Planning to Improve Information Quality

Geoffrey A. Hollinger

Assistant Professor
Mechanical, Industrial & Manufacturing Engineering
Oregon State University

You may also know me from: USC (postdoc), CMU (PhD)

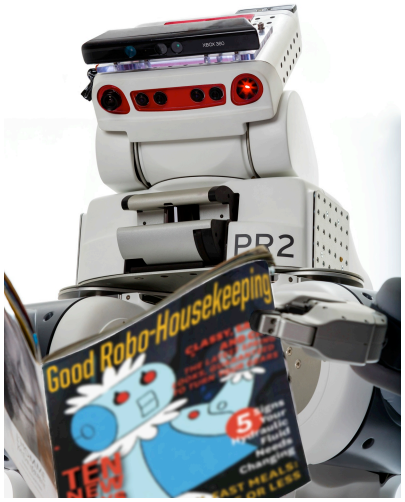
October 28, 2013

A key planning problem

- Plan to maximize **information quality** (how do we measure this?) subject to a **budget** (e.g., time, fuel, energy)

$$\mathcal{P}^* = \underset{\mathcal{P} \in \Psi}{\operatorname{argmax}} \; I(\mathcal{P}) \text{ s.t. } c(\mathcal{P}) \leq B$$

- Potential application domains (to name a few):



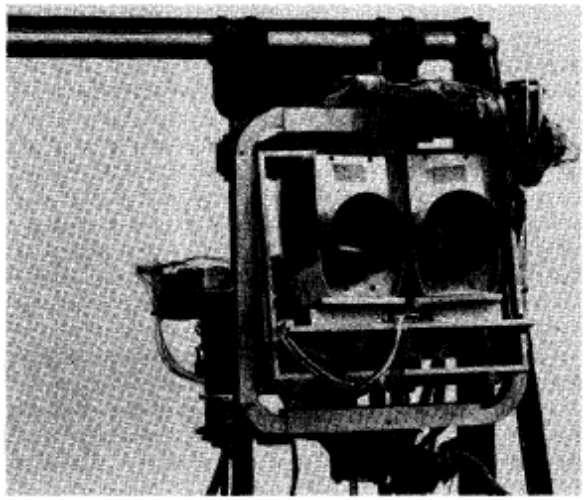
Personal robotics

Marine monitoring

Aerial surveillance

Robotic information gathering

- Isn't this active perception? Didn't they solve that problem?
  (Aloimonos et al. '87, Bajcsy '88)
- New challenging domains
  - Emergency response
  - Marine monitoring
  - Aerial surveillance
  - Space exploration
- Is autonomous information gathering possible in these domains?



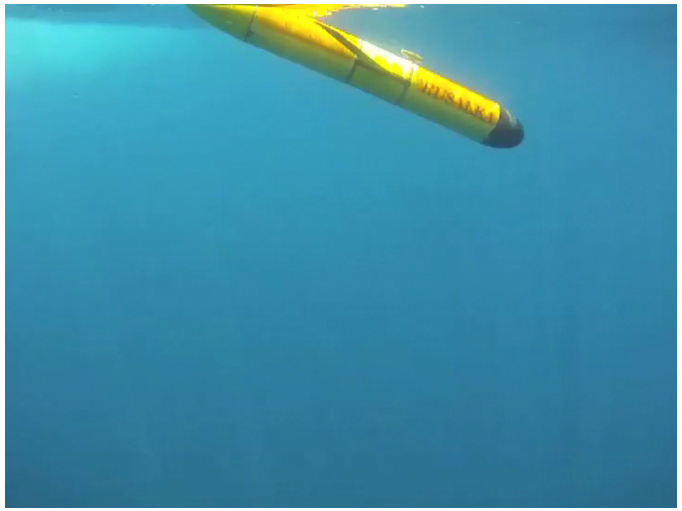
(R. Bajcsy, Proc. IEEE, 1988)

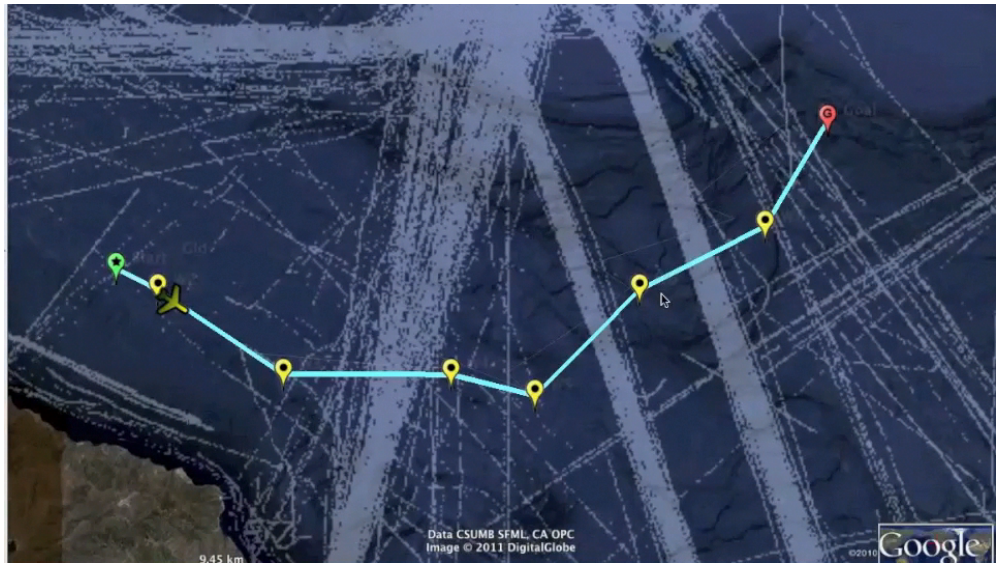
(Hollinger et al., 2013)

Challenges in the real world

Key problems: Planning, Decision Making & Learning

- Real-time operation
- Limited computation
- Dynamic environments
- Sensing uncertainty
- Communication
- Large amounts of data

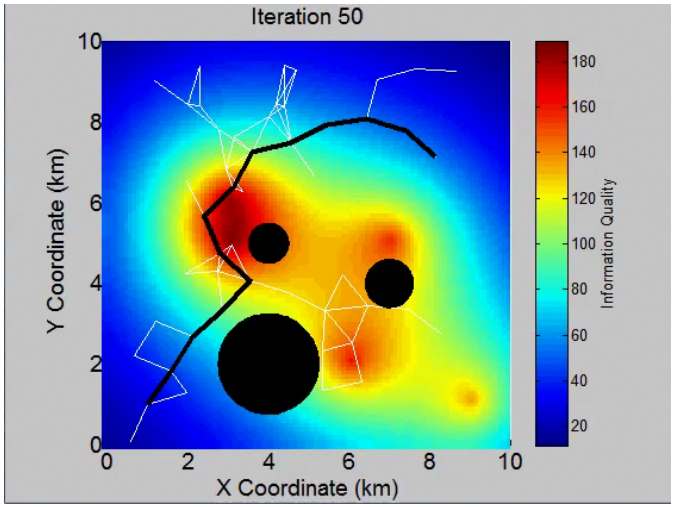




(Hollinger, Pereira and Sukhatme, ICRA 2013)

Why haven't we solved this problem?

- Planning to maximize information quality
  - Typically NP-hard or PSPACE-hard
  - Prior approaches (one or more drawbacks)
    - Limited to discrete spaces ☹
    - Exponential computation ☹
    - Lack of optimality guarantees ☹
  - Avenues for future work
    - Continuous spaces ☺
    - Performance guarantees ☺
    - Scalability and adaptability ☺



(Hollinger et al., RSS 2013)

Robotic Decision Making Laboratory

Oregon State University

Thanks!

Oregon State UNIVERSITY

Geoffrey A. Hollinger

geoff.hollinger@oregonstate.edu

http://research.engr.oregonstate.edu/rdml/