ME 290-N System Identification Fall 2008

Tuesdays and Thursdays 3:30 - 5:00 pm, 3105 Etcheverry Hall

System Identification deals with the problem of building dynamical models from data. These models could be used for forecasting, prediction, estimation, and feedback control. In this course we will provide a comprehensive treatment of both classical system identification and control-oriented system identification. Numerical, practical, and theoretical aspects will be covered. Topics treated include time and frequency domain methods, generalized parameter estimation, identification of structured non-linear systems, modeling uncertainty bounding, and state-space modeling methods.

Instructor:	Kameshwar Poolla, 5141 or 5105 Etcheverry Hall Tel. 520-1150, poolla@berkeley.edu
Prerequisites:	ME 232 or EECS 221A or consent of instructor Good MATLAB skills
Text:	*System Identification: Theory for the User* (2nd Edition) L. Ljung, Prentice Hall, 1999. ISBN: 0136566952
Course Web Site:	http://jagger.berkeley.edu/me290n/
Office Hours:	Wednesdays 2:00-4:00pm
Grading Policy:	To be determined

Outline:

- *Basic Issues in Modeling:* (2 weeks) Model sets, experiment design, sampling effects, algorithm analysis, bias and variance, identifiability, robustness, convergence and consistency, model verification.
- *Review of Probability Theory:* (2 weeks) Random variables, density and distribution, conditioning, expectation, convergence notions, large number laws, central limit theorem, random processes, stationarity, ergodicity, autocorrelation and power spectral density.
- *Parametric Time-domain Methods:* (3 weeks) Nonlinear programming, Kalman filtering, maximum likelihood estimation, the EM algorithm, generalized LFT-based estimation, prediction-error methods, correlation methods, state-space methods, persistence of excitation.
- *Noise Modelling:* (1 week) Periodograms, estimation of noise statistics, spectral estimation, spectral factorization, time-series analysis.
- *Non-Parametric Frequency-Domain Methods:* (1 week) Spectral methods, empirical transfer-function estimation, windowing methods, convergence aspects.
- *State-space methods for LTI Systems:* (1 week) Subspace methods, relation to the EM algorithm, convergence aspects.
- *Identification of Nonlinear Systems:* (2 weeks) Hammerstien and Weiner models, Interconnected models, Volterra kernels, Dispersion function based identification methods.
- *Other topics:* (1 week) Model validation via correlation, experiment design, model-order selection, Akaike information criterion, the Hannon-Quinn theorem.
- *Control-oriented system Identification:* (2 weeks) Identification in $\mathcal{H}_\infty$, Identification in ℓ_1, model validation, randomized algorithms.