ENG ME/EC/SE 701: Optimal and Robust Control, Spring 2022

INSTRUCTOR:
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Office hours: W 10-11 am, F 4:15-5:15 pm

MEETING TIME AND PLACE
Mondays and Wednesdays, 12:20 pm - 2:05 pm CAS 204A

INTRODUCTION AND COURSE GOALS
This course aims to provide a rigorous introduction to the fundamentals of optimal and robust control (with a strong focus on optimal). The two topics will be treated essentially independently. Among the topics to be covered are the linear quadratic regular, the calculus of variations, the Pontryagin maximum principle, Hamilton-Jacobi theory, model predictive control, $H_2$, $H_{\infty}$ and the control of uncertain systems (or at least a subset of these).

This is an upper-level graduate course and my assumption (and expectation) is that everyone taking the course is excited about learning the material. The material is highly mathematical and that aspect will be embraced! At the same time, optimal control has many practical implications and they will be highlighted when possible, though I will always focus on mathematical rigor (see again the comment about this being an upper-level graduate course).

COURSE PREREQUISITES
The main requirement is standard mathematical background (linear algebra, ODEs, some exposure to PDEs, Laplace transforms, and so on). Prior experience with Matlab is assumed. Linear system theory, sometimes referred to as state space theory (at the level of ME 501) is technically a prerequisite as well, though I typically cover the material needed anyway. Frequency-domain (or classical) control can be helpful, depending on whether we get to robust control or not. Knowledge of nonlinear systems (at the level of ME 762) is not required and necessary material from nonlinear system theory will be introduced as needed.

COURSE DELIVERABLES AND GRADING
Class performance will be evaluated based on homework sets and a term project. Homework will be assigned semi-regularly with the total number depending on the eventual pace of the course. While you are free to discuss your efforts, each student is responsible for submitting their own homework solution, representing their own work. Homework submission will be through Gradescope.

The term project will be done in small groups. Students will make two presentations, one introducing their topic and goals, and one presenting their final results, and will also produce a final report. The goal of the project is to apply techniques learned in the class to a problem of interest, preferably on a topic that connects to the research of the student. Full details on the project will be forthcoming during the semester.

The weighting of these components with respect to grading is as follows: Homework (50%), Project (50%).

There will be no exams.

COURSE WEBSITE
A website has been setup on slack. All course materials will be disseminated there. While slack can be a bit clunky for file dissemination, it is very good for social interactions. Any questions you have should be posted to me through there.

You should have received an invite to the slack site through e-mail. You can also access it via the link below.

Slack sign-up link

**DROP AND WITHDRAWAL DATES**

The last day to drop the class (without a W appearing on your transcript) is 02.24.2022.
The last day to withdraw from the class (with a W appearing on your transcript) is 04.01.2022.

**TEXTBOOK AND REFERENCES**

No textbook is required. I will be working out of personal notes and some of the references noted below.

*For optimal control:*


*For robust control:*


*For linear and nonlinear control systems:*