Robotic SLAM

1 Introduction

Terms

- State estimation - find out the pose
- Localisation - pose w.r.to landmark or map
- Mapping
- navigation and motion planning - a star, wave front dijkstra

1.1 What is SLAM

Computing robot's poses and the map of the environment at the same time.
Localisation : estimating robots location
Mapping : building a MAP

Given

- Robots control inputs

$$u_{1:T} = \{u_1, u_2, u_3....u_T\}$$

- Observations

$$z_{1:T} = \{z_1, z_2, z_3, ..., z_T\}$$

Wanted

- Map of the environment

$$m$$

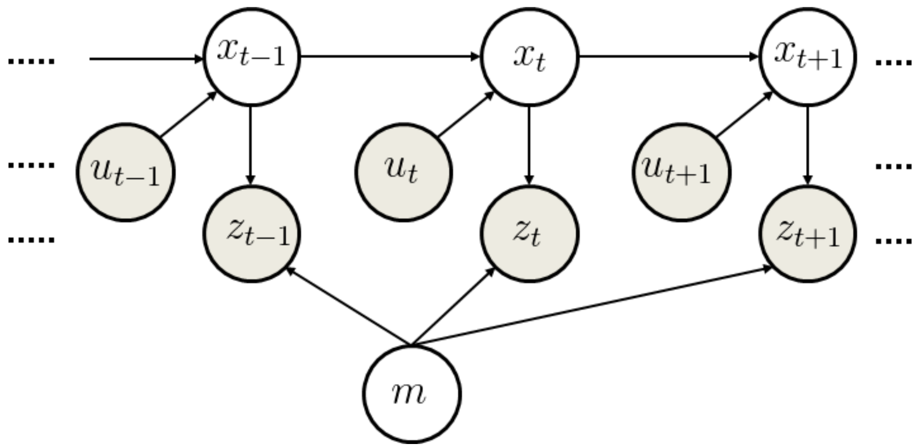
- path of the Robot

$$x_{0:T} = \{x_0, x_1, x_2, ..., x_T\}$$

Using the robots control inputs we can predict the position of the robot. From the observations $z_{1:T}$, we can calculate the position of the robot. Both the steps have some error associcated with it . Lets call the first one the model noise and second one the sensor noise. So we have to associate a probability with both of them. The error accumulates over time(even if the error in individual measurements is really small)

So in the probalistic terms our problem minimises to

$$p(x_{0:T}, m|z_{1:T}, u_{1:T})$$



1.2 Full Slam vs online SLAM

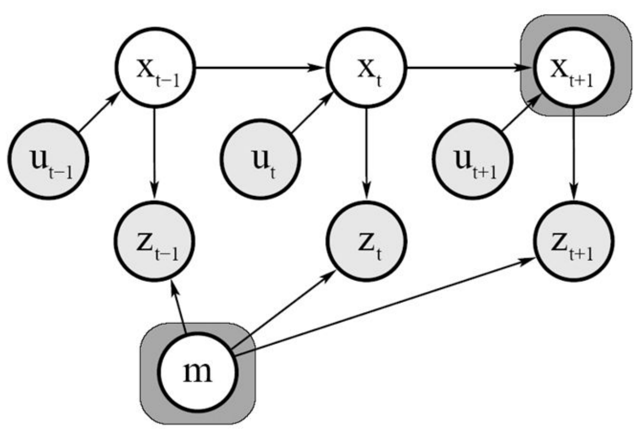
- Full SLAM estimates the entire path

$$p(x_{0:T}, m | z_{1:T}, u_{1:T})$$

- Online SLAM estimates only the most recent pose

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

Graphical Model of Online SLAM:



$$p(x_t, m \mid z_{1:t}, u_{1:t}) = \int\int\ldots\int p(x_{1:t}, m \mid z_{1:t}, u_{1:t})\, dx_1 dx_2 \ldots dx_{t-1}$$

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