PREREQUISITE: ECE 6601. Strong background in probability is a must.

COURSE OBJECTIVE:

To study the design and implementation of digital communications systems.

OFFICIAL TEXT:


SUPPLEMENTAL READING:


INSTRUCTOR:

John R. Barry  
Centergy 5136  
404-894-1705  
E-Mail: barry@ece.gatech.edu  
Office Hours: After lecture, or by appointment.

WEBSITE: http://barry.ece.gatech.edu/6602/

HONOR CODE:

Violations of the honor code (http://www.honor.gatech.edu) will be reported.

HOMEWORK:

Homework may or may not be graded, depending on whether there is a GTA; an announcement will be made during the second week of classes. Collaboration on homeworks is encouraged.

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Deterministic signal processing

- energy and power
- Fourier transforms
- sampling, aliasing, and the sampling theorem
- Complex envelopes, in-phase and quadrature components
- up & downconversion
- Hilbert transform and the phase splitter
- Vector spaces
- Inner products, Schwarz inequality
- Subspaces, projection, and the orthogonality principle
- Gram-Schmidt orthonormalization

Modulation and Detection

- Examples: PAM, FSK, PSK
- Signal-Space diagrams and constellations
- Minimum-distance detection
- projection and correlation receivers; the matched filter
- complex signal spaces

Probabilistic Detection

- Maximum-A-Posteriori (MAP) detection
- Maximum-Likelihood (ML) detection
- Computing the probability of error
- In AWGN, sufficiency of projection
- In AWGN, ML reduces to minimum-distance detection
- Bit-wise versus symbol-wise decisions
- Soft decisions and the log-likelihood ratio (LLR)
Power versus Bandwidth

- Shannon limit
- Nyquist criterion: time and frequency domain
- Minimum-bandwidth PAM via an ideal DAC
- Power vs bandwidth for Gray-coded M-ary PAM
- Gap to capacity for PAM
- Power vs bandwidth for Gray-coded M-ary QAM
- Equivalence of PAM and QAM
- Power vs bandwidth for Gray-coded M-ary PSK
- The union bound and the union bound approximation
- Power vs bandwidth for orthogonal modulation
- Power vs bandwidth for simplex modulation
- Power vs bandwidth for biorthogonal modulation

Advanced Techniques

- Error-control coding
- Coding gain and bandwidth expansion for (n, k) binary codes with 2-PAM
- Shaping and coding gain for multidimensional constellations
- OFDM
- Linear equalization: zero forcing (ZF) and minimum-mean-squared error (MMSE)
- Decision-feedback equalization: ZF and MMSE
- ML sequence detection via the Viterbi algorithm