EE 527
Detection and Estimation Theory
Spring 2009

T R 2:10–3:30, 204 Marston

Instructor: Aleksandar Dogandžić
3119 Coover
mailto:ald@iastate.edu
Office hours: M W 1–2

http://home.eng.iastate.edu/~ald/EE527.html

Prerequisites: EE 422 and knowledge of matrix algebra, or consent of the instructor. (EE 524 is sufficient as well.)

Textbook: S.M. Kay, *Fundamentals of Statistical Signal Processing: Estimation Theory*. Englewood Cliffs, NJ: Prentice-Hall, 1993.

Reference Books:

S.M. Kay, *Fundamentals of Statistical Signal Processing: Detection Theory*. Englewood Cliffs, NJ: Prentice-Hall, 1998.

B.C. Levy, *Principles of Signal Detection and Parameter Estimation*. New York: Springer-Verlag, 2008.

H.V. Poor, *An Introduction to Signal Detection and Estimation*. 2nd ed., New York: Springer-Verlag, 1994.

A. Gelman, J.B. Carlin, H.S. Stern, and D.B. Rubin, *Bayesian Data Analysis*. 2nd ed. New York: Chapman & Hall, 2004.

L. Wasserman, *All of Statistics: A Concise Course in Statistical Inference*. New York: Springer-Verlag, 2004.

Grading (tentative):

30% Homework and projects,

40% Midterm examinations,

30% Final examination.

Course Outline:

- Estimation Theory
  - Background material,
  - Cramér-Rao bound and minimum variance unbiased estimation,
  - Maximum likelihood estimation

    - expectation-maximization (EM) algorithm,
    - Newton-Raphson and Fisher scoring algorithms.
  - Bayesian inference, sequential Bayesian approach and Kalman filter, Bayesian EM algorithm,
  - An introduction to Monte Carlo (MC) and Markov chain Monte Carlo (MCMC) methods, particle filters,
  - Hidden Markov models, forward and backward recursions, Viterbi algorithm,
  - An introduction to graphical models,
  - Signal-processing, NDE, and communications applications.

- Detection Theory
  - Background material,
  - Bayes detectors,
  - Neyman-Pearson detectors (matched filter, estimator-correlator, ...),
  - Large-deviation analysis of detector performance,
  - Multiple hypothesis tests,
  - Signal-processing, NDE, and communications applications.