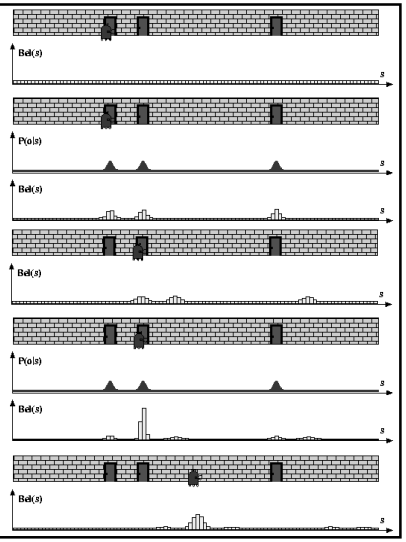
AI-based Mobile Robotics

Mobile Robot Localization

Kalman filters
Discrete
Particle filters

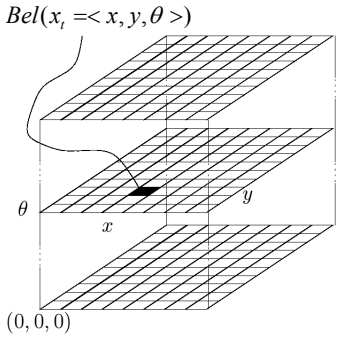
Piecewise Constant



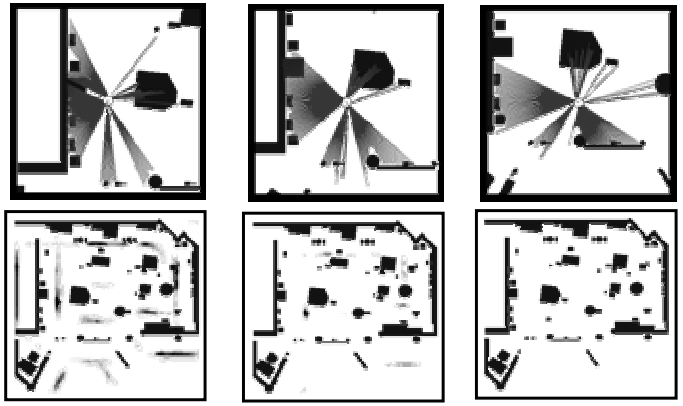
Discrete Bayes Filter Algorithm

1. Algorithm **Discrete_Bayes_filter**(*Bel(x),d*):
2. η=0
3. If *d* is a perceptual data item *z* then
4. For all *x* do
5. $Bel'(x) = P(z \mid x) Bel(x)$
6. $\eta = \eta + Bel'(x)$
7. For all *x* do
8. $Bel'(x) = \eta^{-1} Bel'(x)$
9. Else if *d* is an action data item *u* then
10. For all *x* do
11. $Bel'(x) = \sum_{x'} P(x \mid u, x') \; Bel(x')$
12. Return *Bel'(x)*

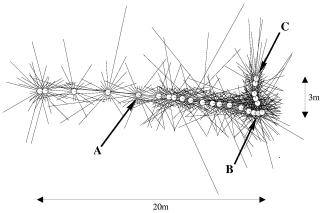
Piecewise Constant Representation

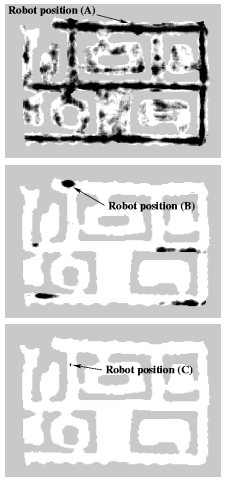


Grid based Localization



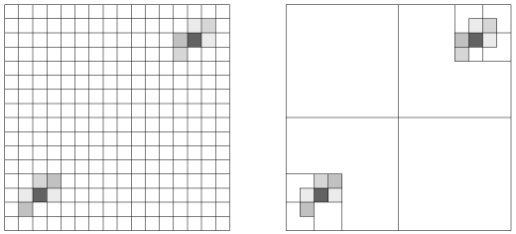
Sonars and Occupancy Grid Map





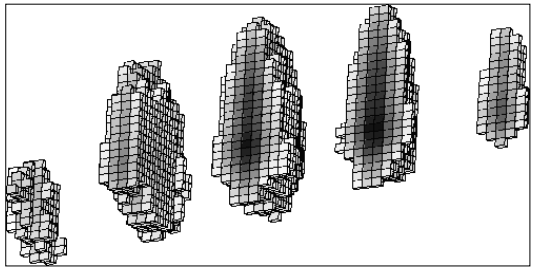
Tree-based Representation

Idea: Represent density using a variant of Octrees



Tree-based Representations

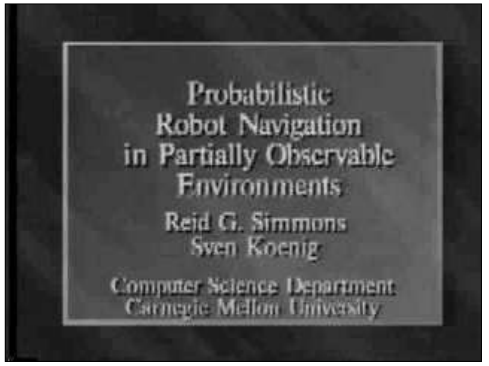
- Efficient in space and time
- Multi-resolution



Localization Algorithms - Comparison

	Kalman filter	Multi-hypothesis tracking	Grid-based (fixed/variable)		
Sensors	Gaussian	Gaussian	Non-Gaussian		
Posterior	Gaussian	Multi-modal	Piecewise constant		
Efficiency (memory)	++	++	-/+		
Efficiency (time)	++	++	o/+		
Implementation	+	o	+/o		
Accuracy	++	++	+/++		
Robustness	-	+	++		
Global localization	No	Yes	Yes		

Xavier:
Localization in a Topological Map



Localization Algorithms - Comparison

	Kalman filter	Multi-hypothesis tracking	Grid-based (fixed/variable)	Topological maps	
Sensors	Gaussian	Gaussian	Non-Gaussian	Features	
Posterior	Gaussian	Multi-modal	Piecewise constant	Piecewise constant	
Efficiency (memory)	++	++	-/+	++	
Efficiency (time)	++	++	o/+	++	
Implementation	+	o	+/o	+/o	
Accuracy	++	++	+/++	-	
Robustness	-	+	++	+	
Global localization	No	Yes	Yes	Yes	