EECS C106B / 206B Robotic Manipulation and Interaction **Spring 2021**

Lecture 1: Course Introduction

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Contents

1.1 Logistics

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1.1.1 Course goals

- Be proficient at reading, comprehending, critiquing, and reimplementing research papers in the field of robotics
- Have experience conducting independent research in model-based robotics, vision, and intelligent machines
- Have tools necessary to reason about nonlinear control systems, robotic manipulators, steering systems subject to non-holonomy, path-planning, active vision, image reconstruction, robotic grasping, and other advances in robotics

1.1.2 Who to go to

- For homework questions ask Amay, Haozhi, Valmik (depends if he comes)
- For administrivia questions ask Jaeyun (Stella)
- For projects ask Any TA!

1.1.3 Lecture

Lecture will be Tuesdays and Thursdays from 9:30-11am at Berkeley time using the same *link as last semester*. Similar to last semester, everything will go through the link https://berkeley.zoom.us/s/91438087917 , including OH, HWP, etc.

*Can click red text for link.

1.1.4 Discussion

Discussions will be Wednesday 2-3pm and 4-5pm. There will also be a recorded version for asynchronous people and review. The link will be the same as the lecture link.

1.1.5 Lab Logistics

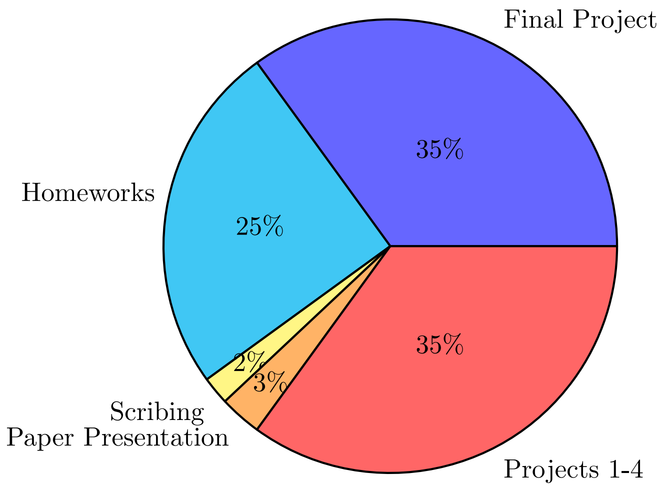
There will be three labs this semester:

- Thursday 5-8pm, Ron
- Friday 8-11am, Jay
- Friday 2-5pm, Josephine

Labs will be different than 106A and entail the following:

- Journal club-style presentation for the first 1.5-2 hours where 1-2 papers will be presented.
- Each person will present a paper with a team.
- Presentations can be slide or board based, taking approximately 20 minutes.
- Sign ups and more information will come out next week.

1.1.6 Grade breakdown



1.1.7 Planned Homework Assignments

Homework	Date Assigned	Due Date
Homework 1: Review	1-20	2-2
Homework 2: Controls	2-3	2-12
Homework 3: Path Planning	2-12	2-23
Homework 4: Vision	3-3	3-16
Homework 5: Grasping	3-17	3-30

1.1.8 Scribing

Everyone has a responsibility to write notes for one lecture for this class. Two people will be assigned each lecture and are responsible for one set of notes.

The deliverables are as follows:

- Scribed notes are due on Gradescope the day after lecture at 11:59pm.
- Scribed notes must be in LaTeX. There is a template for it.
- You must turn in the pdf file and the LaTeX file.
- Notes will be scored on a 0, 1, or 2.
- Sign ups are on a google sheet.

1.1.9 Projects

For projects (not including the final project) we have the following:

Project	Date Assigned	Due Date
Lab 0: Setup and Review	1-19	1-29
Project 1a: Trajectory Tracking w/ Baxter	1-22	2-1
Project 1b: Trajectory Tracking w/ Baxter	2-1	2-15
Project 2: Nonholonomic Control w/ Turtlebots	2-15	3-8
Project 3: Structure from Motion & Image Reconstruction	3-8	3-22
Project 4: Hand-Eye Coordination	3-22	4-5

Note that:

- Projects take approximately 3 weeks each. Take a look at the *course calendar*
- Deliverables include reports, graphics, and code snippets.
- 3 people per group (one person w/ 106A experience and one person w/ controls experience is preferred)
- These projects are different from 106A in that they're open ended and meant to be more like experimentation and research rather than implementation.
- Each project is expected to take approximately 40-60 man hours.

1.1.10 TODOS

Make sure to do the following or face the dire consequences!

- **HW 0 (optional)**
- **HW1 (released 1/20)**
- **Lab 0AB (requires checkoff)**
- **Project 1A released 1/22**
- **Discussion 1/20**
- **Sign up for scribing.**
- **Fill out the lab section form by 1/20!**
- **Always know that course staff and your classmates are here to support you as students AND people. This class is already hard in a typical semester, so never be afraid to ask for help.**

1.2 Introduction and Get Hyped

Now is an amazing time to get into robotics. The following are just samplers of what's out there, what's being done, potential opportunities, and potential problems.

1.2.1 Opportunities Abound

There are many different cookie jars that Berkeley has its hands in, some of which go into interdisciplinary fields. Here are some examples:

- TRUST: Team for Research in Ubiquitous Secure Technology
- BSAC
- CITRIS: Center for Information Technology Research in the Interest of Society
- FI: Fung Institute for Engineering Leadership
- FHL Vive Center for enhanced Reality
- BWRC: Berkeley Wireless Research Center

The ultimate goals of such organizations are to solve the biggest problems with the best technology.

1.2.2 Sensor Webs

There has been big push for sensor webs, which per Wikipedia are a network of sensors that can work together to act as a unit.

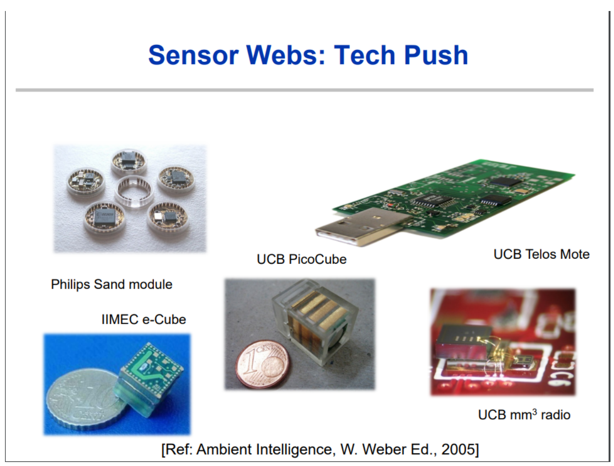


Figure 1.1: Examples of sensors

Though, there is still a lot to be done, in smart objects, artificial skin, microscopic health monitoring, etc.

These sensor webs have become ubiquitous and vital towards society. Examples include environmental monitoring and structural monitoring. More specifically, they've become important towards security, surveillance, health care, natural disaster detection, threat detection, safety, etc.

Some Berkeley examples include monitoring of Great Duck Island, Redwood Tree moisture consumption, Soil Monitoring, etc.

This has resulted in the fusion of computing and communication as we see in the following image where we have IOT/Sensor webs are on the outside and cloud computing on the inside.

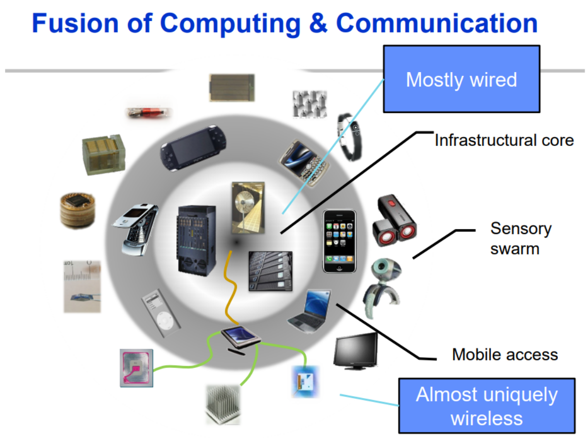


Figure 1.2: Fusion of Computing Communication

A consequence of this is that compute has become more and more accessible to the average person.

1.2.3 Societal Consequences, Utility vs Privacy

These new technologies have important implications for society that we have to be very mindful of. A particularly important subject to watch is privacy and how new methods of data collection/aggregation/disaggregation, the IOT, and cyber physical systems can harm them.

An example was in the seemingly harmless idea of collecting energy consumption data and smart meter data in order to figure out how to better conserve energy / improve efficiency. It turns out that if you collect enough data on energy consumption, you could actually infer class income and even what devices were being turned on/off at a particular location! In fact, there was actually organized crime trying to use such an idea in order to perform burglaries and get free power.

There has to be contracts that balance privacy and other rights with efficiency and utility of growing technologies.

While on one hand, data can help provide better services and improve efficiency, but could be used to infringe on privacy as the level of inference from data continues to improve. Designing services that trade privacy for value may also be problematic. Figuring out how to be tactful in implementing these new technologies is called mechanism design.

1.2.4 Robotics and Learning

One of the biggest problems in robotics right now is grasping and manipulation in robotics. Many areas like manufacturing would benefit tremendously as it continues to improve.

One interesting attempts for a solution is data driven grasping using DexNet, which is a cloud based network for machine learning robotic manipulation methods of 3d grasping. The question now is can deep learning and learning solve grasping? The answer does appear to be yes as other professors at Berkeley have made strides in the field. If so, can it be proved?

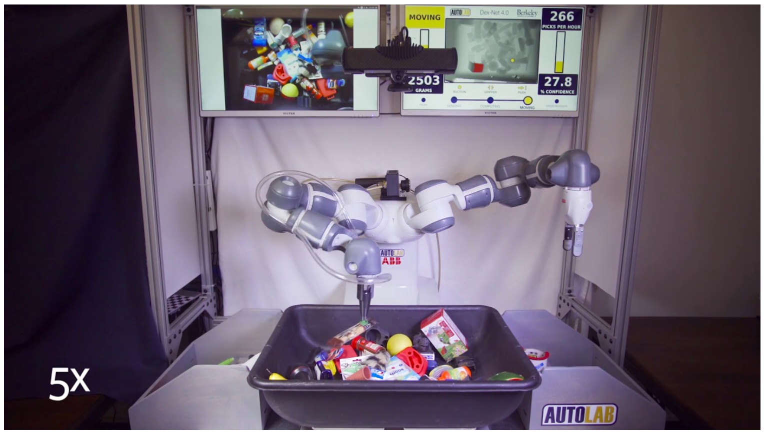


Figure 1.3: Using DexNet

Other important issues are human robotic interactions and how to work together safely. Additionally, how do you make this "working together" intuitive and natural to humans?

Learning deep visuomotor policies: enable robots to autonomously acquire new skills by learning from human demonstrations.

Cooperative inverse reinforcement learning: understanding value alignment between humans and machines.

Indirect learning from humans: context and motion from archived videos

In cars, a former PHD student at Berkeley student, now at Stanford found that you can perform inverse learning in order to learn the behavior of drivers. For example, whether or not a driver is aggressive, neutral, etc.

This has been extended to UAVs, safe learning, autonomous vehicles, etc.

In terms of humans and robots working together, it turns out that the most efficient way to work together isn't necessarily what's intuitive and natural to humans.

AR/VR/XR is also a hot new field where attempts to integrate robotics and other disciplines into our lives are being made everyday.