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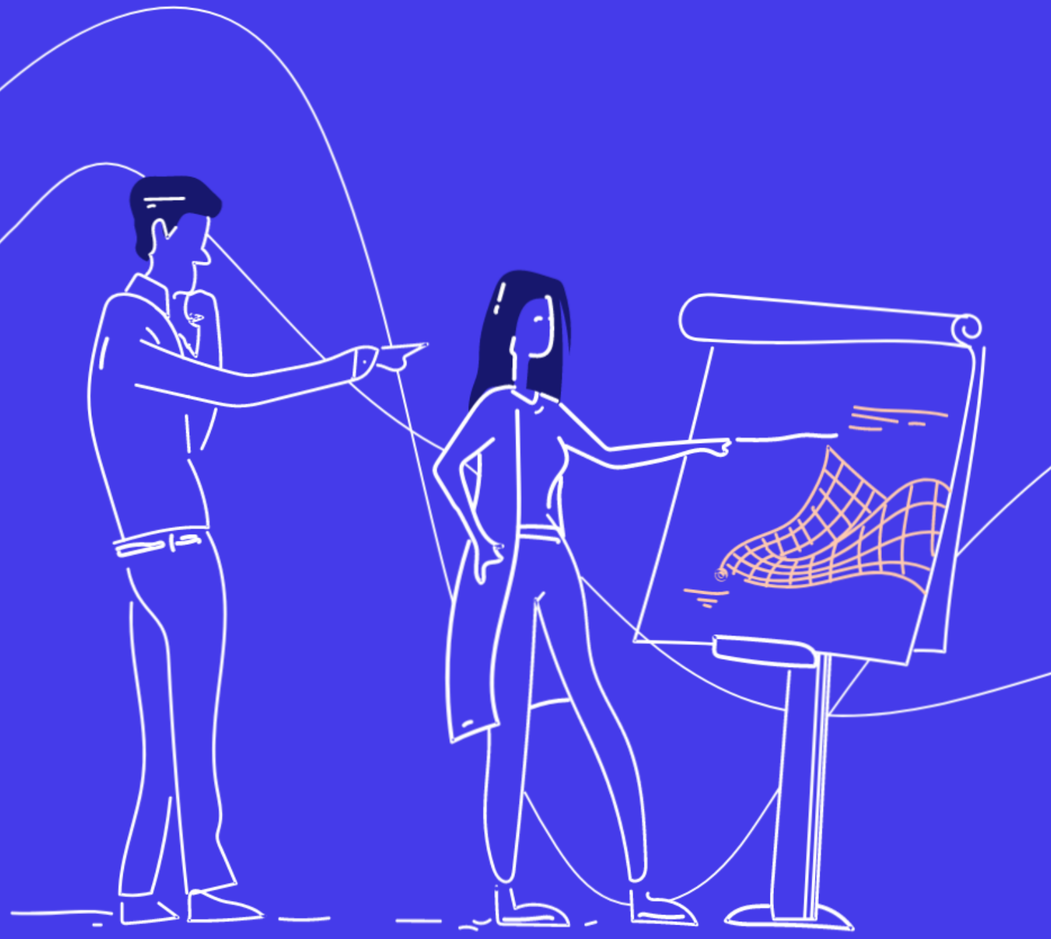
Aerospace Radar and Modern Wireless Communications Systems Curriculum



SciEngineer’s training courses are designed to help organizations and individuals close skills gaps, keep up-to-date with the industry-accepted best practices and achieve the greatest value from MathWorks® and COMSOL® Products.

Radar and Modern Wireless Communications Systems Curriculum

SciEngineer's Training Services

Signal Processing Fundamentals

- Signal Processing with MATLAB (2 days)
- Signal Processing with Simulink (3 days)
- Simulink for Analog Mixed-Signal Design (2 days)

Communications Systems Modeling Fundamentals

- Wireless Communications Systems Design with MATLAB and USRP (2 days)
- Communication Systems Modeling with Simulink (1 day)

Radio Communications

- Designing LTE and LTE Advanced Physical Layer Systems with MATLAB (3 days)
- Upgrading from LTE to 5G with MATLAB (1 day)
- RF System Design Using MathWorks Tools (2 days)
- Modeling Wireless Communications Systems using Phased Array Systems Toolbox (1 day)

Hardware Implementation

- Generating HDL Code from Simulink (2 days)
- DSP for FPGAs (3 days)
- Programming Xilinx Zynq SoCs with MATLAB and Simulink (2 days)
- Software-Defined Radio with Zynq using Simulink (1 day)

Signal Processing with MATLAB

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. This course focuses on creating and analyzing signals, performing spectral analysis, designing and analyzing filters, designing multirate and adaptive filters.

Prerequisites

MATLAB Fundamentals or equivalent experience using MATLAB, and a good understanding of signal processing theory, including linear systems, spectral analysis, and filter design

Detailed course outline »

TOPICS

Day 1

- Signals in MATLAB
- Spectral Analysis
- Linear Time Invariant Systems

Day 2

- Filter Design
- The Signal Analysis App
- Multirate Filters
- Adaptive Filter Design

Signal Processing with Simulink

This two-day course focuses on modeling battery packs using Simscape™ and designing key control functionalities of battery management system using Stateflow®.

Prerequisites

Fundamental knowledge of Simulink, Stateflow and Simscape.

Detailed course outline »

TOPICS

Day 1

- What is Simulink?
- Creating and Simulating a Model
- Modeling Discrete Dynamic Systems
- Modeling Logical Constructs
- From Algorithm to Mode

Day 2

- Mixed-Signal Models
- Simulink Solvers
- Subsystems and Libraries
- Conditional Subsystems
- Spectral Analysis

Day 3

- Designing and Applying Filters
- Multirate Systems
- Incorporating External Code
- Combining Models into Diagrams
- Automating Modeling Tasks

Simulink® for Analog Mixed-Signal Design

This two-day course, targeted toward new users of Simulink, uses basic modeling techniques and tools to demonstrate how to develop Simulink block diagrams for mixed-signal applications.

Prerequisites

MATLAB Fundamentals and basic knowledge of digital signal processing and mixed signal design.

Detailed course outline »

TOPICS

Day 1

- Creating and Simulating a Model
- Modeling Discrete Dynamic Systems
- Modeling Logical Constructs
- Mixed-Signal Models

Day 2

- Simulink Solvers
- Subsystems and Libraries
- Testbenches and Measurements
- Control Design Analysis

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

This two -day course shows how to design and simulate singleand multi -carrier digital communications systems using MATLAB. Multi - antenna and turbo -coded communication 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. The instructor will demonstrate a radio -in - the - loop system using real -time hardware (RTL - SDR and USRP).

Prerequisites

MATLAB Fundamentals and basic knowledge of digital signal processing and mixed signal design.

Detailed course outline »

TOPICS

Day 1

- Communication over a Noiseless Channel
- Noisy Channels, Channel Coding, and Error Rates
- Timing and Frequency Errors and Multipath Channels

Day 2

- Multicarrier Communications Systems for Multipath Channels
- Using Multiple Antennas for Robustness and Capacity Gains
- Building a Radio -in -the -Loop System

Communication Systems Modeling with Simulink

Using hands-on examples, this one-day course demonstrates the use of Simulink products to design common communication systems. The emphasis is on designing end-to-end communication systems using Simulink®, Communications Toolbox™, and DSP System Toolbox™.

Prerequisites

MATLAB Fundamentals, MATLAB for Signal Processing, and Simulink for Signal Processing, or working experience with MATLAB, Simulink, and DSP System Toolbox

Detailed course outline »

TOPICS

Day 1

- Amplitude Modulation Using Simulink
- Modeling Using Communications Toolbox
- Communication Systems Analysis
- Channel Impairments and Receiver Algorithms

Designing LTE and LTE Advanced Physical Layer Systems with MATLAB

This three-day course provides an overview of the LTE and LTE-Advanced physical layer. You will learn how to generate reference LTE waveforms and build and simulate an end-to-end LTE PHY model. This course focuses on OFDMA and SC-FDMA multi-carrier techniques, MIMO multi-antenna systems, uplink and downlink LTE physical channels and methods for golden reference verification with the standard.

Prerequisites

MATLAB Fundamentals and knowledge of wireless communications systems

Detailed course outline »

TOPICS

Day 1

- Introduction to 3GPP Long Term Evolution
- OFDM Theory Review
- LTE Frames, Slots and Resources

Day 2

- Procedures
- MIMO Background
- LTE Downlink Physical Layer Modulation
- MIMO in LTE R8

Day 3

- LTE Multiplexing and Channel Coding
- LTE Uplink Physical Layer Modulation
- LTE Release 9
- LTE Advanced – Release 10

Upgrading from LTE to 5G with MATLAB®

This one-day course provides an overview of the differences and new features of the 5G physical layer relative to the LTE physical layer. Using MATLAB and 5G Toolbox™, attendees will learn how to generate reference 5G NR waveforms and build and simulate an end-to-end 5G NR PHY model.

Prerequisites

- MATLAB Fundamentals or equivalent experience using MATLAB.
- Designing LTE and LTE Advanced Physical Layer Systems with MATLAB or significant experience with LTE systems

Detailed course outline »

TOPICS

Day 1

- Introduction to the 5G NR Physical Layer
- 5G NR Waveform Generation and System Simulation Using the 5G Toolbox

RF System Design Using MathWorks Tools

This two-day course shows how to use RF Blockset™ and RF Toolbox™ for modeling wireless front ends. You will learn when to use two different modeling paradigms to speed up the simulation of RF signals: Equivalent Baseband and Circuit Envelope. The fundamentals of the simulation techniques will be discussed, and best modeling practices will be highlighted.

Prerequisites

Signal Processing with Simulink or equivalent experience using Simulink®, and a good understanding of RF theory

Detailed course outline »

TOPICS

Day 1

- What is RF Blockset?
- Fundamentals of RF Simulation
- Importing S-Parameters and Modeling Linear Elements

Day 2

- Fundamentals of Noise Simulation
- Modeling Nonlinear Operation
- Building Tunable Networks and Developing Custom Models

Modeling Wireless Communications Systems using Phased Array Systems Toolbox

This one-day course provides a comprehensive introduction to the Phased Array System Toolbox™. Themes including wireless system design and modeling, complex MIMO antenna arrays, propagation paths, and spatial signal processing are explored throughout the course.

Prerequisites

Basic wireless communications knowledge and experience using MATLAB®

Detailed course outline »

TOPICS

Day 1

- Working with the Phased Array System Toolbox, Antenna Toolbox and Communications System Toolbox
- Phased Array Design and Analysis
- Design and Model Components of a Wireless System
- Spatial Signal Processin
- Adding Antenna Patterns and Mutual Coupling
- Advanced topics

Generating HDL Code from Simulink

This two-day course shows how to generate and verify HDL code from a Simulink model using HDL Coder and HDL Verifier. This course focuses on preparing Simulink models for HDL code generation, fixed-point precision control, generating HDL code for multirate models, optimizing generated HDL code, interfacing external HDL code and verifying HDL code with cosimulation.

Prerequisites

Signal Processing with Simulink or equivalent experience using Simulink

Detailed course outline »

TOPICS

Day 1

- Preparing Simulink Models for HDL Code Generation
- Fixed-Point Precision Control
- Generating HDL Code for Multirate Models

Day 2

- Optimizing Generated HDL Code
- Using Native Floating Point
- Interfacing External HDL Code with Generated HDL
- Verifying HDL Code with Cosimulation

DSP for FPGAs

This three-day course reviews DSP fundamentals from the perspective of implementation within the FPGA fabric. Topics discussed include DSP fixed-point arithmetic, signal flow graph techniques, HDL code generation for FPGAs, FFT implementation, design and implementation of FIR, IIR and CIC filters and adaptive algorithms, CORDIC algorithm and techniques for synchronization and digital communications timing recovery.

Prerequisites

MATLAB Fundamentals and Simulink Fundamentals

Detailed course outline »

TOPICS

Day 1

- Introduction to DSP FPGA Hardware
- Linear Systems DSP Algorithm Review
- FPGA Technology
- FPGA elements for DSP algorithms
- DSP Arithmetic Essentials • Signal Flow Graph (SFG) Techniques

Day 2

- Frequency Domain Processing
- Multirate Signal Processing for FPGAs
- CORDIC Techniques

Day 3

- Adaptive DSP Algorithms and Applications
- DSP Enabled Communications and FPGAs
- Timing and Synchronisation Issues

Programming Xilinx Zynq SoCs with MATLAB and Simulink

This two-day course focuses on developing and configuring models in Simulink and deploying on Xilinx Zynq-7000 All Programmable SoCs. This course shows how to generate, validate, and deploy embedded code and HDL code for software/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.

Prerequisites

Simulink Fundamentals (or Simulink Fundamentals for Automotive Applications or Simulink Fundamentals for Aerospace Applications). Knowledge of C and HDL programming languages.

Detailed course outline »

TOPICS

Day 1

- Zynq Platform Overview and Environment Setup
- Introduction to Embedded Coder and HDL Coder
- IP Core Generation and Deployment
- Using AXI4 Interface
- Processor-in-the-Loop Verification

Day 2

- Data Interface with Real-Time Application
- Integrating Device Drivers
- Custom Reference Design

Software-Defined Radio with Zynq using Simulink

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 discussed include model and simulate RF signal chain and communication algorithms, implementation of Radio I/O and prototype deployment with real-time data via hardware/software codesign.

Prerequisites

Programming Xilinx Zynq SoCs with MATLAB and Simulink. Knowledge of concepts of communications and hardware design.

Detailed course outline »

TOPICS

Day 1

- Model Communications System using Simulink
- Implement Radio I/O with ADI RF SOM and Simulink
- Prototype Deployment with Real-Time Data via HW/SW Co-Design

The Value of an Experienced Training Expert

Our training courses are developed by MathWorks' 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.

Learn Relevant Skills

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.

Receive Expert Instruction

Our training employs industry-accepted best practices for adult learning and technical instruction, and has developed course content that facilitates a “Presentation, Practice, Test” approach to learning. All training engineers have been selected based on their theoretical knowledge, technical education, experience, and teaching ability.

Increase Team Success Rates

According to post-training surveys, teams who receive 40 hours of training meet project objectives three times as often as those who receive 30 hours or less. This increase in training time raises the likelihood of meeting objectives by 90%.

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Expand your knowledge