

Signal Processing with MATLAB®

Training Objectives

This two-day course shows how to analyze signals and design signal processing systems using MATLAB®, Signal Processing Toolbox™, and DSP System Toolbox™.

Topics include:

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

Products

- MATLAB
- Signal Processing Toolbox
- DSP System Toolbox

Course Outline

Day 1 of 2

Signals in MATLAB (2.0 hrs)

Objective: Generate sampled and synthesized signals from the command line and visualize them. Create noise signals for a given specification. Perform signal processing operations like resampling, modulation, and correlation.

- Creating discrete signals
- Sampling and resampling
- Visualizing signals
- Modeling noise
- Performing resampling, modulation, and correlation
- Generating streaming signals

Spectral Analysis (3.0 hrs)

Objective: Understand different spectral analysis techniques and the use of windowing and zero padding. Become familiar with the spectral analysis tools in MATLAB and explore nonparametric (direct) and parametric (model-based) techniques of spectral analysis.

- Discrete Fourier transform
- Windowing and zero padding
- Power spectral density estimation
- Time-varying spectra
- Using a spectrum analyzer in MATLAB

Linear Time Invariant Systems (2.0 hrs)

Objective: Represent linear time-invariant (LTI) systems in MATLAB and compute and visualize different characterizations of LTI systems.

- LTI system representations
- z-transform
- Frequency and impulse response
- Visualizing filter properties
- Applying filters to finite and streaming signals

Day 2 of 2

Filter Design (3.0 hrs)

Objective: Design filters interactively using the Filter Designer app. Design filters from the command line using filter specification objects.

- Filter specifications
- Interactive filter design
- Common filter design functions
- Filter design with filter specification objects
- Reducing filter delay
- Frequency-domain filtering

The Signal Analyzer App (1.0 hrs)

Objective: Learn to use a powerful all-in-one app for importing and visualizing multiple signals, performing spectral analysis on them, and designing and applying filters to the signals. Make cursor measurements on signals.

- Browse signals and make cursor measurements
- Perform interactive spectral analysis
- Design and apply filters to signals interactively

Multirate Filters (1.5 hrs)

Objective: Understand principles of polyphase multirate filter design. Design multirate interpolating and decimating filters. Design multistage and narrow-band filters.

- Downsampling and upsampling
- Noble identities and polyphase FIR structures
- Polyphase decimators and interpolators
- Design multistage and interpolated FIR filters

Adaptive Filter Design (1.5 hrs)

Objective: Design adaptive filters for system identification and noise cancellation.

- Basics of adaptive filtering
- Perform system identification
- Perform noise cancellation
- Improve adaptive filter efficiency