

CS 378: Autonomous Intelligent Robotics

FRI II

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http://justinhart.net/teaching/2017_fall_cs378/

Today

- What makes a good project?
- Project Ideas
- Team Formation

Good Projects

- Start with a goal
 - A good scientific question
 - A novel method that can be fully implemented
- Your job is then to become informed
 - How do you know that your question is good?
 - How do you know that your method is novel?
 - **Answer: Literature Survey**

What is a literature survey?

The process

- Find out what work precedes yours
- Find the major conferences and journals discussing your topic
- Find what others have hypothesized, and tested
- Is there a standard test regarding your question?

Example: My dissertation

- Previous mirror papers, mirror work in animals
- Robotics & AI conference, psych journals
- Bayesian approaches, image-based approaches
- The “mirror test”

Literature Surveys

- Situate your work in the literature
- In the case of scientific questions, inform your hypotheses and methods
- In the case of development, inform you of the state-of-the-art and help you to make good design decisions

Several Types of Class Projects

- A self-contained research project
- Groundwork for work that the lab will continue
- Development of needed infrastructure

Self-Contained Projects

- Should ask a relevant scientific question
- Should have all development take place during the semester
- Should be thoroughly tested
- Final report should report on scientific findings

Self-Contained Projects

- **Example: No Fair!! An Interaction with a Cheating Robot.**
 - Started as a class project
 - Was completed the following Summer/Fall
 - Asked what happens when a robot cheats.
 - Found attributions of agency, higher participant engagement
- Actually seeing a project through to publication will probably take more than this semester

Groundwork

- Very similar to a self-contained project
- Works on an area or topic of **known** interest to the BWI lab
- More ambitious than self-contained project, not intended to be completed in 1 semester
- Still performs: Lit survey, Development, Testing
- However, where it ends is negotiated with instructor and is more flexible
- Not a guarantee of a scholarship, mentor position, or future employment
 - This may be continued by other members of the lab

Groundwork

- Example: A face for the segbot
- Potential work this semester
 - Review previous work on robot faces
 - Specify face for Segbot
 - Construct and program face
 - Rigorously test features in human-robot interaction experiment
 - Does it look like the face is looking where we expect it?
 - Are emotions conveyed properly?
 - Does speech look correct?

Infrastructure

- Not experimentally-based
- Develops necessary equipment or software
- Literature survey used to establish that state-of-the-art techniques are used
- Intended to be completed entirely during the semester
- Testing demonstrates the capability and that the system works
- Still must write all reports
- May have experimental / novel components

Infrastructure

- Example: Imaging turntable (for BWI & RoboCup@Home)
- Potential work for this semester
 - Design hardware or choose hardware for purchase
 - Develop software to automatically image object placed on turntable
 - Develop software to stitch merged 3D point clouds from input images
 - Develop software to provide training data to YOLO (object recognition software)
 - Make sampled data available for research projects at UT

Project Idea: Imaging Turntable

- Infrastructure / Long-Term Research
- Turntable that objects rest on for imaging from multiple angles
- Useful for
 - 3D reconstruction
 - Object recognition
- Immediate Plans
 - [RoboCup@Home](#) Object recognition
 - Natural Language Learning experiment in Spring

Project Idea: Imaging Turntable

- Scope of work:
 - Design & manufacture or purchase a turntable
 - 3D printing, machining, servos, drivers, arduino
 - Controller for turntable
 - 2D/3D image capture
 - 3D point cloud merging, stitching, reconstruction
 - Device calibration for turntable & camera

Project Idea: Table-to-Table Manipulation

- Infrastructure / Long-Term Research
- The Natural Language Understanding group wants to be able to verbally instruct a robot to pick an object up off of one table, navigate to another table, and drop it off
- Grasping is not reliable enough
- Vision doesn't have a large enough object library

Project Idea: Table-to-Table Manipulation

- This is **high priority** for the NLU group
- Opportunity to work with the robot arm, agile grasp, and newer grasp and motion planning technologies
- Will work mostly on reliability of grasp planning
- We have a software package that we're interested in deploying as a first go at this

Project Idea: Semantic Mapping & Navigation

- Semester Project / Long-Term Research
- A current horizon in robotic navigation is Semantic Mapping
 - Not just a map of the open space, but labels on objects in the environment, recording of their positions
 - Will build a map from scratch
 - No human labeling, as in current solution.
 - Fully-autonomous

Project Idea: Semantic Mapping & Navigation

- Possible technologies
 - RTAB SLAM
 - Google Cartographer (maybe)
- 3D mapping with Kinect, LIDAR, Primesense
- Useful for:
 - NLU experiments
 - RoboCup@Home

Project Idea: A Robotic Face

- Semester Project / Long-Term
- The current obvious interface to the Segbot faces the BACK of the Segbot
 - It is oriented towards the programmer
- In the long-term, the interface should be on the front.
- Want to develop a 3D rendered face for the robot.
 - Turn monitor to face the front of the robot

Project Idea: A Robotic Face

- Scope of work:
 - Find or develop software that renders a 3D face
 - Does the face look natural?
 - Make it look like the face is looking at targets in the room
 - Experiment: Can people identify what the robot is looking at?
 - Make speech look natural for NLU experiments.

Project Idea: Scavenger Hunt

- Semester Project / Long-Term Research
- Inspired by AAI Scavenger Hunt challenge
- Robot is assigned to look for an object
- Verbal instructions given to the robot
 - Find a blue hat
 - Find a red can in the kitchen
 - Turn left
- Robot could potentially ask for help

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Project Idea: Automatic 3D Slam & Dead-Reckoning

- Semester Project
- Robot constructs, autonomously, a 3D map of its environment
- Robot autonomously dead-reckons its position on startup
 - Eliminates the startup step in rviz where you tell the robot where it is and where it is pointing

Project Idea: Automatic 3D Slam & Dead-Reckoning

- Potential technologies
 - RTAB SLAM / Cartographer
- Computer vision + SLAM

Group Formation

- Break into groups of 3-4 students
- Collect
 - Your names
 - A project you'd potentially be interested in working on from the list
 - A project idea not from the list
 - Areas of computer science, AI, or robotics that interest you
 - Then email me this information
 - hart@cs.utexas.edu

Project Idea Recap

- Ideas

- Imaging Turntable
- Table-to-Table Manipulation
- Semantic Mapping & Navigation
- A Robotic Face
- Scavenger Hunt
- Automatic 3D Slam & Dead Reconing

- Instructions

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