TEL 603 Detection & Estimation

Fall 2014

School of ECE, Technical Univ. of Crete

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

Lectures: Wed., Thur. 17.00-19.00, HMMY Conf. Room.

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

Office Hours: Friday $12.00 - 14.00$. 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) Term project. You will be asked to present a research paper and reproduce its results; Talk to the instructor for valid topics - new research trends are also welcomed!

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)

Week 1: Revision of Linear Algebra and Probability, Bayesian Binary Hypothesis Testing and Sufficient Statistics.

Week 2: Receiver Operating Characteristic (ROC), Neyman-Pearson Tests and Minimax Hypothesis Testing.

Week 3: M-ary Hypothesis Testing and Performance Analysis Bounds.

Week 4: Bayesian Estimation, Mean Squared Error and Linear Least Squares Estimators.

Week 5-6: Estimation of Non-random parameters, Cramer-Rao Bound, Uniform Minimum Variance Unbiased (UMVU) Estimators, BLUE Estimators.

Week 7: Parameter Estimation of Sinusoidal Signals (e.g. Periodogram), Performance Bounds and Applications.

Midterm!

Week 8: Asymptotic Behavior of Maximum Likelihood (ML) Estimators.

Week 9: Composite Hypothesis Testing: UMP Tests.

Week 10: Composite Hypothesis Testing: GLR Tests and Asymptotic Properties of GLRT.

Week 11: Standard Kalman/Wiener Filtering.

Week 12: Introduction to non-parametric estimation: particle filtering.

Week 13: Introduction to inference: factor-graphs and the sum-product algorithm.

Week 14: Project Presentations.

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. Harry L. Van Trees, Detection, Estimation, and Modulation Theory, Part I, John Wiley & Sons, 2001.
4. H. Vincent Poor, An Introduction to Signal Detection and Estimation, 2nd edition, Springer, 1994.
5. Athanasios Papoulis, Probability, Random Variables and Stochastic Processes, McGraw-Hill.
6. Lecture Notes.