SLAM For Autonomous Ground Vehicles

Attached 1

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Overall

- Research Motivation
- Literature Reviews
- Research Approaches
- Progress
- Application

Research motivation

1. REDUCED ACCIDENTS

   Self-driving cars are projected to reduce traffic deaths by 90 percent, saving 30,000 lives a year

2. REDUCED TRAFFIC CONGESTION

   "Our experiments show that with as few as 5 percent of vehicles being automated and carefully controlled, we can eliminate stop-and-go waves caused by human driving behavior," said Daniel B, a lead researcher in the traffic congestion study.

3. REDUCED CO2 EMISSIONS

   The reduction in congestion will most likely result in a reduction of CO2 emissions as well.

Research Motivation

4. TRANSPORTATION ACCESSIBILITY

   The US House Energy and Commerce Committee website adds: "With self-driving cars, tasks like commuting to work, going to the doctor, and visiting family across town could become easier for seniors and those with disabilities."

5. REDUCED TRAVEL TIME AND TRANSPORTATION COSTS

   AVs may cut travel time by up to 40 percent, recover up to 80 billion hours lost to commuting and congestion, and reduce fuel consumption by up to 40 percent

Literature Reviews

- https://www.youtube.com/playlist?list=PLgnQpQtFTOGQrZ4O5QzbIHgl3b1JHimN_
- An implementation of SLAM with extended Kalman filter
  Abu Bakar Sayuti H M Saman ; Ahmed Hesham Lotfy
- 3 Dimensional application of SLAM for ground navigation
  Nak Yong Ko ; Tae Gyun Kim ; Wonkeun Youn ; Taesik Kim

Research Approaches

State Esitimation

Localization

Mapping

SLAM

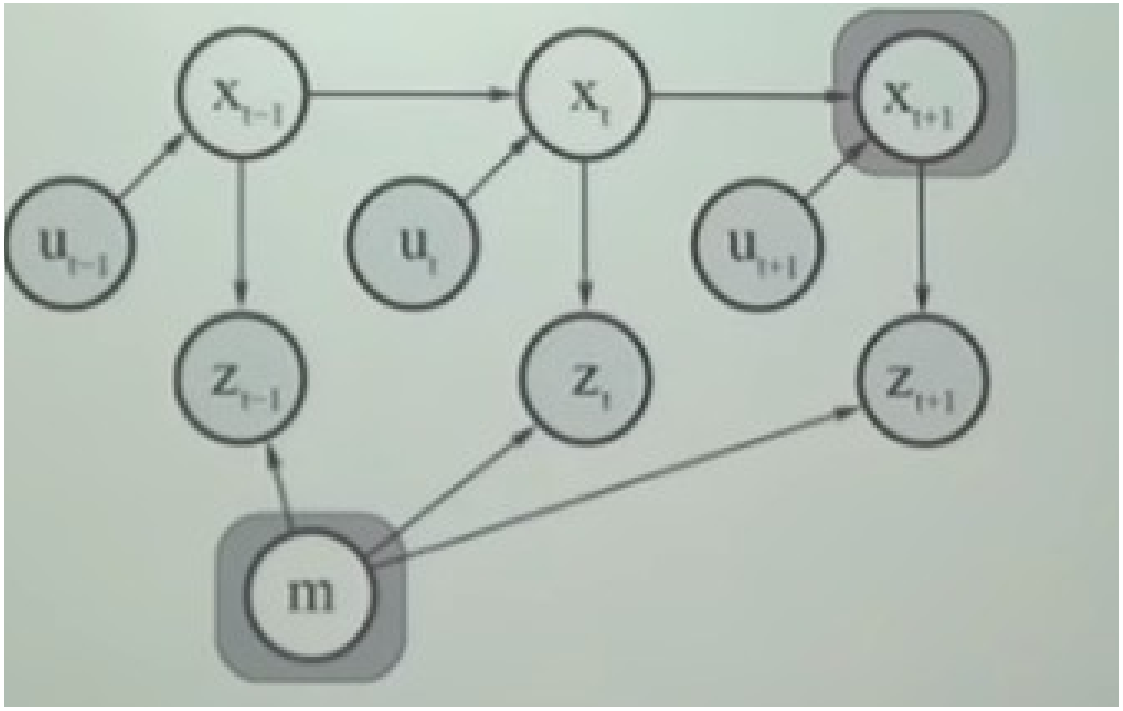
Navigation

Motion Planning

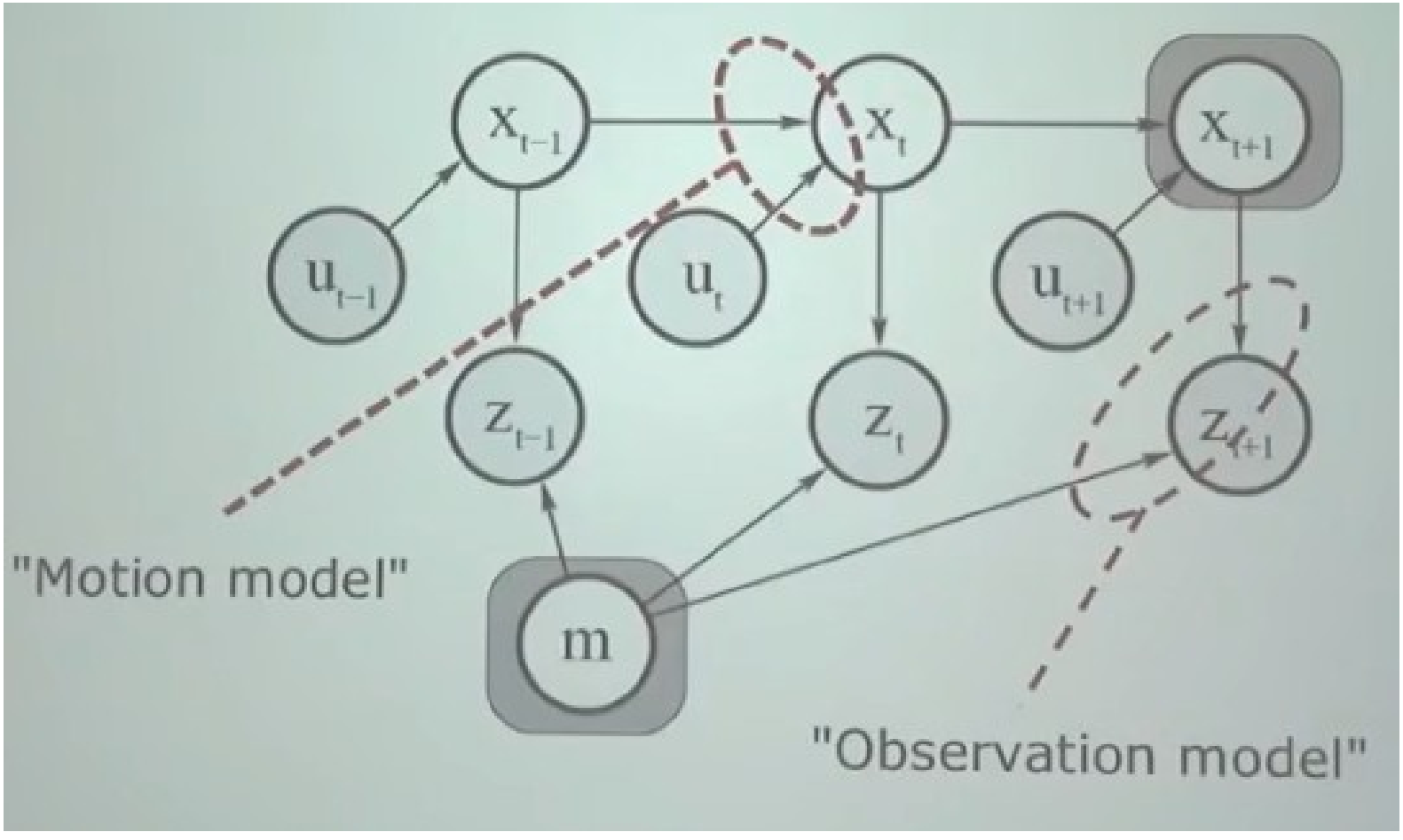
Control

Graphical Model for Online SLAM

$$p(x_t, m | z_{1:t}, u_{1:t})$$

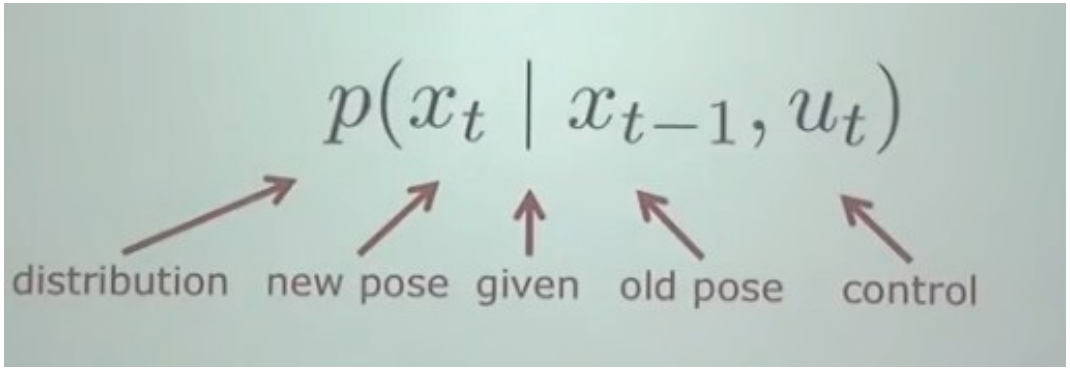


Motion and Observation model



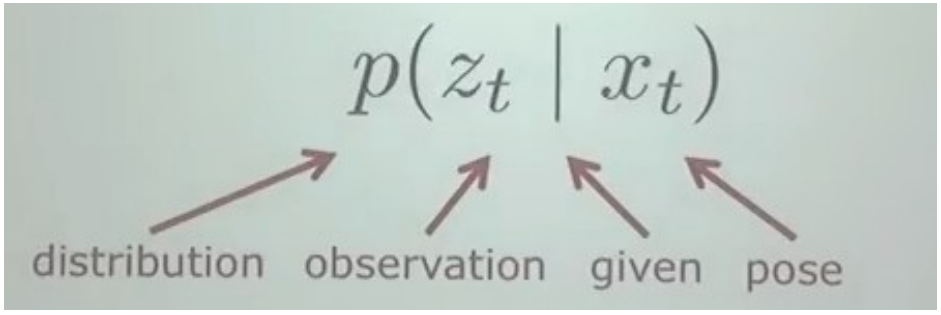
Motion Model

- The motion model describes the relative motion of the robot



Observation Model

- The observation or sensor model relates measurements with the robot's pose



Three Main SLAM Paradigms

Kalman filter

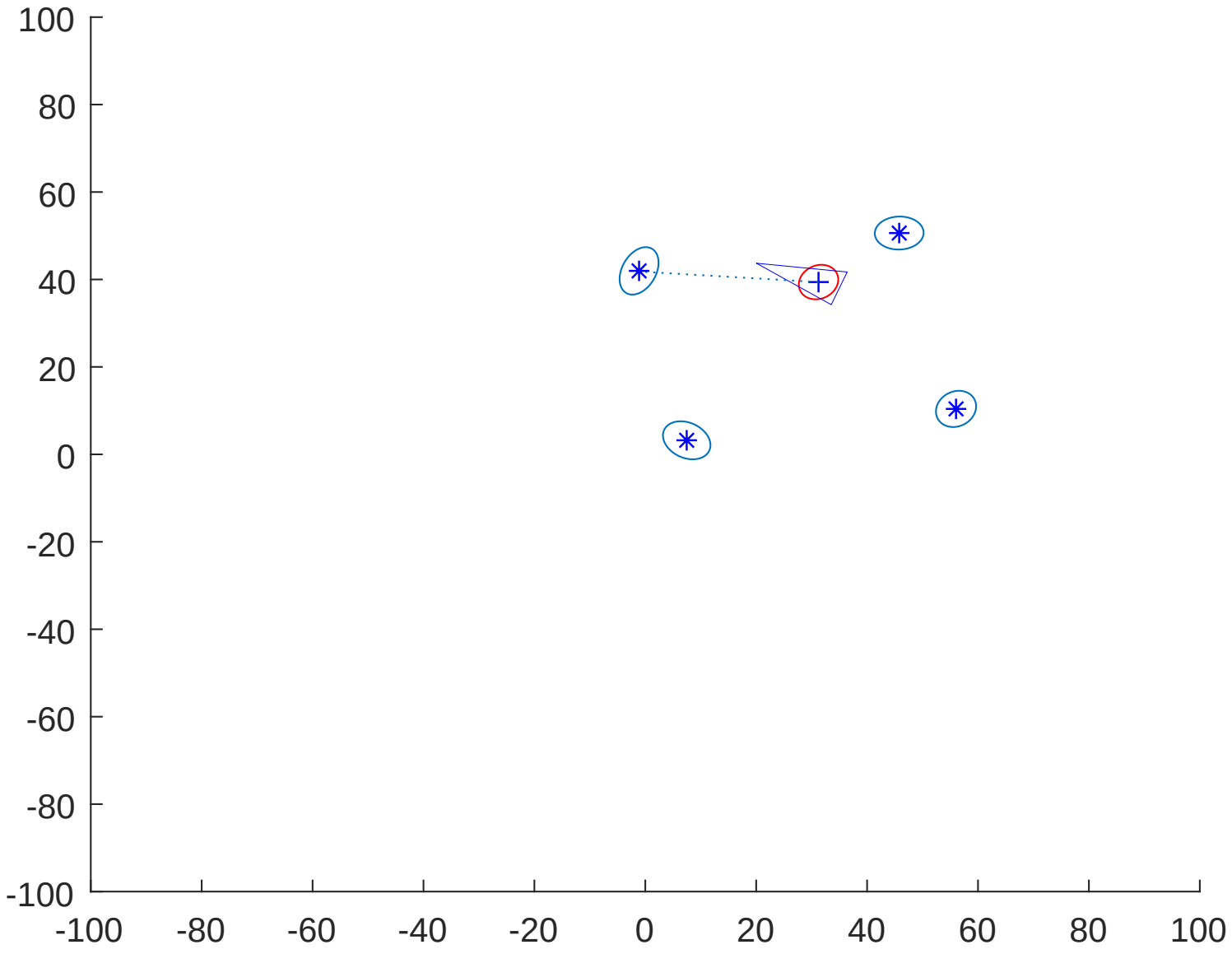
Particle filter

Graph-based filter

EKF SLAM: Filter Cycle

1. State prediction
2. Measurement prediction
3. Measurement
4. Data association
5. Update

EKF SLAM Simulation



Goal and Application

I can build a small autonomous car in the specific space, and help me with cleaning.