EECS 659
Adaptive Signal Processing

Fall 2003

LECTURES: Tu-Th 12:00-1:30, 153 EWRE
INSTRUCTOR: Alfred Hero, 4229 EECS, (76)3-0564 (hero@eecs.umich.edu).

OFFICE HOURS: Tu-Th 1:30-2:30, and by appointment.

PREREQUISITES: EECS559 or EECS564 or permission of instructor

TEXTS: *Adaptive signal processing algorithms: stability and performance*, V. Solo and X. Kong, Prentice-Hall, 1995.
The elements of statistical learning: data maining, inference, and prediction, T. Hastie, R. Tibshirani, J. Friedman, Springer-Verlag, 2001.

Course homepage: http://www.eecs.umich.edu/ hero/EE659/ee659.html

Course Description

Adaptive signal processing refers to a collection of theory and design techniques which seeks to develop detection, estimation, or filtering algorithms which operate reliably in uncertain or changing environments. In many cases additional constraints are placed on adaptive signal processing algorithms such as: data recursivity, low complexity, low power, real-time operation, parallelizability, etc. Much of the early work on adaptive signal processing was in the context of linear prediction using least-squares theory. This leads to the Widrow LMS algorithm, recursive least squares, and other variants. We will follow the required SK text fairly closely for this material. In addition the course will cover aspects of statistical learning theory and practice in the context of linear and non-linear filtering, prediction, and classification. We will follow the HTF text for this part of the course. Applications will be drawn from the following areas: adaptive interference cancelling, spatio-temporal array processing, channel equalization, inverse problems, pattern recognition, classification, and clustering.

The only exam will be a takehome final. 50% of your course grade will be based on this takehome final with the other 50% based on an individual course project. The project will consist of a short (10 page) report due in class on Tue. December 9 followed by a 20 minute oral presentation on Sat. morning (9AM-12PM) December 13, 2003. The subject matter of your project is flexible so please see me in the next few weeks during office hours to discuss. A short 2 page description of your intended project (project proposal) will be due on Thurs. October 9, 2003.

REFERENCE TEXTS (Reserve Desk in Media Union):

SK *Adaptive signal processing algorithms: stability and performance*, V. Solo and X. Kong, Prentice-Hall, 1995.

HTF *The elements of statistical learning: data maining, inference, and prediction*, T. Hastie, R. Tibshirani, J. Friedman, Springer-Verlag, 2001.

[R] *Pattern recognition and neural networks*, Ripley, Cambridge Univ.

[WS] *Adaptive Signal Processing*, B. Widrow and S. Stearns, Prentice-Hall, 1985.

[S] *Linear Prediction Theory - A Mathematical Basis for Adaptive Systems*, P. Strobach, Springer-Verlag, NY, 1989.

[TJL] *Theory and Design of Adaptive Filters*, J. R. Treichler, C. R. Johnson, and M. G. Larimore, Wiley, New York, 1987.

[A] *Adaptive Signal Processing – Theory and Applications*, S. T. Alexander, Springer-Verlag, New York, 1986.

[H] *Adaptive Filter Theory*, S. Haykin, Prentice-Hall, 1991.

[LS] *Theory and Practice of Recursive Identification*, L. Ljung and T. Söderström, MIT Press, Cambridge MA, 1987.

[C] *Adaptive Antennas – Concepts and Performance*, R. T. Compton, Prentice Hall, Englewood Cliffs NJ, 1988.

[K] *Foundations of Neural Networks*, T. Khanna, Addison-Wesley, New York, 1990.