CALIFORNIA INSTITUTE OF TECHNOLOGY
Control and Dynamical Systems

CDS 110b - Introduction to Control Theory
Winter 2006

Instructor

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Office hours: Fri, 3-4p

Teaching Assistants

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Grading

The final grade will be based on homework sets, a midterm exam and a final exam.

- Homework: 50%
  Homework sets will be handed out weekly and due on Mondays by 5 pm to the box outside of 109 Steele. *Late homework will not be accepted without* **prior** *permission from the instructor.*
- Midterm exam: 20%
  A midterm exam will be handed out at the beginning of midterms week and due at the end of the midterm examination period. The midterm exam will be open book.
- Final exam: 30%
  The final exam will be handed out on the last day of class due at the end of finals week. It will be an open book exam.

Note: Students working on the course project will not be required to take the midterm or final. Instead, two project reports will be due documenting the experimental work performed as part of the class.

Homework policy

Collaboration on homework assignments is encouraged. You may consult outside reference materials, other students, the TA, or the instructor. All solutions that are handed in should reflect your understanding of the subject matter at the time of writing. MATLAB scripts and plots are considered part of your writeup and should be done individually.

Course Text and References

The recommended texts for the course are

- B. Friedland, *Control System Design: An Introduction to State-Space Methods*, McGraw-Hill, 1986. Available in the Caltech bookstore (Dover Edition).
- J. Doyle, B. Francis, A. Tannenbaum, *Feedback Control Theory*, Macmillan, 1992. Available online via the course homepage.
- K. J. Åström and R. M. Murray, *Design and Analysis of Feedback Systems*, Preprint, 2006. Available online at `http://www.cds.caltech.edu/~murray/books/AM05/wiki`.

You may find the following texts useful as well:

- G. F. Franklin, J. D. Powell, and A. Emami-Naeni, *Feedback Control of Dynamic Systems*, Addison-Wesley, 2002.
- N. E. Leonard and W. S. Levine, *Using Matlab to Analyze and Design Control Systems*, Benjamin/Cummings, 1992.

These have been put on reserve in the Sherman Fairchild Library.

Class homepage

Information on the class is available via the World Wide Web in the CDS 110 homepage:

`http://www.cds.caltech.edu/~murray/cds110`

All course handouts and other administrative data about the course will be available via the class homepage.

Course outline

The rough plan for the course is as follows:

Week	Topics	Reading
1	Course overview + optimal control	Notes
2	Linear quadratic optimal control	Friedland Ch 9
3	Receding horizon optimal control	Notes
4	Stochastic sytems	Friedland Ch 10
5	Kalman filters + midterm review	Fridland Ch 11
6	H_∞ control	DFT Ch 2 & 3
7	Robust stability	DFT Ch 4
8	Robust performance	DFT Ch 4
9	Design constraints	DFT Ch 6
10	Design example + final review	Notes

A more detailed course outline is available on the course web page.

Course project

Students interested in the implementation of control systems may opt to do a course project in lieu of the midterm and final exams. The course project will involve implementing control algorithms on a working application. For 2006, the experiment will be control of an autonomous road vehicle.