ECE-520 Discrete-Time Control Systems
Winter 2007

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Recommended Text: Discrete-Time Control Systems (2nd Edition), Prentice-Hall, 1995 by Katsuhiko Ogata

GRADING POLICY

Each Exam	15%
Labs	40%
Homework/Matlab/Simulink	20%
Project	10%

Notes:

1. You must acceptably complete each lab to pass the class.

2. For the majority of the labs, you will be required in the preceding homework to derive some relationships we will be using in lab or simulate a system (or systems). If you understand the homework the lab should not be a problem.

3. Many of the homework problems will require you to use Matlab or Simulink as part of the problem. If you do not do these parts of the problem, do not expect to receive credit for any parts of the problem.

4. You are expected to do your own work. You can certainly talk with each other and help each other, but the work you hand in should be your own. As an example, if two people hand in the same Simulink plot and both came from the same directory, neither will receive any points!

5. The project will be to fill in the steps in a recursive-least squares derivation and use the technique to estimate the transfer function of a system that is changing over time. You are expected to work on your own for this project (you will have a few weeks to do this).

6. Unless specifically told otherwise on a particular problem, you are expected to work out the problem by hand (or use Matlab). *If you write on your assignment that you used Maple and are copying the answer, expect to get no points.* You can use Maple to check your answers. You cannot turn in any Maple code or plot as part of the solution to a problem.

Labs:

1. You can work individually or in groups of two for the labs. Each partner is responsible for contributing to the lab.

2. You must write a short memo summarizing your results. You should include **as attachments** in the memo the plots and you made for the lab. The lab write up is generally to be computer generated and each graph needs to be labeled as a figure (with a caption). Usually students find it easier to just copy and paste all the figures they need into a document and explain the figure or answer questions as they are doing the lab.

3. Your labs are 40% of your grade, so do a good job. Each graph should be associated with a Figure number and caption, and the axes should be appropriately labeled where appropriate.

4. The systems in the lab use Matlab 6.5.1. You can either do all of your problems in the lab or load Matlab 6.5.1 on your laptops. If you modify the Simulink models with a different version of Matlab, you may not be able to utilize them on the systems (Matlab 6.5.1 may not be able to read the files.)

Tentative Schedule

11/26 z-transforms
11/27 z-transforms
No Lab
11/29 z-transforms

12/3 Review of vectors/matrices
12/4 Matrix Calculus, Least Squares Estimates
Lab 1: System identification in the continuous domain (2 1 dof systems)
12/6 Linear Independence, span of vectors, rank, null spaces

12/10 Solving the state equations (in continuous time)
12/11 Zero order hold, discrete-time state variable descriptions
Lab 2: System identification in the continuous domain (2 2 dof systems
12/13 Computing exp(At)

12/17 Discrete-time state variable descriptions with delays
12/18 Cayley-Hamilton Theorem, controllability, observability
Lab 3: Discrete-Time PID Controllers
12/20 Cayley-Hamilton Theorem, controllability, observability

1/7 State variable feedback
1/8 State variable feedback
Lab 4: Discrete-Time I-PD and PI-D Controllers
1/10 State variable feedback

1/14 Servo systems
1/15 Servo systems
Lab 5: State variable feedback
1/17 ***Exam 1***

1/21 Full order observers
1/22 Full order observers
Lab 6: State feedback with servo systems
1/24 Full order observers

1/28 Minimum order observers
1/29 Minimum order observers
Lab 7: Full order observers with/without servo systems
1/31 Minimum order observers

2/4 Current observers
2/5 Current observers
Lab 8: Minimum order observers with/without servo systems
2/7 Quadratic optimal control

2/11 Quadratic optimal control
2/12 Quadratic optimal control
Lab 9: Inverted pendulum control
2/14 ***Exam 2***