EE 105: Feedback Control Systems

Fall 2019
M/W 1:30-2:45pm, Halligan 111B

Control systems are everywhere: in your house, in your car, in your body, and even in social structures. Anything that measures a result and adjusts in response is a feedback control system. In EE 105, we apply linear systems theory and linear algebra first to understand these systems, and then to make them do our bidding — automatically.

This course will give you a toolbox full of theoretical methods for designing control systems, the ability to use computational tools for control systems analysis, and hands-on experience building a digital feedback control system with real hardware.

After successfully completing this course, you will be able to:

- Begin with a physical system with known dynamics, and formulate models using differential equations, tranfer functions, and state space methods.
- Analyze single-input-single-output (SISO) feedback systems using time domain, root locus and frequency response techniques.
- Analyze both SISO and MIMO systems using state space methods.
- Design feedback controllers using lead/lag compensation, PID, and pole placement.
- Write software to implement feedback control on a real embedded system (e.g., a quadcopter).

Communication:

Steven Bell `sbell@ece.tufts.edu`

Halligan Hall 202C

Office hours:

- Mondays 10:30-12:30pm
- Tuesdays 3:00-5:00pm
- Thursdays 3:00-4:00pm (walking office hours – see my webpage for details)
- I'm also available other times by appointment, or just drop by my office if my door is open.

To minimize distraction, I generally only check email a few times a day. However, I will make a strong effort to answer all messages within 24 hours on weekdays.

All materials will be posted on the course website: http://www.ece.tufts.edu/ee/105/

If you have a general question about the course content or course logistics, please post on Piazza rather than emailing me. That way anyone can answer the question, and everyone benefits from the response. Sign up for this course on Piazza here: http://piazza.com/tufts/fall2019/ee105.

Teaching assistant:

Maziar Amiraski `maziar@eecs.tufts.edu`

Prerequisites:

EE 23 (Linear systems) and MATH 70 (Linear algebra), or graduate standing.

Textbook:

You'll want one of the following two textbooks:

Franklin, Powell, and Emami-Naeini, *Feedback Control of Dynamic Systems*, 8th Edition, Prentice Hall, 2018. ISBN-13: 978-0134685717

Ogata, *Modern Control Engineering*, 5th Edition, Prentice Hall, 2010. ISBN-13: 978-0136156734

Franklin et al., (FPE) is a bit easier to read and has more real-world examples, including a chapter full of case studies. Ogata is a bit more theoretical and math-heavy. Both books are on reserve at the library.

Late work:

After the deadline, homework will be accepted for 70% credit until graded homework has been returned or solutions have been posted.

Exams:

There will a 24-hour take-home midterm and final exam. The exact timing will be determined to meet the needs of the class.

Grading:

Grades will be assigned on an absolute scale (not curved), with the following components:

In-class exercises: 5%

Homework: 25%

Exams (midterm and final): 50%

Project: 20%

Collaboration:

I encourage you to work in groups to solve the homework problems and to study — one of the biggest predictors of success in courses like EE 105 is whether or not you have a study group. However, each person must write up and submit their own assignment. For code-based questions, this means that it is fine to dicuss ideas and algorithms and to compare results, but each person must write their own code.

Schedule:

The schedule of class topics, assignments, and corresponding readings is on the course website. It will almost certainly be adjusted to meet the needs and pace of the class.