MATLAB EXPO 2018

What’s New in MATLAB and Simulink  R2017b  R2018a

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Platform
Productivity

Getting your work
done faster

Workflow
Depth

Support for your
entire workflow

Application
Breadth

Products for the
work you do
- Create Your Designs Faster
- Simplify Analysis
- Simulate Faster and Scale Your Work
- Collaborate
Create Your Designs Faster

Explore and Analyze Storm Events

Frequency of Events
Explore the frequency of various storm events and locations and the associated damage costs.

```matlab
load preEvents
data = timetable2table(data);
head(data)
```

Visualize with a Heatmap
This is helpful in exploring patterns across categories like events and locations.

```matlab
bigfigure;
heatmap(data,'state','weathercats');
xlabel('State')
ylabel('Storm Event')
title('Frequency of Events by Location')
```
Create Your Designs Faster

MATLAB

App Designer
Create Your Designs Faster

MATLAB

Simulink
Create Your Designs Faster

MATLAB

Simulink

Stateflow
Simplify Analysis with Apps

These interactive applications automate common technical computing tasks

- Econometric Modeler app
  - Perform time series analysis, specification testing, modeling, and diagnostics

- Analog Input Recorder app
  - Acquire and visualize analog input signals

- Wavelet Signal Denoiser app
  - Visualize and denoise time series data
Simplify Analysis by Simulating at Wall Clock Speed

Slow down the simulation for easier model interactivity

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

Use parallel computing to run multiple simulations faster

- Run multiple parallel simulations with `parsim`
- Monitor simulation status and progress in the Simulation Manager
Scale Your Work

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

- Use familiar MATLAB functions and syntax
- Support for hundreds of functions
- Works with Spark + Hadoop clusters
Simulate Faster

Redesigned execution engine runs MATLAB code faster

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

Use advanced software development features to manage, test, and integrate MATLAB code
Team Collaboration

Use advanced software development features to manage, test, and integrate MATLAB code

Identify differences between model elements, Stateflow charts, and MATLAB Function blocks
- Create Your Designs Faster
- Simplify Analysis
- Simulate Faster and Scale Your Work
- Collaborate
- Deployment of MATLAB Algorithms and Applications
- Code Generation from Simulink Models
- Verification and Validation
Deploy MATLAB Algorithms and Applications

**Access Data**
- Sensors
- Files
- Databases

**Analyze Data**
- Data exploration
- Preprocessing
- Domain-specific algorithms

**Develop**
- AI model
- Algorithm development
- Modeling & simulation

**Deploy**
- Desktop apps
- Enterprise systems
- Embedded devices
Deploy MATLAB Algorithms and Applications

Share your work outside of MATLAB without having to recode your algorithms

- Standalone desktop applications
- Add-ins for Microsoft Excel
- Software components to integrate with other languages (C/C++, .NET, Python, Java)
- Software components for web and enterprise applications
Deploy MATLAB Algorithms and Applications

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Deploy MATLAB Algorithms

Deploy machine learning and deep learning models using automatically generated code

- Generate C code for predictive machine learning and deep learning models
- Generate optimized code for deep learning, embedded vision, and autonomous systems
- Target NVIDIA GPUs as well as Intel and ARM CPUs

Deploying Deep Neural Networks to Embedded GPUs and CPUs
Rishu Gupta, Ph.D
PID Control Tuning

Implement an embedded PID auto-tuning algorithm

- Automatically tune PID controller gains in real time against a physical plant
- No model of plant dynamics required
- Deploy the auto-tuning algorithm to embedded software using automatic code generation
Prepare Your Model for Code Generation

Prepare model components for code generation
Prepare Your Model for Code Generation

Prepare model components for code generation

Prepare model data for code generation
Generate Code from Simulink Models

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

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

Row-major memory layout option

Generating Industry Standards Production C Code Using Embedded Coder
Rajat Arora, Durvesh Kulkarni
Connecting Your Design to Hardware

Connect directly to hardware with support packages

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

Demo Station: Hardware Connectivity with MATLAB and Simulink
Deploying to FPGA or ASIC Hardware

Algorithm

Algorithm w/ Hardware Implementation

HDL Verifier

HDL Coder

Fixed-Point HDL

FPGA/ASIC Implementation

Native Floating Point

1/sqrt(3)

Alpha_Gain

Matrix Support

Matrix Multiply

int16 (3)

uT

int16 [1x3]

Vision HDL Toolbox

LTE HDL Toolbox

HDL Checks in Model Advisor

Designing and Verifying Digital and Mixed-Signal Systems
Aniruddha Dayalu
Verification and Validation

Products for the entire workflow

Simulink Requirements

Simulink Design Verifier

Simulink Check

Simulink Coverage

Simulink Test

Polyspace

Verification and Validation of High-Integrity Systems
Chethan CU, Vaishnavi HR

now supports
- Deployment of MATLAB Algorithms and Applications

- Code Generation from Simulink Models

- Verification and Validation
- Autonomous Systems
- Wireless Communications
- Artificial Intelligence (AI)
Designing Autonomous Systems

- Sense
- Perceive
- Decide & Plan
- Act
Designing Autonomous Systems

Mapping of environments using sensor data

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

Understanding the environment using computer vision and deep learning techniques

- Object detection and tracking
- Semantic segmentation using deep learning

Designing Autonomous Systems

Design synthetic driving scenarios to test controllers and sensor fusion algorithms

- Interactively design synthetic driving scenarios composed of roads and actors (*vehicles, pedestrians, etc.*)
- Generate visual and radar detections of actors
Designing Autonomous Systems

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

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

Demo Station:
Closed-Loop Design with Model Predictive Control and Sensor Fusion
Full Vehicle Simulation

Ride & handling

Chassis controls

Automated Driving

Full Vehicle Simulation for Electrification and Automated Driving Applications
Prasanna Deshpande, R. Vijayalayan
Design with the Latest Wireless Standards

- **LTE**
- **5G**
- **802.11ax**
- **ZigBee**
- **NB-IoT**

**5G: What’s Behind the Next Generation of Mobile Communications?**
Tabrez Khan
Model-Based Design for Wireless Communications

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

**Code Generation and Verification**
- Fixed-Point Designer
- HDL Coder
- HDL Verifier
- LTE HDL Toolbox
- Embedded Coder
RF and Antenna Design and Prototyping

Use RF and Antenna models through your entire development cycle

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

Model HVAC and environmental control systems

- Model and simulate HVAC systems for a plant, such as a building, automobile, aircraft
- New library contains chambers, reservoirs, local restrictions, energy converters, sources and sensors
- Ensure acceptable temperature, pressure, humidity, condensation within the environment
- Note for Simscape in general: Run simulations about 5x faster with local solver option
Artificial Intelligence

Data → COMPUTER → Model

Output
Text Analytics Toolbox

Data

repairNotes = 517x1 string array
"PM SERVICE, CHECK TURN SIGNAL, CLUNKING NOISE"
"SERVICEROB,EXT,5684"
"NEED 4 PLOW PINS"
"INSTALL SPINNER ASSY"
"DON'T START"
"DOG BONE PIN BROKEN"
"NEED SERVICE, CHECK BRAKES"
"HYD CAP CHECK ENGINE LIGHT ON"
"TARP VALVE STICKING RIGHT SIDE MIRROR BRACKET"
"HANDEL IN CAB LOOSE"
"NO PLOW LIGHTS"
"WIND CHIME BROKEN"

Model

Output

MATLAB EXPO 2018
Text Analytics

Work with text from equipment logs and operator reports

- **Preprocess** raw text data by extracting, filtering, and splitting
- **Visualize** text using word clouds and text scatter plots
- **Develop** predictive models using built-in machine learning algorithms (LDA, LSA, word2vec)
Predictive Maintenance

Data

Sensors

Model

Remaining Useful Life (RUL) Estimation

Failure Threshold

RUL ~ 9.5 days

Real Data

Prediction

Predictive Maintenance Toolbox

Normal Operation

Monitor Closely

Maintenance Needed

New Product
Predictive Maintenance

Design and test condition monitoring and predictive maintenance algorithms

- Import sensor data from local files and cloud storage (Amazon S3, Windows Azure Blob Storage, and Hadoop HDFS)
- Use simulated failure data from Simulink models
- Estimate remaining useful life (RUL)
- Get started with examples (motors, gearboxes, batteries, and other machines)

Predictive Maintenance Using MATLAB and Simulink
Amit Doshi
Deep Learning

Data → Model → Output

- Neural Network Toolbox
- Computer Vision System Toolbox
- GPU Coder
Deep Learning

Design, build, and visualize convolutional neural networks

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

Demystifying Deep Learning
Amod Anandkumar, PhD

Prediction (TitanXP GPU)

Images / sec

<table>
<thead>
<tr>
<th>Model</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>AlexNet</td>
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<td>ResNet-50</td>
<td>200</td>
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<tr>
<td>VGG-16</td>
<td>100</td>
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</table>

TensorFlow
MATLAB
MXNet
GPU Coder
FREE

Learn to Use MATLAB for Deep Learning in 2 Hours
What’s New in MATLAB and Simulink?

Platform Productivity
- Design Creation
- Analysis
- Simulation, Scaling
- Collaboration

Workflow Depth
- Deployment
- Code Generation
- Verification and Validation

Application Breadth
- Autonomous Systems
- Wireless Communications
- Artificial Intelligence (AI)
Experiential Learning
Online Learning
Collaborative Learning
MATLAB Enabled Campus

Experiential Learning
- Interactive Live Editor and App Designer
- Hardware Connectivity and Internet of Things

Online Learning
- MATLAB Online and MATLAB Mobile
- Cody Coursework
- MATLAB Online Self-paced Training
- MATLAB Courseware

Collaborative Learning
- Student Competitions
- MOOCs
WHAT IF EVERYONE ON CAMPUS HAD MATLAB?

More than 1 million students and 700 universities around the world—including the top 10 ranked universities—have unlimited access to MATLAB and Simulink with a Total Academic Headcount (TAH) license.

HANDBS-ON LEARNING
42,000 Faculty and students using MATLAB to program hardware

"On multidisciplinary projects, students with quite different educational backgrounds can work together more easily because they are using the same tools."

Professor Jakob Stoustrup, Aalborg University

JOB OPPORTUNITIES
82% Fortune 100 companies with a MATLAB license

"If you want to work at Google, make sure you can use MATLAB."

Jonathan Rosenberg, Senior Vice President of Products, Google

RESEARCH PRODUCTIVITY
1,970,000 Google Scholar results referencing MATLAB

"Our teams are here to do world-class research, and easy access to MATLAB enables them to be their most productive."

Shahla Shervin, Director of Research Computing, Albert Einstein College of Medicine of Yeshiva University
MATLAB Online Self-paced Training

MATLAB Academic Online Training Suite (MAOTS)

- Includes all MATLAB Online Self-paced Training Courses
- Bundled with University Campus License
- Available to all registered University staff/students
- Access to course completion certificate
Upgrade your MATLAB Code and Simulink Models
MATLAB EXPO 2018

Thank You!