

SYLLABUS

Introduction to Multi-antenna Systems

- Motivation
- Types of multi-antenna systems
- MIMO vs. multi-antenna systems

Diversity

- Exploiting multipath diversity
- Transmit diversity
- Space-time codes
- The Alamouti scheme
- Delay diversity
- Cyclic delay diversity
- Space-frequency codes
- Receive diversity
- The rake receiver
- Combining techniques

Spatial Multiplexing

- Spectral efficiency and capacity
- Transmitting independent streams in parallel
- Mathematical notation
- The generic MIMO problem
- Singular Value Decomposition
- Eigenvalues and eigenvectors
- Equalising MIMO systems
- Disadvantages of equalising MIMO systems
- Predistortion in MIMO systems
- Disadvantages of predistortion in MIMO systems
- Precoding and combining in MIMO systems
- Advantages of precoding and combining
- Disadvantages of precoding and combining
- Channel state information
- Codebooks for MIMO

Beamforming

- Beamforming principles
- Increased spectrum efficiency
- Interference cancellation
- Switched beam beamformer
- Adaptive beamformer
- Narrowband beamformer
- Wideband beamformer

Case study: MIMO in LTE

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

Propagation Channels

- Time & frequency channel dispersion
- AWGN and multipath propagation channels
- Delay spread values and time variations
- Fast and slow fading environments
- Complex baseband multipath channels
- Narrowband and wideband channels
- MIMO channel models

Channel Estimation

- Channel estimation techniques
- Estimation and tracking
- Training based channel estimation
- Blind channel estimation
- Channel estimation architectures
- Iterative channel estimation
- MMSE channel estimation
- Correlative channel sounding
- Channel estimation in single carrier systems
- Channel estimation for CDMA
- Channel estimation for OFDM