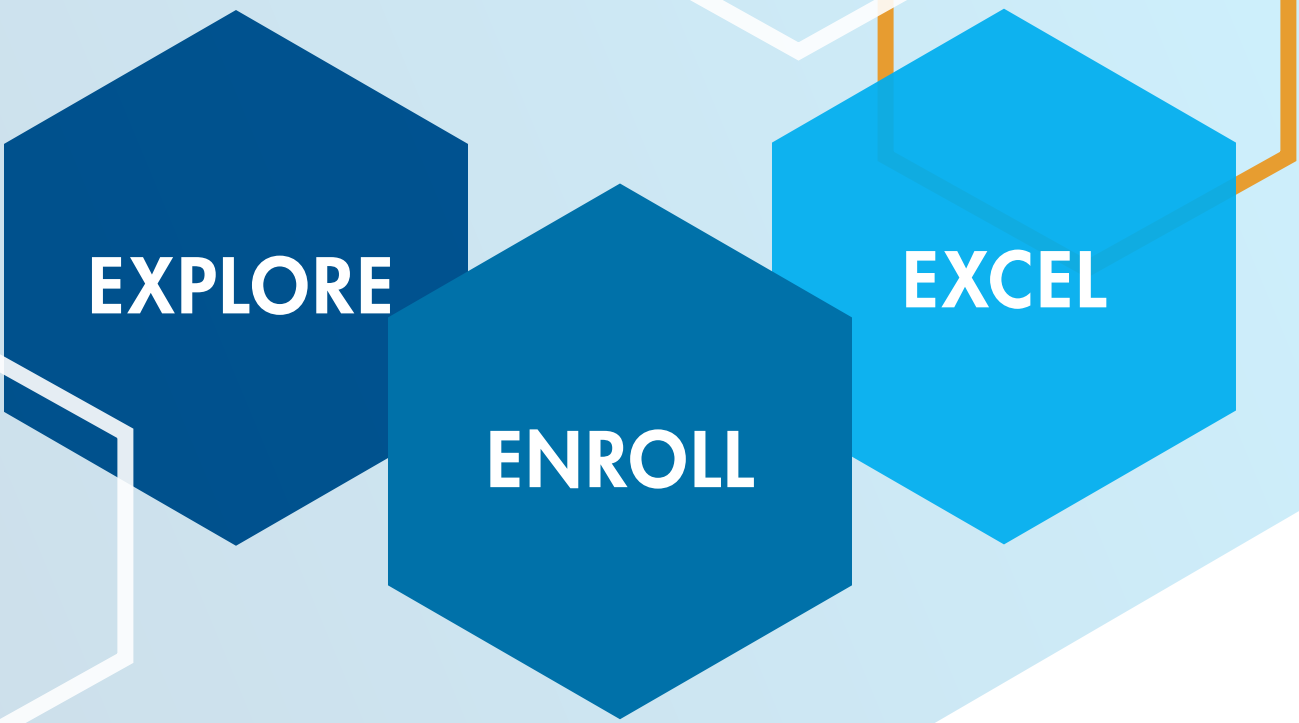
MathWorks® | *Training Services*

EXPLORE

ENROLL

EXCEL

2018

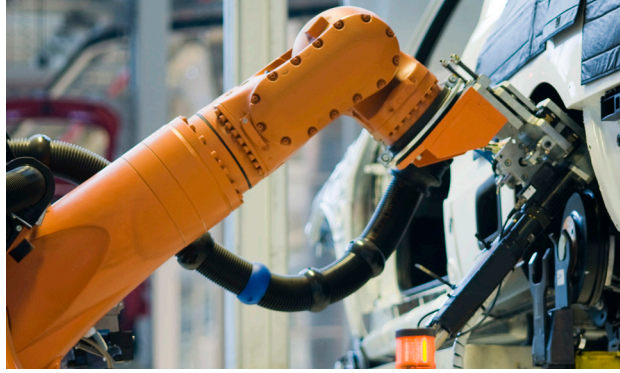


WHY CHOOSE MATHWORKS FOR TRAINING?

MathWorks courses are developed by a team of training engineers with exclusive product knowledge gained from working closely with product developers. They acquire significant hands-on experience by using new products months before they are released and are always current on new capabilities.

Expert instructors understand that not everyone learns in the same way. That's why the team—engineers themselves with advanced degrees and years of industry experience—uses a variety of techniques to reinforce concepts and build proficiency.

TABLE OF CONTENTS



MATHWORKS TRAINING INFORMATION

TRAINING FORMATS

For details and a full schedule, visit *mathworks.com/2018training*.

Classroom training. Learn in a physical classroom setting. Courses are offered at MathWorks facilities and public sites around the world.

Live, online courses. Live, online courses are led in real time by MathWorks instructors and contain the same course content and materials used in the classroom setting.

Self-paced training. Learn MATLAB® online with our interactive courses containing demonstrations, exercises, and quizzes that you complete at your own pace.

Training at your work site. MathWorks instructors tailor the curriculum based on your attendees' learning styles and abilities. They create a curriculum that meets your team's specific goals with company-specific or industry-specific examples.

GUARANTEED TO RUN

When you register for a course that is "Guaranteed to Run", you can rest assured that the class will not be cancelled or rescheduled for any reason.

TRAINING CREDITS

Maximize your training budget by purchasing training credits, which give you discounts on future courses. You can apply credits to any classroom, onsite, or online training course within one year of purchase.

TWO EASY WAYS TO REGISTER

Visit: *mathworks.com/2018training*

Call:
Australia: +61-2-8669-4700
India: +91-80-6632-6000
The Netherlands: +31-40-2156700
Nordic Region: +46-8-5051-6900
Switzerland: +41-31-950-60-20
United Kingdom: +44-1223-226700
United States and Canada: 508-647-7000

Fees include all course materials. Payment must be received at the time of registration to ensure your seat in the course.

The MathWorks BV is a Cedeo-approved training organization.

MathWorks is registered with GARP as an Approved Provider of Continuing Professional Education (CPE) credits.

GET STARTED ON THE RIGHT PATH

Taking courses in a recommended order can help accelerate your proficiency with MATLAB and Simulink®. Learning paths aid in building a proper foundation and help you get the most out of your products.

These paths represent the suggested sequence of courses based on your particular area of interest.

For other paths not listed here, please visit *mathworks.com/2018training*.

	PREREQUISITE	CORE CURRICULUM	OPTIONAL
Data Analytics with Machine Learning	MATLAB Fundamentals →	MATLAB for Data Processing and Visualization *and* Machine Learning with MATLAB →	Accelerating and Parallelizing MATLAB Code
Programming and Application Deployment: Code Development and Management	MATLAB Fundamentals →	MATLAB Programming Techniques *and* Accelerating and Parallelizing MATLAB Code →	Object-Oriented Programming with MATLAB
Embedded Design: FPGA Design	Simulink for System and Algorithm Modeling →	Generating HDL Code from Simulink *and* Testing Generated Code in Simulink *or* Embedded Coder for Production Code Generation →	Programming Xilinx Zynq SoCs with MATLAB and Simulink
Control and Algorithm Design: Control Design and Analysis	Simulink for System and Algorithm Modeling →	Control System Design with MATLAB and Simulink →	Stateflow for Logic-Driven System Modeling

PROVE YOUR MATLAB KNOWLEDGE

MATLAB Certification can help accelerate professional growth and achievement by establishing a standard of excellence that demonstrates MATLAB proficiency to customers, industry peers, and employers.

For organizations, certification is a strategic investment that pays off through increased productivity and project success. MATLAB training courses cover all concepts tested in exam questions.

MathWorks®
CERTIFIED MATLAB® ASSOCIATE

MathWorks®
CERTIFIED MATLAB® PROFESSIONAL

There are more than 700 testing centers available.
For test locations, dates, and fees, visit *mathworks.com/certification*.

144%

Average increase in competence with MATLAB after training

Based on 2017 data

MATLAB

MATLAB Fundamentals

FUNDAMENTAL

This three-day course provides a comprehensive introduction to the MATLAB technical computing environment. Topics include:

- Data analysis
- Visualization
- Modeling
- Programming

Prerequisites: Undergraduate-level mathematics and experience with basic computer operations

MATLAB Fundamentals for Aerospace Applications

FUNDAMENTAL

Based on the *MATLAB Fundamentals* outline, this three-day course offers hands-on aerospace examples and exercises that apply basic techniques to realistic problems in a variety of aerospace and defense applications.

Prerequisites: Undergraduate-level mathematics and experience with basic computer operations

MATLAB Fundamentals for Automotive Applications

FUNDAMENTAL

Based on the *MATLAB Fundamentals* outline, this three-day course offers hands-on automotive examples and exercises that apply basic techniques to realistic problems in the automotive industry.

Prerequisites: Undergraduate-level mathematics and experience with basic computer operations

MATLAB for Financial Applications

FUNDAMENTAL

This three-day course provides a comprehensive introduction to the MATLAB technical computing environment for financial professionals. Themes of data analysis, visualization, modeling, and programming are explored throughout the course, with an emphasis on practical application to finance, such as time-series analysis, Monte Carlo simulation, portfolio management, and empirical modeling. Topics include:

- Importing data from spreadsheets and other sources
- Representing financial data in MATLAB
- Working with dates and times
- Visualizing data and results using advanced plots
- Filtering large data sets based on logical criteria
- Developing algorithms using programming constructs
- Performing data analysis, modeling, and simulation
- Generating reports and exporting data to files

Prerequisites: Undergraduate-level mathematics and experience with basic computer operations

MATLAB for Data Processing and Visualization

INTERMEDIATE

This one-day course focuses on importing and preparing data for data analytics applications. The course is intended for data analysts and data scientists who need to automate the processing, analysis, and visualization of data from multiple sources. Topics include:

- Importing data
- Processing data
- Customizing visualizations
- Working with irregular data

Prerequisites: *MATLAB Fundamentals*

MATLAB Programming Techniques

INTERMEDIATE

This two-day course covers details of performance optimization as well as tools for writing, debugging, and profiling code. Topics include:

- Creating robust applications
- Structuring code
- Structuring data
- Creating custom toolboxes

Prerequisites: *MATLAB Fundamentals*

Building Interactive Applications in MATLAB

INTERMEDIATE

This one-day course demonstrates how to create an interactive user interface for your applications in MATLAB. No prior experience in programming graphical interfaces is required. Topics include:

- Graphics objects
- User interface controls
- Callback functions
- Graphical user interface development environment (GUIDE)
- Application deployment

Prerequisites: *MATLAB Fundamentals*

Interfacing MATLAB with C Code

INTERMEDIATE

This one-day course covers details of interfacing MATLAB with user-written C code. Topics include:

- Source MEX-files
- Data exchange between MATLAB and MEX-files
- The MATLAB engine interface

Prerequisites: *MATLAB Fundamentals* and a basic working knowledge of the C programming language

Optimization Techniques in MATLAB

INTERMEDIATE

This one-day course introduces applied optimization in the MATLAB environment, focusing on using Optimization Toolbox™ and Global Optimization Toolbox. Topics include:

- Running optimization problems in MATLAB
- Specifying objective functions and constraints
- Choosing solvers and setting options
- Evaluating results and improving performance
- Using global optimization methods

Prerequisites: *MATLAB Fundamentals*

Signal Processing with MATLAB

INTERMEDIATE

This two-day course shows how to analyze signals and design signal processing systems using MATLAB and Signal Processing Toolbox™. Parts of the course also use DSP System Toolbox™. Topics include:

- Creating and analyzing signals
- Performing spectral analysis
- Designing and analyzing filters
- Designing adaptive filters
- Designing multirate filters

Prerequisites: *MATLAB Fundamentals*

Image Processing with MATLAB

INTERMEDIATE

This two-day course provides hands-on experience with performing image analysis interactively and programmatically. Examples and exercises demonstrate the use of appropriate MATLAB and Image Processing Toolbox™ functionality throughout the analysis process. Topics include:

- Importing and exporting images
- Removing noise
- Aligning images and creating a panoramic scene
- Detecting lines and circles in an image
- Segmenting objects
- Measuring and modifying object shape properties
- Performing batch analysis over sets of images

Prerequisites: *MATLAB Fundamentals*

Machine Learning with MATLAB

INTERMEDIATE

This two-day course focuses on data analytics and machine learning techniques in MATLAB using functionality within Statistics and Machine Learning Toolbox™ and Neural Network Toolbox™. The course demonstrates the use of unsupervised learning to discover features in large data sets and supervised learning to build predictive models. Examples and exercises highlight techniques for visualization and evaluation of results. Topics include:

- Importing and organizing data
- Finding natural patterns in data
- Building predictive models
- Evaluating and improving the model

Prerequisites: *MATLAB Fundamentals*

Accelerating and Parallelizing MATLAB Code

INTERMEDIATE

This two-day course shows a variety of techniques to speed up MATLAB code, including using Parallel Computing Toolbox™ to parallelize code and MATLAB Distributed Computing Server™ to scale up across multiple computers. Attendees who are working with long-running simulations will benefit from the hands-on demonstrations and exercises in the course. Topics include:

- Improving code performance
- Generating MEX-files
- Parallelizing computations
- Offloading execution
- Working with clusters
- Performing computations on GPUs

Prerequisites: *MATLAB Fundamentals* or equivalent experience using MATLAB

The instructor demonstrated many features and functions in MATLAB and showed how you can solve complex problems even if you don't have a strong mathematical or computational background. Without this course, I would not have discovered all those capabilities.

Svenja Caspers,

Forschungszentrum
Jülich GmbH

Object-Oriented Programming with MATLAB

INTERMEDIATE

This two-day course focuses on using object-oriented programming techniques to develop and maintain complex MATLAB applications. Topics include:

- Defining robust, intuitive, and reusable custom data types
- Creating maintainable and extensible applications using inheritance and aggregation
- Enhancing the reliability and flexibility of applications with unit tests
- Enabling object synchronization using events and listeners

Prerequisites: *MATLAB Programming Techniques* or equivalent experience using MATLAB

Credit Risk Management with MATLAB NEW

INTERMEDIATE

This one-day course provides a comprehensive introduction to modeling credit risk using MATLAB and computational finance toolboxes. The course is intended for risk practitioners with prior experience of MATLAB, developing credit risk models using common modeling practices and the Basel II/III advanced internal ratings-based approach. Topics include:

- Classifying credit ratings and assessing credit transition probabilities
- Performing ad-hoc concentration analysis
- Fitting discrete interest rate models
- Implementing reduced-form, structural, and historical probability of default models
- Determining capital requirements with the asymptotic single risk factor (ASRF) model

Prerequisites: *MATLAB for Financial Applications*

"I thoroughly enjoyed the course! Although I have years of experience with MATLAB I never had any formal training. This course showed me how to do things more efficiently than the homegrown way I've been doing them."

- Jeremy Heer

Market Risk Management with MATLAB NEW

INTERMEDIATE

This one-day course provides a comprehensive introduction to market risk management using MATLAB and computational finance toolboxes. It is intended for risk analysts, risk managers, portfolio managers, and other financial professionals with prior experience of MATLAB, who analyze, assess, and manage market risk. The course uses examples from market risk, although the techniques demonstrated are applicable in most risk areas, including liquidity, interest rate, and operational risk. Topics include:

- Constructing baselines for market risk assessment and analysis
- Assessing the impact of market risk and relative portfolio performance
- Performing portfolio backtesting and computing commonly used risk metrics
- Creating and analyzing SABR, GARCH, and extreme-value models for market risk using Monte Carlo simulations
- Evaluating value-at-risk models by performing hypothesis tests and descriptive backtesting

Prerequisites: *MATLAB for Financial Applications* and knowledge of risk management concepts

MATLAB for Asset Allocation

INTERMEDIATE

This one-day course explains the technical details and benefits of using Financial Toolbox™ data types for portfolio optimization. The course is designed for financial professionals who want to explore the capabilities of asset allocation. Topics include:

- Optimizing mean-variance portfolios
- Defining investment constraints
- Selecting solvers, options, and metrics
- Employing custom scenarios
- Automatically generating custom reports

Prerequisites: *MATLAB for Financial Applications*

Designing Robotics Algorithms in MATLAB

INTERMEDIATE

This one-day course is for engineers designing mobile robotics algorithms for Robot Operating System (ROS)-enabled simulators and robots. Topics include:

- Listing the design workflows possible with Robotics System Toolbox™
- Communicating with ROS and Gazebo
- Building and testing mobile robotics algorithms
- Designing algorithms for execution and data sharing

Prerequisites: *MATLAB Fundamentals* and basic knowledge of Robot Operating System (ROS)

Statistical Methods in MATLAB

INTERMEDIATE

This two-day course provides hands-on experience performing statistical data analysis with MATLAB and Statistics and Machine Learning Toolbox. Examples and exercises demonstrate the use of appropriate product functionality throughout the analysis process, including:

- Data import and organization
- Exploratory analysis
- Confirmatory analysis
- Simulation

Prerequisites: *MATLAB Fundamentals*

Wireless Communications Systems Design with MATLAB and USRP Software-Defined Radios

ADVANCED

This two-day course shows how to design and simulate single- and multi-carrier digital communications systems using MATLAB. Multi-antenna and turbo-coded communications systems are introduced, and different channel impairments and their modeling are demonstrated. Components from LTE and IEEE 802.11 systems will be used as examples. Students will build a radio-in-the-loop system using real-time hardware (RTL-SDR and USRP). The target audience for this course includes system engineers and RF engineers who need a fast ramp-up on modern communications techniques and the radio-in-the-loop workflow.

Prerequisites: *MATLAB Fundamentals* and knowledge of digital communications systems

Designing LTE and LTE-Advanced Physical Layer Systems with MATLAB

ADVANCED

This three-day course provides an overview of the LTE and LTE-Advanced physical layer. Using MATLAB and LTE System Toolbox™, attendees will learn how to generate reference LTE waveforms and build and simulate an end-to-end LTE PHY model. Topics include:

- Review of the advanced communications techniques forming the core of an LTE system:
  - OFDMA and SC-FDMA multi-carrier techniques
  - MIMO multi-antenna systems
- Descriptions of all of the signals and elements of the processing chain for the uplink and downlink LTE physical channels
- Methods for golden reference verification with the standard

Prerequisites: *MATLAB Fundamentals* and knowledge of wireless communications systems

Time-Series Modeling in MATLAB

ADVANCED

This one-day course provides a comprehensive introduction to time-series modeling using MATLAB and Econometrics Toolbox™. Topics include:

- Identifying long-term and seasonal trends in time-series data
- Creating and fitting ARIMA and GARCH time-series models to a data set
- Testing data stationarity using hypothesis tests
- Comparing different model fits for the same data
- Analyzing model dynamics using Monte Carlo simulations
- Forecasting data using fitted models

Prerequisites: *MATLAB for Financial Applications* and basic knowledge of time-series modeling concepts is strongly recommended

Computer Vision with MATLAB

ADVANCED

This two-day course provides hands-on experience with performing computer vision tasks. Examples and exercises demonstrate the use of appropriate MATLAB and Computer Vision System Toolbox™ functionality. Topics include:

- Importing, displaying, and annotating images and videos
- Detecting, extracting, and matching object features
- Automatically aligning images using geometric transformations
- Detecting objects in images and videos
- Tracking objects and estimating their motion in a video
- Removing lens distortion from images
- Measuring planar objects
- Working with point clouds
- Reconstructing a 3D scene from two or multiple images

Prerequisites: *MATLAB Fundamentals* or equivalent experience using MATLAB. *Image Processing with MATLAB* and basic knowledge of image processing and computer vision concepts.

SIMULINK

Simulink for System and Algorithm Modeling

FUNDAMENTAL

If your application involves signal processing or communications, see *Signal Processing with Simulink*.

This two-day course is for engineers who are new to system and algorithm modeling and design validation in Simulink. The course demonstrates how to apply basic modeling techniques and tools to develop Simulink block diagrams. Topics include:

- Creating and modifying Simulink models and simulating system dynamics
- Modeling continuous-time, discrete-time, and hybrid systems
- Modifying solver settings for simulation accuracy and speed
- Building hierarchy into a Simulink model
- Creating reusable model components using subsystems, libraries, and model references

Prerequisites: *MATLAB Fundamentals*

Simulink for Aerospace System Design

FUNDAMENTAL

Based on the *Simulink for System and Algorithm Modeling* outline, this two-day course is for aerospace engineers who are new to system and algorithm modeling and teaches attendees how to validate designs using Simulink.

Prerequisites: *MATLAB Fundamentals*, *MATLAB Fundamentals for Aerospace Applications*, or *MATLAB Fundamentals for Automotive Applications*

Simulink for Automotive System Design

FUNDAMENTAL

Based on the *Simulink for System and Algorithm Modeling* outline, this two-day course is for automotive engineers who are new to system and algorithm modeling and teaches attendees how to validate designs using Simulink.

Prerequisites: *MATLAB Fundamentals*, *MATLAB Fundamentals for Aerospace Applications*, or *MATLAB Fundamentals for Automotive Applications*

HAVE TRAINERS COME TO YOU

Available worldwide, onsite training is ideal for large groups or those who want customized instruction. To maximize your productivity, instructors can tailor the curriculum to meet your specific needs, and address challenges and process issues familiar to attendees.

INCREASE YOUR SUCCESS RATE

Each course contains a set of learning objectives designed to help participants quickly master necessary skills. Our hands-on approach allows participants to practice, apply, and evaluate their knowledge in the classroom.

Signal Processing with Simulink

FUNDAMENTAL

This three-day course covers basic modeling techniques and tools for developing Simulink block diagrams for signal processing applications. Topics include:

- Modeling single-channel and multichannel discrete dynamic systems
- Implementing sample-based and frame-based processing
- Modeling mixed-signal (hybrid) systems
- Developing custom blocks and libraries
- Modeling condition-based systems
- Performing spectral analysis with Simulink
- Integrating filter designs into Simulink
- Modeling multirate systems
- Incorporating external code
- Automating modeling tasks

Prerequisites: *MATLAB Fundamentals* and basic knowledge of digital signal processing

Integrating Code with Simulink

INTERMEDIATE

This one-day course presents multiple methods for integrating C code and MATLAB code into Simulink models. Topics include:

- Writing C MEX S-functions
- Integrating MATLAB code
- Integrating C code

Prerequisites: *MATLAB Fundamentals* and *Simulink for System and Algorithm Modeling*

Control System Design with MATLAB and Simulink

INTERMEDIATE

This two-day course provides a general understanding of how to accelerate the design process for closed-loop control systems using MATLAB and Simulink products. Topics include:

- Control system design overview
- System modeling
- System analysis
- Control design
- Controller implementation

Prerequisites: *MATLAB Fundamentals* and *Simulink for System and Algorithm Modeling*

SimEvents for Discrete-Event System Modeling NEW

INTERMEDIATE

This one-day course focuses on modeling event-driven systems in Simulink using SimEvents®. Topics include:

- Creating discrete-event models
- Defining attributes and event actions
- Controlling queue and server behavior
- Developing variable model topologies using routing and resources
- Integrating discrete-event and time-domain systems
- Determining optimal system parameters

Prerequisites: *MATLAB Fundamentals* and *Simulink for System and Algorithm Modeling*

Real-Time Testing with Simulink Real-Time and Speedgoat Hardware NEW

INTERMEDIATE

This two-day course focuses on real-time testing workflows using Simulink Real-Time™ and Speedgoat real-time target computers. Topics include:

- Converting desktop-based simulation applications into real-time applications
- Conducting rapid control prototyping (RCP) with physical device under control
- Creating interactive interfaces
- Creating formal test suites
- Using standard communications protocols
- Optimizing real-time applications
- Hardware-in-the-loop (HIL) testing

Prerequisites: *Simulink for System and Algorithm Modeling* (or *Simulink for Automotive System Design* or *Simulink for Aerospace System Design).* Knowledge of Simscape™ preferred.

Verification and Validation of Simulink Models

ADVANCED

This one-day course describes techniques for testing Simulink model behavior against system requirements. Topics include:

- Identifying the role of verification and validation in Model-Based Design
- Creating test cases for Simulink models
- Analyzing simulation results to verify model behavior
- Automating testing activities and managing results
- Formally verifying model behavior
- Automatically generating artifacts to communicate results

Prerequisites: *MATLAB Fundamentals* and *Simulink for System and Algorithm Modeling.* This course is intended for intermediate or advanced Simulink users.

OUR TRAINING FORMAT WORKS

According to post-training surveys, even individuals with multiple years of experience using MATLAB and Simulink are known to benefit from their classroom experience with MathWorks engineers.

Simulink Model Management and Architecture

ADVANCED

This two-day course describes techniques for applying Model-Based Design in a common design workflow. It provides guidance on managing and sharing Simulink models when working in a large-scale project environment. Topics include:

- Implementing interface control of Simulink subsystems and models
- Managing requirements in Simulink models
- Partitioning models using Simulink subsystems, libraries, and model references
- Managing a model and all its dependencies
- Controlling the location, scope, and code generation behavior of model data
- Establishing and enforcing modeling standards
- Documenting a Simulink model

Prerequisites: *MATLAB Fundamentals* and *Simulink for System and Algorithm Modeling*

Communications Systems Modeling with Simulink

ADVANCED

This one-day course uses hands-on examples to demonstrate how to design end-to-end communications systems using Simulink, Communications System Toolbox™, and DSP System Toolbox. Topics include:

- Modeling using Communications System Toolbox
- Analyzing the bit error rate (BER) of a communications system
- Adding channel impairments
- Designing receiver algorithms

Prerequisites: *MATLAB Fundamentals*, *Signal Processing with MATLAB*, and *Signal Processing with Simulink*

PHYSICAL MODELING

Modeling Physical Systems with Simscape

INTERMEDIATE

This one-day course discusses how to model systems in several physical domains and combine them into a multidomain system in the Simulink environment using Simscape. Topics include:

- Creating models in various physical domains, such as electrical, mechanical, and hydraulic
- Interpreting Simscape diagrams
- Combining Simulink models and Simscape models
- Modeling energy transfer between different physical domains
- Creating user-defined Simscape components

Prerequisites: *MATLAB Fundamentals* and *Simulink for System and Algorithm Modeling*

Modeling Electrical Power Systems with Simscape

INTERMEDIATE

This one-day course discusses how to model electrical power systems in the Simulink environment using Simscape Power Systems™ (formerly SimPowerSystems™). Topics include:

- Creating three-phase systems with passive components
- Creating three-phase systems with electrical machines
- Analyzing and controlling electrical power systems
- Modeling power electronic components
- Speeding up simulation of electrical models

Prerequisites: *MATLAB Fundamentals*, *Simulink for System and Algorithm Modeling*, and *Modeling Physical Systems with Simscape*

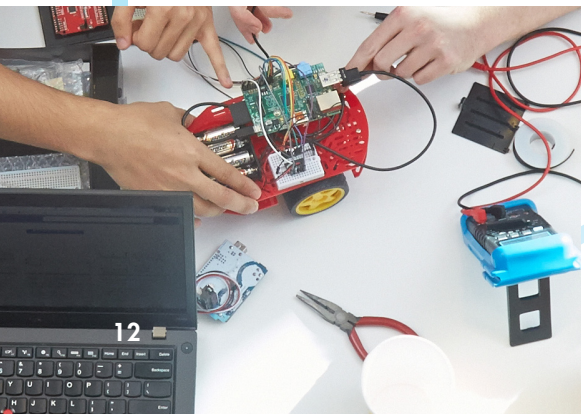
Modeling Multibody Mechanical Systems with Simscape

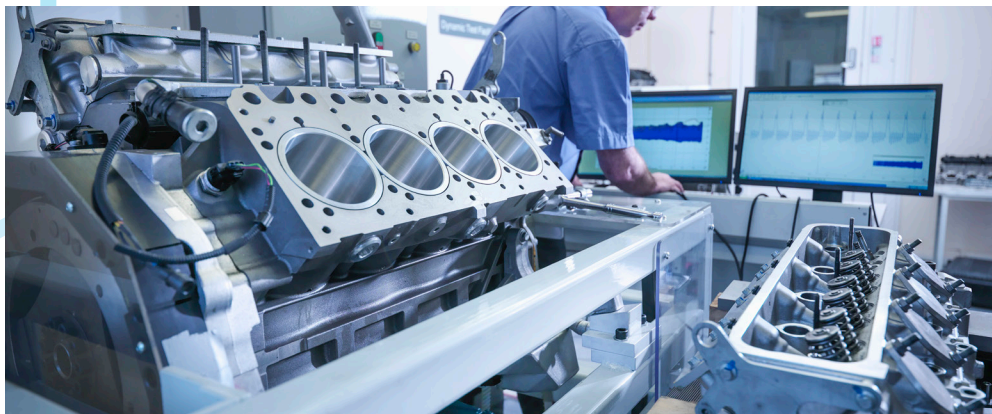
INTERMEDIATE

This one-day course discusses how to model rigid-body mechanical systems in the Simulink environment using Simscape Multibody™ (formerly SimMechanics™). Topics include:

- Modeling simple multibody systems
- Combining Simulink, Simscape, and Simscape Multibody blocks
- Importing models from CAD software
- Creating reusable models of mechanical systems

Prerequisites: *MATLAB Fundamentals*, *Simulink for System and Algorithm Modeling*, and *Modeling Physical Systems with Simscape*





Number of countries where MathWorks training is held

Based on 2017 data

28

Modeling Fluid Systems with Simscape

INTERMEDIATE

This one-day course focuses on modeling hydraulic systems in Simulink using Simscape Fluids™ (formerly SimHydraulics®). Topics include:

- Modeling fluid power and fluid delivery systems
- Actuating and controlling hydraulic system models
- Connecting fluid, mechanical, and thermal modeling domains
- Creating custom model components using blocks, data, or equations

Prerequisites: *MATLAB Fundamentals*, *Simulink for System and Algorithm Modeling*, and *Modeling Physical Systems with Simscape*

Modeling Driveline Systems with Simscape

INTERMEDIATE

This one-day course focuses on modeling mechanical systems for automotive applications in the Simulink environment using Simscape Driveline™ (formerly SimDriveline™). Topics include:

- Modeling vehicle bodies and tires
- Designing and optimizing braking systems
- Designing mechanical power transmission mechanisms
- Creating multidomain automotive models with closed-loop controllers

Prerequisites: *MATLAB Fundamentals*, *Simulink for System and Algorithm Modeling*, and *Modeling Physical Systems with Simscape*

CODE GENERATION

Testing Generated Code in Simulink

FUNDAMENTAL

This one-day course provides a working introduction to designing and testing embedded applications with Simulink Coder™ and Embedded Coder®. Themes of simulation speedup, parameter tuning in the deployed application, structure of embedded code, code verification, and execution profiling are explored in the context of Model-Based Design. Topics include:

- Simulation speedup with code generation
- Parameter tuning with external mode
- Code generation
- Hardware-in-the-loop verification
- Software-in-the-loop verification
- Code execution profiling

Prerequisites: *Simulink for System and Algorithm Modeling* (or *Simulink for Automotive System Design* or *Simulink for Aerospace System Design*). Knowledge of C programming.

MATLAB to C with MATLAB Coder

INTERMEDIATE

This two-day course covers C code generation from MATLAB code using MATLAB Coder™. The focus is on making existing MATLAB code compliant, generating C code that meets optimization requirements, and integrating generated code with external modules. Topics include:

- Preparing MATLAB code for code generation
- Working with fixed-size and variable-size data
- Integrating with external code
- Optimizing generated code

Prerequisites: *MATLAB Fundamentals* and basic working knowledge of the C programming language

Embedded Coder for Production Code Generation

ADVANCED

This three-day course focuses on developing models in the Simulink environment to deploy on embedded systems. The course is designed for Simulink users who intend to generate, validate, and deploy embedded code using Embedded Coder. Topics include:

- Generated code structure and execution
- Code generation options and optimizations
- Integration of generated code with external code
- Data customization
- Code generation for multirate systems
- Code deployment

Prerequisites: *Simulink for System and Algorithm Modeling* (or *Simulink for Automotive System Design* or *Simulink for Aerospace System Design*). Knowledge of C programming.

95%

Of attendees said coursework had real-world application to their jobs

Based on 2017 data

Code Generation for AUTOSAR Software Components

ADVANCED

This one-day course discusses AUTOSAR-compliant modeling and code generation using the Embedded Coder Support Package for AUTOSAR Standard. Workflows for top-down and bottom-up software development approaches are discussed in the context of Model-Based Design. This course is intended for automotive industry software developers and systems engineers who use Embedded Coder for automatic C/C++ code generation. Topics include:

- Generating Simulink models from existing ARXML system descriptions
- Configuring Simulink models for AUTOSAR-compliant code generation
- Configuring AUTOSAR communications elements in a Simulink model
- Modeling AUTOSAR events in Simulink
- Creating calibration parameters

Prerequisites: *Simulink for System and Algorithm Modeling (*or *Simulink for Automotive System Design* or *Simulink for Aerospace System Design)* and *Embedded Coder for Production Code Generation.* Knowledge of C programming and the AUTOSAR standard.

Generating HDL Code from Simulink

ADVANCED

This two-day course shows how to generate and verify HDL code from a Simulink model using HDL Coder™ and HDL Verifier™. Topics include:

- Preparing Simulink models for HDL code generation
- Generating HDL code and test bench for a compatible Simulink model
- Performing speed and area optimizations
- Integrating handwritten code and existing IP
- Verifying generated HDL code using test bench and co-simulation

Prerequisites: *Signal Processing with Simulink*

DSP for FPGAs

ADVANCED

This three-day course reviews DSP fundamentals from the perspective of implementation within the FPGA fabric. Particular emphasis will be given to highlighting the cost, with respect to both resources and performance costs associated with the implementation of various DSP techniques and algorithms. Topics include:

- Introduction to FPGA hardware and technology for DSP applications
- DSP fixed-point arithmetic
- Signal flow graph techniques
- HDL code generation for FPGAs
- Fast Fourier transform (FFT) implementation
- Design and implementation of FIR, IIR, and CIC filters
- CORDIC algorithm
- Design and implementation of adaptive algorithms such as LMS and QR algorithm
- Techniques for synchronization and digital communications timing recovery

Prerequisites: *MATLAB Fundamentals* and *Simulink for System and Algorithm Modeling*

Programming Xilinx Zynq SoCs with MATLAB and Simulink

ADVANCED

This two-day course focuses on developing and configuring models in the Simulink environment and deploying on Xilinx® Zynq®-7000 All Programmable SoCs. The course is designed for Simulink users who intend to generate, validate, and deploy embedded code and HDL code for software and hardware codesign using Embedded Coder and HDL Coder. A ZedBoard™ is provided to each attendee for use throughout the course. The board is programmed during the class and is yours to keep after the training. Topics include:

- Zynq platform overview and environment setup
- Introduction to Embedded Coder and HDL Coder
- IP core generation and deployment
- Usage of AXI4 interface
- Processor-in-the-loop (PIL) verification
- Data interface with real-time application
- Device drivers integration

Prerequisites: *Simulink for System and Algorithm Modeling (*or *Simulink for Automotive System Design* or *Simulink for Aerospace System Design).* Knowledge of C and HDL programming languages.

Software-Defined Radio with Zynq Using Simulink

ADVANCED

This one-day course focuses on modeling designs based on software-defined radio in MATLAB and Simulink and configuring and deploying on the ADI RF SOM. Topics include:

- Model communications systems using Simulink
- Implementation of Radio I/O with ADI RF SOM and Simulink
- Prototype deployment with real-time data via hardware/software co-design

Prerequisites: *Programming Xilinx Zynq SoCs with MATLAB and Simulink*

STATEFLOW

Stateflow for Logic-Driven System Modeling

FUNDAMENTAL

This two-day course shows how to implement complex decision flows and finite-state machines using Stateflow®. The course focuses on how to employ flow charts, state machines, truth tables, and state transition tables in Simulink designs. Topics include:

- Flow charts
- State machines
- Hierarchical and parallel state diagrams
- Events and functions in state machines
- Truth tables and state transition tables
- Design considerations

Prerequisites: *MATLAB Fundamentals* and *Simulink for System and Algorithm Modeling*

Stateflow for Automotive Applications

FUNDAMENTAL

This version of *Stateflow for Logic-Driven System Modeling* is for automotive engineers who wish to model and simulate event-driven and logic systems. This course offers hands-on automotive examples and exercises that apply basic techniques to realistic problems in the automotive industry.

Prerequisites: *MATLAB Fundamentals for Automotive Applications* and *Simulink for Automotive System Design*

POLYSPACE PRODUCTS

Polyspace for C/C++ Code Verification

ADVANCED

This two-day course discusses the use of Polyspace Bug Finder™ and Polyspace Code Prover™ to prove code correctness, improve software quality metrics, and ensure product integrity. Topics include:

- Creating a verification project
- Reviewing and understanding verification results
- Emulating target execution environments
- Handling missing functions and data
- Managing unproven code (color-coded in orange by Polyspace® products)
- Applying MISRA C® rules
- Reporting

Prerequisites: Strong knowledge of C or C++

Polyspace Bug Finder for C/C++ Code Analysis

ADVANCED

This one-day course discusses the use of Polyspace Bug Finder to remove algorithmic defects, improve software quality metrics, and improve product integrity. This hands-on course is intended for engineers who develop software or models targeting embedded systems. Topics include:

- Creating a code analysis project
- Reviewing and understanding analysis results
- Emulating target execution environments
- Applying MISRA C rules
- Reporting

Prerequisites: Strong knowledge of C or C++

MathWorks®

Accelerating the pace of engineering and science

mathworks.com/2018training

7434v18 11/16