MAE 544/444: Digital Control Systems

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Spring 2007

Instructor:
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Office-Hours: My office is 1010 Furnas. My planned office hours are Tuesday and Thursday 2-3pm. You may see me outside my office-hours for urgent work.

Course Content:

Week                      Topic
1-2 Continuous vs. Digital Systems.
  1. Laplace Transforms and Transfer Functions
  2. Block Diagrams, Root Locus and Frequency Response Design
  3. Feedback Control
  4. Digitization and Effect of Sampling

2-5 Discrete System Analysis
  1. Linear Difference Equation
  2. The Discrete Transfer Function
  3. The z-Transform – key basic principles
  4. z- Transform Input and Response modeling
  5. Final Value and Other Response Tests
  6. Essential Properties of z-Transformation
  7. Sampled Data Systems

5-7 Design of Discrete-Time Control Systems by Transforms Techniques
  1. System Specifications
  2. Design by Emulation
  3. Root Locus in z-plane
4. Frequency Response Methods
5. Direct Design Methods

Mid-Term Exam
Project Topic Announcement (Graduate Students Only)
Lab Starts

8-10 **State-Space Analysis**
   1. Pole Placement and Controllability
   2. Full State Feedback Control
   3. Estimator Design and Observability
   4. Regulator Design
   5. Integral Design and Disturbance Estimation

10-12 **Quadratic Optimal Control**
   1. LQR Steady State Optimal Control
   2. Optimal Estimation and LQG Control
   3. Multivariable Control Design

12-13 **Sensitivity Analysis**
   1. Quantization Effects
   2. The Sampling Theorem’s Limit
   3. Sensitivity to Parameter Variation
   4. Multirate Sampling

13-15 **Nonlinear Control**
   1. Linearization and Equivalent Gains
   2. Lyapunov’s Method
   3. Introduction to Adaptive Control
   4. Engineering Examples

Project Presentations (Graduate Students Only)

**Text Book:** Katsuhiko Ogata, “Discrete-Time Control Systems,” Prentice Hall

**Other Suggested Readings:**
Grading and Honor Policy:

Home-works: 20% (15% Graduate Students)
Lab: 30% (25% Graduate Students)
Mid-Term Exam: 20% (15% Graduate Students)
Project: 15% (Graduate Students Only)
Final Exam: 20%
Quizzes: 10%

- Exams and quizzes will be administered in-class, closed book. Each exam will be of minimum 1hr. duration.
- Home-work problems will involve analytical and numerical work. You will be required to write several computer programs in your favorite programming language as a part of your home-work assignments. These computer programs will help you with your final project. I do not expect you to edit other student’s programs and submit them as your own.
- You may collaborate with fellow students on home-work assignments, but each student should submit his/her own individual write-up for each problem.
- There is no collaboration permitted in all exams, quizzes and projects.
- Failure to comply with the above may have severe impact on your final grades.
- Academic integrity is a fundamental university value. When an instance of suspected or alleged academic dishonesty by a student arises, it will be resolved according to the procedures set forth by UB. For more information on UB policies and procedures regarding academic integrity, please visit: http://www.student-affairs.buffalo.edu/judicial/art3a.shtml#integrity
- I reserve the rights to assign final grades depending upon the over-all performance (including class attendance) of each student, especially when there is clear evidence that your scores do not reflect your understanding of the material.