MATLAB EXPO 2015
INDIA
23 April – Bangalore
28 April – Pune
Register at matlabexpo.in
What's New in MATLAB & Simulink

Prashant Rao
Technical Manager
MathWorks India
MathWorks Product Overview

New Releases of MATLAB and Simulink

Four new products:
- Antenna Toolbox
- Robotics System Toolbox
- Simulink Test
- Vision HDL Toolbox
Overview of Topics

- Graphics and Data
- Design
- Performance
- Design Management

- Application Deployment
- Antenna Toolbox R2015a
- Signal Processing and Communications
- Vision HDL Toolbox R2015a
- Simulink Test R2015a
- Hardware Support Packages
- Robotics System Toolbox R2015a
- Resources for Teaching & Learning
  - Training Services
What Was New for MATLAB in R2012b?

The New MATLAB Desktop
See what you’ve been missing.

R2012b introduces a fresh new MATLAB® Desktop, making it easier to find what you need.

**Toolstrip**
Highlights commonly used functionality

**Apps Gallery**
Displays in-product and user-written apps

**Online Documentation and Redesigned Help**
Improves searching, browsing, and filtering
New MATLAB Graphics System
What was new for Simulink in R2012b?

DISCOVER
THE NEW
LOOK AND FEEL
of
Simulink

With Simulink® Release 2012b, it’s even easier to build, manage, and navigate your Simulink and Stateflow® models:

- Smart line routing
- Tabbed model windows
- Simulation rewind
- Signal breakpoints
- Explorer bar
- Subsystem and signal badges
- Project management

MATLAB®
& SIMULINK®
Simulink – New graphical controls and displays
Simulink – Better Simulation Data Analysis

New Simulation Data Inspector
Stateflow – Watch Data
Store, edit and access design data using the data dictionary

- Change tracking and differencing
- Defined relationship with SLDD file
- Componentization
- Scalability
- Integration with Simulink Projects
- Make changes programmatically R2015a
MATLAB Data Types

- **Heterogeneous data**
  - structure
  - cell
  - char

- **Numeric**
  - int8, uint8, single, double
  - int16, uint16
  - int32, uint32
  - int64, uint64

- **Logical**

- **Function handle**
Simulink – Accelerate Model Building

Smart Editing Cues
Simulink – Comment Out / Through

Comment a block so that the output equals the input

- Signal passes through the block during simulation
- Comment out option remains available
- Works on blocks with the same number of inputs and outputs
Simulink – Model Templates

Build models using design patterns that serve as starting points to solve common problems

- Use shipped templates to get started with building models or create custom templates to from a Simulink model
- Avoid repetitive tasks when starting out to build a new model
- Enforce a standard process for building models for the entire team or organization
Performance

Simulink – Performance Advisor
Performance

Simulink – Faster Consecutive Simulations

Fast Restart
Performance

Stateflow – Start Simulation Faster

Just-In-Time Compilation
MATLAB – Big Data Capabilities

Memory and Data Access
- 64-bit processors
- Memory Mapped Variables
- Disk Variables
- Databases
- Datastores \textit{R2014b}

Programming Constructs
- Streaming
- Block Processing
- Parallel-for loops
- GPU Arrays
- SPMD and Distributed Arrays
- MapReduce \textit{R2014b}

Platforms
- Desktop (Multicore, GPU)
- Clusters
- Cloud Computing (MDCS on EC2)
- Hadoop \textit{R2014b}
MATLAB and Simulink – Managing Code and Models

Source Control Integration

- Manage your code from within the MATLAB Desktop and your models from within Simulink Projects
- Leverage modern source control capabilities
  - GIT and Subversion integration in Current Folder browser
- Use Comparison Tool to view and merge changes between revisions
Simulink – Sharing Projects

Share a project on GitHub® via e-mail or as a MATLAB Toolbox

- Make your project publicly available on GitHub.
- Share your project via email.
- Package your project as a MATLAB toolbox
Overview of Topics

- Graphics and Data
- Design
- Performance
- Design Management

- Application Deployment
- Antenna Toolbox R2015a
- Signal Processing and Communications
- Vision HDL Toolbox R2015a
- Simulink Test R2015a
- Hardware Support Packages
- Robotics System Toolbox R2015a
- Resources for Teaching & Learning
  - Training Services
Application Deployment

MATLAB Compiler for sharing MATLAB programs without integration programming

MATLAB Compiler SDK provides implementation and platform flexibility for software developers

MATLAB Production Server provides the most efficient development path for secure and scalable web and enterprise applications
Statistics and Machine Learning Toolbox

- Import and interactively explore data
- Specify validation schemes
- Perform feature selection
- Train SVM, kNN, bagged trees and other algorithms
- Assess results using classification accuracy, ROC curves and Confusion Matrices
- Export models to the MATLAB, or generate MATLAB code to integrate models into applications.

New Classification Learner app
Antenna Toolbox
Signal Processing & Communications

Antenna-to-Bits Simulation

- Antenna Toolbox
- Phased Array System Toolbox
- Communications System Toolbox

Antenna → Radio front end (RF + Digital) → Baseband (Digital)

```matlab
% txBits=bitStream(1:end-6);
txBits=[bitStream,zeros(634,1)];
% Modulate
tx = modulateBitstream(txBits, constParams, tunedParams);
```

Simulation parameters:
- TX Power
- Mobile Range
- Mobile Angle
- Interf Power
- Interf Range
- Interf Angle
- Modulation order
- Antenna type
- Number of Antennas
- Steering angle

Spectrum Analyzer
- Frequency (GHz)
- Sample Rate (Hz)
- T (s)

Find Amplifier gain to Normalise symbols

```matlab
ps = asdf('example');
```
Phased Array Design with Simulink

- 7 Libraries
  - Beamforming
  - Detection
  - Direction of Arrival
  - Environment and Target
  - STAP
  - Transmitters and Receivers
  - Waveforms
- 47 blocks
- Supports code generation
Over-the-air Testing with Radio Hardware

Process original data bits and generate custom digital baseband waveforms in transmitter.

Spectrum Analyzer

Baseband Waveform Analysis

Supported SDR Receivers

Supported SDR Transmitters

RF Signal Capture Instruments

RF Signal Generation Instruments

Baseband Waveform Generation

MathWorks

&

&

LTE System Toolbox™

LTE System Toolbox™

Zynq SDR

RTL SDR

USRP SDR

Process received samples in receiver. Decode/recover original data.
Supported SDRs & RF instruments

RF Signal Generator
Zynq Radio SDR
USRP SDR

RF Spectrum Analyzer
Zynq Radio SDR
USRP SDR
RTL SDR

Transmitter
Receiver
Vision HDL Toolbox

A Complete Solution for Embedded Vision

Concept Development → Algorithm Development → Prototyping → Architecture design → Prototyping → Chip design

Frame based

Pixel based

Computer Vision System Toolbox

Image Processing Toolbox

Vision HDL Toolbox

HDL Coder

MATLAB Coder

Fixed Pt Designer

HDL Verifier

MATLAB
## Simulink Test

<table>
<thead>
<tr>
<th>1. Test Harnesses</th>
<th>2. Test Sequence Block</th>
<th>3. Test Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Synchronized, simulatable test environment</td>
<td>• Inputs and assessments based on logical, temporal conditions</td>
<td>• Author, execute, manage test cases • Review, export, report</td>
</tr>
</tbody>
</table>

**Test Harness**

- Main Model
- Component under test

**Test Sequence Block**

- Simulink Test Main Model

**Test Manager**

- Report Generated by Test Manager
Hardware Support Packages

- Downloadable add-ons that provide hardware support
- Used by Simulink and Embedded Coder to deliver targets
Connecting to Target Hardware

Host computer
MATLAB algorithm or Simulink model

Data I/O
Ethernet / USB / Bluetooth
MATLAB Hardware Support Packages

Target
Simulink Hardware Support Packages

Low Cost Hardware
Android Sensors
Lego EV3
Arduino

Low Cost Hardware
R2014b
iPhone
R2015a
Introducing Robotic System Toolbox

Build Robots with Low-Cost Hardware?
- Drivers Provided
- Comprehensive Algorithms

Use Powerful Robots Running ROS?
- ROS/Gazebo Interface
- ROS Node Generation
- Comprehensive Algorithms

Hardware Support Package

Robotics System Toolbox
Robotic System Toolbox

Test Robotics Algorithms on your Desktop

Test with Gazebo through MATLAB-ROS Interface
Test it with a physical robot running ROS
Key Capabilities of Robotics System Toolbox

MATLAB-ROS Interface
- Create a ROS node inside MATLAB
- Design and test robotics algorithms on a robot simulator such as Gazebo
- Test robotics algorithms on a physical robot
- Import rosbag log files into MATLAB

Simulink-ROS Interface
- Simulink I/O with ROS networks
- ROS node generation from Simulink models

Algorithms in Robotics System Toolbox
- Map utilization
- Path planning
- Path following
- Read point clouds
Resources for Teaching and Learning
Classroom Resources at mathworks.in

Classroom Resources
Find links to videos, code, models, books, and other resources for classroom instruction or individual learning. Explore by department or cross-disciplinary topic, or search for specific materials. The links point to user-hosted Web sites as well as mathworks.com.

Topics
- Communication Systems
- Computational Biology
- Computational Finance
- Computational Methods
- Control Systems
- Digital Signal Processing
- Embedded Systems
- Image and Video Processing
- Measurement and Instrumentation
- Numerical and Symbolic Math
- Programming and Computer Science
- Project-Based Learning
- Robotics and Mechatronics
- Statistics and Data Analysis
- System Modeling and Simulation

Departments
- Aerospace Engineering
- Biological and Health Sciences
- Biomedical Engineering
- Business, Economics, and Finance
- Chemical Engineering
- Chemistry
- Civil and Environmental Engineering
- Computer Science
- Earth, Atmospheric, and Ocean Sciences
- Electrical and Computer Engineering
- Industrial and Manufacturing Engineering
- Materials Sciences
- Mathematics
- Mechanical Engineering
- Physics and Astronomy
- Psychology
- Statistics

Resource Types
- Course materials
- Downloadable code or models
- Technical literature
- Textbooks
- Tutorials
- Videos
### Robotics and Mechatronics

#### Classroom Resources

Use MATLAB and Simulink to teach key areas in robotics and mechatronics, such as:

- Kinematics and dynamics
- Motor control and computer vision
- Multi-domain simulation and optimization
- Electromechanical systems

#### Group by Department

<table>
<thead>
<tr>
<th>Title</th>
<th>Summary</th>
<th>Resource Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulink models and demo hardware for control design (from B &amp; R Automation)</td>
<td>Simulink models for Airball and Reaction Wheel Pendulum systems</td>
<td>Downloadable code or models</td>
</tr>
<tr>
<td>MATLAB and Simulink interface to a Robotino® mobile robot system</td>
<td>MATLAB and Simulink libraries to control a Robotino robot over a USB or TCP/IP interface</td>
<td>Downloadable code or models</td>
</tr>
<tr>
<td>LEGO MINDSTORMS NXT Software for MATLAB and Simulink</td>
<td>MATLAB toolboxes for USB &amp; wireless (Bluetooth) control; Simulink blocksets for NXT code generation</td>
<td>Downloadable code or models</td>
</tr>
<tr>
<td>Quanser - Hardware/Software solutions for teaching mechatronics</td>
<td>Integrated hardware/software solutions (based on Simulink) and course material for mechatronics</td>
<td>Course materials</td>
</tr>
<tr>
<td>Teaching Mechatronics Using MATLAB and Simulink</td>
<td>Webinar on using Simulink to model, analyze, and visualize mechatronic systems</td>
<td>Video</td>
</tr>
<tr>
<td>MATLAB Toolbox for the iRobot Create Mobile Robot</td>
<td>A MATLAB toolbox for controlling an iRobot Create over a serial port or Bluetooth wireless</td>
<td>Downloadable code or models</td>
</tr>
</tbody>
</table>
MathWorks Support for Student Competitions

MathWorks prepares and supports the next generation of scientists and engineers with software, training, and mentoring to tackle the same technical issues as professional engineers. Student teams receive industry insights in a flexible design environment with the expertise to move from classroom theory to competition one.

28 competitions
400 student teams
100 maker teams

AEROSPACE
- AUVSI Foundation Competitions
- International Micro Air Vehicle
- UAV Challenge – Outback Rescue

AUTOMOTIVE
- American Solar Challenge
- EcoCAR2
- EducEco
- Formula SAE Competition of Japan
- Formula Student Germany
- Freescale Cup
- Smart Car Contest

SIGNAL PROCESSING
Resources for Teaching and Learning

Student Competitions – Robocon India 2015

- Free software offering for all teams
- 85 teams from all over India
- Prize for most innovative usage of MathWorks tools
Resources for Teaching and Learning

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)
July 2014 News

*IEEE Spectrum* analyzed 12 different metrics to compare programming language popularity and use.

**Results:** MATLAB ranks 10th, appearing alongside the likes of C, C++, and Java – traditional, general-purpose languages.

**Data sources:** Google, CareerBuilder, IEEE Xplore, Github, and more.
Resources for Teaching and Learning

MATLAB Academy

- Online Self-Paced Training Content
- 2-hour free Onramp Course
- Further courses in:
  - MATLAB Fundamentals
  - MATLAB Programming Techniques
  - MATLAB for Data Analysis and Visualization
- Campus/Corporate Option
Resources for Teaching and Learning

**PC-Based Rapid Prototyping and HIL**
- SLRT Real-Time Workshop® Fundamentals

**Model-Based Design**
- SLMB Adopting Model-Based Design

**Physical Modeling**
- SLP_M Physical Modeling of Mechanical Systems with SimMechanics
- SLP_S Physical Modeling of Multidomain Systems using Simscape

**Code Generation**
- SLEC Real-Time Workshop® EmbeddedCoder for Production Code Generation
- SLHL Generating HDL Code from Simulink®
- MLEM MATLAB® to C with MATLAB® Coder™

**Optimization**
- MLOP MATLAB® Based Optimization Techniques

**Statistics**
- MLST Statistical Methods in MATLAB®

**Visualization**
- MLVI MATLAB® for Data Processing and Visualization

**Programming Techniques**
- MLPR MATLAB® Programming Techniques

**Graphical User Interfaces**
- MLGU MATLAB® for Building Graphical User Interfaces

**Code Integration**
- MLEX Integrating MATLAB® with External Applications

**Application-Specific Trainings**
- **STATEFLOW® - Event-Based Modeling**
  - SLSF Stateflow® for Logic Driven Modeling
  - SLSF-A Stateflow® for Automotive Applications

**Signal Processing and Communications**
- MLSG MATLAB® for Signal Processing
- SLBE_G Simulink® for Signal Processing
- SLCM Simulink® for Communication Systems

**Control System Design and Analysis**
- SLCT MATLAB® and Simulink® for Control Design Acceleration

**Image and Video Processing**
- MLIP MATLAB® for Image Processing

**Test & Measurement**
- MLTM MATLAB® for Data Acquisition and Instrument Control

**Financial Modeling and Analysis**
- MLFO MATLAB® for Portfolio Optimization

**Application Deployment**
- MLJA Deploying MATLAB®-Based Applications – Java™ Edition
- MLNE Deploying MATLAB®-Based Applications – .NET™ Edition

**Distributed and Parallel Computing**
- MLPC Parallel Computing with MATLAB®
New Training Courses and Modules

**Training Courses**
- Risk Management with MATLAB
- Machine Learning with MATLAB
- Design LTE and LTE Advanced Physical Layer Systems with MATLAB
- Designing Robotics Algorithms in MATLAB
- Implementing Model Based Design Workflow

**Training Modules**
- MATLAB for Asset Allocation
- Introduction to Database Toolbox
- MATLAB Interfaces to EXCEL
- Polyspace for Ada Code Verification
- Polyspace Bug Finder for C/C++ Code Analysis
- Real-Time Application with Simulink Real-Time
- Physical Modeling of Automotive Systems with SimDriveline
- Physical Modeling of Mechanical Systems with SimMechanics – 1G
Resources for Teaching and Learning

MathWorks Certification

MathWorks Certified MATLAB Associate Exam
Bangalore: 29th July, 25th Nov
Pune: 3rd June

MathWorks Certified MATLAB Professional Exam
Will be introduced in 2016
Summary

- Graphics and Data
- Design
- Performance
- Design Management

- Application Deployment
- Antenna Toolbox
- Signal Processing and Communications
- Vision HDL Toolbox
- Simulink Test
- Hardware Support Packages
- Robotics System Toolbox
- Resources for Teaching & Learning
  - Training Services
Thank You!