Application Breadth

Products for the work you do

Workflow Depth

Support for your entire workflow

Platform Productivity

Getting your work done faster
- Create Your Designs Faster
- Simplify Analysis
- Simulate Faster and Scale Your Work
- Collaborate
Create Your Designs Faster

MATLAB Live Editor

Explore and Analyze Storm Events

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

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

Visualize with a Heatmap
This is helpful in exploring patterns across categories like the 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

Econometrics Toolbox
Data Acquisition Toolbox
Wavelet Toolbox
Simplify Analysis by Simulating at Wall Clock Speed

Slow down the simulation for easier model interactivity

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

Parallel Computing Toolbox
MATLAB Distributed Computing Server
Scale Your Work

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

- Use familiar MATLAB functions and syntax
- 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.

MATLAB® Test Report

- Timestamp: 04-Jan-2017 13:28:06
- Host: A4-SDE
- Platform: win64
- MATLAB Version: 9.1.0.441655 (R2016b)
- Number of Tests: 17
- Testing Time: 0.4516 seconds
- Overall Result: PASSED
Team Collaboration

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

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Overview

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>File Test: Right-Test</td>
<td>0.1469 seconds</td>
</tr>
<tr>
<td>File Test: RightSent</td>
<td>0.1142 seconds</td>
</tr>
<tr>
<td>File Test: RightPos</td>
<td>0.1372 seconds</td>
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</table>

Details

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>File Test: BigLength</td>
<td>0.2006 seconds</td>
</tr>
</tbody>
</table>

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

Deploy machine learning and deep learning models using automatically generated code

- Generate C code for predictive machine learning and deep learning models
- Generate optimized CUDA code for deep learning, embedded vision, and autonomous systems
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
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.
Deploying to FPGA or ASIC Hardware

**Algorithm**

**Algorithm w/ Hardware Implementation**

**HDL Coder**

**Fixed-Point HDL**

**FPGA/ASIC Implementation**

**Native Floating Point**

![Native Floating Point Diagram](image)

**Matrix Support**

![Matrix Support Diagram](image)

**Vision HDL Toolbox**

![Vision HDL Toolbox Diagram](image)

**LTE HDL Toolbox**

![LTE HDL Toolbox Diagram](image)

**HDL Checks in Model Advisor**

- HDL Coder
- Checks for blocks and block settings
- Checks for industry-standard checks
- Model configuration checks
  - Check for safe model parameters
  - Check for global reset setting for Xilinx and Altera devices
  - Check for finite configuration settings
  - Check for visualization settings
  - Check for visualization settings
  - Check delay balancing setting
  - ^Check logical top
- Native floating-point checks

HDL Verifier
HDL Coder
Fixed-Point Designer
Vision HDL Toolbox
LTE HDL Toolbox
Verification and Validation

Products for the entire workflow

Simulink Requirements

Simulink Design Verifier

Simulink Check

Simulink Coverage

Simulink Test

Polyspace

now supports

AUTOSAR R2018a
- 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

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

Model Predictive Control Toolbox
Full Vehicle Simulation

Ride & handling

Chassis controls

Automated Driving
Design with the Latest Wireless Standards

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

... to implementation
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

Data

```
repairNotes = 617x1 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 STICKINGRIGHT SIDE MIRROR BRACKET"
"HANDLES IN CAB LOOSE"
"NO PLOW LIGHTS"
```

Model

Output
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

Normal Operation
Monitor Closely
Maintenance Needed
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)
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

TensorFlow
MATLAB
MXNet
GPU Coder

Prediction (TitanXP GPU)

Images / sec

AlexNet
ResNet-50
VGG-16
FREE

Learn to Use MATLAB for Deep Learning in 2 Hours

Launch Deep Learning Onramp
What’s New in MATLAB and Simulink?

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

Workflow Depth
- Deployment
- Code Generation
- Verification and Validation

Application Breadth
- Autonomous Systems
- Wireless Communications
- Artificial Intelligence (AI)
Upgrade your MATLAB Code and Simulink Models