Advanced Lecture Proposal
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1 Abstract

A primary task of modern robots is manipulating objects in their environment. A prerequisite for manipulating something is knowing where it is. When most robots look for things, their activities are limited to moving themselves, and observing their environment with cameras (or other sensors). When people look for things though, they open drawers, turn over rocks, and generally manipulate their environment to facilitate their search. We discuss new research in how robots can perform some of these same activities. In particular we focus on the two tasks of deciding the probability that certain spaces contain certain objects (based on how often objects occur together, and what objects will fit in the space), and on deciding what order spaces should be searched in to maximize the probability of finding desired objects as quickly as possible.

2 Rough Outline

1. Overview

   (a) Robotic object search has been limited to active visual search

   (b) Manipulation-based search requires an emphasis on planning as manipulation by mobile robots is still error-prone and expensive

2. Observed information can inform a search

   (a) co-occurrence of objects

   (b) geometric information (which objects could fit into a given space)

3. Background research

   (a) Assumed functionality

      i. Execution of actions once they have been planned
      ii. Object recognition/computer vision

(b) Active visual search - list of papers

4. Search planning

5. Co-occurrence based belief updates

6. Geometric constraint based belief updates

7. Results of paper

8. Future Directions - brief intro to generalized framework for integrated robot task and motion planning

3   Division of Labor

Well both work on all the slides (division of labor in the preparation stage will be somewhat ad-hoc, according to time, ability, knowledge, etc). On presentation day the current plan is that Neil Forrester will present the first half (up through approximately part 4), and Troy Astorino will present the second half (part 5 and onward). This is subject to change, of course, and either of us may pop in to answer audience questions as appropriate.

4   References

- Wong, Lawson LS, Leslie Pack Kaelbling, and Tomas LozanoPerez. "Manipulation-based Active Search for Occluded Objects."

- Kaelbling, Leslie Pack, and Tomas Lozano-Perez. "Integrated robot task and motion planning in belief space."

- T. Kollar and N. Roy. Utilizing object-object and object-scene context when planning to find things.

- L. P. Kaelbling and T. Lozano-Perez. Unifying perception, estimation and action for mobile manipulation via belief space planning.

- Jean-Claude Latombe. Motion Planning With Uncertainty: The Preimage Backchaining Approach