EECS 121: Introduction to Digital Communication Systems

Instructor: David Tse, Room 257 Cory, x2-5807, dtse@eecs. Office hours: 5-6, Tues. and 11-12, Wed.

Teaching Assistant: Lenny Grokop, lgrokop@eecs, office hour: 4:30-5:30 Wed

Lecture and Discussion Hours:

Lectures: 11-12:30, Tues and Thurs, 289 Cory.
Discussions: 10-11, Mon, 54 Barrows and 1-2, Wed, 2066 Valley LSB.

Course Assistant: Therese George, Room 253 Cory, therese@eecs

Description:

Digital communication systems are basic workhorses behind the information age. Examples include the Internet, wireless systems such as cellular and WiFi , wireline DSL, compact discs, etc. This course is an introduction to the basic principles underlying the design and analysis of digital communication systems. The principles will be illustrated by examples.

Prerequisite:

The basic prerequisites for this course are familiarity with EECS 120 (Signals and Systems) and EECS 126 (Probability and Random Processes). Come and talk to me if you lack these prerequisites.

Requirements:

Weekly problem sets (20 % of the grade), a midterm (30 %) and a final (50 %).

Midterm and Final Dates:

Midterm: March 20, in class.

Final: May 20, 8-11am.

Required Text:

None. Course notes will be posted on the class homepage.

Course Outline:

0. **Overview** (1 lecture)

   Digital vs analog communication. Block diagram of a digital communication system. Source-channel separation as a layering technique.

1. **Source Coding and Compression** (5 lectures)

   Huffman and Lempel-Ziv compression algorithms. Source entropy. Quantization. Sampling.

2. **Communication over Erasure Channels** (3 lectures)

   Notion of reliable communication. Feedback vs forward error correction coding. Linear codes and iterative decoding algorithms. Example: fountain codes for reliable packet delivery over the Internet.

3. **Communication over Noisy Gaussian Channels** (7 lectures)

   Gaussian noise model. Optimal maximum likelihood detection under Gaussian noise. Error probability performance analysis. Scalar vs vector detection. Modulation schemes. Energy-efficient and rate-efficient communication.

4. **Communication over Bandlimited Channels** (6 lectures)

   Baseband pulse amplitude modulation (PAM). Nyquist criterion. Pulse design for bandlimited channels. Power and bandwidth as fundamental resources for communication. Channel capacity. Inter-symbol interference. Equalization: maximum likelihood sequence detection via the Viterbi algorithm. Orthogonal frequency division multiplexing (OFDM). Examples: DSL modems.

5. **Communication over Wireless Channels** (7 lectures)

   Complex baseband representation of passband channels. Modeling of multipath wireless channels. Key parameters: delay spread, coherence bandwidth, coherence time, Doppler spread. Channel fading. detection in flat fading channels. Time, frequency and antenna diversity techniques. Examples: GSM, CDMA and WiMax.