TEL 603 Detection & Estimation

Fall 2009

ECE Department, Technical Univ. of Crete

Instructor: Aggelos Bletsas (aggelos at telecom teleia tuc teleia gr)

Lectures: Tuesday and Wednesday $16:00-17:30$ B1.007.

[Replacement day (upon notice): Monday $18.00:19.30$].

Class web site: courses.ece.tuc.gr ($\rightarrow$ Select "TEL 603" from course list)

Office Hours: Available all week. Please RSVP.

Welcome to grad course TEL 603! This is a core graduate course, useful for people specializing in various aspects of engineering. Throughout the semester, we derive and discuss basic theoretical tools and provide concrete examples. Even though practical engineering problems will be analyzed, the course aims to develop solid problem solving skills, applicable to more general settings.

Grading

1) Mid-term and Final written exam.
2) 5-6 Problem Sets.
3) Class participation, effort, as well as instructor's subjective assessment on how well the material has been grasped by the student.
4) Optional class project/paper (for bonus credit). Talk to the instructor for valid topics!

Important Notes

A. Written exams are open-book. You can bring whatever (non-electronic) material you want.

B. Cooperation in groups of $2-3$ students is permitted during problem sets preparation. However,

$$\texttt{cooperation} \neq \texttt{copying}.$$

You are responsible to provide your own report, indicating with whom you cooperated.

C. Problem sets are due in class. You are allowed to hand-write the answers, provided that your notes are crystal clear and easy to read (no deciphering is needed). Please, do not spend time on latexing your answers.

D. Class starts exactly at the advertised time; there is NO "academic quarter" or any other type of (Greek) delay. Please, try to come on time.

Indicative Syllabus

Tentative, subject to change (A.B. 18/9/09)

L0: Introduction/Course Logistics

L1: Bayesian Binary Hypothesis Testing

L2: Hypothesis Testing contd, Sufficient Statistics

L3: Neyman-Pearson Test

L4: Receiver Operating Characteristic (ROC)

L5: Gaussian Detection, M-ary Hypothesis Testing

L6: Optimum Bayesian Parameter Estimation (MSE, MAE, MAP), Properties of MSE

L7: Bayesian Parameter Estimation contd

L8: Linear Least-squares Estimation

L9: Non-random parameter Estimation: Maximum Likelihood (ML)

L10: ML contd, Sufficient Statistics

L11, L12: Cramer Rao Bound

L13, L14: Revision & Mid Term

L15: Uniform Minimum Variance Unbiased Estimation (UMVU)

L16: UMVU contd and RBLS Theorem

L17: Asymptotic Behavior of ML Estimators

L18: Best Linear Unbiased Estimators (BLUE)

L19, L20: Joint Detection & Parameter Estimation: GLRT

L21, L22: Detection of Signals with Uknown parameters: Bayesian and GLRT Formulation

L23, L24: Kalman/Wiener Filtering

L25, L26: Partially Observed Markov Chains or Expectation Maximization (EM) Algorithm (alternate years)

Additionally, other topics will be covered upon request from interested students (e.g. there has been a request for sequential hypothesis testing and SPRTs).

Bibliography

1. Bernard C. Levy, Principles of Signal Detection and Parameter Estimation, Springer 2008.
2. Steven M. Kay, Fundamentals of Statistical Signal Processing, Volumes I (Estimation) and II (Detection), Prentice Hall, 1993.
3. Athanasios Papoulis, Probability, Random Variables and Stochastic Processes, McGraw-Hill.
4. Lecture Notes.