

EE:620
Signal Detection and Estimation Theory

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Text Books:

Lecture Notes (Lecture slides plus white board examples)

Also you can refer to these text books:

1. Steven M. Kay, Fundamentals of Statistical signal Processing: Estimation Theory, (Prentice Hall 1993.)
2. Steven M. Kay, Fundamentals of Statistical signal Processing: Detection Theory, (Prentice Hall 1998.)

Course Outline

1. Introduction to Detection & Estimation
2. Introduction to **Estimation Theory**
3. Bayesian Estimation (Random Parameter Estimation)
 - a. Conditional Mean Estimator (CME) or Mean Square Error (MSE) or Minimum Mean Square Error (MMSE)
 - b. Maximum A Posterior Estimator (MAP)
 - c. Conditional Median Estimator (CmE)
 - d. Examples and Properties of Bayesian Estimation
4. Non-Bayesian Estimation (Non-Random Parameter Estimator)
 - a. Minimum Variance Unbiased Estimator (MVUE)
 - b. Method's of Moments (MoM)
 - c. Maximum Likelihood Estimation (ML)
 - d. Cramer-Rao Lower Bounds (CRLB) and Fisher Information
 - e. General Problem of Signal in Gaussian noise
 - f. Examples
5. Least Square Estimation
 - a. General LS Estimation
 - b. Linear LS Estimation
 - c. Vector Extension of Linear LS Estimation
 - d. Constrained LS Estimation
 - e. Non-Linear LS Estimation
 - f. Example Problems
6. Introduction to **Detection Theory**
7. Bayesian Likelihood Ratio Tests
 - a. Binary Hypothesis
 - b. Multiple Hypothesis
 - c. Examples
8. Neyman-Pearson Tests (Non-Bayesian) and Examples
9. ROC Curves
10. Deterministic Signal Detection in Noise (Matched Filter)
11. Random Signal Detection in Noise (Energy Detector)
12. Composite Hypothesis Testing

- 13. Uniformly Most Powerful Tests (UMPT)
- 14. Generalized Likelihood Ratio Tests (GLRT)
- 15. Locally Most Powerful Tests (LMPT)

Evaluation: The grading system applied in this course is as follows:

Two Mid-Exams	:	80% to 70%
Research Presentations/Project etc	:	20% to 30%