CS 287: Advanced Robotics
Fall 2015

Lecture 1: Introduction

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Course Staff

Professor

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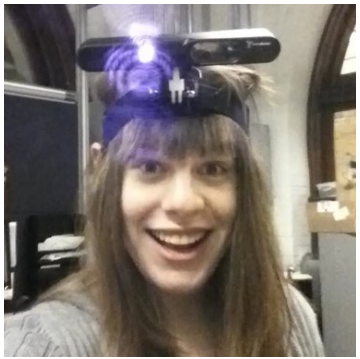
GSIs

Sandy Huang



Zoe McCarthy

WWW

- http://www.cs.berkeley.edu/~pabbeel/cs287-fa15

- [Step through webpage]

Remainder of Lecture Outline

- Questions?

- A few robotic success stories …

  and connections with materials covered in the course

Driverless Cars

- Darpa Grand Challenge: First long-distance driverless car competition
  - 2004: CMU vehicle drove 7.36 out of 150 miles
  - 2005: 5 teams finished, Stanford team won nova-race
- Darpa Urban Challenge (2007)
  - Urban environment: other vehicles present
  - 6 teams finished (CMU won) urban challenge
- Google Self-Driving Car
  - 2010: Mountain View -> Santa Monica; >140,000 miles; Lombard, Golden Gate, Tahoe, Pacific Coast Highway -- gcar
  - by July 2015: 1M miles, 14 minor accidents (never at fault)
- Ernst Dickmanns / Mercedes Benz: autonomous car on European highways
  - Paris highway and 1758km Munich -> Odense, lane changes up to 140km/h; longest autonomous stretch: 158km (1995)
- Maneuvers: parking

Kalman filtering, LQR, mapping, terrain & object recognition

Autonomous Helicopter Flight [Abbeel, Coates & Ng]

Kalman filtering, model-predictive control, LQR, system ID, trajectory learning

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Four-legged locomotion

[Kolter, Abbeel & Ng]

value iteration, receding horizon control, motion planning, inverse reinforcement learning, nolearning, learned

Two-legged locomotion

[Tedrake +al.]

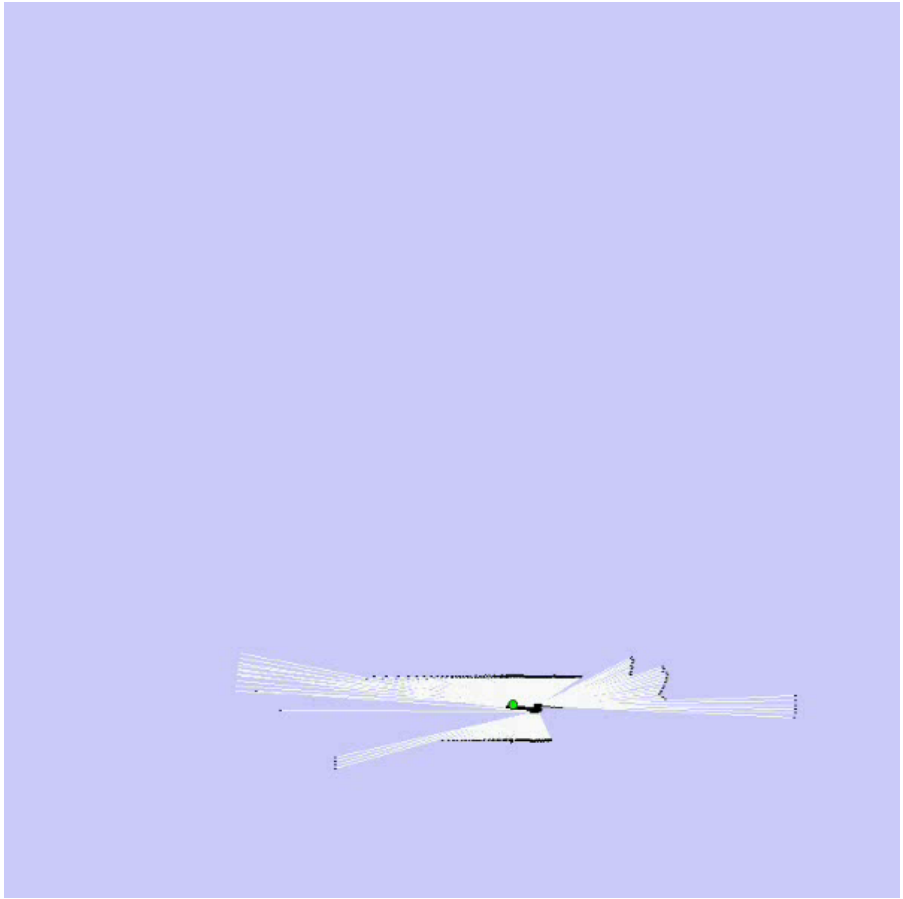
Mapping

[Video from W. Burgard and D. Haehnel]

“baseline” : Raw odometry data + laser range finder scans

Mapping

[Video from W. Burgard and D. Haehnel]



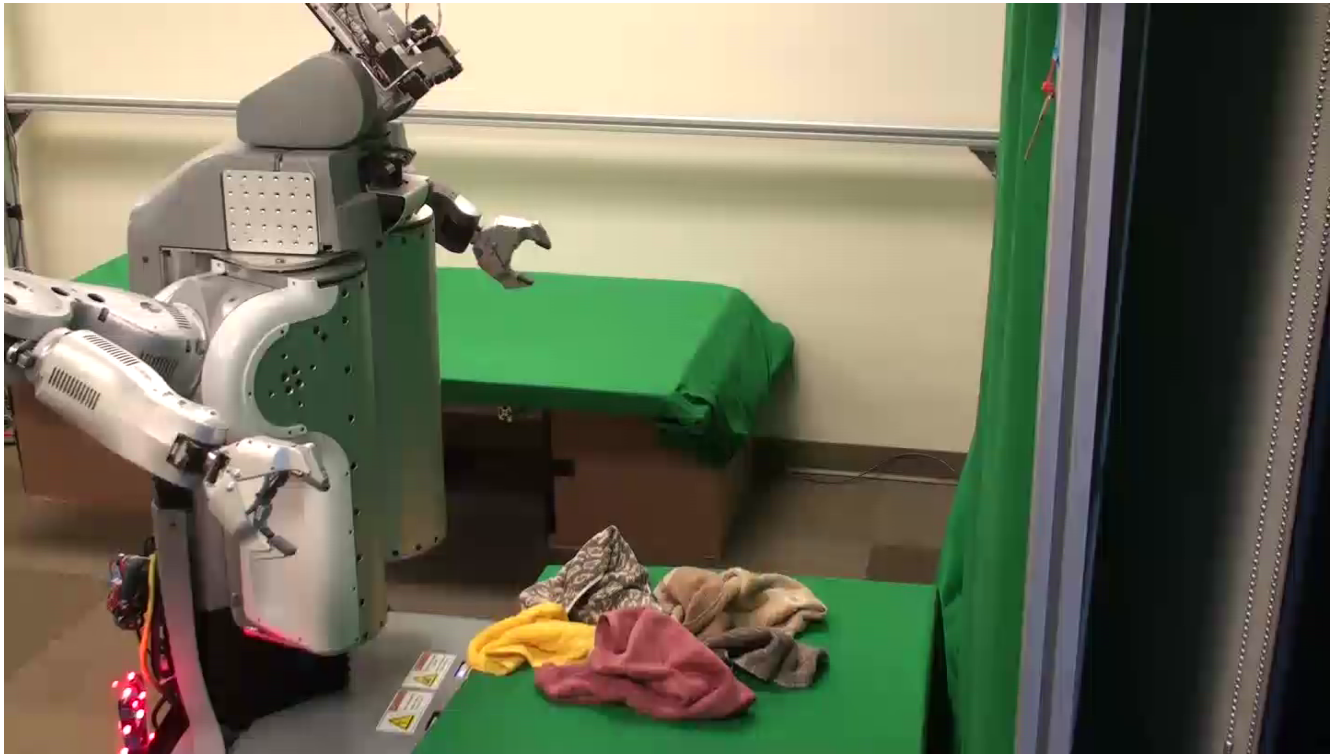
FastSLAM: particle filter + occupancy grid mapping

Mobile Manipulation [Quigley, Gould, Saxena, Ng + al.]

SLAM, localization, motion planning for navigation and grasping, grasp point selection, visual category recognition (speech recognition and synthesis)

Mobile Manipulation

[Maitin-Shepard, Cusumano-Towner, Lei, Abbeel, 2010]



localization, motion planning for navigation and grasping, grasp point selection, visual recognition

Visuomotor Learning

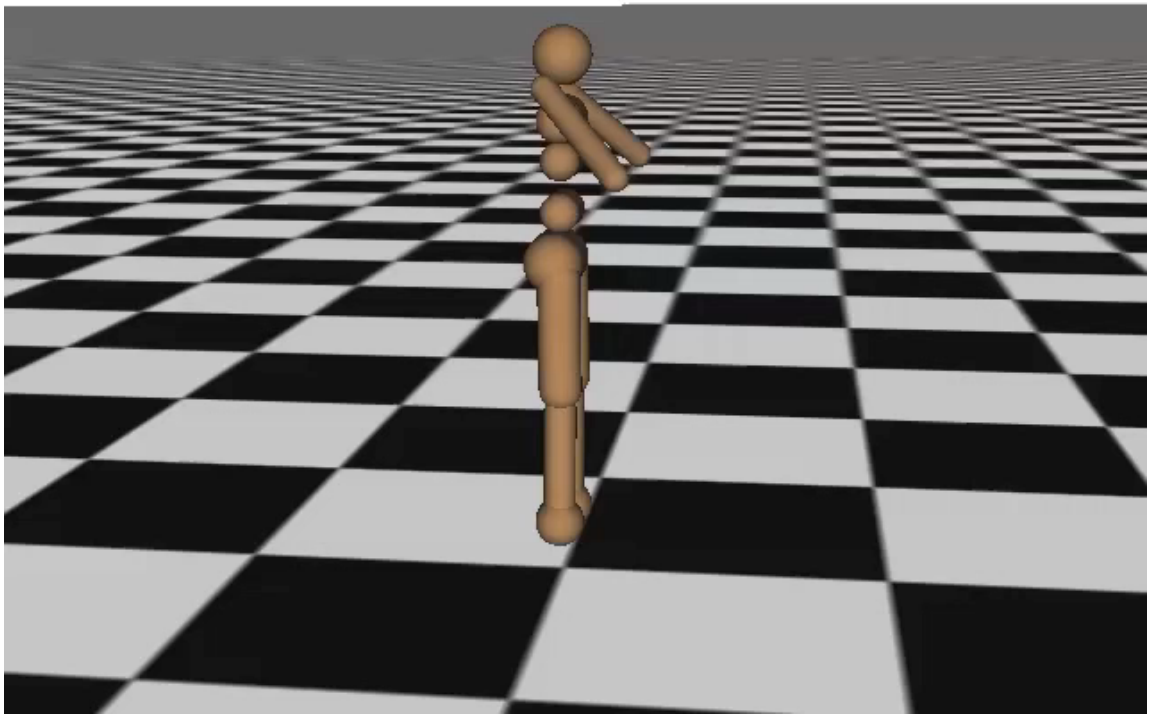
[Levine*, Finn*, Darrell, Abbeel, 2015]

Learned Visuomotor Skills

[Levine*, Finn*, Darrell, Abbeel, 2015]

LQR, guided policy search, deep learning

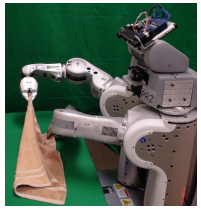
Learning Locomotion [Schulman, Moritz, Levine, Jordan, Abbeel, 2015]



policy gradients, value function approximation

Why a Great Time to Study CS287 Advanced Robotics?

- Robotic hardware is getting in great shape, expertise in algorithms +math+programming are limiting factors
- So many different robotic systems, yet a few core techniques are (near-)sufficient to rule them all
  - Probabilistic Reasoning
  - Optimization
- Applicability of these techniques extends well beyond robotics




That's it for today

- Starting optimal control on Tuesday
- Check out the webpage!
- Sign up on piazza!

- Come talk to me now about any lingering questions