EE290-005: Integrated Perception, Learning, and Control

Yi Ma, Jitendra Malik, Claire Tomlin, and Shankar Sastry
Lecture One: Overview

• A Course Overview (20min, Yi Ma)

• A Brief History and Future Vista in Robotics (30min, Shankar Sastry)

• An Overview of Perception and Action (30min, Jitendra Malik)

• A Viewpoint on Perception, Planning, and Control (30min, Claire Tomlin)
Lecture Time: Wednesday 10:00am – 12:00pm

Lecture and Office Hours: https://berkeley.zoom.us/j/97126955125

EE290-006 Course Websites:

- GitHub: administrative information and resources
  https://pages.github.berkeley.edu/ee290-005/sp21-site/

- Piazza: announcements, Q&A, and team collaborations
  https://piazza.com/berkeley/spring2021/ee290005

A Related Course EE106B/206B: Robotic Manipulation and Interaction
https://ucb-ee106.github.io/106b-sp21site/
Grading Policy: 2 Units (Participation) + 1 Unit (Project)

- Participation (2-unit):
  ✓ 60% **prepare presentation** and lead discussion for a topic of choice
  ✓ 20% **review papers** before class and participate in-class discussions
  ✓ 20% **take notes** and summarize for a topic of choice (scribing)

- Course Project (1 additional unit):
  ✓ 30% **a midterm project proposal** and 5-10min presentation
  ✓ 70% a final 10-15min project presentation and report (conference paper style, e.g., the NeurIPS or IROS template.)

Presentation, scribing, and project will be done with a team of 2-3 students. Sign-up forms with be available soon.
**Goals**: studies the integrated roles of perception, learning, and control in a closed-loop for autonomous robotic systems, under various levels of modeling uncertainty for the environment and of resource constraint for the agent.

**Course Goals and Scope**

Main Application Domains:

- Navigation
- Manipulation
- Locomotion
- Human & Machine Interaction
A Closed-Loop Autonomous System:

- **Agent**
  - Planner
  - Controller
  - Decision Maker

- **Environment**
  - Controlled Plant
  - Dynamical System

- **Learning**
- **Optimization**

- **Resources**
  - Data
  - Space
  - Computation

- **Feedback**
- **Perception**

- **Cost**
- **Utility**
- **Reward**

- **Model Uncertainty**
  - Deterministic
  - Stochastic
  - Adversarial
Phase I: Technical Methods and Lectures by Instructors:

- January 20: Overview
- January 27: Perception for Manipulation and Navigation (Malik and Ma)
- February 3: Optimal Control and LQR (Tomlin)
- February 10: Kalman Filters and SLAM (Sastry)
- February 17: Reinforcement Learning (Ma and Sastry)
Phase II: Paper Study and Presentation by Students:

- February 24 -- March 17: Student Paper Presentation
- March 24: Spring Recess
- March 31: (Midterm Project Proposal Presentation?)
- April 7 -- April 28: Student Paper Presentation
- May 12: Final Project Presentation
Suggestions for Presentation and Project

Paper Presentation:
• Problem formulation and assumptions (model uncertainty)
• Justification for the proposed method (other better alternatives?)
• Generalizability in the proposed solution (instance versus a class)
• Data and computational resource needed for the method (offline/online)

Course Project:
• Integration of multiple components
• Bridge simulation to physical-world systems
• Combine model-based and data-driven
• Out of the box applications or tasks
Questions, please?