2.160
Identification, Estimation, and Learning

3-0-9 H-Level Graduate Credit
Spring 2006
General Course Information

Prerequisite	2.151 or similar subject
Instructor in charge	Professor H. Harry Asada Ford Professor of Mechanical Engineering asada@mit.edu, Room 3-346, x3-6257
Office Hours	Monday and Wednesday, 2:30 pm ~ 3:00 pm, and Tuesday 4:00 pm ~ 5:00 pm
Course Secretary	Amy Shea, amyshea@mit.edu , Room 3-348, x3-2204
Class	Monday and Wednesday, 1:00 pm ~ 2:30 pm, Room 1-273
Lecture Notes	Lecture notes will be provided for every lecture except for research survey lectures. See the table of contents below.

References

Most of the course materials have been developed based on the following references.

1. "System Identification: Theory for the User, Second Edition", Lennart Ljung, Prentice-Hall 1999, ISBN 0-13-656695-2
2. "Adaptive Filtering, Prediction, and Control", Graham Goodwin and Kwai Sang Sin, Prentice-Hall 1984, ISBN 0-13-004069-x, QA402.G658
3. "Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach, Second Edition", Kenneth Burnham and David Anderson, Springer 1998, ISBN 0-387-95364-7, QH323.5 B87
4. "Introduction to Random Signals and Applied Kalman Filthering, Third Edition", Robert Brown and Patrick Hwang, Wiley 1997, ISBN 0-471-12839-2, TK5102.9.B75

These books are available in Room 3-348 for your reference. You can borrow these books for a limited period of time. No textbook will be used for this subject.

Grading

First exam*, (12:30 pm – 2:30 pm, April 3, 2006)	30%
Second exam*, (12:30 pm – 2:30 pm, May 17, 2006)	30%
Homework Assignment (8 ~ 9 assignments)	20 %
Term project (Suggested topics and guidelines will be provided.)	20%
Total	100%

* Both exams are 120 minutes, 30 minutes longer.

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Spring 2005
Lecture Schedule

1.	2/8-W	Introduction
2.	2/13-M	Recursive Least Square algorithms
3.	2/15-W	Properties of RLS
4.	2/21-T	Random processes, Active noise cancellation (Rescheduled for Friday 2/17)
5.	2/22-W	Discrete Kalman Filter-1 (Rescheduled for Friday 2/24)
6.	2/27-M	Discrete Kalman Filter-2
7.	3/1-W	Continuous and Extended Kalman Filters
8.	3/6-M	Prediction modeling of linear systems
9.	3/8-W	Model structure of linear time-invariant systems
10.	3/13-M	Time series data compression, Laguerre series expansion
11.	3/15-W	Non-linear models, Function approximation theory, Radial basis functions
12.	3/20-M	Neural networks
13.	3/22-W	Error back propagation algorithm
	3/27&29	Spring Break
14.	4/3-M	Mid-Term Exam
15.	4/5-W	Time-frequency analysis
16.	4/10-M	Wavelet transforms
17.	4/12-W	Multi-resolution analysis, Daubechies' wavelets
	4/17-M	Patriots Day, No class
18.	4/19-W	Perspective of system identification, Informative data sets and consistency
19.	4/24-M	Persistent excitation, frequency domain analysis
20.	4/26-W	Asymptotic distribution of estimates, central limit theorems
21.	5/1-M	Experiment design, Pseudo random binary signals
22.	5/3-W	Maximum Likelihood Estimate
23.	5/8-M	Cramer-Rao Lower Bound and best unbiased estimate
24.	5/10-W	Kullback-Leibler information distance, Akaike's Information Criterion
25.	5/15-M	Model structure selection and system order estimate
26.	5/17-W	End-of-Term Exam

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2.160 Lecture Notes

Identification, Estimation, and Learning

Part 2 REPRESENTATION AND LEARNING

Part 3 SYSTEM IDENTIFICATION THEORY