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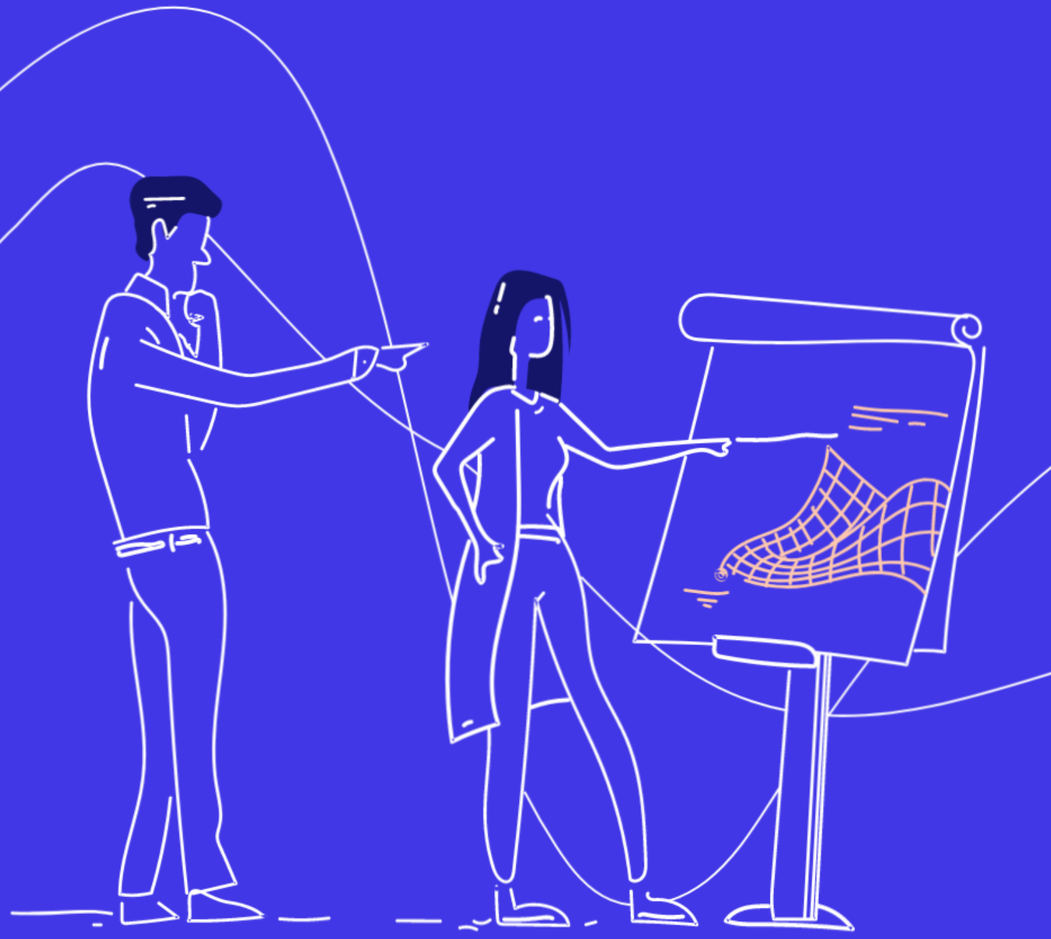
5G Fundamentals with MATLAB



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.

5G Fundamentals with MATLAB

This two-day course provides an overview of the 5G NR physical layer, highlighting differences and new features 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 and knowledge of wireless communication systems

TOPICS

Day 1

- Motivation and Requirements for 5G
- OFDM Theory Review
- 5G NR Waveforms
- 5G MIMO Background
- 5G NR Data Channels

Day 2

- 5G NR Control Channels
- 5G NR Physical Signals
- 5G NR Initial Acquisition Procedures
- 5G NR Waveform Generation and System Simulation Using 5G Toolbox

Motivation and Requirements for 5G

OBJECTIVE: Receive an introduction to the 5G standard and its differences from the LTE standard. Understand general use cases and requirements for 5G.

- 5G use cases
- 5G requirements
- 5G deployment scenarios

OFDM Theory Review

OBJECTIVE: Understand the basics of OFDM modulation, cyclic prefix insertion, and windowing.

- Motivation for multi-carrier vs single-carrier
- Introduction to OFDM
- Generation of OFDM symbols using the IFFT
- Cyclic prefix (guard interval)
- Windowing to reduce out of band emissions
- Advantages and disadvantages of OFDM
- SC-FDMA review

5G NR Waveforms

OBJECTIVE: Learn about the resource grid and frame structure and numerology of 5G waveforms.

- Wireless Waveform Generator App
- 5G waveforms
- 5G frame structure: carriers and bandwidth parts
- 5G numerology: subcarrier spacing

5G MIMO Background

OBJECTIVE: Understand different MIMO techniques, namely beamforming and spatial multiplexing. Learn about singular value decomposition as the solution to the generic MIMO problem.

- Spectral efficiency and capacity
- Beamforming
- Spatial multiplexing
- Singular value decomposition
- Equalizing, predistortion, precoding, and combining

5G NR Data Channels

OBJECTIVE: Understand basic processing elements for downlink and uplink transport and physical data channels. Learn about allocation, mapping types, and transform precoding.

- DL-SCH and PDSCH processing chains
- PDSCH allocation and mapping types
- UL-SCH and PUSCH processing chains
- Transform precoding and PUSCH mapping types

5G NR Control Channels

OBJECTIVE: Understand the structure and characteristics of downlink and uplink control channels, including DCI and UCI formats, PDCCH and PUCCH processing chains, CORESETs, search spaces, and scheduling requests.

- DCI formats and PDCCH processing chain
- Resource element groups and control channel elements
- CORESET structure and characteristics
- PDCCH mapping to CORESETs and search spaces
- UCI formats and PUCCH processing chain
- UCI usage and scheduling requests

5G NR Physical Signals

OBJECTIVE: Learn about key 5G NR physical signals, including DM-RS, CSI-RS, and SRS. Understand DM-RS usage and available mapping types. Explore channel sounding using CSI-RS and SRS. Introduce geolocation using PRS and TDOA estimation.

- DM-RS usage and mapping types
- Signals for channel sounding: CSI-RS and SRS
- PRS and Positioning Support

5G NR Initial Acquisition Procedures

OBJECTIVE: Understand the construction of 5G NR synchronization signals, BCH and PBCH processing chains, and SS block patterns. Learn about initial acquisition procedures including cell search, PBCH decoding including beam sweeping, and RACH.

- Synchronization signals: PSS and SSS
- BCH and PBCH processing chains
- Broadcast channel and master information block
- SS block patterns and bursts
- Cell search: PSS and SSS search
- PBCH decoding, including beam sweeping
- RACH

5G NR Waveform Generation and System Simulation Using 5G Toolbox

OBJECTIVE: Learn best practices and workflows for using 5G Toolbox. Understand how to generate 5G waveforms, set up spatial channel models, and send a signal through the channel. Explore receiver implementation issues and end-to-end performance metrics. Receive an introduction to various application-specific workflows.

- Overview of 5G Toolbox
- Interactive and programmatic 5G waveform generation
- Configuration of cluster delay line and tapped delay line wireless channel models
- Signal transmission through a noisy channel
- Receiver implementation, including synchronization and channel estimation
- End-to-end system performance metrics
- Overview of application-specific workflows

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