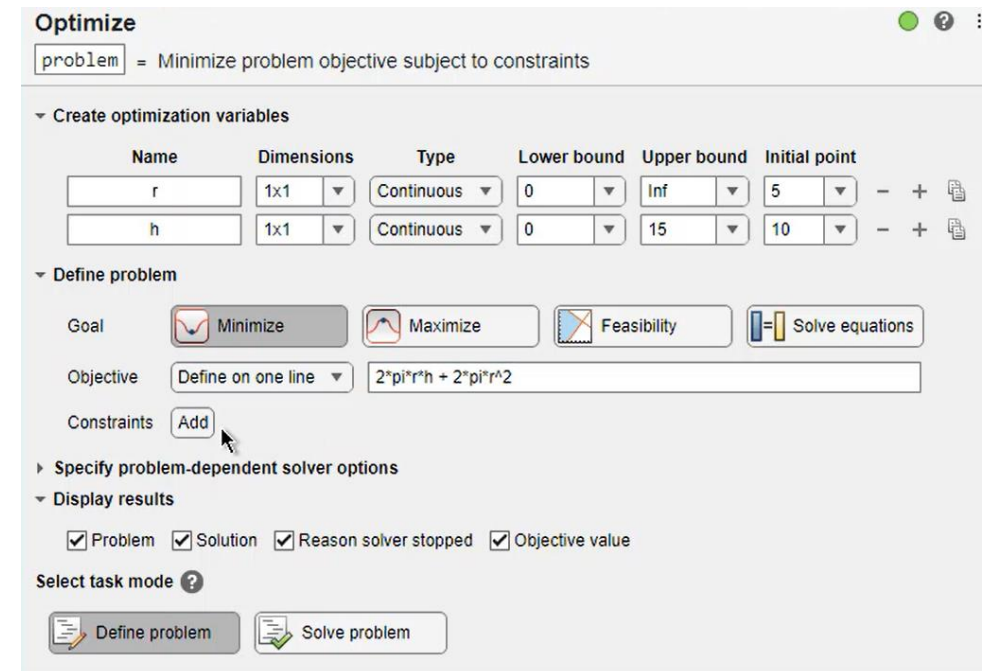


MATLAB®
PRODUCT FAMILY

SIMULINK®
PRODUCT FAMILY

Optimalizácia

- Interaktívna optimalizácia
 - Optimize Live Editor task
 - [Ukážka](#)
- Zjednodušenie optimalizácie
 - Problem-based workflow
 - [Ukážka](#)
- Podpora generovania kódu
 - fmincon, quadprog, fsolve, ...
- Riešiče
 - surrogateopt, paretosearch, coneprog



```

prob = optimproblem;

x = optimvar('x');
y = optimvar('y');

prob.Objective = exp(x).*(4*x.^2 + 2*y.^2 + 4*x.*y + 2*y - 1);
prob.Constraints.c1 = x.*y/2 + (x+2).^2 + (y-2).^2/2 <= 2;
prob.Constraints.c2 = x + y <= 1;

x0.x = -3;
x0.y = 3;
[sol,fval,exitflag,output] = solve(prob,x0)

```

Symbolická matematika

- Podpora v Live Editore
- Postupnosť krokov
 - Next Step Suggestions
- Lineárna algebra
 - Maticový zápis
- Podpora generovania kódu

Solve Symbolic Equation

`solution` = Analytic solution of equation `QuadraticEquation` with respect to `x`

Select equation

Equation: `QuadraticEquation` Variables: `x`

Specify solver options

Return real solutions
 Return conditions
 Ignore analytic constraints
 Return one solution
 Expand all roots
 Ignore properties

Display result

Equation
 Solution

`solution` =

$$\frac{-b + \sqrt{b^2 + 168ac - 4ac}}{2a}$$

Simplify Symbolic Expression

`simplifiedExpr` = Simplified expression `LogSum` using `Combine`

Select expression

Expression: `LogSum`

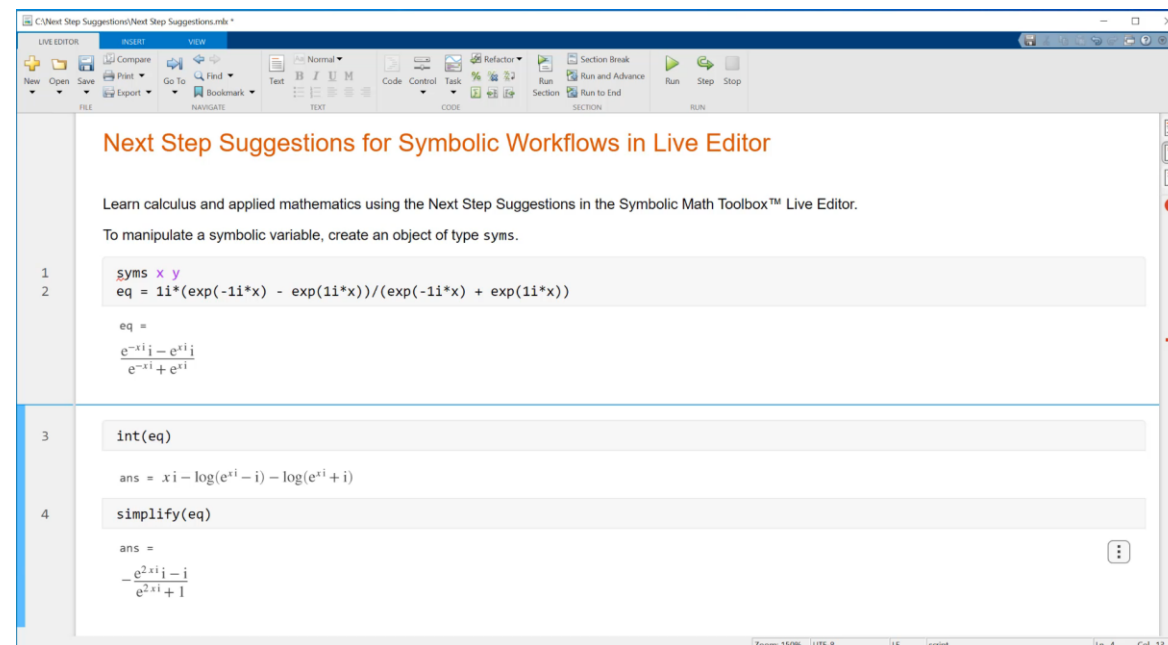
Specify simplification method

Method: `Combine` Target: `log`
 Ignore analytic constraints

Display result

Expression
 Simplified expression

`simplifiedExpr` = `log(ab)`



Next Step Suggestions for Symbolic Workflows in Live Editor

Learn calculus and applied mathematics using the Next Step Suggestions in the Symbolic Math Toolbox™ Live Editor.

To manipulate a symbolic variable, create an object of type `syms`.

```

1 syms x y
2 eq = 1i*(exp(-1i*x) - exp(1i*x))/(exp(-1i*x) + exp(1i*x))

eq =

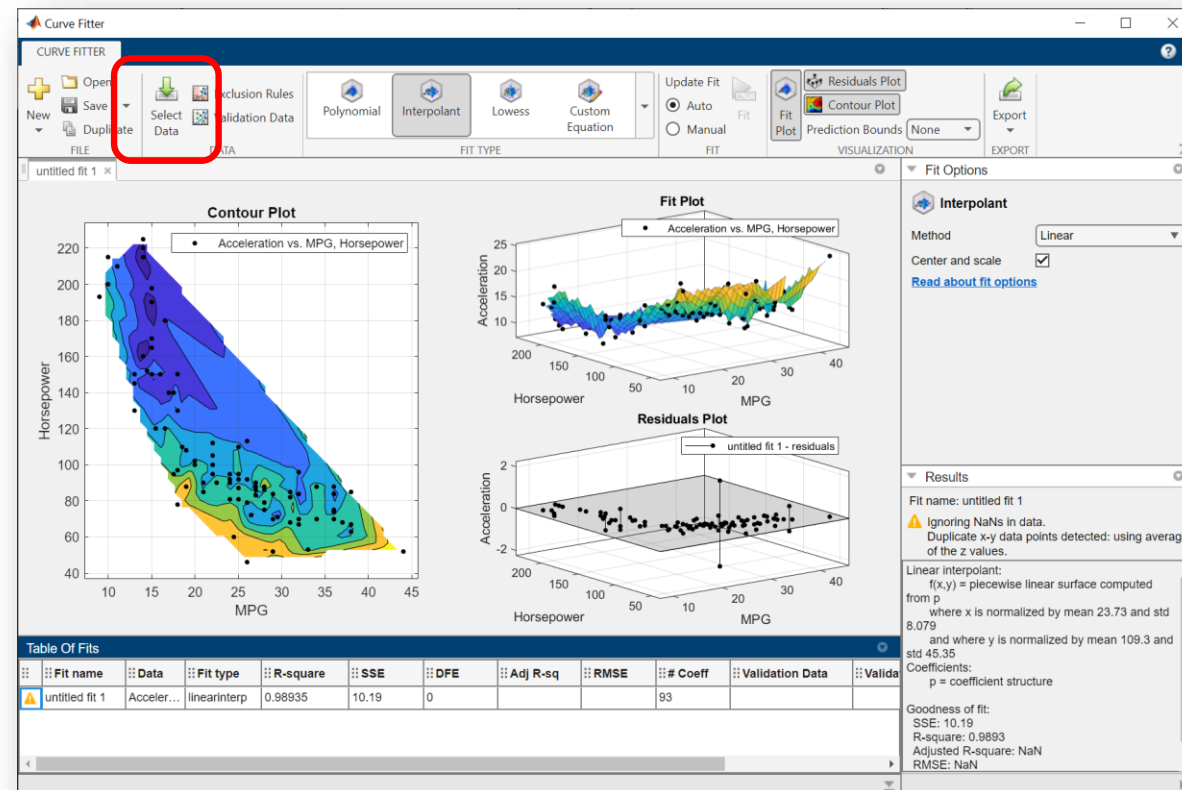
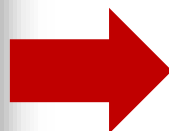
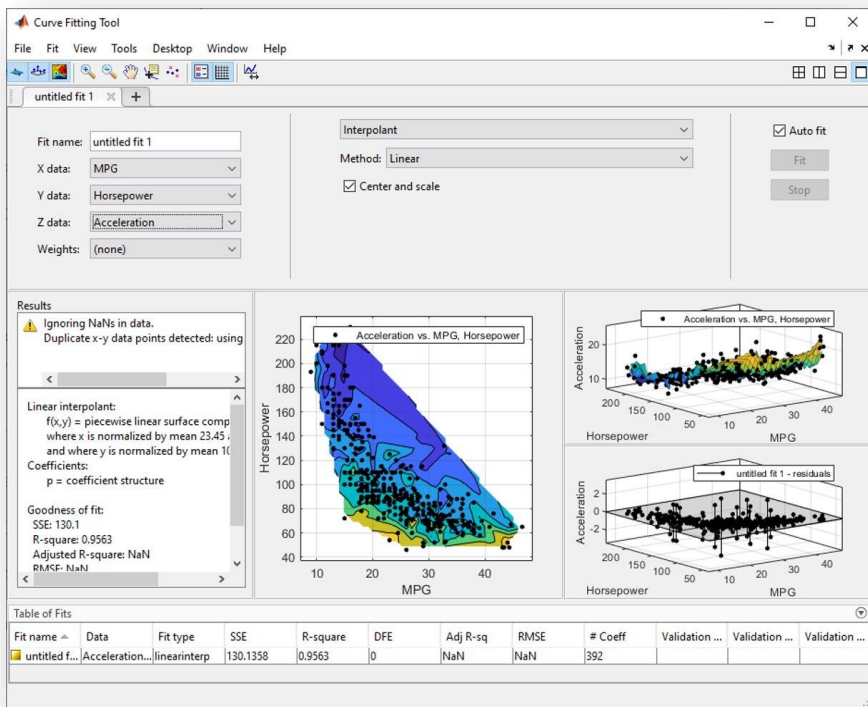
$$\frac{e^{-xi}i - e^{xi}i}{e^{-xi} + e^{xi}}$$

3 int(eq)
ans = xi - log(e^{xi} - i) - log(e^{xi} + i)
4 simplify(eq)
ans =

$$\frac{e^{2xi}i - i}{e^{2xi} + 1}$$

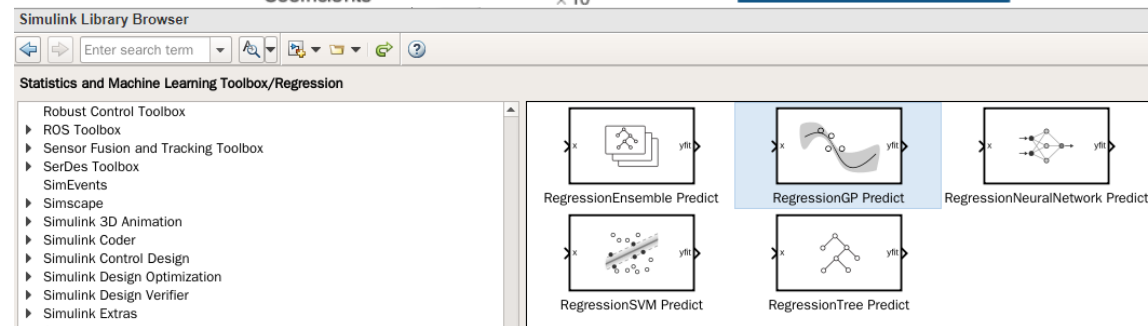
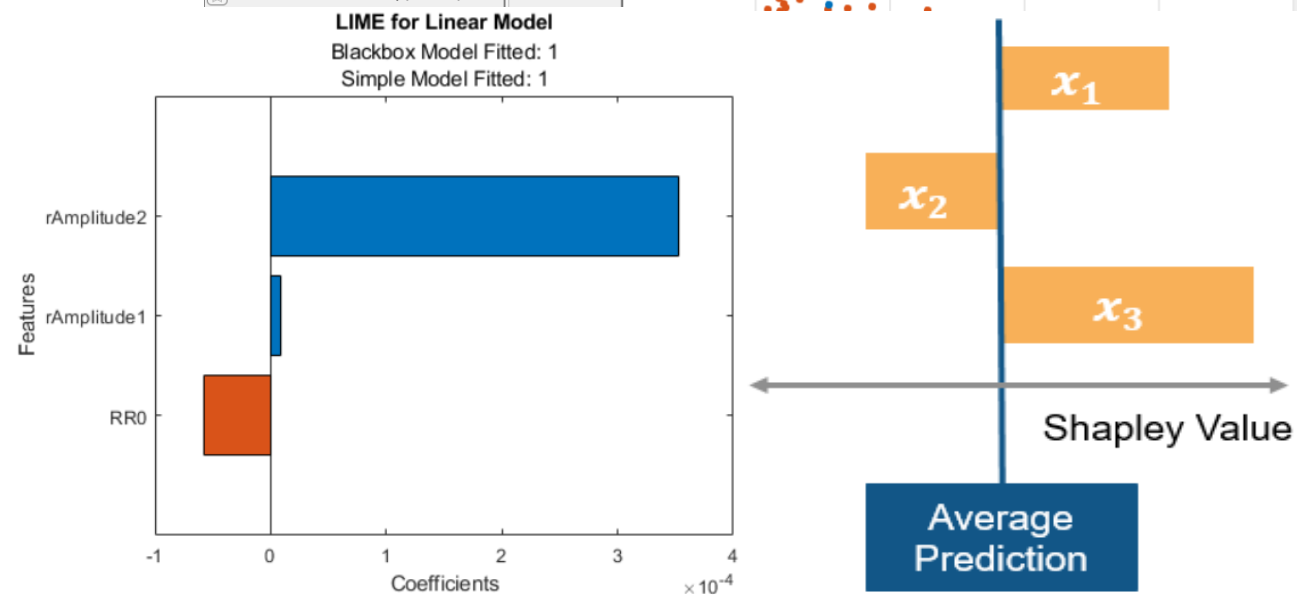
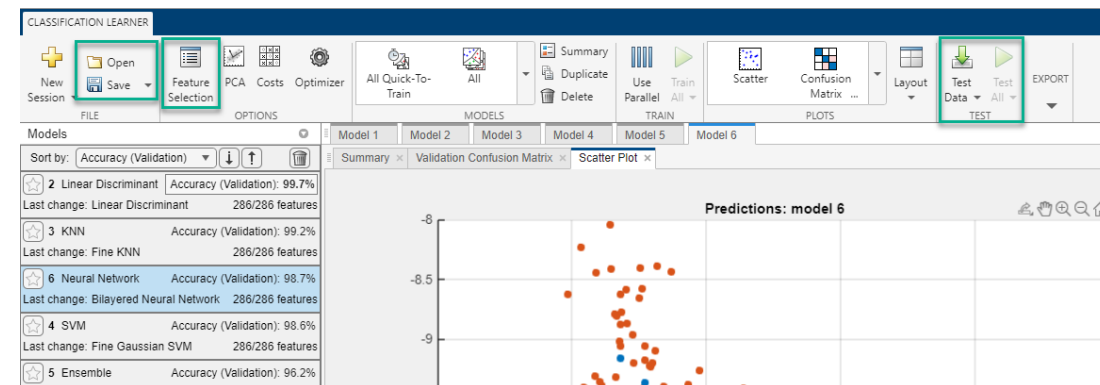

```

Fitovanie kriviek



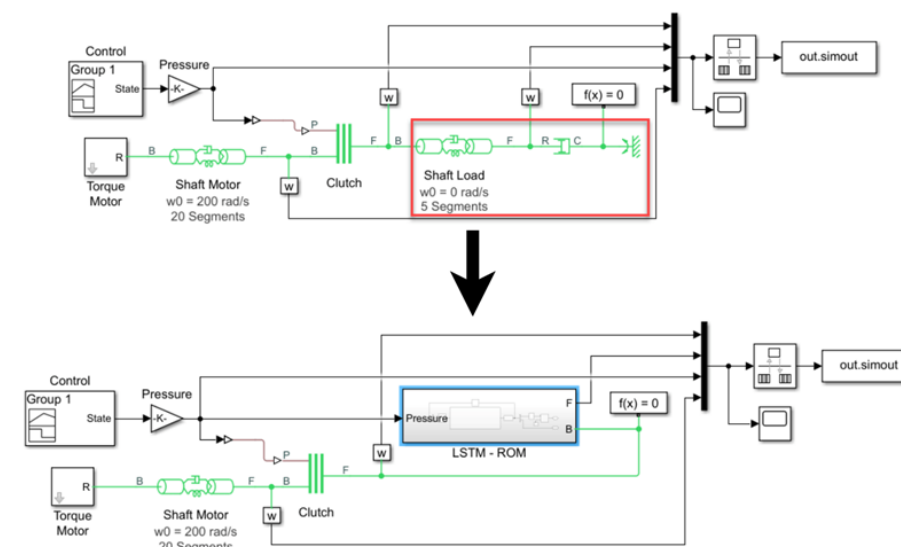
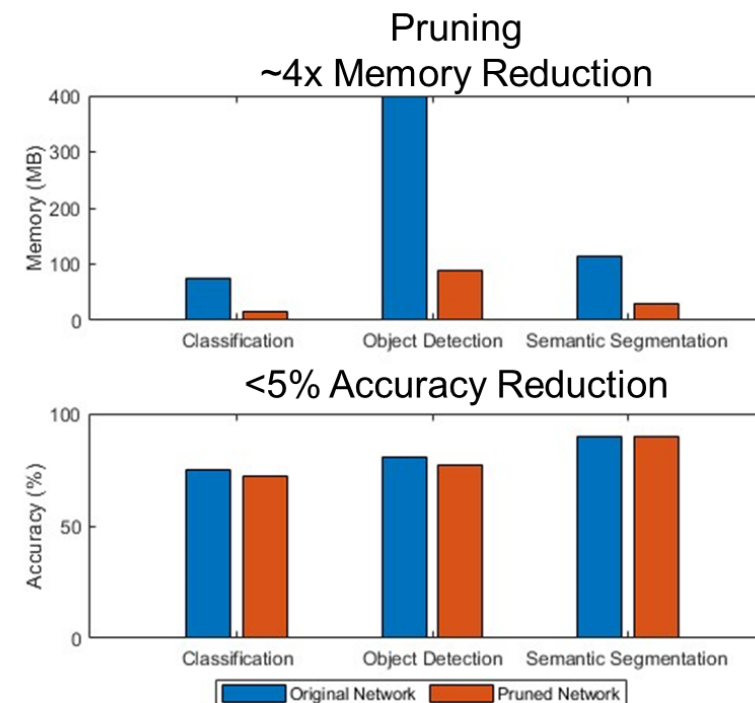
Strojové učenie

- Classification/Regression Learner app
 - Save/Load Session
 - Klasické neurónové siete
- Interpretabilita
 - Shapley hodnoty
 - Partial Dependence Plots (PDP)
- Inkrementálne učenie, stream dát
 - Detekcia driftu
- Simulácia a generovanie kódu



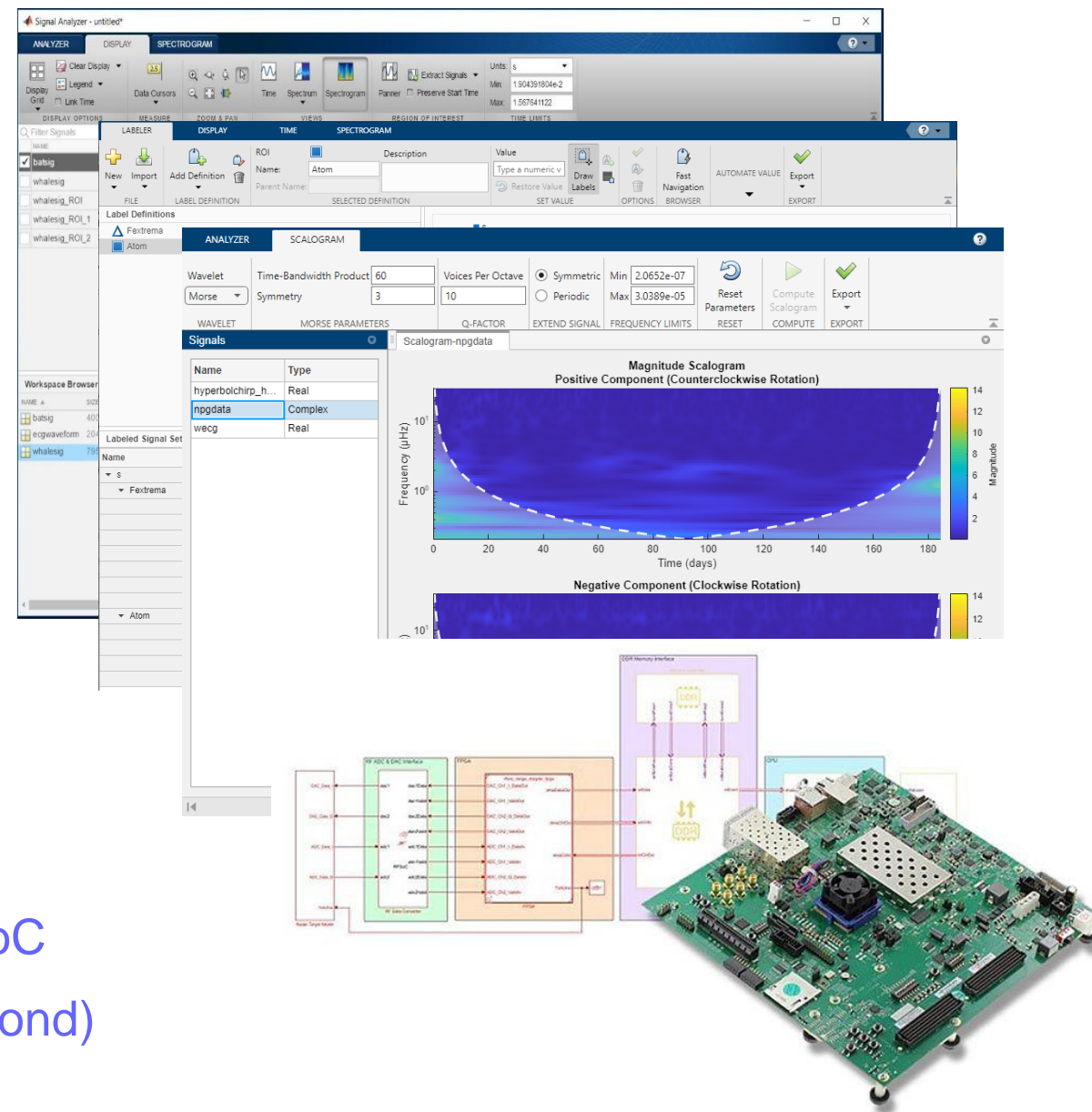
Deep Learning

- Redukcia pamäte a spotreby
 - Deep Network Quantization App
 - Quantizácia – float -> fixed
 - Pruning – odstránenie nepotrebných častí
- Podpora v Simulinku
 - Simulácia AI v rozsiahlych modeloch
 - Náhrada rozsiahlej časti AI modelom
- [MATLAB Deep Learning Model Hub](#)
 - Predtrénované modely
 - Pridávané pravidelne
 - Viaceré oblasti využitia



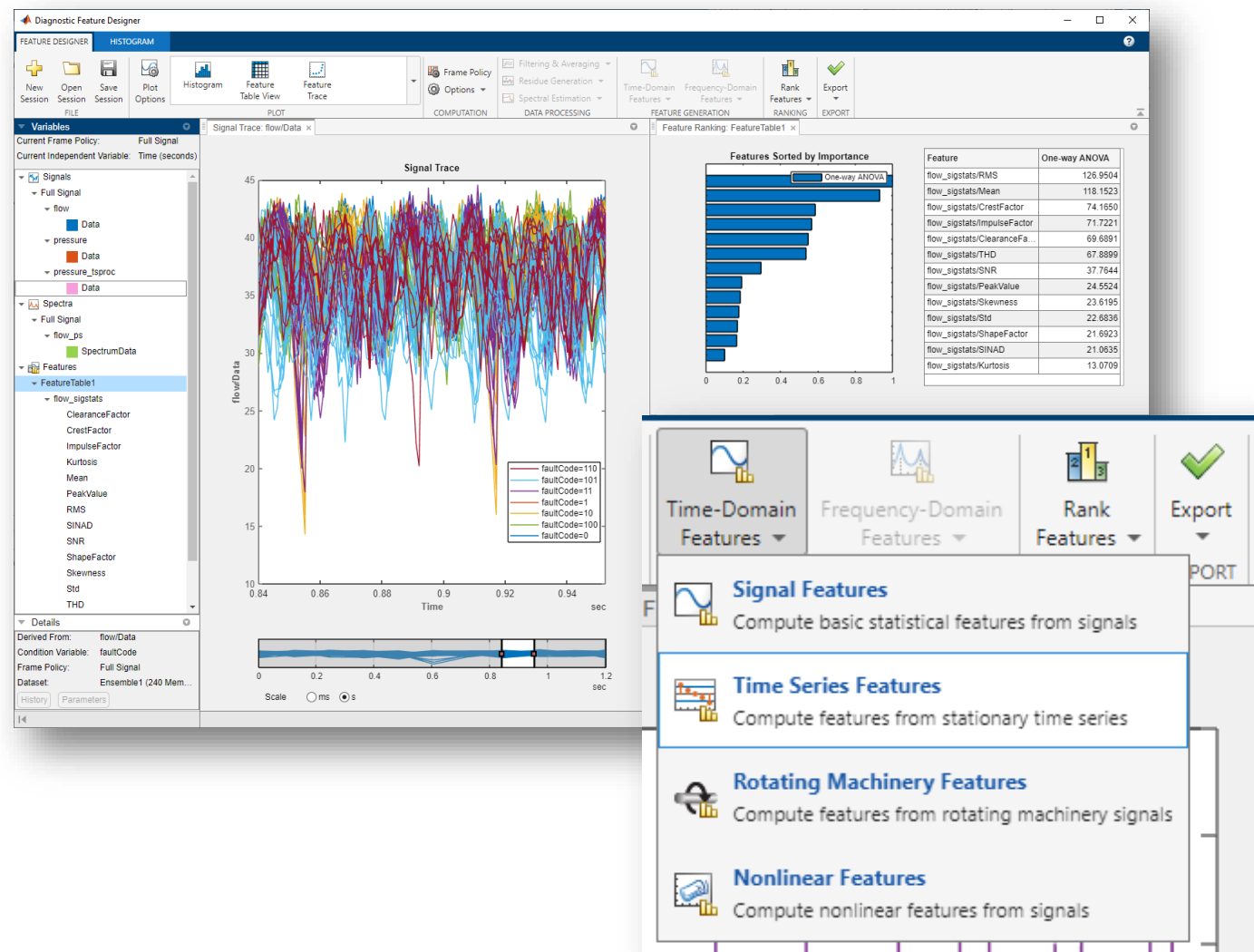
Spracovanie signálov

- Podpora AI
 - predspracovanie, príznaky, označovanie
- Interaktívne aplikácie
 - Signal Analyzer app, Signal Labeler app
 - Wavelet Time-Frequency Analyzer
- Generovanie kódu
 - C/C++ pre viac ako 200 funkcií, GPU
- DSP HDL Toolbox
 - spracovanie signálov pre FPGA, ASIC, SoC
 - vysoká priepustnosť (gigasample-per-second)
 - bloky optimalizované pre HDL



Prediktívna údržba

- Diagnostic Feature Designer
 - výber, vizualizácia a hodnotenie príznakov
- Výber príznakov
 - stacionárne časové rady
- Generovanie kódu
 - výpočet príznakov
 - RUL predikcia

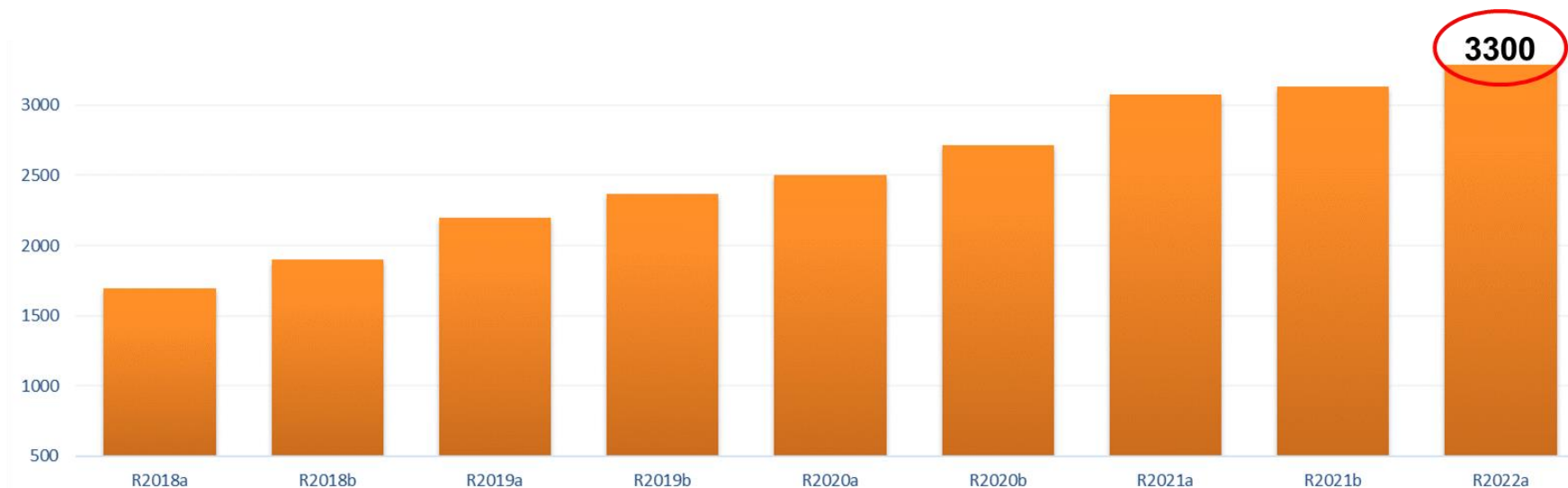


The screenshot displays the Diagnostic Feature Designer interface. The main window shows a 'Signal Trace' plot of 'flowData' over time (0.84 to 1.2 seconds) for various fault codes. A 'Features Sorted by Importance' bar chart and a 'One-way ANOVA' table are visible. The ANOVA table lists features and their corresponding values:

Feature	One-way ANOVA
flow_sigstats/RMS	126.9504
flow_sigstats/Mean	118.1523
flow_sigstats/CrestFactor	74.1650
flow_sigstats/ImpulseFactor	71.7221
flow_sigstats/ClearanceFa...	69.6891
flow_sigstats/THD	67.8899
flow_sigstats/SNR	37.7644
flow_sigstats/PeakValue	24.5524
flow_sigstats/Skewness	23.6195
flow_sigstats/Std	22.8836
flow_sigstats/ShapeFactor	21.6923
flow_sigstats/SINAD	21.0635
flow_sigstats/Kurtosis	13.0709

Below the main window, a dropdown menu is open, showing feature categories: Signal Features, Time Series Features, Rotating Machinery Features, and Nonlinear Features.

Generovanie kódu

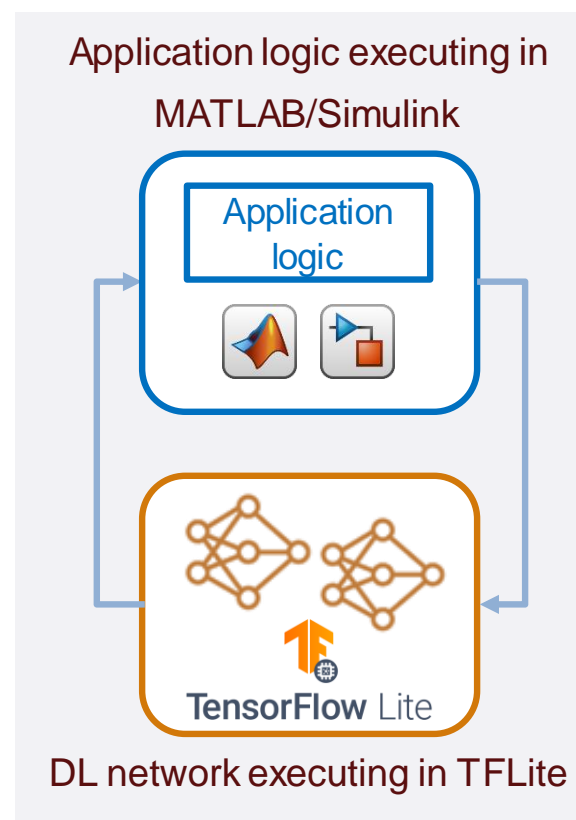


- 5G Toolbox
- Aerospace Toolbox
- Antenna Toolbox
- Audio System Toolbox
- Automated Driving Toolbox
- Communications Toolbox
- Computer Vision Toolbox
- Control System Toolbox
- Deep Learning Toolbox
- DSP System Toolbox
- Fixed-Point Designer
- Fuzzy Logic Toolbox
- Image Acquisition Toolbox
- Image Processing Toolbox
- Instrumental Control Toolbox
- Lidar Toolbox
- Mapping Toolbox **R2021a**
- Mixed-Signal Blockset **R2021a**
- Model Predictive Control Toolbox
- Navigation Toolbox
- Optimization Toolbox
- Phased Array System Toolbox
- Predictive Maintenance Toolbox **R2021a**
- Radar Toolbox **R2021a**
- Reinforcement Learning Toolbox **R2021b**
- Robotics System Toolbox
- ROS Toolbox **R2021a**
- Satellite Communications Toolbox **R2021a**
- Sensor Fusion and Tracking Toolbox
- SerDes Toolbox
- Signal Processing Toolbox
- Stats & Machine Learning Toolbox
- System Identification Toolbox
- UAV Toolbox
- Vision HDL Toolbox **R2021b**
- Wavelet Toolbox
- WLAN System Toolbox

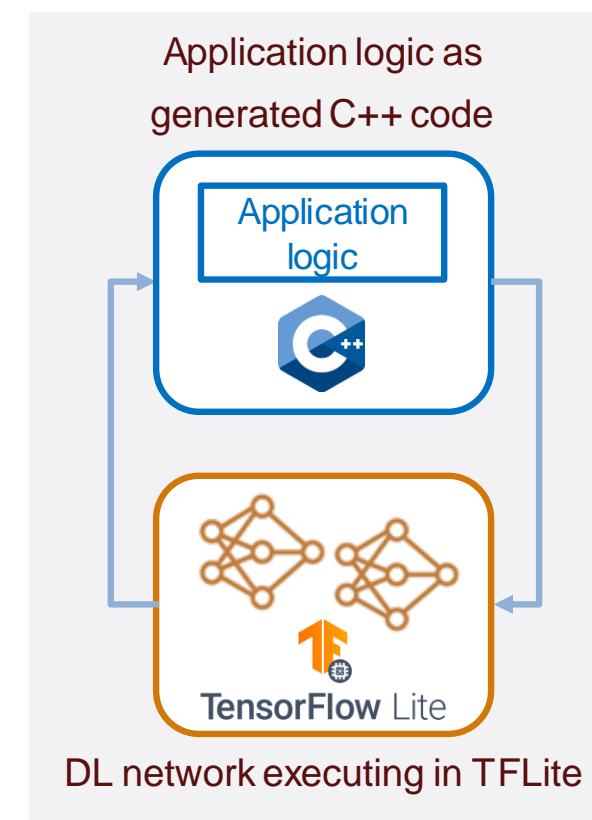
Podpora TensorFlow Lite

- TensorFlow Lite
 - Open source DL framework
 - pre koncové zariadenia
- Simulácia a nasadenie
 - Predtrénované modely TFLite
 - MATLAB a Simulink
- TFLite Support Package
 - Linux platforma

Simulácia

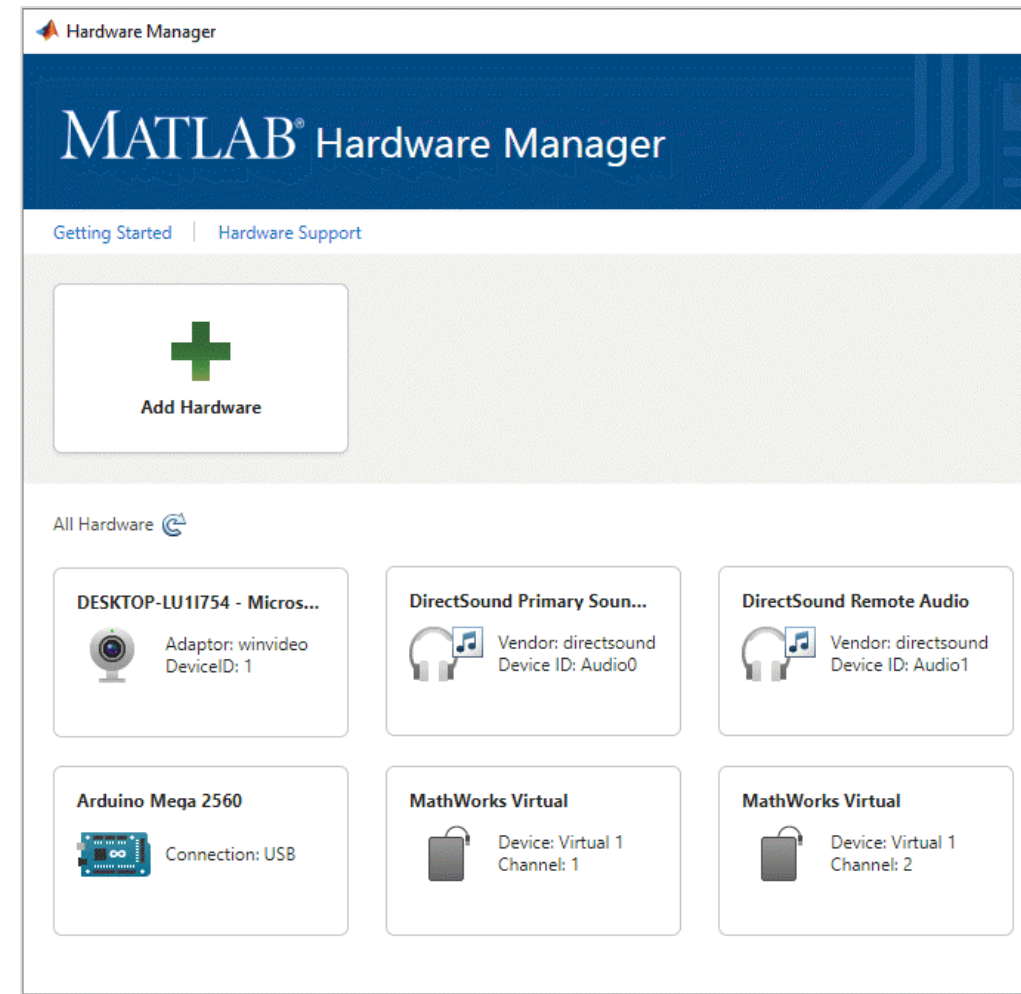


Generovaniu kódu



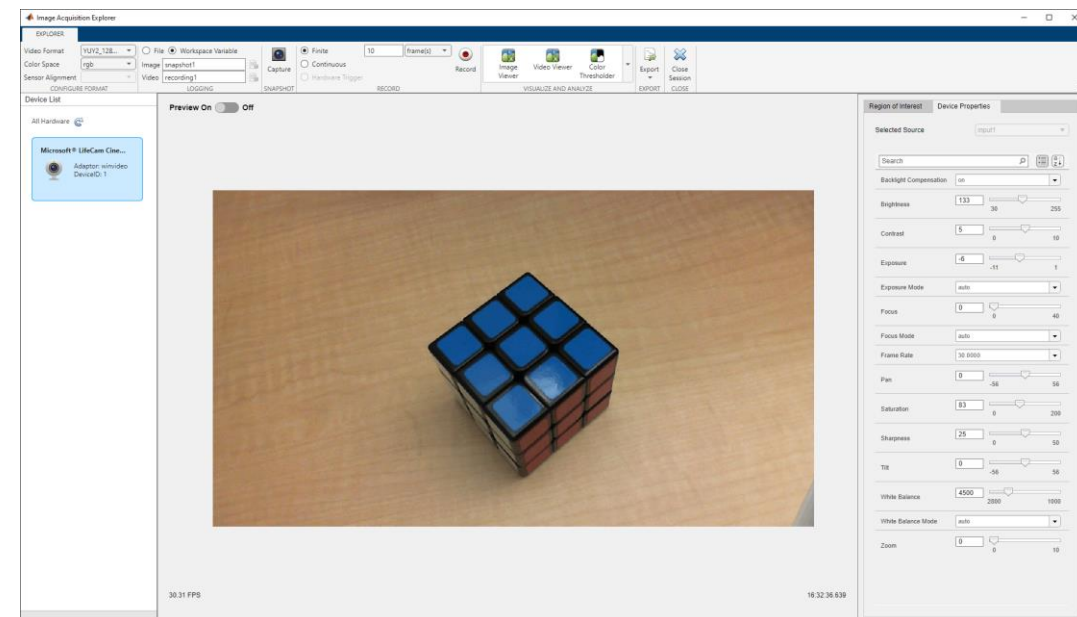
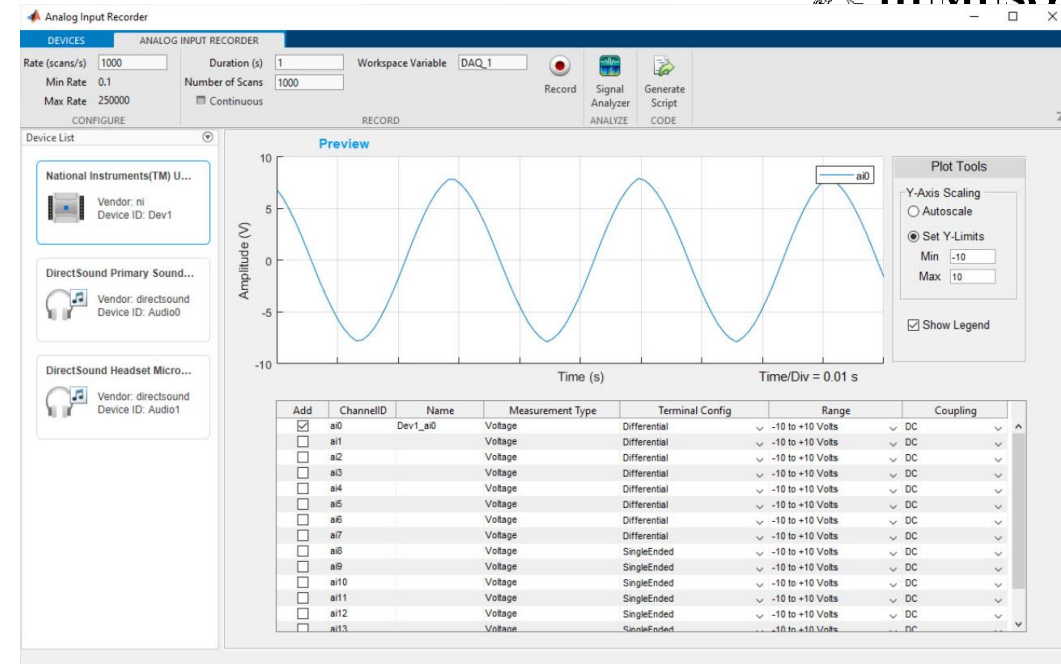
Komunikácia so zariadeniami

- Hardware Manager
 - nájsť a pripojiť k hardvéru z MATLABu
- Serial Explorer
 - pripojenie a komunikácia pomocou sériového spojenia
- TCP/IP Explorer
 - vytvorenie TCP/IP klienta na komunikáciu s TCP/IP serverom



Aplikácie získavania dát

- Analog Input Recorder app
 - Čítanie a vizualizácia DAQ dát
- Analog Output Generator app
 - Zápis dát na analógové DAQ výstupy
- Image Acquisition Explorer app
 - Náhľad a nastavenia parametrov pre získavanie obrazu
 - Generovanie kódu pre MATLAB



Prístup k priemyselným dátam

- Industrial Communication Toolbox
- Prístup k OPC UA serveru
 - aj šifrovane
- Komunikácia pomocou protokolov
 - Modbus
 - MQTT
 - OSIsoft PI System

```
serverList = opcuaserverinfo('localhost')
```

```
serverList =  
OPC UA ServerInfo 'SimulationServer@AH-ewetjen':
```

Connection Information:

Hostname: 'AH-ewetjen.dhcp.mathworks.com'

Port: 53530

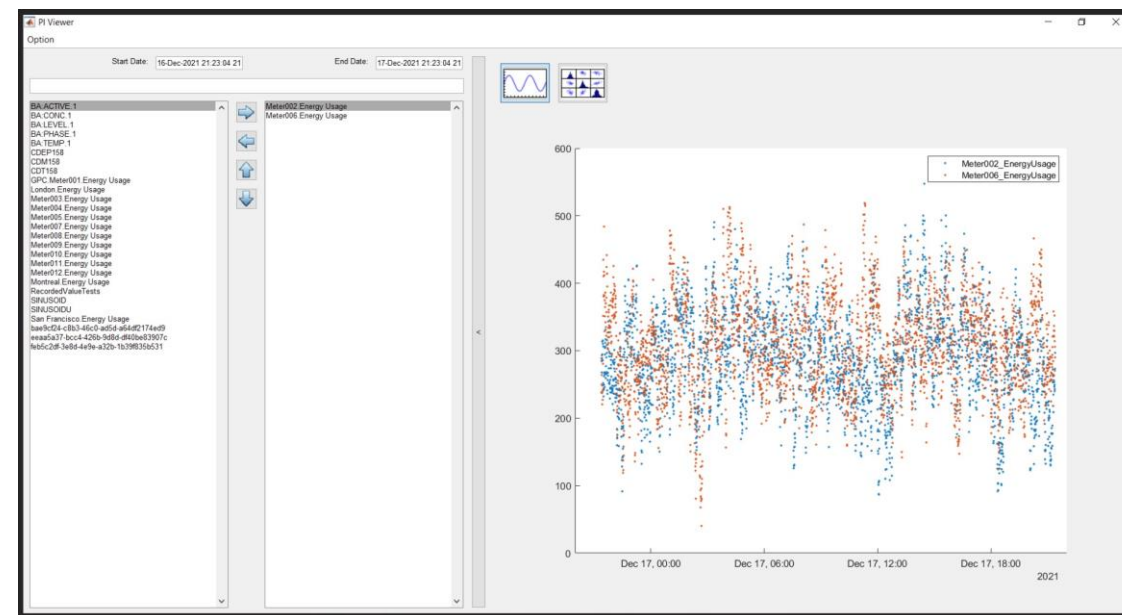
Endpoints: [1x11 opc.ua.EndpointDescription]

Security Information:

BestMessageSecurity: SignAndEncrypt

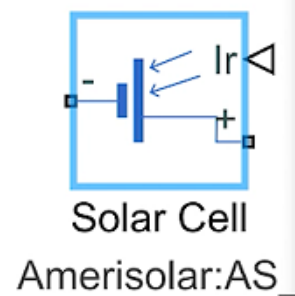
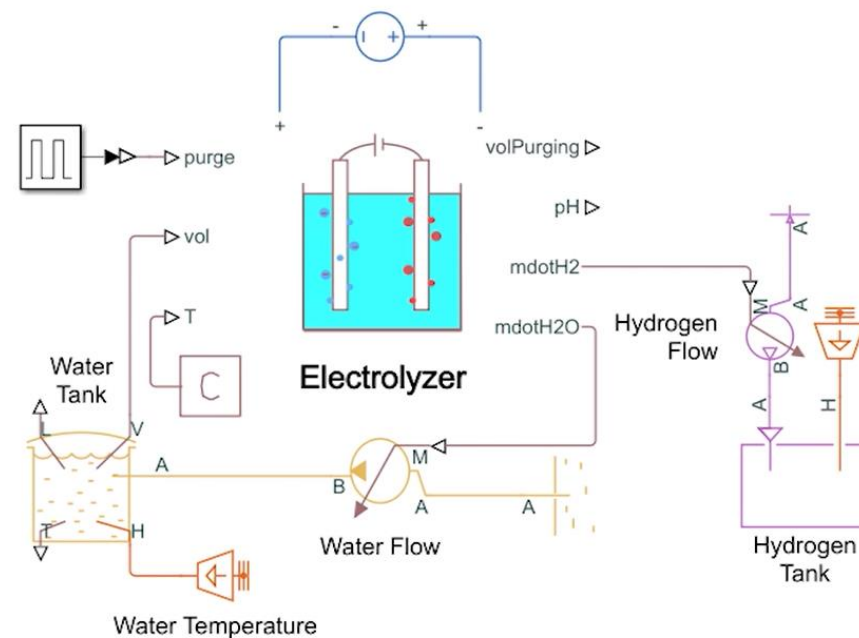
BestChannelSecurity: Aes256_Sha256_RsaPss

UserTokenTypes: {'Anonymous' 'Username' 'Certificate'}



Simscape Electrical

- Elektrifikácia
 - obnoviteľné zdroje, vodík, microgrid
- Electrolyzer
 - výroba vodíka
 - štúdie pokrývajúce viaceré domény
- Solar Cell
 - parametrizácia
 - 250 datasetov od výrobcov



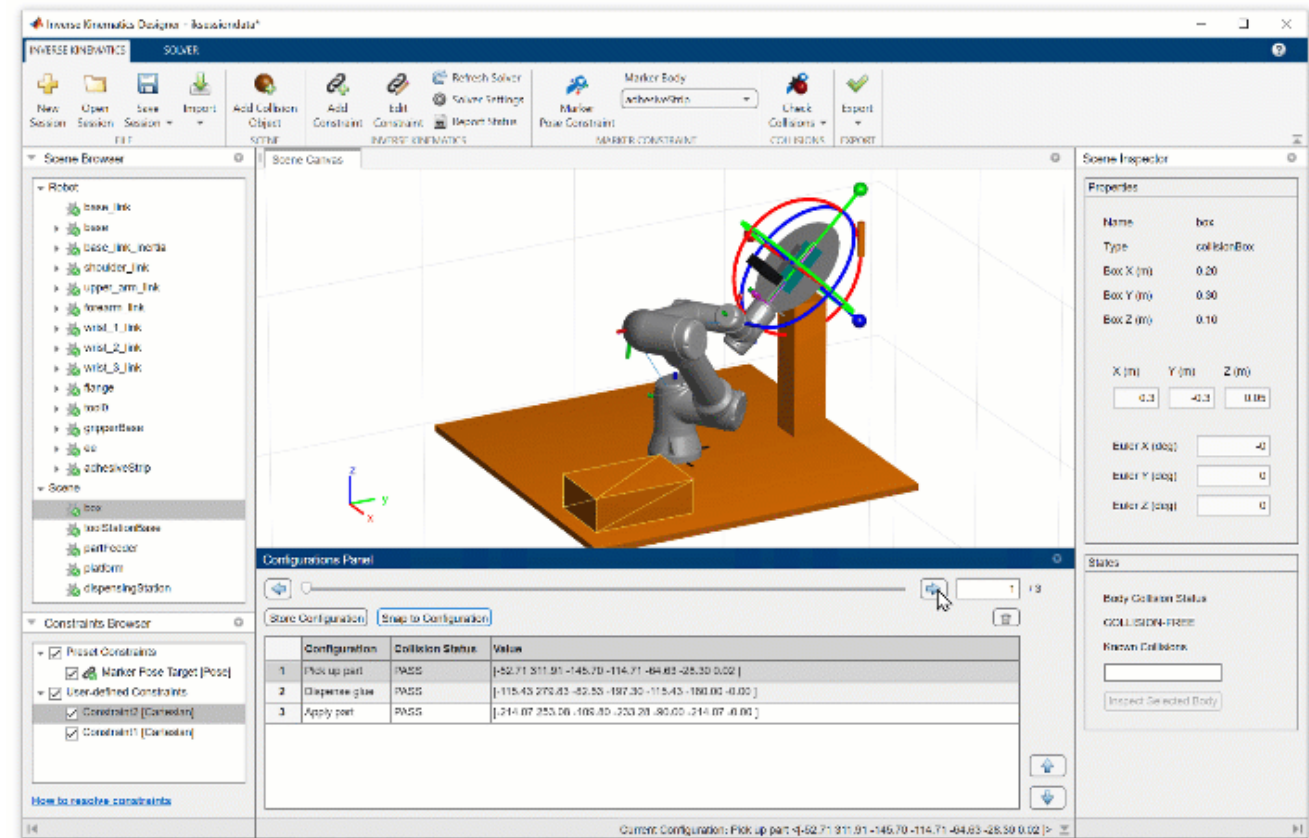
Block Parameterization Manager: Solar Cell

Part number	Manufacturer	Part Type
AS_6M30_HC_32...	Amerisolar	320.00W, Mono-crystallin
AS_6M_360W_PE...	Amerisolar	355.00W, Mono-crystallin
AS_6P30_HC_280W	Amerisolar	280.00W, Poly Silicon, H
AS_6P_HC_340W	Amerisolar	340.00W, Poly Silicon, H
AS_6P_HC_360W	Amerisolar	360.00W, Poly Silicon, H
ThinFilm_AS_100W	Amerisolar	100.00W, Amorphous silic
ThinFilm_AS_85W	Amerisolar	85.00W, Amorphous silicc
CHSM5001T_110W	Astronergy	110.00W, Amorphous silic
3C44_30sqmm	AzurSpace	12.00W, GaInP/GaInAs/C
3C44_9sqmm	AzurSpace	3.92W GaInP/GaInAs/Ge

Attribute	Value
Manufacturer	An
Part number	AS
Part series	
Web link	htt
Part type	28
Parameterization date	17
Parameterization note	Pr
Part data file location	Sc

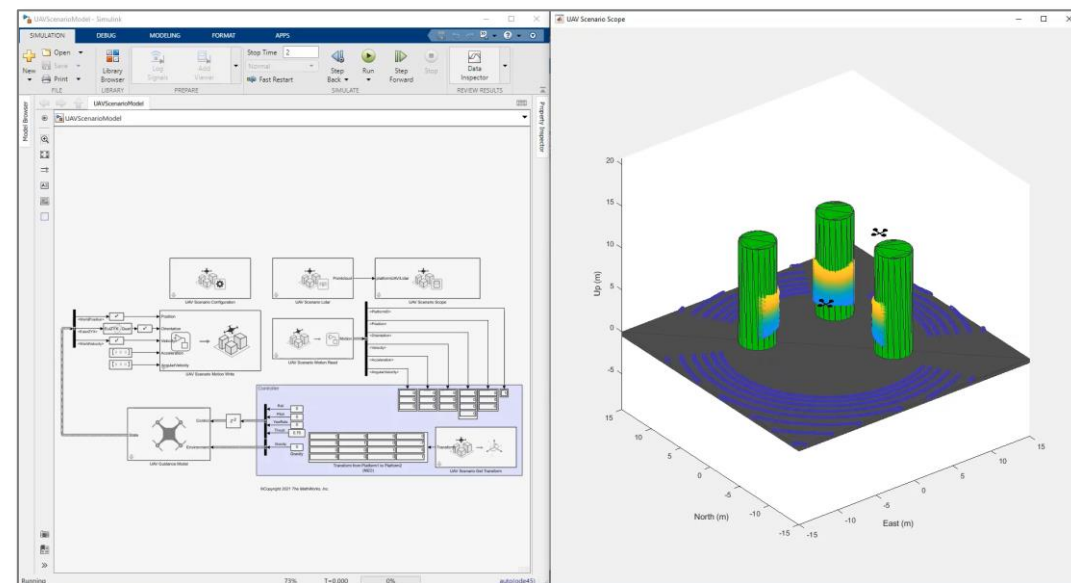
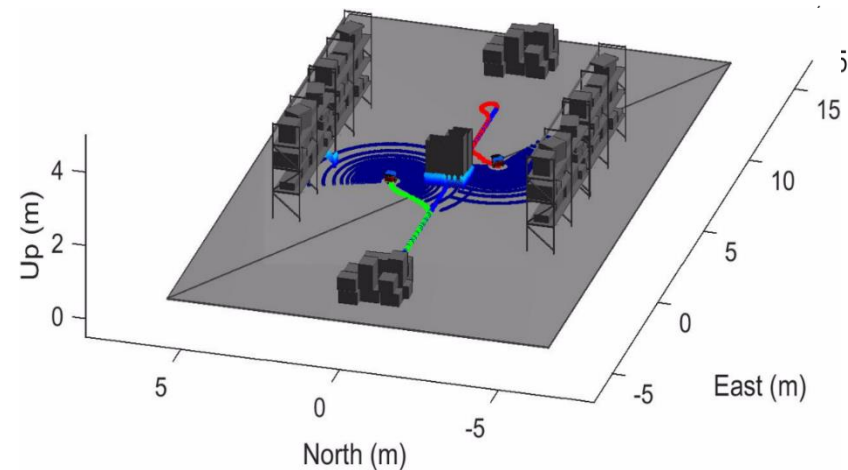
Robotika a UAV

- Inverse Kinematics Designer
 - vizualizácia a ladenie riešičov
 - kolízie a prekážky
 - export do MATLABu



Robotika a UAV

- Inverse Kinematics Designer
 - vizualizácia a ladenie riešičov
 - kolízie a prekážky
 - export do MATLABu
- Tvorba scenárov
 - robotika aj UAV
 - scenáre aj simulácia snímačov
 - integrácia s kinematikou



Robotika a UAV

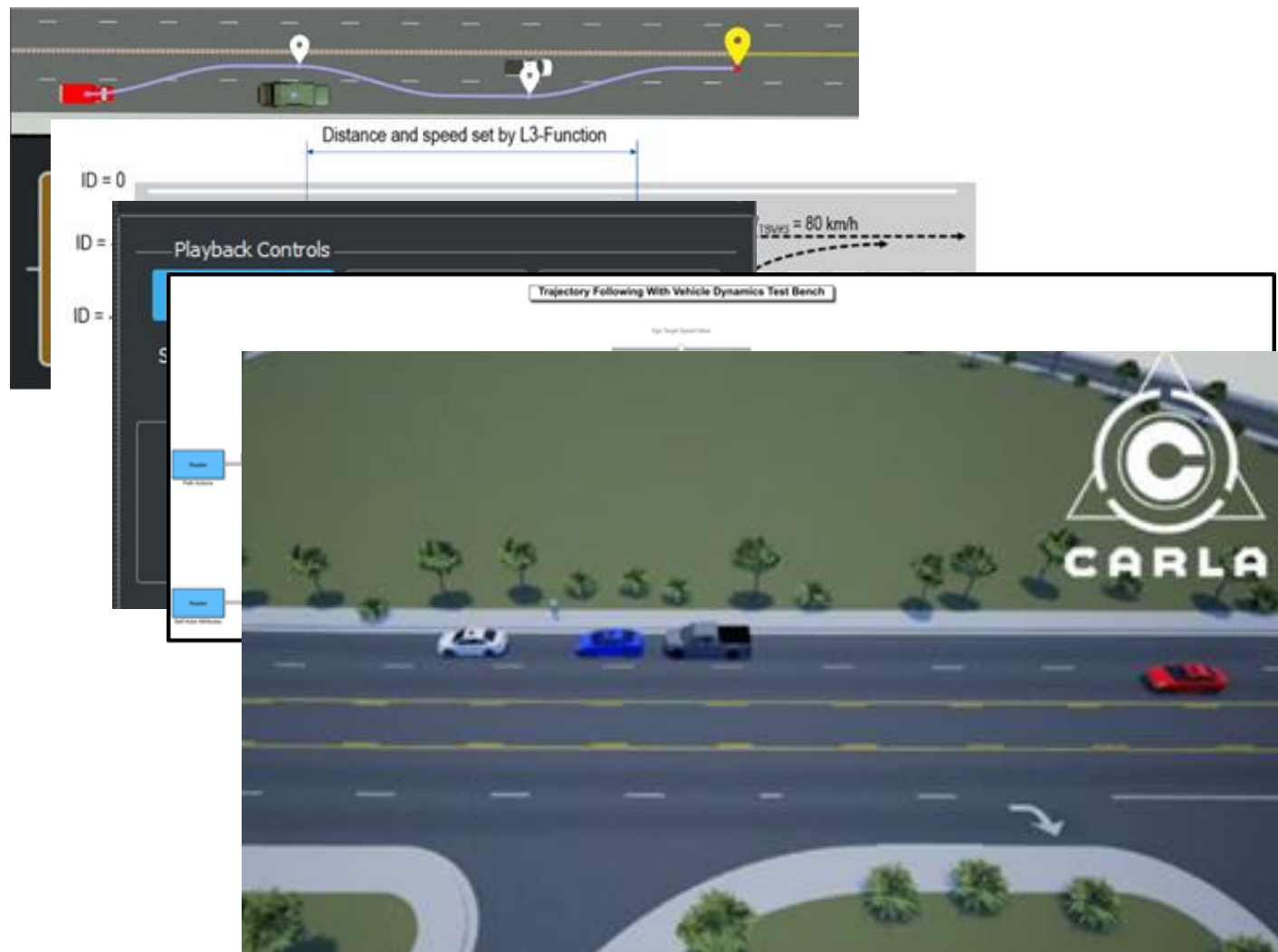
- Inverse Kinematics Designer
 - vizualizácia a ladenie riešičov
 - kolízie a prekážky
 - export do MATLABu
- Tvorba scenárov
 - robotika aj UAV
 - scenáre aj simulácia snímáčov
 - integrácia s kinematikou
- UAV Scenario Designer App
 - terén, objekty snímáče, trajektórie
 - import/export a simulácia

Time	X	Y	Z	Course	Group
0	-583.0000	-133.0000	-52.0500	42.9300	
18.4260	-262.0000	16.0000	-52.0500	-11.5900	
25.9700	-137.0000	-63.0000	-52.0500	-51.3600	
36.5420	-27.0000	-243.0000	-52.0500	-48.5400	

Návrh a simulácia scenárov

- RoadRunner Scenario
 - Interaktívny návrh scenárov
 - Prepojenie s OpenSCENARIO
 - Automatizácia úloh
 - Simulácia scenárov

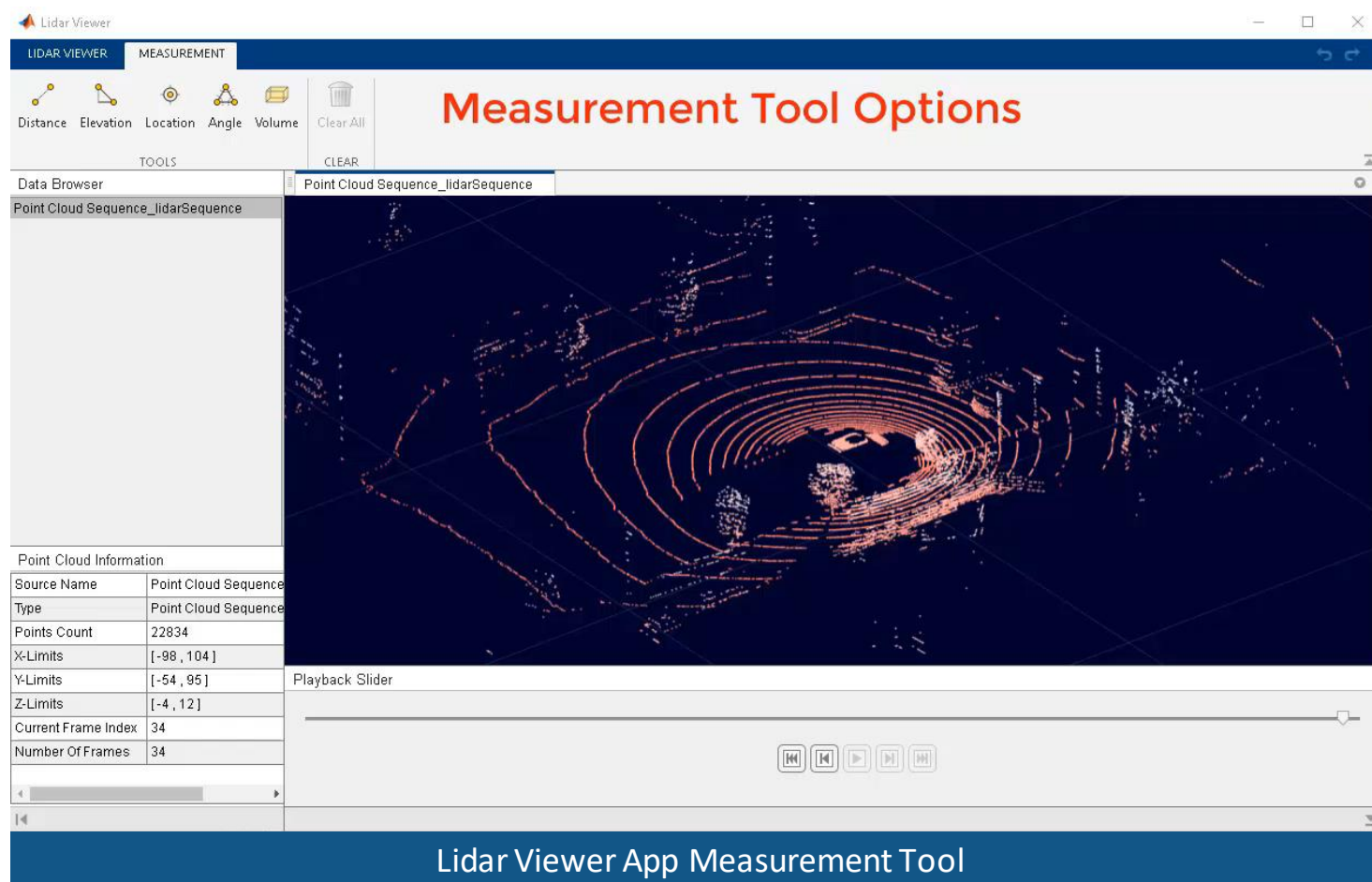
- Integrácia
 - MATLAB a Simulink
 - CARLA



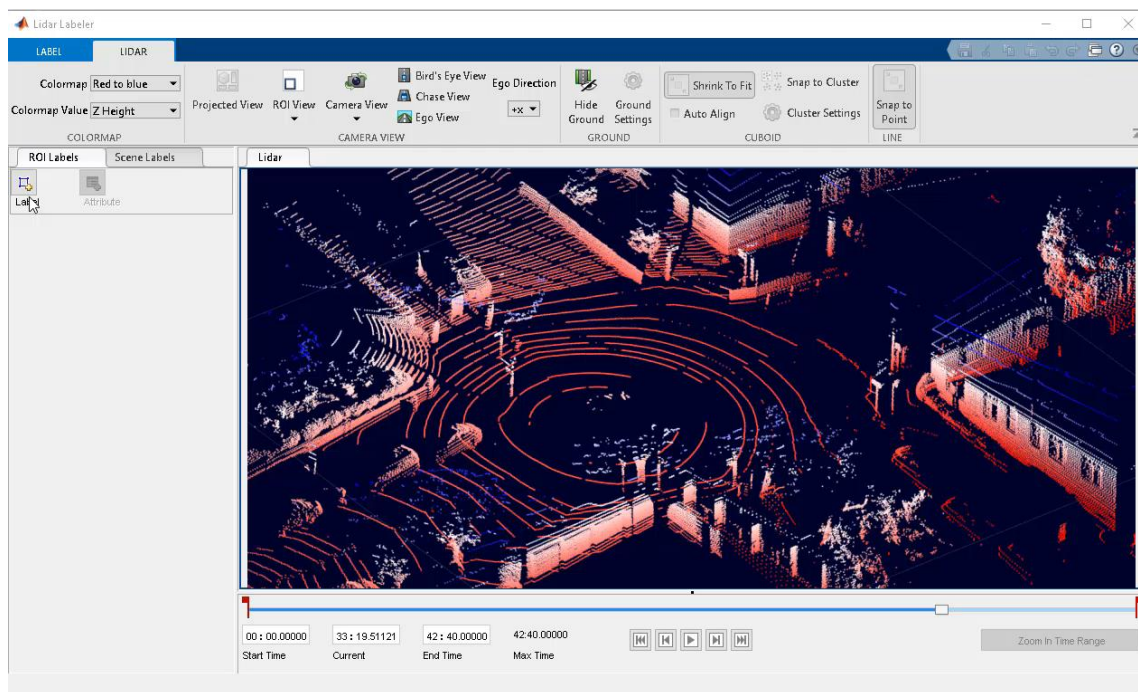
Práca s lidarom

- Lidar Viewer
 - Import a export
 - Vizualizácia
 - Predspracovanie

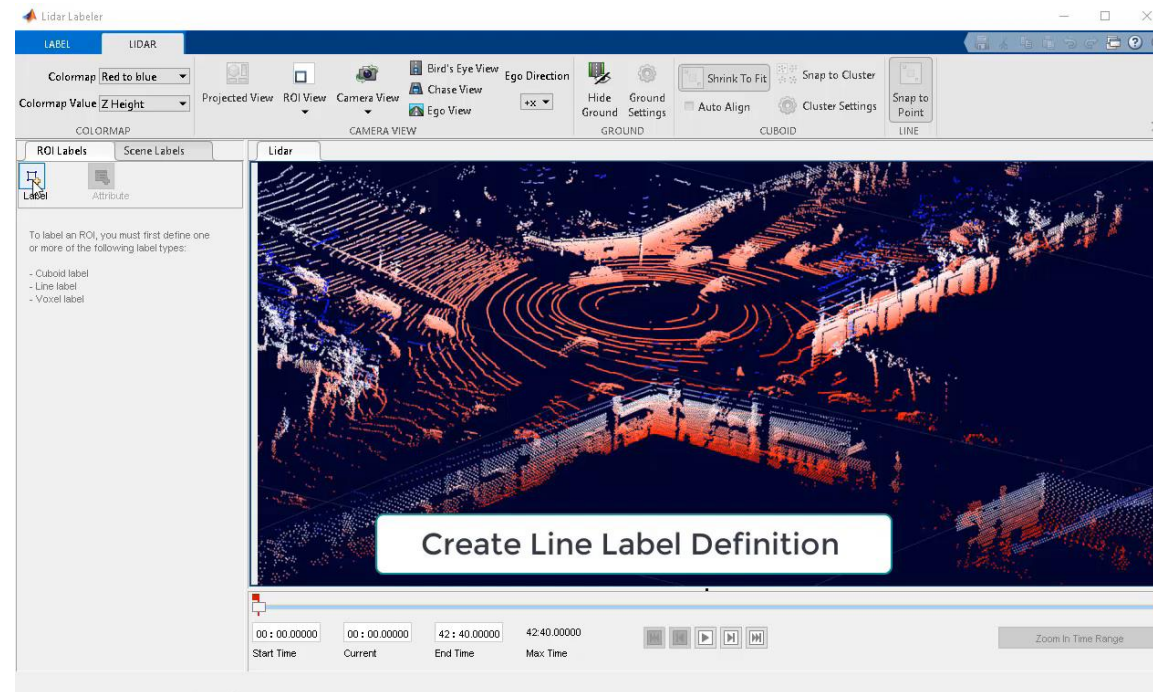
- Meranie
 - Vzdialenosť
 - Uhly
 - Poloha
 - Objem
 - ...



Práca s lidarom - označovanie



Voxel ROI – 3D Semantic Labeling

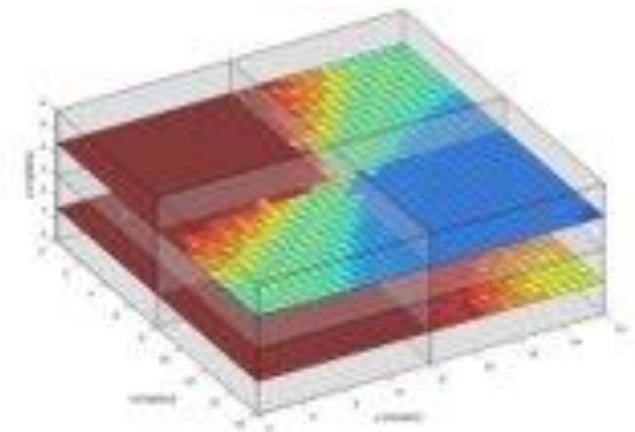


3D Line Labeling – Extending 2D line ROI to 3D Line

Rozšírená podpora bezdrôtových štandardov

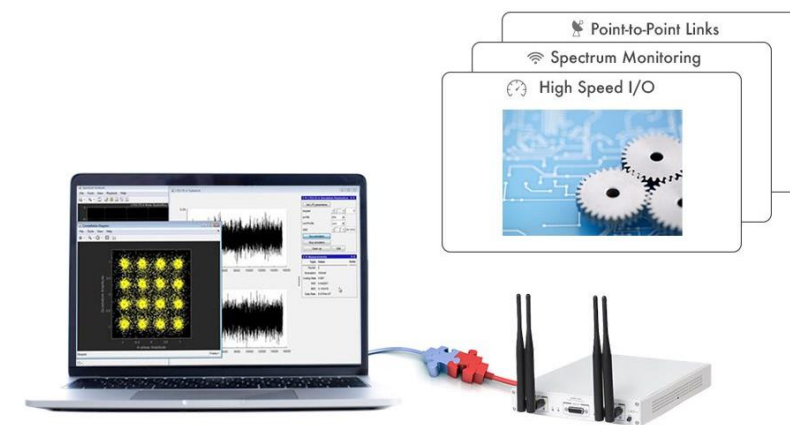
- Bluetooth Toolbox

- Supports Bluetooth Low Energy (LE)
- Bluetooth Classic
- konfigurácia, simulácia a analýza komunikácia
- koexistencia, interferencia, lokalizácia



- Wireless Testbench

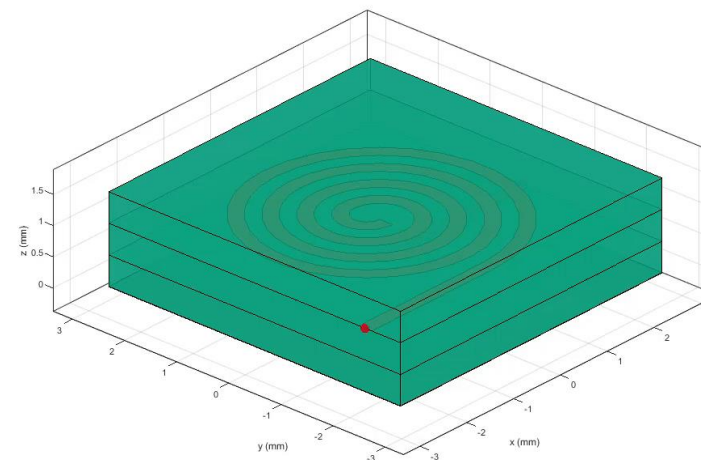
- Referenčné aplikácie pre vysoko-rýchlostny prenos
- Monitorovanie spektra
- Testovanie na SDR hardvéri



Podpora RF a antén

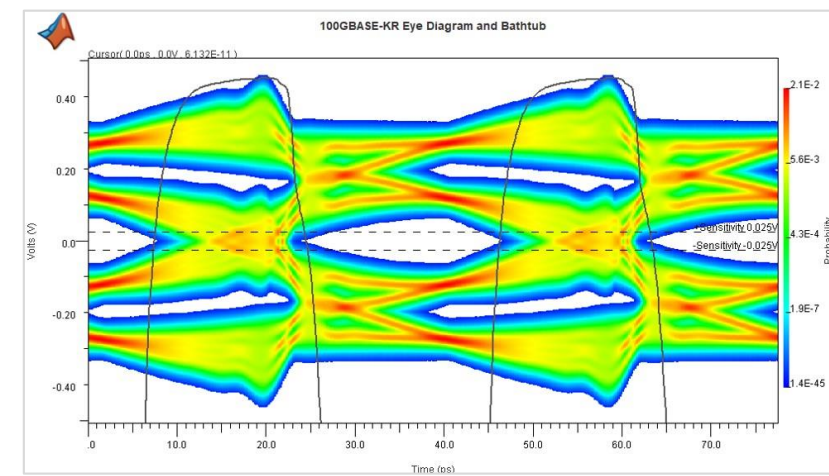
- RF PCB Toolbox

- elektromagnetická analýza PCB
- integrácia výsledkov na systémovej úrovni
- analýza návrhu PCB



- Signal Integrity Toolbox

- vysokorýchlostné sériové a paralelné linky
- splnenie priemyselných štandardov
- simulácia a verifikácia návrhov v spolupráci s ďalšími nastavbami



R2022a at a Glance

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R2022a Release Highlights

New Products

- **Bluetooth Toolbox** – Simulate, analyze, and test Bluetooth communications systems
- **DSP HDL Toolbox** – Design digital signal processing applications for FPGAs, ASICs, and SoCs

Resources

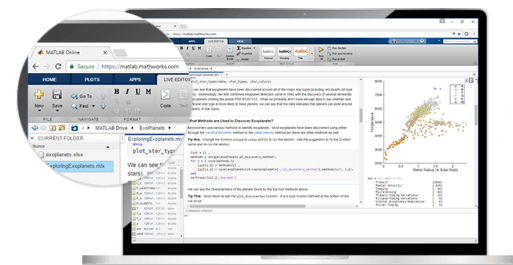
- [Release Notes](#)
- [Why Upgrade?](#)
- [License-Related Changes](#)

https://www.mathworks.com/products/new_products/latest_features.html

Online služby



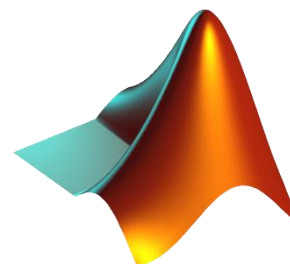
ThingSpeak



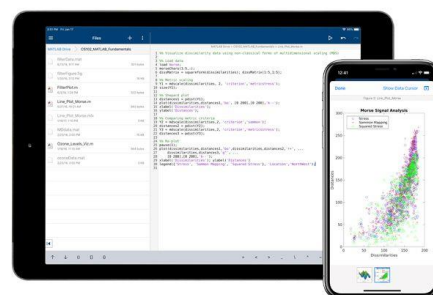
MATLAB Online



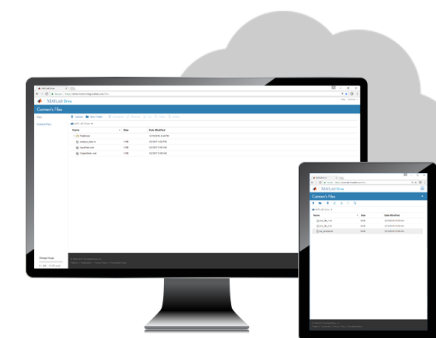
MATLAB Grader



Simulink Online
















MATLAB Mobile



MATLAB Drive

MATLAB a Simulink vlastným tempom

Getting Started

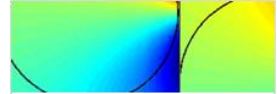
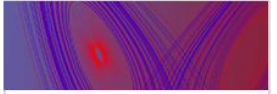
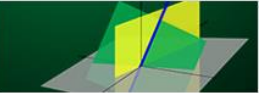


 FREE MATLAB Onramp	 FREE Deep Learning Onramp	 FREE Reinforcement Learning Onramp	 FREE Machine Learning Onramp	 FREE Image Processing Onramp	 FREE Signal Processing Onramp	 NEW FREE Optimization Onramp	 NEW Wireless Communications Onramp
 FREE Simulink Onramp	 FREE Control Design Onramp with Simulink	 FREE Stateflow Onramp	 FREE Simscape Onramp	 NEW FREE Circuit Simulation Onramp			

MATLAB and Simulink

 MATLAB Fundamentals	 NEW Simulink Fundamentals	 MATLAB for Data Processing and Visualization	 NEW Signal Processing with MATLAB
 Deep Learning with MATLAB	 Machine Learning with MATLAB	 Image Processing with MATLAB	 MATLAB Programming Techniques

Computational Mathematics

* Available exclusively for users with Online Training Suite

 Solving Nonlinear Equations with MATLAB	 Solving Ordinary Differential Equations with MATLAB	 Introduction to Linear Algebra with MATLAB
 Introduction to Statistical Methods with MATLAB	 Introduction to Symbolic Math with MATLAB	

Aktuálne semináre – jeseň/zima 2022

Aplikace MATLABu ve výuce matematiky, fyziky a dalších přírodních věd	13.09.2022 13:00, 50 min 14.09.2022 17:00, 50 min
Od prípravy dát po spracovanie signálov	04.10.2022 13:00, 95 min 05.10.2022 17:00, 95 min
MATLAB v přehledu	11.10.2022 13:00, 115 min 12.10.2022 17:00, 115 min
Tvorba interaktívnych grafických aplikácií v prostredí MATLAB	25.10.2022 13:00, 50 min 26.10.2022 17:00, 50 min
Prediktivní analytika, detekce anomálií a vizuální inspekce	08.11.2022 13:00, 95 min 09.11.2022 17:00, 95 min
Paralelní výpočty a big data v prostředí MATLAB	29.11.2022 13:00, 50 min 30.11.2022 17:00, 50 min
Open Science s prostředím MATLAB	10.01.2023 13:00, 50 min 11.01.2023 17:00, 50 min
Zpracování obrazu v medicínských a přírodovědných aplikacích	31.01.2023 13:00, 50 min 01.02.2023 17:00, 50 min

Ďakujem za pozornosť