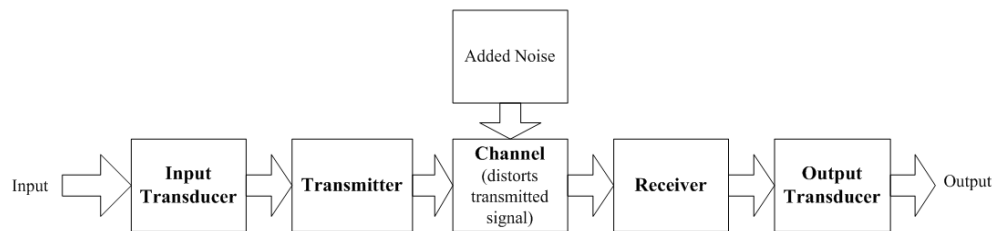


Summary of EE370: Communications Engineering I

Chapter 1: Introduction to Communications

- What is communication?
- What is modulation and why to modulate? (Baseband vs. Passband (carrier Communications))
- Modulation Types (AM, FM, PM)
- Digital vs. Analog Communications
- Important terms in communication systems (signal, system, **signal to noise ratio (SNR)**, **Bit Error Rate (BER)**, **Bandwidth**, **Data Rate**, **Power**)
- Basic Building Blocks of a Communication System
- What does the channel do? (Distortion vs. distortion-less channels)



Chapter 2: Introduction to Signals

- Classification of Signals (Periodic, discrete, analog,....)
- Energy, Power, and root mean squared (rms)
- Signal Operations (shifting, scaling, inversion,...)
- Unit impulse, step, ramp,...
- Trigonometric and compact Fourier Series (FS)
 - How to find (equations)?
 - Magnitude and phase spectra (single sided)
- Exponential Fourier Series (double sided)

Chapter 3: Introduction to Signals

- Fourier Transform (FT) of aperiodic signals
- *Rect* and *sinc* relation
- FT properties (time shifting , scaling, modulation, time scaling,....)
- Use of short tables of FT pairs and properties
- Signal transmission through linear system
 - Convolution
 - Distortionless systems (Example 3.16)
- Filters

Chapter 4: Amplitude Modulation (AM)

- Why do need the carrier? (revisited)
- Modulation, demodulation, block diagram and general form of the following types:
 - DSB: Double Sideband
 - DSB-sc: Double Sideband-suppressed carrier
 - DSB+c: Double Sideband + carrier (AM), modulation index, and power efficiency
 - SSB: Single sideband
 - VSB: Vestigial Sideband
 - QAM: Quadrature Amplitude Modulation
- Carrier Acquisitions (PLL)
- The super-heterodyne receiver (Questions & answers, why IF?, down conversion, why filter at RF, image stations,...

Chapter 5: Frequency Modulation (FM)

- General Form of FM/PM
- Relation between FM and PM
- Instantaneous Frequency
- See summary of FM Modulation Chapter (available in the web)
- **Bandwidth of Angle Modulated signals (Carson's Rule)**
- **Generation/Construction of Narrowband Frequency and Phase Modulators**
- If FM is not efficient in terms of BW compared with AM , **Why FM ?** (mention three reasons)
- Analysis of performance of FM signals under nonlinearity
- Generation of Wideband FM (WBFM):
 - Direct Method VCO (+,-)
 - Indirect Armstrong Method (*See Examples*)
- **Demodulation of FM/PM signals**
 - **Frequency Discriminator**
 - **Phase Locked Loop (PLL)**
 - Zero Crossing Detector
 - Ratio Detector
- FM reception (stereo)

Chapter 6: Sampling and Pulse Coded Modulation (PCM)

- Extend the concept of voice to two dimensional sampling still images (3 colors) , and three for video (frames /sec)
- Nyquist Sampling Theorem
- Spectrum of sampled signal
- Signal reconstruction (The interpolation formula)
- Practical Difficulties in signal reconstruction

- Aliasing
 - Practical Sampling (non ideal delta)
- Maximum information rate
- TDM
- Analog: Pulse Modulation Signals (PAM, PWM=PDM, PPM)
- Digital: PCM
- Quantization
 - Quantization error (assuming uniform)
 - Relation between number of levels (or number of bits) and noise power
 - Non-uniform Quantization (Th compander A-law, μ -law)
- The T1 Carrier system
 - Synchronization (framing)
 - Signaling
- Rate and time calculations
- DPCM (steps!, prediction)
- Delta Modulation (type of errors) adaptive delta

Chapter 7: Principle of Digital Data Transmission

- Line coding (types, features, power spectral density PSD)
- What is ISI? And what causes it?
- Nyquist Criteria for zero-ISI
- How to avoid ISI?
 - Pulse Shaping (sinc, raised cosine), roll off factor, excess bandwidth
 - Controlled ISI (Partial response signaling) Duo-binary signaling, Duo-binary with differential Encoding
- M-ary Communications.
 - Multi-amplitude
 - Orthogonal
- Digital Carrier Communications (ASK (OOK), PSK, FSK, QAM)
- Multiplexing and digital Hierarchy (bit stuffing,+, -)

New Technologies in the Communications Field