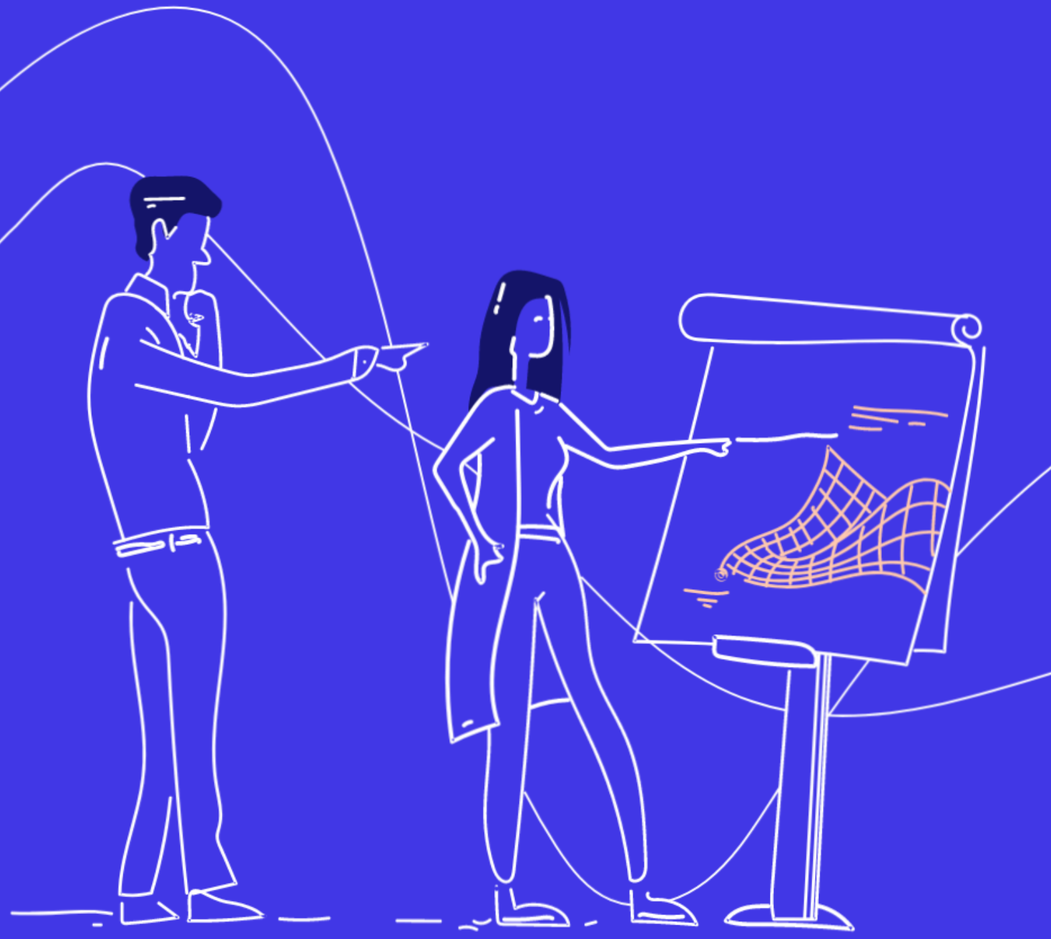
sciengineer

Digital Signal Processing 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.

Digital Signal Processing Curriculum

Signal Processing Fundamentals

- MATLAB Fundamentals (3 Days)
- Signal Processing with MATLAB (2 Days)
- Signal Processing with Simulink (2 Days)

Architecting, Managing, Testing & Verifying Models

- Simulink Model Management and Architecture (2 Days)
- Simulation-Based Testing with Simulink (1 Day)
- Design Verification with Simulink (1 Day)

HDL Code Generation & Verification

- Generating HDL Code from Simulink (2 Days)
- DSP for FPGAs (3 Days)

FPGA Targeting

- Programming Xilinx Zynq SoCs with MATLAB and Simulink (2 Days)
- Software-Defined Radio with Zynq using Simulink (1 Day)
- Embedded Linux and System Integration for Zynq (2 Days)
- Real-Time Testing with Simulink Real-Time and Speedgoat Hardware (2 Days)

SciEngineer's Training Services

MATLAB Fundamentals

This three-day course provides a comprehensive introduction to the MATLAB technical computing environment. Themes of data analysis, visualization, modeling, and programming are explored throughout the course. This course is intended for beginning users and those looking for a review.

Prerequisites

Undergraduate-level mathematics and experience with basic computer operations.

Detailed course outline »

TOPICS

Day 1

- Working with the MATLAB User Interface
- Variables and Commands
- Analysis and Visualization with Vectors

Day 2

- Analysis and Visualization with Matrices
- Tables of Data
- Conditional Data Selection
- Organizing Data

Day 3

- Analyzing Data
- Increasing Automation with Programming Constructs
- Increasing Automation with Functions

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 Model Management and Architecture

This two-day course describes techniques for applying ModelBased Design in a common design workflow. It provides guidance on managing and sharing Simulink models when working in a large-scale project environment. This course is intended for intermediate or advanced Simulink users.

Prerequisites

MATLAB Fundamentals and Simulink Fundamentals. This course is intended for intermediate or advanced Simulink users.

Detailed course outline »

TOPICS

Day 1

- Model-Based Design
- Requirements Linking and Interface Control
- Model Architecture
- Project Management

Day 2

- Data Management
- Data Customization
- Modeling Standards
- Reporting

Simulation-Based Testing with Simulink

This one-day course describes techniques for testing Simulink model behavior against system requirements using Simulink Test, Simulink Requirements, and Simulink Coverage. This course focuses on verification and validation, developing test cases, analyzing test results and creating repeatable groups of tests.

Prerequisites

MATLAB Fundamentals and
Simulink Fundamentals

Detailed course outline »

TOPICS

Day 1

- Verification and Validation in Model-Based Design
- Developing Test Cases
- Analyzing Test Results
- Building Test Suites

Design Verification with Simulink

This one-day course focuses on using Simulink Design Verifier to ensure that a design is devoid of possible design errors, is fully tested, and satisfies necessary requirements. Themes of detecting design errors, automatically generating tests, property proving and managing model complexity are explored throughout the course.

Prerequisites

MATLAB Fundamentals and Simulink Fundamentals

Detailed course outline »

TOPICS

Day 1

- Understanding the Verification Workflow
- Detecting Design Errors
- Automatically Generating Tests
- Property Proving
- Managing Model Complexity

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

Embedded Linux and System Integration for Zynq

This two-day training course focuses on creating and customizing an embedded Linux system for custom target using Zynq. Topics discussed include creating a reference design in Vivado and SDK, software anatomy of a Zynq system, Zynq build system, building a custom Linux image for Zynq and integrating user space device drivers in Simulink.

Prerequisites

Programming Xilinx Zynq SoCs with MATLAB and Simulink.

Detailed course outline »

TOPICS

Day 1

- Creating Reference Design in Vivado and SDK
- Software Anatomy of a Zynq System
- Zynq Build System

Day 2

- Zynq Build System (Continued)
- Integrating User Space Device Drivers in Simulink

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

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 with physical device under control; Creating interactive interfaces and formal test suites, Using standard communication protocols; Ptimizing real-time applications and hardware-in-the-loop testing.

Prerequisites

- Simulink Fundamentals (or Simulink Fundamentals for Automotive Applications or Simulink Fundamentals for Aerospace Applications)
- Knowledge of Simscape ™ preferred

Detailed course outline »

TOPICS

Day 1

- Workflow Overview
- Developing Real-Time Applications
- Building Interactive Interfaces

Day 2

- Automating Real-Time Tests
- Using Communications Protocols
- Optimizing Plant Models for Real-Time Execution
- Hardware-in-the-Loop Testing

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