ME/MS/EC 501 – State Space Control
(a.k.a. Dynamic System Theory)

Fall 2009

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Time and Place: Tue. and Thur. 2-4pm
ENG 202, 110 Cummington Street
Course website: http://people.bu.edu/likeyong/SSC.html

Text: *Control System Design --- An Introduction To State-Space Methods*, Bernard Friedland, McGraw-Hill, 1986 (buy from here).

Some classic references:

Finite Diminsional Linear Systems by Roger W. Brockett, John Wiley and Sons, 1970 (download).

Control Engineering: A Modern Approach, Pierre R. Belanger, Oxford University Press, 1994.

Linear System Theory and Design, Chi-Tsong Chen, Oxford University Press, 3rd Edition, 1999.

Lectures on Dynamic Systems and Control, Mohammed Dahleh, Munther A. Dahleh and George Verghese (download).

Linear Systems, Panos Antsaklis and Anthony Michel, Birkhäuser, Corrected 2nd printing, 2006.

Linear Systems Theory, Wilson Rugh, Prentice Hall, 2nd Edition, 1996.

Grading:

Homework	35%
Midterm Exam	45%
Final Presentation	20%

Prerequisites:

We will review some prerequisites in the class, but familiarity with undergraduate-level control theory is assumed (including Laplace transforms, transfer function, Bode plots, root loci, Nyquist plots). Basic knowledge of differential equations and linear algebra is also assumed.

Software:

Students will be required to use Matlab software on their homework and project. This software is licensed for use on all BU computers. A variety of Matlab tutorials are available on the web. One good one is: http://www.engin.umich.edu/group/ctm/basic/basic.html

See next page for the lecture plan.

Lecture	Section	Topics
1	Introduction	1. Brief history of feedback control 2. Frequency domain vs. state space 3. Things that help you to apply this class
2 - 4	Linear state space model	1. Basic properties 2. Linearization of nonlinear systems 3. Discrete time model 4. Examples
5 – 7	Solution of linear ordinary differential equations	1. Existence and uniqueness of solution 2. Matrix exponentials 3. Properties of the state-transition matrix
8, 9	Finite linear space and the Jordan form	1. Finite dimensional linear spaces 2. Linear transformations and matrices 3. Jordan normal form
10 – 12	Point of contact with frequency domain analysis	1. Stability analysis in the frequency domain (review) 2. The solvent 3. MIMO system
13 – 16	Controllability and Observability	1. Controllability / observability Grammian 2. Algebraic tests 3. Viewed in the Jordan Form 4. Canonical forms
17 – 19	Control Design	1. Linear Quadratic Regulator (LQR) 2. Pole placement 3. Observer
20	Midterm	
21 – 22	Discrete Time Model	1. Stability, controllability and observability 2. Control designs (including discrete-time Kalman filter if we have time)
23 – 24	Constrained robust optimal control	1. Theory 2. Software
25	Final presentation	