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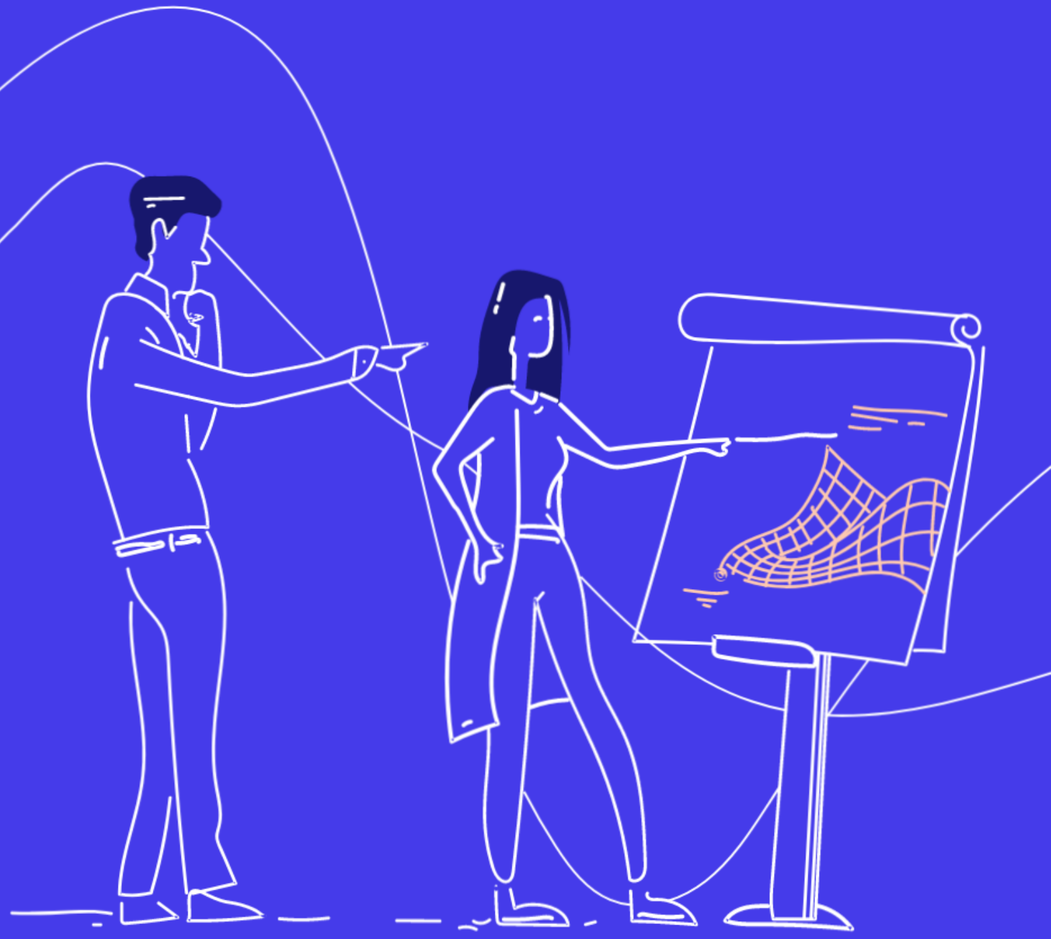
Designing LTE and LTE Advanced Physical Layer Systems with MATLAB



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.

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

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

Introduction to 3GPP Long Term Evolution

OBJECTIVE: Provide an introduction to the LTE standard and its relationship to other 3GPP standards. Understand general requirements and objectives for LTE. Get an overview of different protocol layers within LTE.

- 3GPP evolution from R5 to R11
- Requirements
- Spectrum flexibility
- General characteristics
- Multi-user scheduling
- Resource allocation
- Frequency reuse planning

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

LTE Frames, Slots and Resources

OBJECTIVE: Understand the concepts of frames, subframes, slots, and physical resource grids in LTE downlink and uplink.

- LTE generic frame structure
- Downlink and uplink slot formats
- Resource elements and resource blocks
- Downlink OFDM symbol construction
- Uplink SC-FDMA symbol construction
- LTE downlink resource capacity

Procedures

OBJECTIVE: Understand different physical layer procedures for both downlink and uplink specified in LTE.

- Cell search
- Cell identities in cell search
- Symbol synchronization
- Frame and cell synchronization
- System information acquisition: MIBs and SIBs
- Timing synchronization procedures
- Uplink power control

MIMO Background

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

- Spectral efficiency and capacity
- Transmit and receive diversity
- The Alamouti Scheme
- Delay Diversity and Cyclic Delay Diversity
- Beamforming
- Spatial multiplexing
- Singular value decomposition
- Equalizing, predistortion, precoding, and combining

LTE Downlink Physical Layer Modulation

OBJECTIVE: Understand processing elements for different downlink physical channels and downlink physical signals. Learn about resource grid and control channel element.

- Downlink physical channel processing chain
- Codewords and layers
- Scrambling and modulation
- Transmission schemes
- Diversity, spatial multiplexing, and beamforming
- Synchronization signals: PSS and SSS
- Reference signals: cell and UE specific, MBSFN
- Downlink physical channels: PBCH, PCFICH, PDSCH, and PDCCH
- Control region
- REGs and CCEs, PDCCH search spaces
- Resource grid mapping

MIMO in LTE R8

OBJECTIVE: Learn different MIMO techniques specified in the LTE standard.

- Codewords to layers mapping
- Precoding for spatial multiplexing
- Precoding for transmit diversity
- Beamforming in LTE
- Cyclic Delay Diversity-based precoding
- Precoding codebooks

LTE Multiplexing and Channel Coding

OBJECTIVE: Understand the coding, multiplexing, and mapping to physical channels for all transport channels in downlink and uplink.

- Transport channels and control information: DL-SCH, PCH, BCH, DCI, CFI, HI, ULSCH, and UCI
- Mapping of transport channels to physical channels
- CRC coding and masking
- Code block segmentation
- Convolutional and turbo coding
- Rate matching, bit selection and pruning
- Transport channels and control information processing chains
- HARQ: incremental redundancy, stop-and-wait

LTE Uplink Physical Layer Modulation

OBJECTIVE: Understand processing elements for different uplink physical channels and uplink physical signals.

- Uplink physical channel processing chain
- Scrambling and modulation
- SC-FDMA review
- Uplink Reference signals: DRS and SRS
- Uplink physical channels: PUSCH, PUCCH, and PRACH
- Control information: CQI, RI, PMI, HI, and SR
- Control signaling on PUSCH and PUCCH
- PUCCH formats
- Uplink physical channels and physical signals

LTE Release 9

OBJECTIVE: Learn about new features introduced in LTE Release 9.

- Release 9 features
- MBMS support
- Home eNodeB
- Positioning support
- Transmission schemes

LTE Advanced – Release 10

OBJECTIVE: Learn about new features introduced in LTE Release 10.

- IMT-Advanced Technologies
- Carrier aggregation
- Uplink spatial multiplexing
- Spatial Orthogonal Resource Transmit Diversity
- Downlink enhanced MIMO
- CSI reference signals

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