ELG 5377 Adaptive Signal Processing Fall 2014

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Schedule: MON 10:00-11:30 STE C0136 WED 8:30-10:00 STE C0136

References: S. Haykin, *Adaptive Filter Theory 5th edition,* Prentice Hall, 2013.
A. Sayed, Adaptive Filters, Wiley-IEEE Press, 2008.

Grading:

20%	Assignments: Several assignments, to be handed in during class on the due-date specified. There will be a 5% penalty for each day late, and no assignment will be accepted after one week.
30%	Project: An individual project involving an application of adaptive signal processing. A project report and a short presentation at the end of the course will be required. More details will follow early in the course.
20%	Midterm exam: Closed-book exam, 80 minutes in length.
30%	Final exam: Closed-book exam, 3 hours in length.

Objectives of the Course:

The objective of this course is to provide the mathematical framework for an understanding of adaptive statistical signal processing, where the goal is to extract information from noisy or corrupted data, and where the properties of the signal and/or the interference are partially unknown or change with time. The basic tools of vector spaces and discrete-time stochastic processes are reviewed and applied to the methods of Wiener filtering and least-squares filtering. Various types of adaptive filters will be introduced and their properties will be studied, specifically convergence, tracking, robustness and computational complexity. Applications will mainly be addressed through student projects.

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Course Outline:

1. Introduction
   - scope and objectives of the course
   - overview of issues in adaptive filtering
   - survey of a few applications

2. Background from linear algebra
   - vector spaces
   - inner product
   - projection theorem

3. Random processes and signal modelling
   - discrete-time random processes
   - correlation and power spectrum
   - models: linear processes, harmonic processes, AR, MA, ARMA processes

4. Wiener filters and linear prediction
   - optimal linear filtering
   - forward and backward prediction
   - Levinson-Durbin algorithm
   - lattice predictors
   - joint-process estimation

5. LMS adaptive filtering
   - method of steepest descent
   - LMS algorithm
   - stability and performance analysis

6. Method of least squares
   - least-squares solution
   - properties
   - singular value decomposition and pseudoinverse
   - recursive least-squares method