CS 287: Advanced Robotics
Fall 2013

Lecture 1: Introduction

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[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 Autonomous Cars
  - 2010: Mountain View -> Santa Monica; >140,000 miles; Lombard, Golden Gate, Tahoe, Pacific Coast Highway
  - 2012: 300K miles completed autonomously without accident

- Ernst Dickmanns / Mercedes Benz: autonomous car on European highways
  - Paris highway and 1758km trip Munich -> Odense, lane changes at up to 140km/h; longest autonomous stretch: 158km (1995)

- Maneuvers: parking

Kalman filtering, LQR, mapping, terrain & object recognition
Autonomous Helicopter Flight

[Coates, Abbeel & Ng]

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

value iteration, receding horizon control, motion planning, inverse reinforcement learning, no learning, learned
Two-legged locomotion

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

FastSLAM: particle filter + occupancy grid mapping

[Video from W. Burgard and D. Haehnel]
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
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 you might have