

PacBot

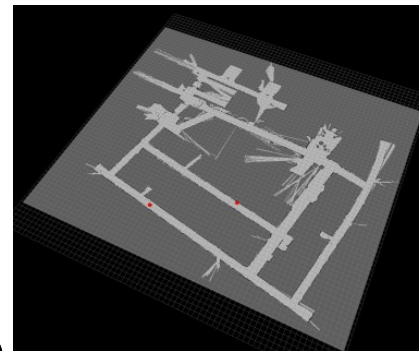
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Alex Takakuwa

CSE 573 Final Project
Autumn 2012

Summary

- **Motivation:** Let the robot **tracks** and chases RFID tags

Robot



Map of the CSE 4th floor

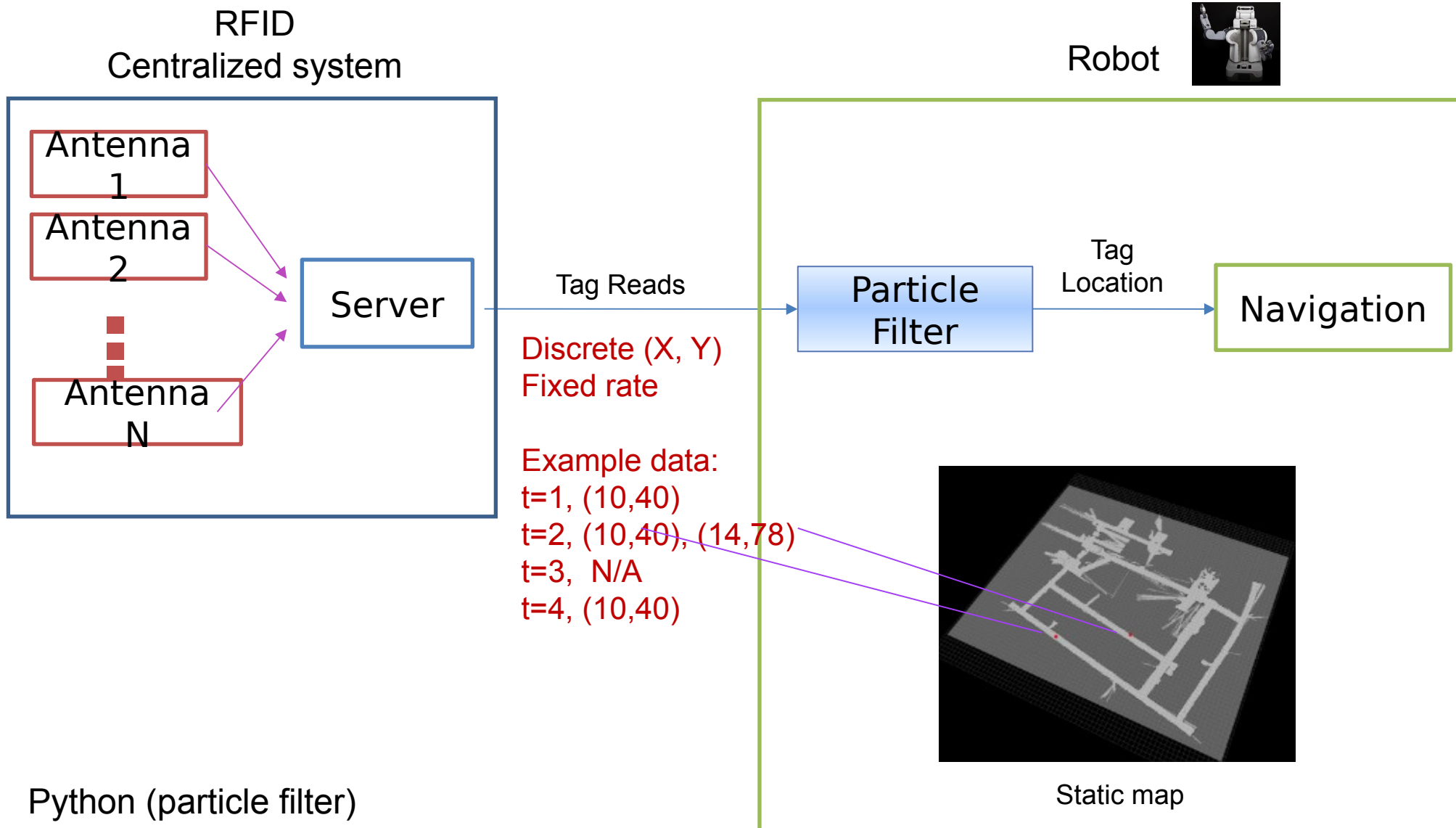
- **Sparse & noisy sensor:** RFID antennas deployed in the CSE building



- › 36 Antennas at fixed location
- › Read “RFID Tags”

- **Particle filter** localization

System Design

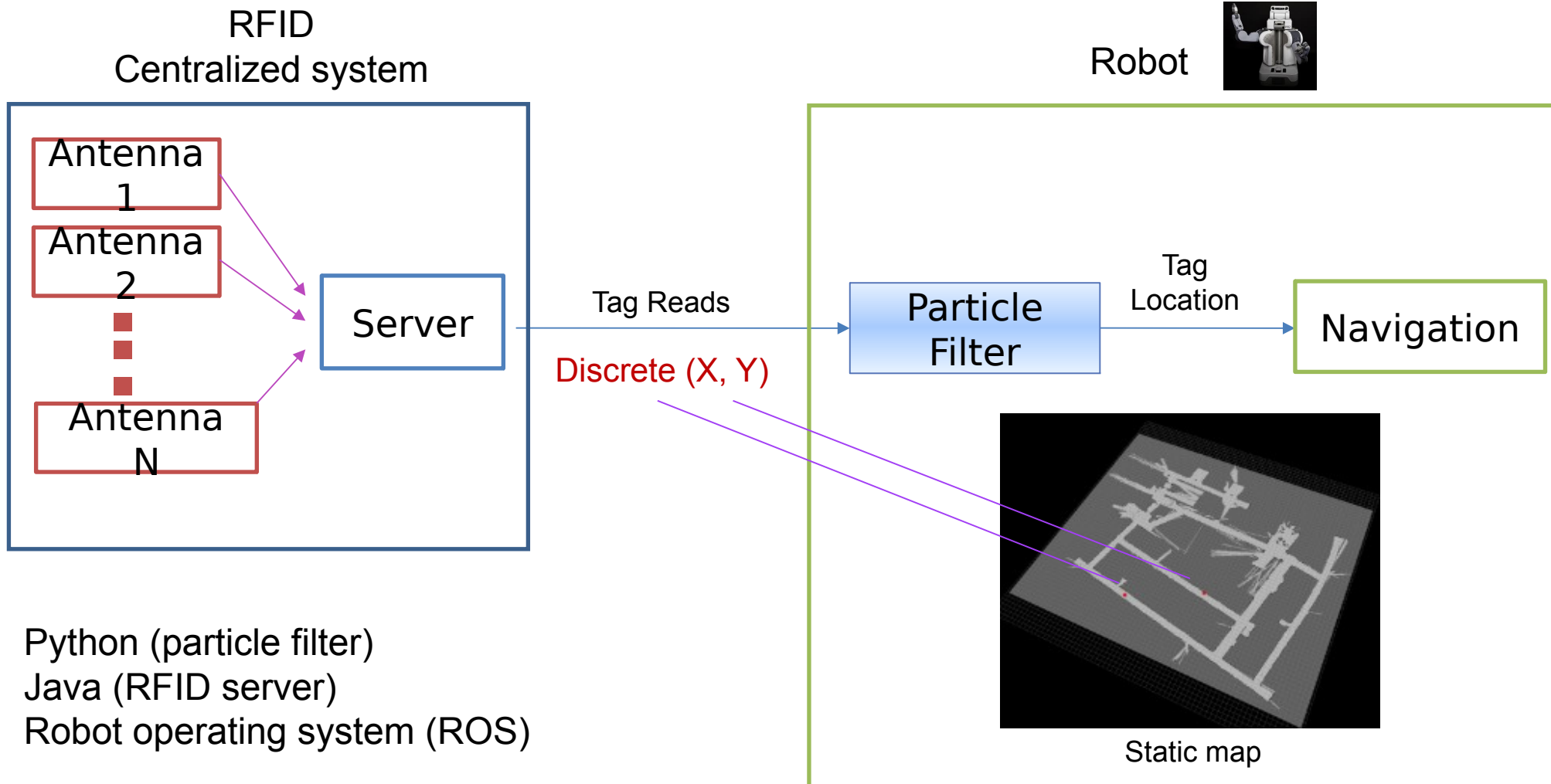


Python (particle filter)

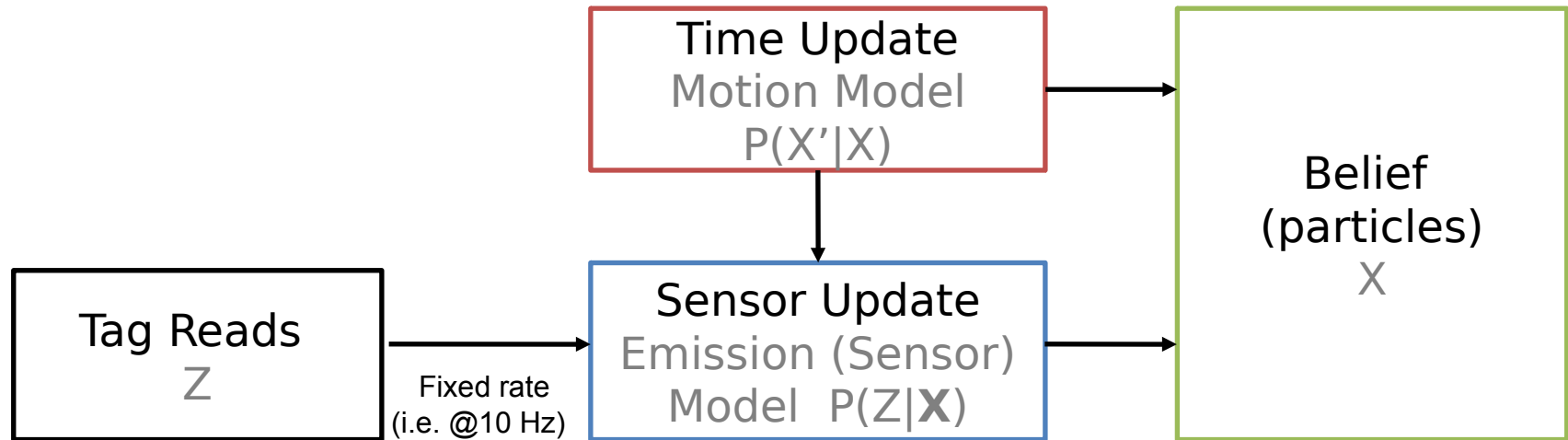
Java (RFID server)

Platform: Linux & Robot operating system (ROS)

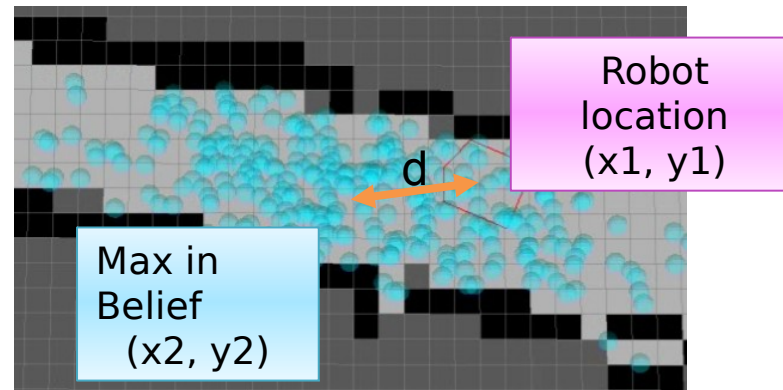
System Design



Particle Filter



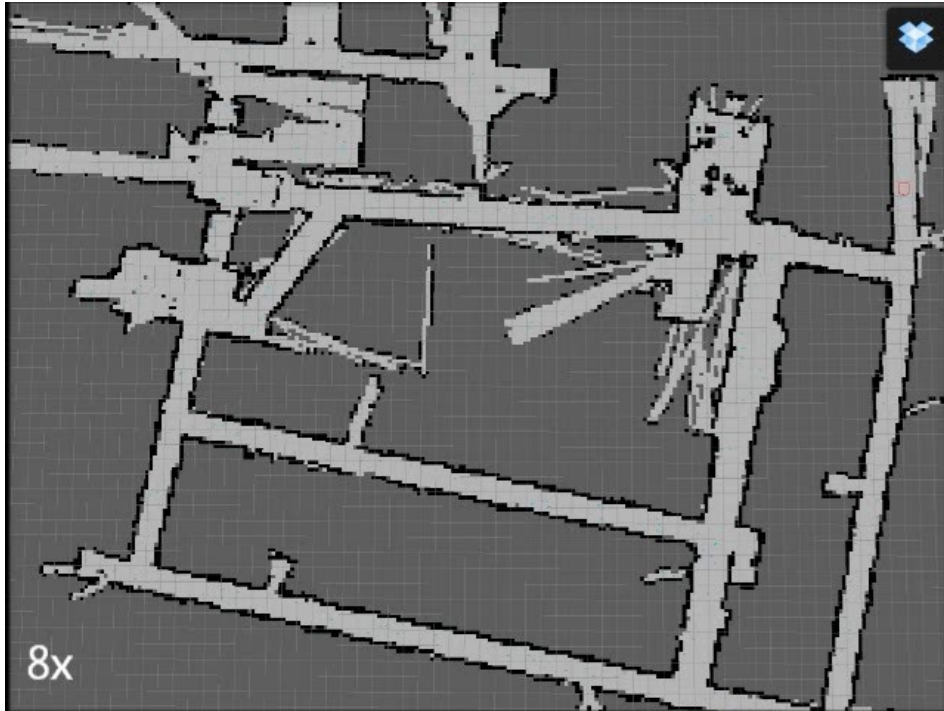
Evaluation: Tracking error



- Track a RFID tag on the robot
- Use the robot's localized coordinate as the ground truth
- Find the error: the distance from the maximum in the particles belief
- Compute the average error over a trial

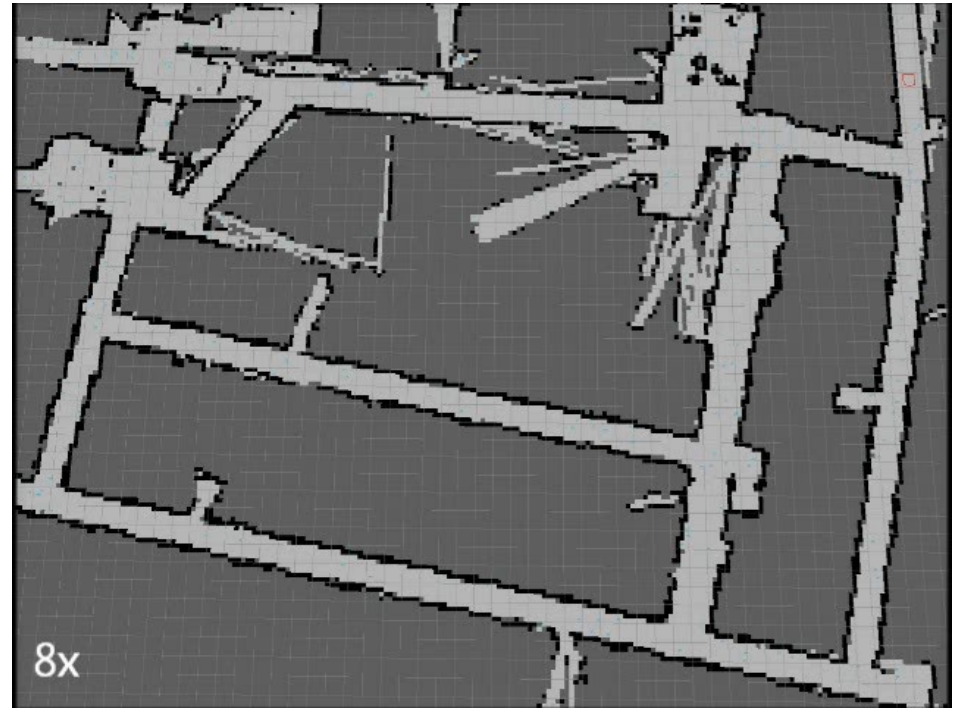
Update Rate

1 Hz



Sensor model $\sigma = 4$
Average error = 9.08 (m)

10 Hz



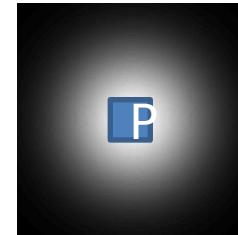
Sensor model $\sigma = 4$
Average error = 2.93 (m)

Time Update
Motion Model
 $P(X'|X)$

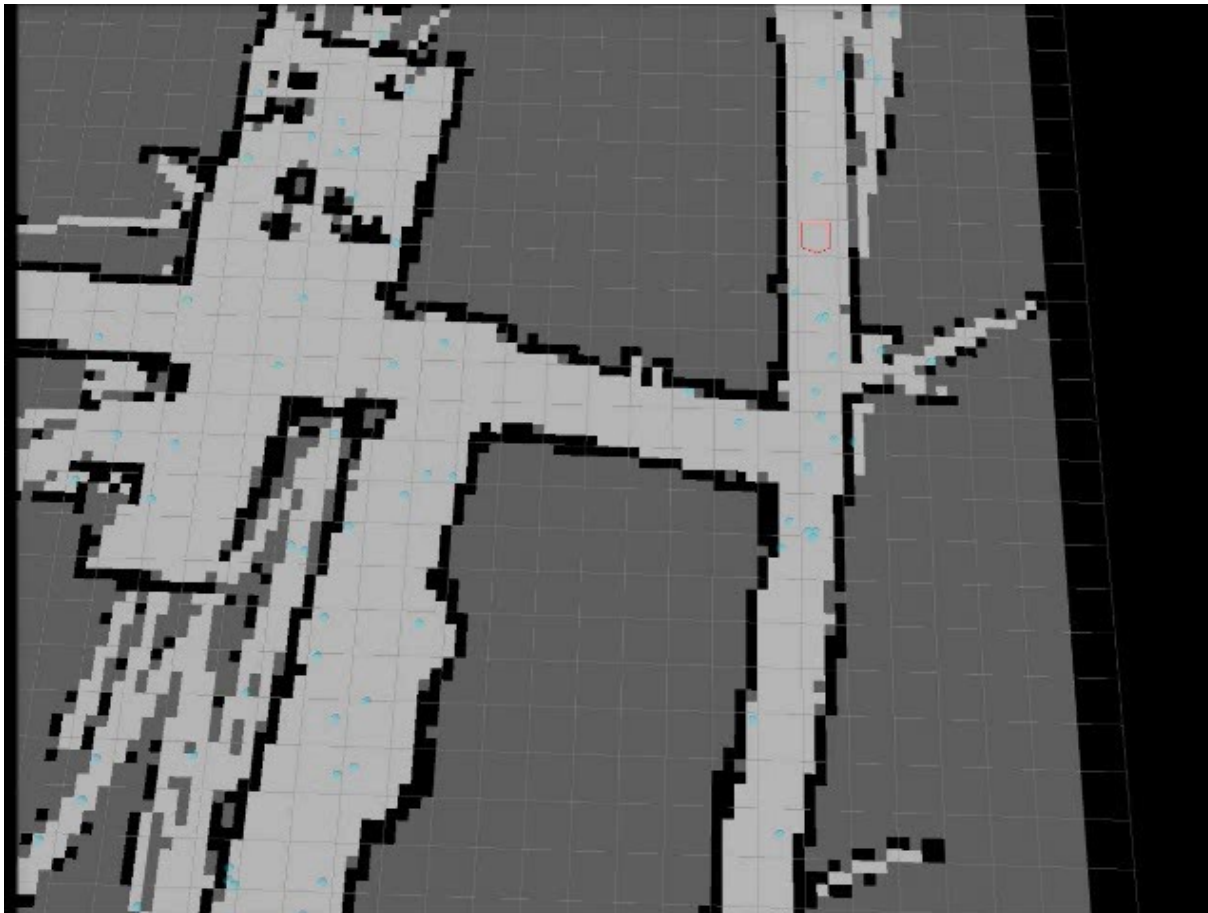
Model

- (1) Random movement
Gaussian (μ , σ) distribution centered at each particle

- (2) **Velocity Model**



 : Particle



With Velocity Model

1 Hz update rate

Sensor model $\sigma = 4$

Average error = 2.756 (m)

Sensor Update
Emission (Sensor)
Model $P(Z|X)$

Model

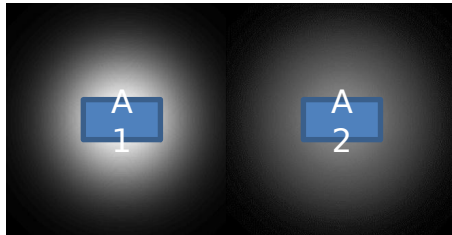
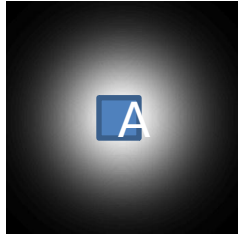
 : Antenna

(1) Single reads

Multiple reads:

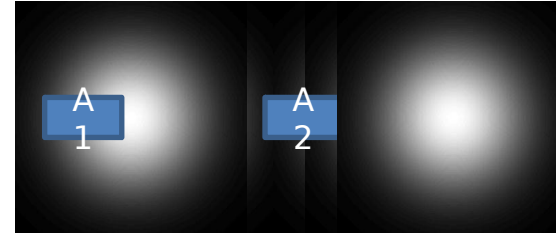
(2) Shifted gaussian

(3) Collect sensor
model from data



20
reads

5
reads

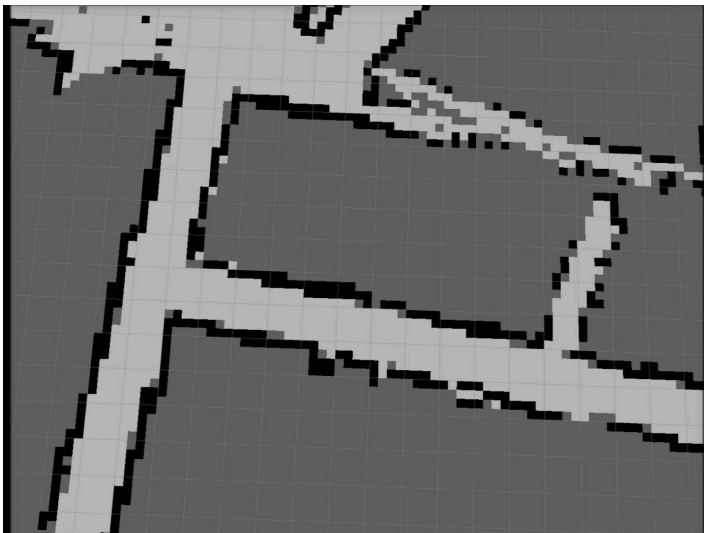


20
reads

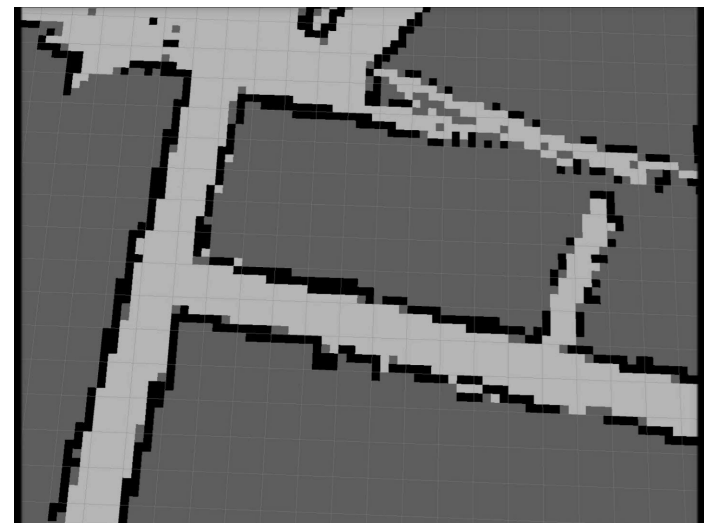
5
reads

	(1) Bimodal Gaussian	(2) Shifted Gaussian
Average Error (m)	1.688	1.716
Standard deviation (m)	0.079	0.041

(1)



(3)



Conclusion

- Implemented and tested a system using particle filter to track RFID tag
- Learn to apply particle filter to real data and real world system
- Evaluated Accuracy of different Sensor and Time updates

Team Work

- Liang-Ting Jiang: System design and implementation, robot integration, data collection
- Alex Takakuwa: Sensor model, motion model design, implementation, and verification