ME 599/699
Robot Modeling & Control
Spring 2020

Instructor: Hasan Poonawala

Department of Mechanical Engineering

Syllabus

- **Lecture:** Tue & Thur 12:30pm - 1:45pm, RGAN 203
- **Office Hours:** Tue & Thur 2:00 pm - 3:00 pm
- **Text:** Notes + M. W. Spong, S. Hutchinson, and M. Vidyasagar, *Robot Modeling and Control*, John Wiley & Sons, 2006.
- **Workload:** 2.5 hours of lecture, 4 to 8 hours of homework and code per week
- **Course announcements:** I use canvas to send information, but don't read inbox messages.

Syllabus

- **Academic Integrity**
- **Accommodations due to disability**
- **Attendance Policy**
- **Classroom Conduct**
- **Excused Absences & Verification of Absences**
- **Exams:** Two mid-terms, no final.
- **Homework:** Weekly assignments, must adhere to rules in syllabus
- **Matlab:** Some HW assignments will require use of Matlab or Julia
- **Grading:** HW 20%, Exam 1 20%, Exam 2 20%, Project 40%

More Information

Read The Syllabus!

About me

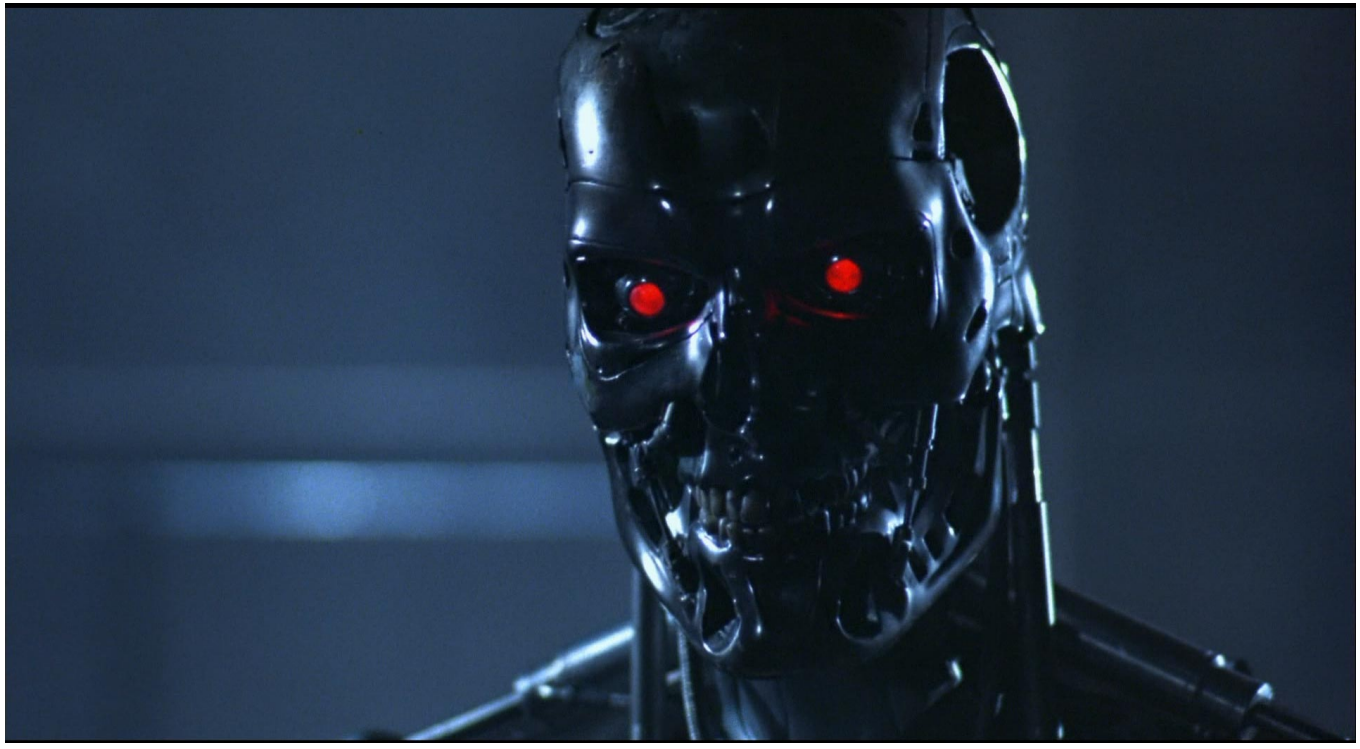
- Grew up in UK and India
- Undergraduate degree in Mech. Engg. in India
- Masters in Mech. Engg from U. Michigan
- Ph.D in Electrical Engg. from UT Dallas
- PostDoc at UT Austin

Research

Goal: Get mechanical robots to control themselves.

Day-to-day: Theory from dynamics and control systems, simulations/experiments involving machine learning and robots.

Motivation



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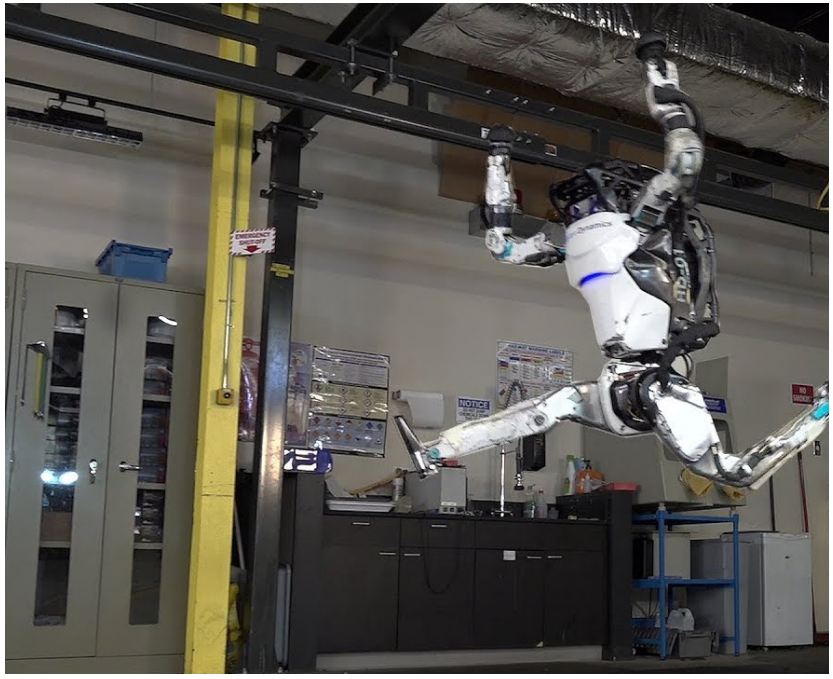

Describing Tasks

What kinds of tasks requires a physical robot?
[Or, what can't your phone do?]

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How would you describe the motion you want to a robot?

How should a robot represent the motions you want, the motions it needs to achieve, and the motions it is actually achieving?

Course Overview

Learning Goals:

1. Understand coordinates and robot configurations.
2. Understand how to transform the robot configuration into task coordinates and *vice versa*, along with the challenges in these processes.
3. Learn approaches to planning motions in both task coordinates and robot configurations.
4. Learn approaches to achieving planned motions using feedback control.
5. Understand the challenges of state estimation.
6. Learn optimization-based approaches to planning and control.
7. Simulate robotic systems and test control algorithms.

Course Overview

Approaches for achieving goals:

- Lecture/Discussion on
  1. Coordinates
  2. Dynamical Systems: single and articulated rigid bodies
  3. Planning Trajectories
  4. Sensing and State Estimation
  5. Feedback Control
- Practice through assignments (code and question) and **Course Project**

Expectations

- Read notes ahead of time,
- Comfort with mathematics:
  - Abstract definitions.
  - Imagining concrete examples to which they apply.
  - Applying definitions to complete derivations and proofs.
- Comfort with code:
  - How to use documentation describing installation and use of packages.
  - Awareness of the need to test code frequently, and that your tests will need testing.
- Study groups. Don't go this one alone.

About You

On an index card (or two), write down:

1. Name
2. Undergrad major(s)/minor(s)
3. Grad program if applicable
4. Research experience/interests if applicable
5. Motivation for this course
6. Other courses you are taking this semester
7. First robot + Favorite robot
8. Concerns about the course
9. Topics you wish were on the syllabus
10. Topics you have already studied
11. Favorite learning/teaching styles