E E - 2 9 5 Statistical Signal Processing

COURSE DESCRIPTION

The purpose of this course is to address some fundamental ideas in statistical signal processing, as applied to digital signal processing (DSP). The major domains of the field of statistical signal processing may be classified as estimation, time series analysis and detection. This course will examine applications of the first two, in DSP. Emphasis will be on two subjects: Adaptive Filtering and Spectral Estimation. An important goal of the course is to describe both estimation and time-series analysis in a consistent and unified manner.

There will be three parts to the course:

Mathematical and Statistical preliminaries
Vector spaces; linear independence; Gram-Schmidt; Linear subspaces; Hermitian transformations; Singular value decomposition; Projections, rotations and pseudoinverses; Quadratic forms; Multivariate Normal Distribution.

Adaptive Filtering
Applications; Waveform Coding of Speech; Adaptive Equalization; Adaptive Noise Cancellation; Minimum Mean-square Error; LMS Stochastic Gradient algorithm; Block Least-squares methods; Recursive Least-squares methods. Lattice Filter; Lattice stochastic gradient algorithm; Applications of Lattice filters; Sensitivity and stability; Recursive Least Squares; Pitch detection; Joint-Process estimation.

Spectral Estimation
Nonparametric methods; Classical spectral estimation; Averaged periodgram; Blackman-Tukey; Parametric methods; Rational transfer function models; Other spectral estimation methods; Applications; Sinusoidal parameter extraction; Signal Detection; Bandwidth Compression.

Prerequisites: EE-270, EE-275.
Times: T, Th, 12:15 - 1:30

Texts:
1. *Adaptive Filters, Structures, Algorithms and Applications*
Honig & Messerschmitt, Kluwer Academic, 1984
2. *Statistical Signal Processing*
Louis L. Scharf, Addison Wesley, 1991
3. *Modern Spectral Estimation, Theory and Application*
S.M.Kay, Prentice Hall, 1988