CONDENSATION TRACKING

Condensation Tracking

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CONDENSATION TRACKING

Conditional Density Propagation

AKA Particle Filtering

• Keeps hypotheses
• Updates using new data
• Selects hypotheses probabilistically
• Copes with: very noisy data & process state changes
• Tunable computation load

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CONDENSATION TRACKING: THEORY

• Maintains set of multiple hypotheses (e.g. state vectors, including different models) with estimated probabilities
• Generates new hypotheses from the set
• Update hypotheses with observed data (Kalman filter)
• Update hypothesis probabilities

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CONDENSATION TRACKING THEORY

Given set of $N$ hypotheses at time $t-1$
\[ \mathcal{H}_{t-1} = \{ \bar{x}_{1,t-1}, \bar{x}_{2,t-1}, \ldots, \bar{x}_{N,t-1} \} \]
with associated probabilities $\{p(\bar{x}_{1,t-1}), p(\bar{x}_{2,t-1}), \ldots, p(\bar{x}_{N,t-1})\}$
Repeat $N$ times to generate $\mathcal{H}_t$:
1. Select a hypothesis $\bar{x}_{k,t-1}$ from $\mathcal{H}_{t-1}$ with probability $p(\bar{x}_{k,t-1})$
2. Generate a new state vector $\bar{s}_k$ from a distribution centered at $\bar{x}_{k,t-1}$
3. Get new state vector using observation $\bar{z}_t$, dynamic model $\bar{x}_{k,t} = f(\bar{s}_k, \bar{z}_t)$ and Kalman filter
4. Evaluate probability $p(\tilde{z}_t | \tilde{x}_{k,t})$ of observed data $\tilde{z}_t$ given state $\tilde{x}_{k,t}$

5. Use Bayes rule to get $p(\tilde{x}_{k,t} | \tilde{z}_t)$ (may need to normalize sum over all $k$ to 1)

**WHY DOES CONDENSATION TRACKING WORK?**

- Many slightly different hypotheses: maybe get one that fits better
- ? model can introduce different effects (eg. state transitions)
- Sampling by probability weeds out bad hypotheses
- Generating by probability introduces corrections

**What We Have Learned**

1. Method to improve estimation by keeping ?
2. Method to refresh pool of estimates