EE608 Adaptive Signal Processing — Jan-April 2008

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Brief Course Outline

1. Introduction to adaptive signal processing, Bayesian estimation, and comparison between ℓ_2, ℓ_1 and ℓ_∞ estimation methods.

Non-Adaptive Algorithms

2. Linear Prediction (Estimation): (i) Wiener Filtering (ii) Levinson-Durbin recursions, (iii) Kalman filtering.

Adaptive Algorithms

3. Method of steepest descent and the least-mean-square (LMS) adaptation algorithm.
4. Recursive Least-Squares (RLS) Algorithm: (i) Equation error approach, and (ii) Output error approach. Relationship between the RLS algorithm and the Kalman filter algorithm, (iii) Divergence problem with the RLS algorithm
5. DCT and Wavelet based adaptive filters.
6. Constant Modulus algorithm and blind channel equalization.
7. Multiuser detection
8. Application of Adaptve Processing in (i) wireless sensor networks and (ii) multihop cellular networks

Reference Books:

Dimitris G. Manolakis, Vinay K. Ingle, Stephen M. Kogan, (2000) *Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing*, McGraw-Hill.

Class pdf slides for all lectures

J. G. Proakis (1995) *Digital Communications*, McGraw-Hill International Edition.

S. Haykin (1986) *Adaptive Filter Theory*, Prentice Hall.

B. Widrow and S. D Stearns (1985) *Adaptive Signal Processing*, Prentice Hall.

G. C. Goodwin and K. S. Sin (1984) *Adaptive Filtering, Prediction and Control*, Prentice Hall.

L. Ljung (1988) *System Identification*, Prentice Hall.

Selected papers

For Matrix Computations

G. H. Golub and C. F. Van Loan (1983) *Matrix Computations*, The Johns Hopkins Press, Baltimore, U.S.A.

G. Strang (1976) *Linear Algebra and Its Applications*, Academic Press, New York.

Suggested Background Reading Basic knowledge of stochastic processes, matrix algebra, and some state variable analysis.

The course will attempt to give a research orientation on the subject of adaptive signal processing. One way this will be achieved is by requiring the students to take up a **class project.** *Home assignments will focus heavily on computer simulation of various adaptive algorithms.*

- *Start thinking of the course project right away. I would like a a 4 slide presentation on the course project by Jan 21, 2007.*
- Start forming groups. Groups should not be of more than three students.
- Start preparing a home page for your group. All simulation submissions and project submission will be web based. I will grade based on your web submissions.

Tentative Grade Distribution

1. Home works, simulation assignments	45%
2. Class Project	20 %
3. In Class Exam	35%