## Course Title:

**Signal Processing with Simulink**

## Course Purpose:

This three-day course, targeted toward new users of Simulink®, uses basic modeling techniques and tools to demonstrate how to develop Simulink block diagrams for signal processing applications. Topics include:

- What is Simulink?
- Using the Simulink interface
- Modeling single-channel and multi-channel 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

## Pre- requisites:

MATLAB Fundamentals and basic knowledge of digital signal processing


- ✓ 3 training days
- ✓ Hours: 09:00-17:00
- ✓ Total training hours: 24

## Teaching method

The course combines lectures, demonstrations and practical exercises in MATLAB, using original training books from MathWorks. The course is in Hebrew but the training materials are in English.



**Training Center Systematics - Contact information:**

**Phone number**: 03-7660111 Ext: 5 **Email:** training@systematics.co.il

**Website:** http://www.systematics.co.il/mathworks

סיסטמטיקס בע"מ
רחוב ראול ולנברג 4, תל אביב 69719
טלפון: 03-7660111
פקס: 03-7660120
מוקד שירות: 03-7660101
דוא"ל: info@systematics.co.il
www.systematics.co.il

## Course Objective:

### What is Simulink?

**Objective:** Get an introduction to Simulink.

- What is Simulink?
- Benefits of using Simulink
- Simulink add-ons
- A look at a Simulink model

### Creating and Simulating a Model

**Objective:** Explore the Simulink interface and block libraries. Build a simple model and analyze the simulation results.

- Creating and editing a Simulink model
- Defining system inputs and outputs
- Simulating the model and analyzing results

### Modeling Discrete Dynamic Systems

**Objective:** Model discrete dynamic systems, and visualize frame-based signals and multichannel signals using a scope.

- Modeling a discrete system with basic blocks
- Finding sample times of block outputs
- Using frames in your model
- Using buffers
- Frames vs. multichannel signals
- Viewing frame-based signals
- Behavior of delay blocks with frame-based signals
- Multichannel frame-based signals

### Modeling Logical Constructs

**Objective:** Model logical expressions. See how zero-crossing detection is used in Simulink and model simple logic in Simulink using MATLAB code.

- Modeling logical expressions
- Modeling conditional signal routing
- Understanding zero-crossing detection
- Modeling with the MATLAB Function block



**Training Center Systematics - Contact information:**

**Phone number**: 03-7660111 Ext: 5 **Email:** training@systematics.co.il

**Website:** http://www.systematics.co.il/mathworks

www.systematics.co.il | מוקד שירות: 03-7660101 דוא"ל: info@systematics.co.il | טלפון: 03-7660111 פקס: 03-7660120 | סיסטמטיקס בע"מ רחוב ראול ולנברג 4, תל אביב 69719

## From Algorithm to Model

**Objective:** Create a model from an algorithm specification.

- Modeling from algorithmic specifications
- Iterative algorithm development through modeling and simulation
- Verifying models against specified algorithms

## Mixed-Signal Models

**Objective:** Model mixed-signal systems.

- What is a mixed-signal model?
- Modeling an ADC with aperture jitter and nonlinearity
- Case study: Modeling TI's ADS62P29 ADC

## Simulink Solvers

**Objective:** Choose the right solver for a Simulink model.

- Understanding the Simulink solver
- Solving simple models
- Solving models with discrete and continuous states
- Solving models with multiple rates
- Fixed-step and variable-step solvers
- Choosing a continuous-state system solver
- Handling zero crossings
- Handling algebraic loops

## Subsystems and Libraries

**Objective:** Create custom blocks in Simulink, apply masks, and develop custom libraries.

- Using a subsystem as a model component
- Masking subsystems
- Creating custom block libraries
- Working with and modifying library blocks
- Adding custom libraries to the Simulink Library Browser
- Creating configurable subsystems



**Training Center Systematics - Contact information:**

**Phone number**: 03-7660111 Ext: 5 **Email:** training@systematics.co.il

**Website:** http://www.systematics.co.il/mathworks

www.systematics.co.il | מוקד שירות: 03-7660101 דוא"ל: info@systematics.co.il | טלפון: 03-7660111 פקס: 03-7660120 | סיסטמטיקס בע"מ רחוב ראול ולנברג 4, תל אביב 69719

## Conditional Subsystems

**Objective:** Model systems with parts that are executed conditionally.

- Conditionally executed subsystems
- Modeling condition-driven systems with enabled subsystems
- Modeling condition-driven systems with triggered subsystems
- Working with an example using the AGC model

## Spectral Analysis

**Objective:** Perform spectral analysis in the Simulink environment, and use spectrum computation in an algorithm.

- Performing spectral analysis with the Spectrum Scope block
- Choosing spectral analysis parameters
- Analyzing power spectrum of a motor noise
- Building a spectral classifier of speech
- Determining the frequency response of a discrete system

## Designing and Applying Filters

**Objective:** Incorporate filters in a model, and explore different ways filters can be designed and implemented in a Simulink model.

- Designing filters in Simulink
- Converting filters to fixed point

## Multirate Systems

**Objective:** Model multirate systems. Resample data and explore multirate filter blocks.

- Modeling multirate systems
- Exploring blocks for multirate signal processing
- Resampling oversampled data
- Designing and implementing anti-imaging and anti-aliasing filters
- Using multirate filter blocks
- Case study: Converting professional audio to CD format
- Converting the design to fixed point



**Training Center Systematics - Contact information:**

**Phone number**: 03-7660111 Ext: 5 **Email:** training@systematics.co.il

**Website:** http://www.systematics.co.il/mathworks

סיסטמטיקס בע"מ
רחוב ראול ולנברג 4, תל אביב 69719
טלפון: 03-7660111
פקס: 03-7660120
מוקד שירות: 03-7660101
דוא"ל: info@systematics.co.il
www.systematics.co.il

## Incorporating External Code

**Objective:** Import or incorporate custom or external MATLAB and C code into a Simulink model.

- Working with custom and external code considerations
- Incorporating MATLAB code with the MATLAB Function block
- Incorporating C code with Legacy Code Tool

## Combining Models into Diagrams

**Objective:** Explore model integration, an important topic for large-scale projects in which several developers are developing different portions of a large system.

- Exploring model referencing and subsystems
- Setting up a model reference
- Setting up model reference arguments
- Exploring model reference simulation modes
- Viewing signals in referenced models
- Browsing the model reference dependency graph

## Automating Modeling Tasks

**Objective:** Control and run Simulink models from the MATLAB command line.

- Automating test runs
- Checking and modifying parameter settings
- Finding blocks with specific parameter values
- Constructing and modifying block diagrams

## Appendix C: Simulink Fixed Point

**Objective:** Get an introduction to Simulink Fixed Point™ and fixed-point mathematics fundamentals. Explore fixed-point scaling and the Fixed-Point Settings interface.

- Simulink Fixed Point
- Simulink built-in data types
- Fixed-point data types
- Fixed-point concepts and arithmetic
- Fixed-point scaling and overflow handling
- Fixed-point rules for targeting embedded processors
- Using the Fixed-Point Settings interface



**Training Center Systematics - Contact information:**

**Phone number**: 03-7660111 Ext: 5 **Email:** training@systematics.co.il

**Website:** http://www.systematics.co.il/mathworks

www.systematics.co.il | מוקד שירות: 03-7660101 דוא"ל: info@systematics.co.il | טלפון: 03-7660111 פקס: 03-7660120 | סיסטמטיקס בע"מ רחוב ראול ולנברג 4, תל אביב 69719