The first half of the course will focus on nonlinear systems analysis. Topics include planar dynamical systems, Lyapunov stability, invariance principles, input-to-state stability, and discontinuous dynamical systems.

The remainder of the course will cover numerous methods of controlling nonlinear systems including feedback control, feedback linearization, feedback stabilization, geometric control theory, input-output stability, small-gain theorems, passivity, and sliding mode control.

Instructor

Name: Cameron Nowzari
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Office: Levine 461

Prerequisites

- Linear Systems and Control
- Proficiency in calculus, linear algebra, and ordinary differential equations
- Proficiency with some simulation software (i.e., Matlab/Mathematica/etc.)
- Real Analysis is a plus

Course textbooks

Main text: Nonlinear Systems by H. K. Khalil, 3rd edition.


Course webpage

http://www.seas.upenn.edu/~ese617/
Tentative schedule

The following is a tentative schedule of when we will cover which topics.

- Introduction to nonlinear systems (Weeks 1-2, Ch. 1,2)
- Existence and uniqueness of solutions (Week 3, Ch. 3)
- Lyapunov stability, LaSalle’s theorem (Weeks 4-5, Ch. 4)
- Input-to-state stability (Week 6, Ch. 4)
- Feedback control (Week 7, Ch. 12)
- Feedback linearization (Weeks 8-9, Ch. 13)
- Nonlinear accessibility, observability, and controllability (Week 10, lecture notes)
- Feedback stabilization (Week 11, Ch. 14)
- Input-output stability (Week 12, Ch. 5)
- Passivity (Week 13, Ch. 6,14)
- Sliding mode control (Week 14, Ch. 14)

Time permitting, we will also cover averaging, singular perturbations, and more.

Exams

Midterm in class on Monday October 5th, 1:30 - 2:45 PM

Final TBA

Homework

Homework will be given every 1-2 weeks and will be due on Wednesdays. All assignments and solutions will be posted on the course website. Late homework will not be accepted.

Grading

Homework: 25%, Midterm: 25%, Final: 25%, Project: 25%

Room location and hours

Lectures in Town 303 on Mondays and Wednesdays from 1:30 - 2:45 PM.

Office hours

Mondays 3:00-4:00 PM in GRASP Lab Conference room or by appointment.