What’s New in MATLAB and Simulink

Prashant Rao
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MathWorks India
Engineers and scientists...
Engineers and scientists…

Develop algorithms

write MATLAB code.

Analyze data
Engineers and scientists…

deploy algorithms and applications within web, enterprise, and production systems.
Engineers and scientists... build Simulink models.

Model systems

Run simulations
Engineers and scientists... combine MATLAB code and Simulink models together.
Engineers and scientists...

generate code.
Engineers and scientists...

connect software to hardware.
And it’s all easier to do in the latest releases.
Analysis and Visualization

Testing and Verification

Modeling and Simulation

Sharing and Collaboration

Performance Support and Services
Analysis and Visualization

Modeling and Simulation

Testing and Verification

Sharing and Collaboration

Performance

Support and Services
MATLAB Live Editor

Change the way you work in MATLAB

- See results together with the code that produced them, accelerating exploratory programming and analysis
- Add equations, images, hyperlinks, and formatted text to create interactive narratives
- Create lectures that combine explanatory text, mathematical equations, code and results

Analysis and Visualization
Graphs and Network Algorithms

- Graphs model the connections in a network
  - Widely applicable in physical, biological, and information systems

- Two new functions for creating graphs
  - `graph` (undirected graphs)
  - `digraph` (directed graphs)

- Graph objects work just like other MATLAB objects

- Multiple graph layouts available (circular, force-directed, tiered)

- New functions available for working with graphs
  - `shortestpath`, `shortestpathtree`, `minspantree`, `distances` (and many others)
MATLAB Graphics

New look makes data easier to interpret and graphics objects are easier to customize

- **R2015b**
  - increased control for customizing plot axes

- **R2016a**
  - Polar plots
  - Multiple y-axis plots
  - Functions for plotting mathematical expressions and equations
One-Click Display

Click a signal line when the simulation is running to view the current value

- Display port value for a signal by clicking it during simulation for easy debugging

- For bus signals, select the signals of interest before simulation
New Interface for Scopes

View and debug signals with cursors and measurements

- Scope, Floating Scope, and Viewers all upgraded with new UI

- Includes simulation data analysis and debugging tools
  - Cursors
  - Measurements
  - Triggers
Flight Instruments Library

Display measurements through standard cockpit instruments using Aerospace Blockset

- Visualize simulation results using realistic cockpit instrumentation, including:
  - Airspeed Indicator
  - Altimeter
  - Artificial Horizon
  - Climb Rate Indicator
  - Heading Indicator
  - Turn Coordinator
Analysis
and
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Support and Services
MATLAB Pause Button

Troubleshoot problems without specifying breakpoints in advance

- Pause the execution of a program from the Editor and enter debug mode
- Check on the progress of long running programs to ensure they are running as expected
- Resume program execution
Deep Learning

Perform fast, accurate image classification

- Enables recognition workflows in autonomous robotics and ADAS
- Convolutional neural network (CNN) algorithm added to Neural Network Toolbox
- Uses cuDNN (a GPU-accelerated library from NVIDIA) (requires Parallel Computing Toolbox)
3D Vision

Enables autonomous systems to map and measure the world

- Supports workflows for ADAS, autonomous driving, and robotics
- New functionality to support:
  - 3D point cloud processing
  - Structure from motion
Wireless System Design

WLAN System Toolbox
- 802.11 a/b/g/n/ac/j/p PHY models

Communications System Toolbox
- cdma2000 and 1xEV-DO waveform generation
- Support for PicoZed SDRs

LTE System Toolbox
- 3GPP Release 12 features

RF Toolbox & SimRF
- RF Budget Analyzer App
- Automatic testbench generation

Antenna Toolbox
- Model custom antennas and dielectrics

Phased Array System Toolbox
- Scenario viewer, phase shift quantization
Audio System Toolbox
Design and test audio processing systems

- Enables real-time audio processing in MATLAB and Simulink
- Libraries of audio processing algorithms and examples
- Low-latency audio streaming from and to standard audio interfaces (e.g. ASIO, CoreAudio, ALSA)
- Live-tuning of MATLAB and Simulink via UI and MIDI controls
- VST plugin generation to run on Digital Audio Workstations
Simulink Start Page

Get started or resume work faster by accessing templates, recent models, and featured examples

- Create new Simulink models using templates
- Use fully developed example models as a reference
- Quickly access most recent Simulink models
Automatic Solver Option

Set up and simulate your model more quickly with automatically selected solver settings

- Simulink will select a solver and step size that is optimized for your specific model
- Considers factors such as model stiffness and simulation performance
- All new Simulink models use the automatic solver option
- Can optionally lock down solver so that it does not change from one simulation to another

Modeling and Simulation
Always-On Tunability

Tune all block parameters and workspace variables during a simulation

- All tunable block parameters can be tuned during simulation while retaining the simulation speed
- Choose between tunable and inline for default parameter behavior during code generation
- Simscape block parameters now tunable as well
Simscape Product Family

- Product names are realigned under the Simscape family

- Thermal liquid library in Simscape Fluids
  - Properties of liquids can vary with temperature
  - Heating and cooling systems, fuel systems, and actuation systems where temperature affects behavior

- Dynamic camera in Simscape Multibody
  - Track moving objects in animations

- Run-time parameters
  - Change parameter values without recompiling model
  - Used for HIL, Model Reference and Fast Restart
Simulink Units

Specify, visualize, and check consistency of units on interfaces

- Specify physical units for Simulink signals and bus elements at the interfaces of components such as subsystems, model references, Stateflow charts and MATLAB function blocks

- Identify unit mismatches at the component interfaces

- Enforce consistency by restricting the unit systems for certain components using the configuration parameter, ‘Allowed unit systems’
Messages

Model asynchronous operations in state charts using objects that carry data and can be queued

- New message object and queue
- Message Viewer block to visualize lifetime of a message
- Signal lines in Simulink to transfer messages between charts
New SimEvents Engine and Block Library

Model operating system task scheduling and communication

- Model interrupts, shared resources, network delays, and other characteristics of multicore and distributed systems
- Predict data races, deadlocks, and livelocks that can effect system performance before going to hardware
- Customize reactions to events using MATLAB and the Discrete Event System block
Analysis and Visualization

Modeling and Simulation

Testing and Verification

Sharing and Collaboration

Performance

Support and Services
Simulink Test

Author, execute and manage simulation-based testing

- Build synchronized executable test environments
- Create inputs and assessments based on logic or temporal conditions
- Qualifiable for safety critical applications
  - DO Qualification Kit (for DO-178)
  - IEC Certification Kit (for ISO 26262 and IEC 61508)
Test Generation for C Code

Automatically generate tests for C code S-functions using Simulink Design Verifier

- Test generation automates a difficult task
- Generated tests lets you gain insight into the simulation of your design containing S-functions
Deploying to Hardware

Run your models on low-cost hardware and stream data into MATLAB

- Acquire images from Raspberry Pi and Kinect V2 into MATLAB and Simulink
- Run Simulink models on Lego EV3, Raspberry Pi 2, Raspberry Pi 3, and Arduino Yun
- Adds to existing support for Arduino, Lego, and Raspberry Pi platforms

Testing and Verification
Certification and Standards

- New Standards and Versions
  - DO-330 TQL-4 (aerospace)
  - AUTOSAR 4.1.3 & 4.2 (automotive)
  - IEC 62304 (medical)
  - MISRA-C: 2012 (many industries)
Analysis and Visualization

Modeling and Simulation

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Performance Support and Services
App Designer

Develop MATLAB applications with an enhanced design environment and expanded UI component set

- Choose from standard components (buttons, check boxes, panels, etc.), as well as gauges, lamps, knobs and switches

- Quickly move between visual design and code development

- New object-based code format makes it easier to share data between parts of the app
Add-On Explorer

Extend the capabilities of MATLAB by providing additional functionality for specific tasks and applications

- Browse, search, and install add-ons directly from MATLAB
- Add-ons include community-authored and MathWorks toolboxes, apps, functions, models, and hardware support
Using MATLAB with Other Languages

Integrate MATLAB with other programming languages, including C/C++, Java, .NET, and Python

- Call MATLAB from another language
- Reuse legacy code written in another programming language within MATLAB
- Package MATLAB programs into language-specific software components to integrate with other programming languages
  - Python support added in R2015b

Sharing and Collaboration
Three-Way Model Merge

Graphically resolve conflicts between revisions within a Simulink project

- Resolve conflicts in model files under source control
- Provides an interactive comparison report with the two conflicting designs along with the original base model

Sharing and Collaboration
MATLAB Execution Engine

Redesigned execution engine runs MATLAB code faster

- All MATLAB code can now be JIT compiled
- Average performance improvement of 40% on 76 performance-sensitive user applications
- A platform for future improvements
- Performance testing framework
  - Measure MATLAB code performance
  - Interface leverages the unit testing framework

Performance
GPU Acceleration and Parallel Computing

Perform parallel computations using GPUs

- Accelerate applications using GPU-enabled functions
  - > 300 in MATLAB
  - > 90 in Statistics and Machine Learning Toolbox
  - > 50 in Image Processing Toolbox

- Use enhanced gpuArray functions for sparse matrices on GPUs

```
Transfer data to GPU
>> GX = gpuArray(X);

GPGPU Computation
>> GY = fft2(GX);

Gather data to CPU
>> Y = gather(GY);
```

Simple GPU code in MATLAB

Performance

![Graph showing performance improvement with increasing grid size](image)

- 18x faster
- 20x faster
- 23x faster

Data and code provided by MathWorks.
Fast Restart

Run consecutive simulations more quickly

- Efficiently run multiple interactive simulations
- Saves simulation time eliminating recompilation between simulation runs
- Improves calibration workflows where the user is tuning block parameters between runs
- API introduced in R2015b
Analysis and Visualization

Modeling and Simulation

Testing and Verification

Sharing and Collaboration

Performance

Support and Services
MOOCs

- Massive Open Online Courses (Coursera, edX)

- MathWorks MOOC Support
  - MATLAB Hosted Web Service Offering
  - Downloadable MATLAB License
  - Dedicated Engineering Team
  - MATLAB Learning Content

- NPTEL: National Programme on Technology Enhanced Learning
  - A joint initiative of the IITs and IISc

Course: MATLAB Programming for Numerical Computation
Duration: 8 weeks (Jan 18 – Mar 18 2016)
MATLAB Online access to ~11000 students registered for the course
Cody Coursework™

- Setup and automatically grade MATLAB assignments
- Students submit solutions online
- Prompt feedback
- Access to learning analytics and grading data
- Preloaded course content
  - 90 Cody Problems
  - 4 Course Areas (Signals, Control systems, Computational Math, Intro. MATLAB)

coursework.mathworks.com
MathWorks Training Services

- Course offerings span entry-level to advanced topics
- Experienced expert instructors

Training Formats

- Classroom
  - Public
  - Onsite
- Online
  - Instructor-led
  - MATLAB Academy

Support and Services
# Public Training Offerings

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<th>Upcoming Public Trainings (see our website for full year schedule)</th>
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<td>May 2-3</td>
<td>Bangalore</td>
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<td>Image Processing with MATLAB</td>
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- **Guaranteed to run**

**MathWorks Certified MATLAB Associate Exam**

- **Bangalore:** 29th Aug, 24th Oct, 19th Dec
- **Pune:** 27th June

**Support and Services**

- Email: training@mathworks.in
- URL: http://www.mathworks.in/services/training
New Training Offerings

Training Courses

- Digital Signal Processing for FPGA
- Modeling Fluid Systems with Simscape
- Object-Oriented Programming with MATLAB

Training Modules

- System Objects
- Modeling RF Systems using MathWorks Tools
- Phased Array System Toolbox Fundamentals
- Code Generation for AUTOSAR Software Components
- Introduction to Database Toolbox
MATLAB Academy

- Online self-paced MATLAB training
  - Easy access from computers
  - Built-in access to MATLAB Online
  - On-demand access to content

- Scalable for individual or enterprise wide learning needs

- Free access to MATLAB On-Ramp (two hour content)
Student Competitions

- Formula Student India 2016
  - 50 Teams

- ABU Robocon India 2016
  - 105 Teams
  - MathWorks Innovation Prize Winners
    1. College of Engineering, Pune {Competition Runners Up}
    2. Mukesh Patel School of Technology Management and Engineering (MPSTME), Mumbai
    3. VSSUT, Sambalpur

- Complimentary software offering, workshops, online training, and technical guidance
Analysis and Visualization

Modeling and Simulation

Testing and Verification

Sharing and Collaboration

Performance

Support and Services
Thank You!