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Grader: Mr. Valentin Krasny

Lectures and practice classes: Online, asynchronous.

Syllabus

- Introduction to Digital Communication.
- Hypothesis testing and decision rules: Minimum error probability, maximum likelihood, Bayes, Neyman-Pearson.
- Discrete-time multidimensional communication systems (vector channels).
- Continuous-time communication systems (waveform channels) in additive white Gaussian noise (AWGN) channels.
- Signal-space representation of finite-energy signals.
- The optimum receiver for known signals in AWGN channels.
- Bit error probability and performance analysis of digital communication systems.
- Digital modulation techniques: PSK, FSK, QAM, high-dimensional constellations: hypercube, orthogonal constellations.
- Introduction to Information Theory: Degrees of freedom, AWGN channel capacity, spectral efficiency, power/bandwidth limited regimes.
- Introduction to Coding Theory
- Block codes, linear block codes, hard and soft decision decoding.
- Convolutional codes, the Viterbi algorithm.

Course Format

The course will be given completely online, and will operate asynchronously via Moodle. Complete lectures and practice classes, as well as homework material and solutions, will be regularly posted and remain accessible throughout the semester. Comprehensive lecture notes covering all the material will be uploaded at the beginning of the semester. An online forum will be available for Q&A, and discussions on the forum are highly encouraged. All announcements posted on Moodle are binding.

Homework

Homework submission is not required. However, students are highly encouraged to individually solve the homework and go over the official solutions.

Quizzes

Two non-obligatory online quizzes will be given (dates TBA). Both quizzes will be based on variations of homework and class exercises. The passing threshold for each quiz is 70.

Exam

The final exam in the course will be in the form of a take-home exam (details TBA).

Final Grade

Let S be the final exam score. The final course grade G will be determined as follows:

- Passing both quizzes (with *any* passing scores): $G = 19 + 0.81 \cdot S$.
- Passing only one quiz (with *any* passing score): $G = 9.5 + 0.905 \cdot S$.
- Failing both quizzes: $G = S$.
- Not taking a quiz for whatever reason is counted as not passing the quiz – no exceptions.
- Please note that your final grade can never be lower than your final exam score.

Literature

- [1] J. M. Wozencraft and I. M. Jacobs, *Principles of Communication Engineering*, New York: John Wiley and Sons, 1965, Reprint Edition by Waveland Pr., 1990.
- [2] J. G. Proakis, *Digital Communications*, 4th Edition, McGraw-Hill, 2000.
- [3] S. Haykin, *Communication Systems*, 4th Edition, New York: John Wiley and Sons, 2000.
- [4] S. Haykin, *Digital Communications*, New York: John Wiley and Sons, 1988.
- [5] H. L. Van Trees, *Detection, Estimation, and Modulation Theory, part I*, New York: John Wiley and Sons, 1968.
- [6] A. Lapidoth, *A Foundation in Digital Communication*, Cambridge University Press, 2017.