EE624 – COURSE CONTENT

Introduction to Coding and Communication

- Error Performance of Coded and Uncoded Systems
- Optimal Decoding and Distance Properties of Codes
- Linear Block Codes and Properties
- Error Detection and Correction Properties of Codes
- Hamming Codes, Error Performance and Hamming Bound
- Error Performance of Codes in Wireless Fading Channels
- Error Performance with Diversity

Convolutional Codes

- Introduction to Convolutional Codes
- Matrix and Transform Representation of Convolutional Codes
- State Diagram and Trellis Representations
- Distance Properties of Convolutional Codes
- ML Decoding and The Viterbi Decoder
- Probability of Error for BSC and AWGN Channels
- Transfer Function Analysis

Turbo Codes

- Introduction to Turbo Codes
- Turbo Encoder Architecture
- Turbo Code Distance Properties
- IOWEF and Transfer Function Analysis
- BCJR Decoder for Turbo Codes

LDPC Codes

- Introduction to LDPC Codes and Probabilistic Decoding
- Tanner Graph and Decoding of Hamming Codes
- Gallager's Regular LDPC Codes
- Density Evolution and LDPC Code Optimization
- Belief Propagation and AWGN Channels
- LDPC Decoding for AWGN and Sum-Product Algorithm

Introduction to Information Theory

- Information Measure and Entropy
- Convexity, Jensen's Inequality and Entropy Bound
- Joint and Conditional Entropies
- Mutual Information, Properties and Data Processing Inequality
- Fano's Inequality

Data Compression

- Entropy Rate of Stochastic Processes and Markov Chains
- Lossless Data Compression
- Uniquely Decodable and Prefix Free Codes
- Kraft Inequality and Minimum Length
- Construction and Optimality of Huffman Codes

Asymptotic Equipartition Property

- Definition and Properties of the Typical Set
- Lossless Compression of IID Sources
- Shannon Capacity of Discrete Memoryless Channels
- Jointly Typical Sequences and Joint AEP
- Proof of the Channel Coding Theorem
- Introduction and Properties of Differential Entropy
- Capacity of the Gaussian Channel

Capacity of Wireless Channels

- Bandwidth reuse in Cellular Systems
- SIMO and MISO Channel Capacities
- Information Capacity of Frequency Selective Channels
- Fading Channel Capacity
- Channel Capacity with Side Information

Multiuser Wireless Channel Capacity

- Capacity of a General Uplink Wireless Channel
- Capacity of CDMA and Orthogonal Cellular Access
- Uplink Fading Channel Capacity
- Multi-User Capacity with Diversity

Multiple-Input Multiple-Output (MIMO) Channel

- Fast fading MIMO Capacity
- Capacity with CSI at Receiver
- Slow-fading MIMO Channel Capacity
- Diversity Multiplexing Tradeoff