AA/EE/ME 548: Linear Multivariable Control

Lecture 05

4/14/2025

Announcements/reminders

- Week 1 & 2 folks: Worked example due Wednesday
- Week 3 folks: Pay attention to lecture material this week.
- Wednesday we have a guest lecture
  - Dr. Edward Schmerling, Senior Research Scientist at NVIDIA
  - Introduction to sequential decision-making
  - Optional reading
    - Chapter 7 from https://underactuated.csail.mit.edu/
    - https://www.mit.edu/~dimitrib/dpbook.html
- Homework 1 due next week!
- More information on course project posted on website
  - Resources on writing proposals, reading papers, and writing papers.

Last week

- Intro to optimization:
  - **(Un)constrained optimization:** objective function and constraints
  - **Method to solve:** gradient descent, sampling-based methods (refer to Algorithms for Optimization textbook)
  - **Convex optimization**: "Nice" objectives and "nice" constraints

- Control Barrier Functions and Control Lyapunov Functions
  - Extension from Lyapunov functions to *Control* Lyapunov functions
  - **Forward (control) invariant sets**: If start inside set, will/can always stay inside set
  - **Control Barrier Functions**: Similar to CLFs, but concerns with set containment rather than convergence to a state.

This week

- Guest lecture by Dr. Max Cohen
- Wrap up CBFs
- **Sequential decision-making**: control/decision-making over a horizon, or making multiple decisions rather than a single decision once.

Freshman

What should I spend my time on now so I can have a successful career in the future?

I have a midterm tomorrow morning. Should I eat a healthy meal, go to sleep early, or study through the night?

I have a homework due in 2 weeks, should I start now or go skiing with friends?

Should I attend that networking event or go home and just Netflix and chill?

Other examples of sequential decision-making

- **Driving**: choosing the appropriate lanes to make the necessary turns
- **Video games**: chess, StarCraft/League of Legends
- **Resource allocation**: Adjusting investments, inventory as the markets/demand/supply changes
- **Healthcare**: What drugs/treatment to use given potential risks/benefits and patient conditions.