Planning to Improve Information Quality

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A key planning problem

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

\[ P^* = \arg\max_{P \in \Psi} I(P) \text{ s.t. } c(P) \leq B \]

- 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)

Depth = 0.00 m

(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)
Thanks!

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