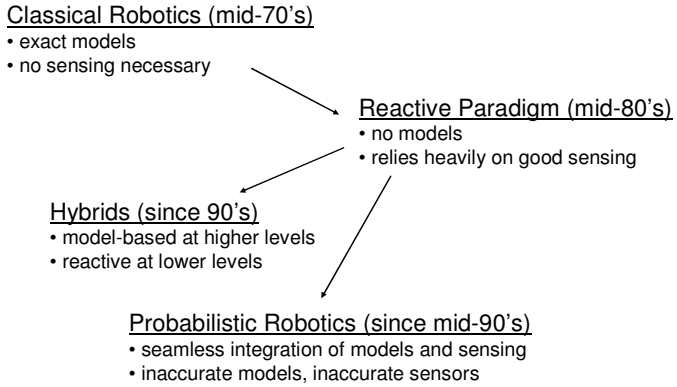
CSE-481
Robotics Capstone

Discussion

Trends in Robotics Research



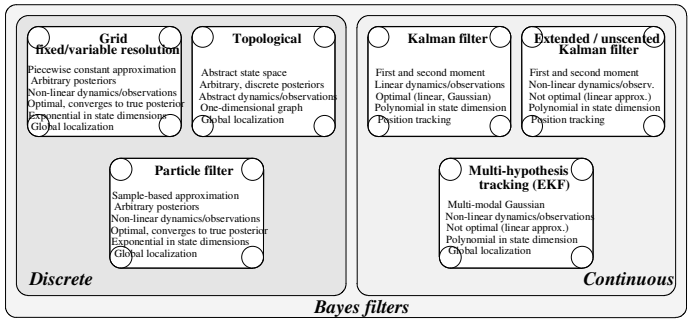
Topics in Robotics

- Low-level control / collision avoidance
- Localization
- Map building
- Control / planning / active sensing

Bayes filters

- Bayes rule allows us to compute probabilities that are hard to assess otherwise.
- Under the Markov assumption, recursive Bayesian updating can be used to efficiently combine evidence.
- Bayes filters are a probabilistic tool for estimating the state of dynamic systems.

Bayes filter Implementations



$$Bel(x_t) = \eta\ P(z_t \mid x_t) \int P(x_t \mid u_{t-1}, x_{t-1})\ Bel(x_{t-1})\ dx_{t-1}$$

Sensor Models

- Explicitly modeling uncertainty in sensing is key to robustness.
- Models should be adjusted using real data.
- It is extremely important to be aware of the underlying assumptions!
- Probabilistic approach forces us to do this.

Mapping

- Hard estimation problem (still just a Bayes filter!)
- Once positions are known, building metric, sub-symbolic maps is not too hard (occupancy grids).
- Most active research in concurrent mapping and localization.
- SLAM estimates full posterior using EKF.
- FastSLAM uses particles for robot poses.
- Data association problem!

Markov Decision Processes

- **Assumption:**
  - Fully observable state
- **Given:**
  - States x, actions u
  - Transition probabilities $p(x'|u,x)$
  - Reward / payoff function $r(x,u)$
- **Find:**
  - Policy $\pi(x)$ that maximizes the future expected reward

Paper Discussion (Due June 7)

- Which problem are you solving?
  - Why is it important?
  - Why is it hard?
- How did you solve the problem?
  - Why is this a good way of solving it?
  - What are alternatives?
- Which results did you get?
  - Illustrate strengths
  - Illustrate limitations and weaknesses!
- What did you learn?
  - What was harder / easier than you throught?

Paper Discussion (Due June 7)