Overview, Simulator, and Projects

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Where is Oussama?
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Overview

- course logistics
- software
- example project ideas
Course logistics

- all announcements will be sent through Piazza
  - questions for the staff should be posted here as well
- gradescope will be used to submit assignments (due Friday at midnight)
- office hours and section will be held in Gates 119 (upstairs)
- please forgive our scheduling changes!
Homework

- the first 3 homeworks (0-2) will introduce software
  - you’ll do your first control of a robot here!
- in homework 3, you will implement the control laws on a real robot (puma)
- additionally, you will prepare a few slides for lecture (later on)
  - these are informal and only meant to show your project progress
Projects

- Some lectures will be devoted to project discussion, please come prepared
  - For instance next Tuesday
- Heavy on the code (but it will serve you well)
  - May require work in external domains (CV especially)
- Projects should be finalized by the end of April
  - This gives you roughly 5 weeks to complete it!
- In terms of requirements
  - Finalized project slides (~ week 4)
  - Weekly check-ins with your mentor (short email, or stop by office hours)
  - Midterm report (~ week 6) (extra credit if you’ve made great progress)
  - Demo for the staff (~ week 9)
  - Public demo (during finals week)
  - Final report (don’t worry too much about this)
- We are here for you
  - Please come to office hours to discuss ideas often!
Questions?
Software

- main emphasis of this course
- essentially the product of the material in CS223A
  - but is now VERY actionable
- consists of two parts
  - simulator
  - controller
Simulator

- input: joint torques, current state \((q, dq)\)
- output: state at next time step
- perform integration over time (time constant matters)
- may also report/resolve contact forces
  - advanced feature, we will say more about this later
Controller

- input: current state, possibly other sensor data (visual, force, etc.)
- output: joint torques to apply
- from current state and kinematics you can compute all necessary quantities
  - like in CS223A...
  - but we do this for you!
- you will implement everything from joint space to operational space control
SAI

- used to be SCL but we are working on repackaging it with more utilities
  - thank you to Samir Menon for developing this!
- our simulator + controller package
- flexible specification of robots
  - and then we compute everything for you
- allows for combining multiple tasks into a single controller
- framework makes it easy to mix and match robots and controllers
- provides visualization (incredibly helpful for debugging)

- examples provided through tutorials
  - in fact, it is the homework to go through these

- will definitely take some work learn how to use
  - but again, we are here for you
Demo time...
But wait, how many are used to command line?
Real demo time!
Process of implementing a controller on a real robot

- derive/design the control
- test in simulator
- run on robot

- essentially the order of the class
- must go in this order!
  - robots are very fun to use... but very expensive to break
- should alternate between steps 2 and 3 as you add more features
  - for instance, connecting the robot to visual input
Ready to start?

- we will be making a few changes to repositories
  - you should be fine if you have already got things working
  - otherwise we will put out instructions for macs tomorrow
  - sorry windows users :(
- come to section or OH tomorrow if you need help setting up
  - or want to talk about the project!
  - the essential information can be found on the SCL wiki
  - slides will be posted after section
- please think about project ideas over the weekend
  - make posts on Piazza discussing your interests
  - we will discuss these in class Tuesday
Some project ideas
Passivity controller for teleoperation

https://stanfordrobotics.atlassian.net/wiki/display/TEL/Control+Framework
3D dynamic surface traversal

https://stanfordrobotics.atlassian.net/wiki/display/TEL/Control+Framework
robotic learning through demonstration

https://stanfordrobotics.atlassian.net/wiki/display/TEL/Control+Framework