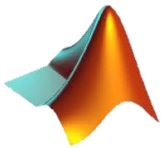
Chapter Presentation

Outline

1. Introduction
2. The Bayes Filter
3. Gaussian filters
4. The Kalman filter

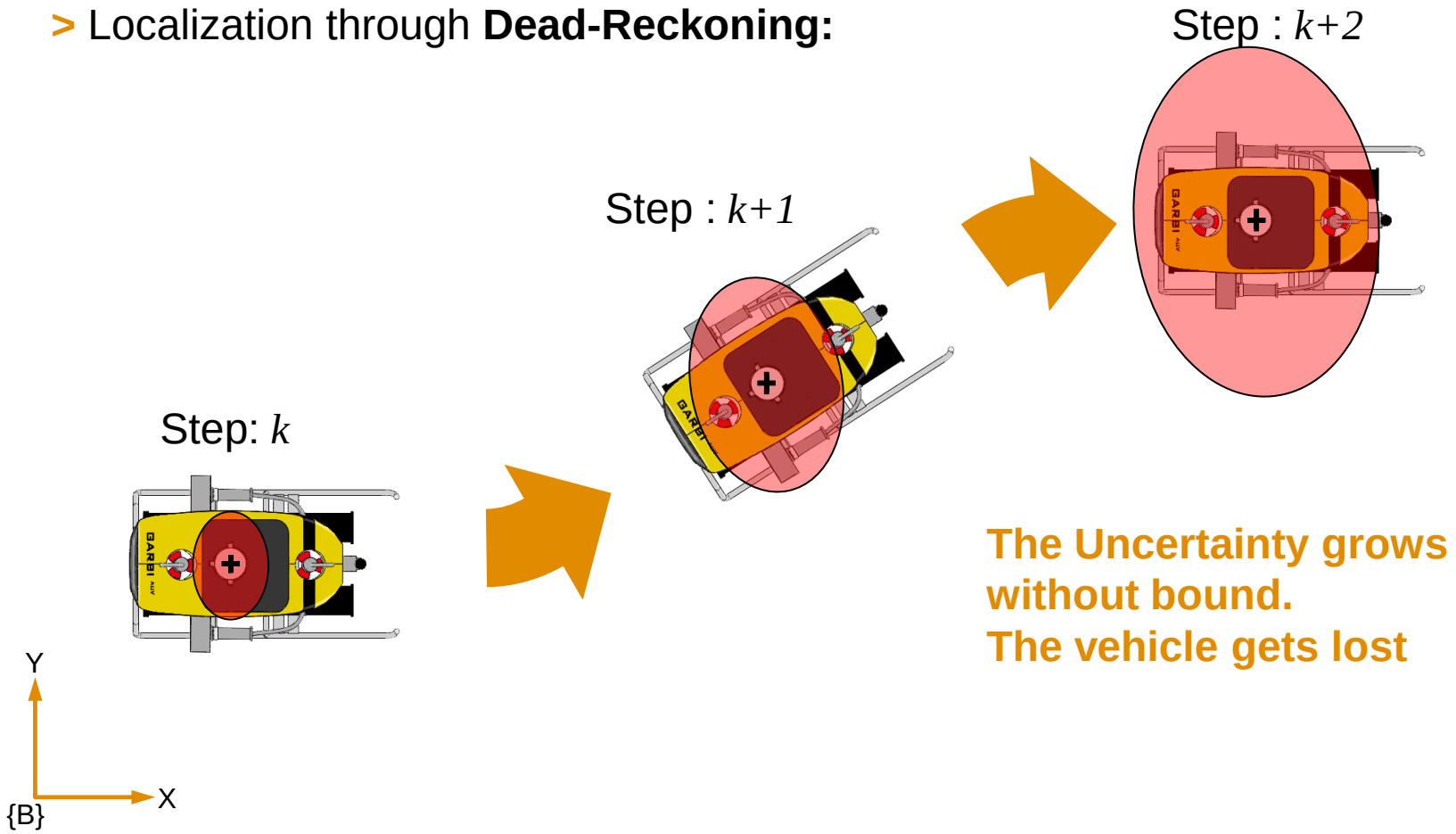
Labs:
SLAM Toolbox with Matlab



Assessment:
Labs + Exam (100%)

1 Introduction

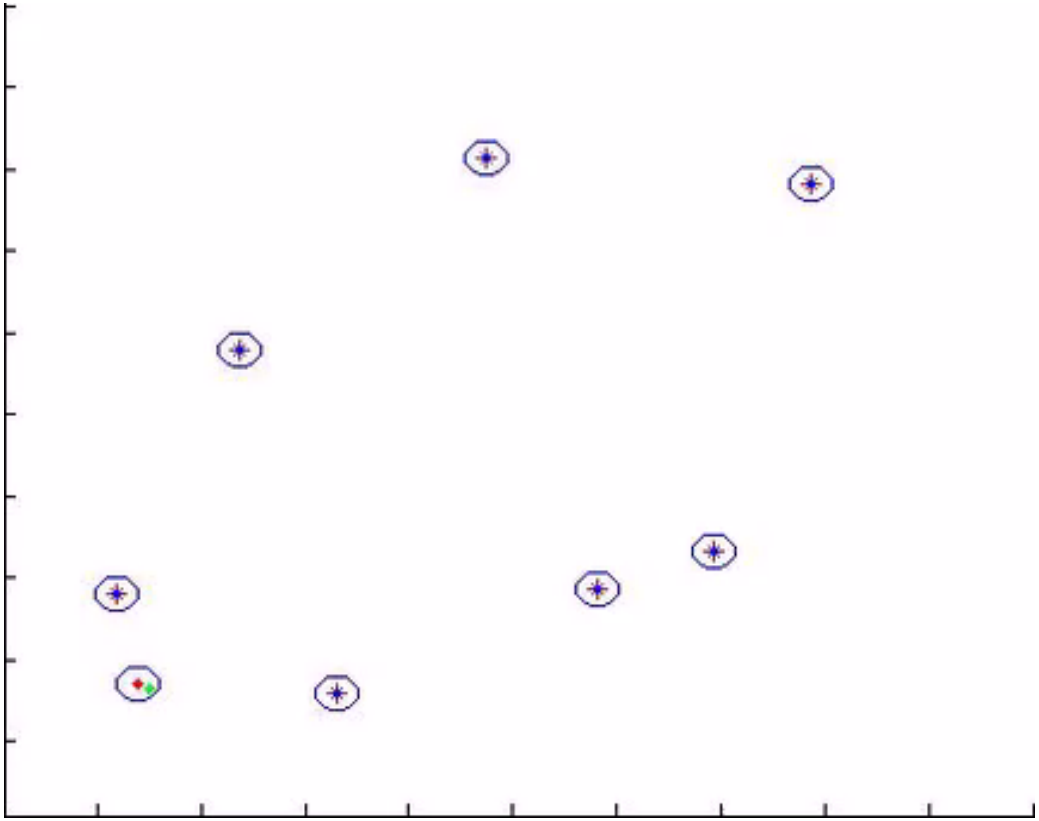
> Localization through **Dead-Reckoning:**



The Uncertainty grows without bound.
The vehicle gets lost

1 Introduction

- Localization through **Dead-Reckoning:**
  - **Velocity measured – Landmarks not measured**



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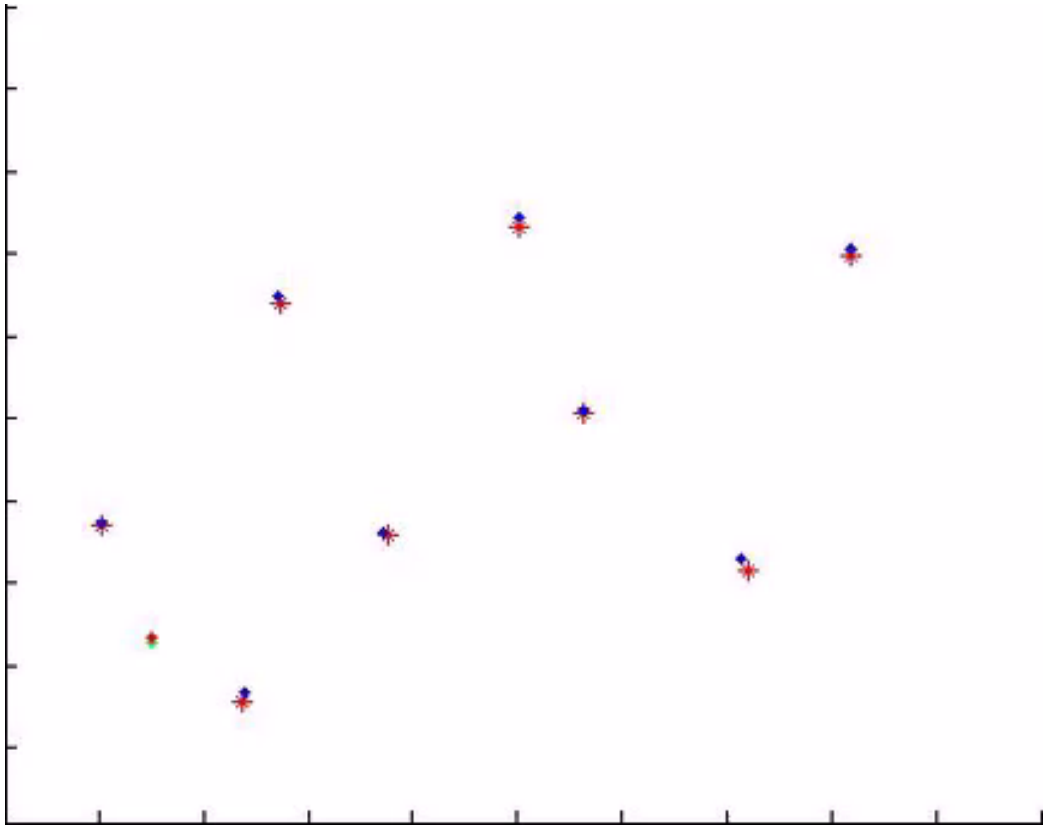
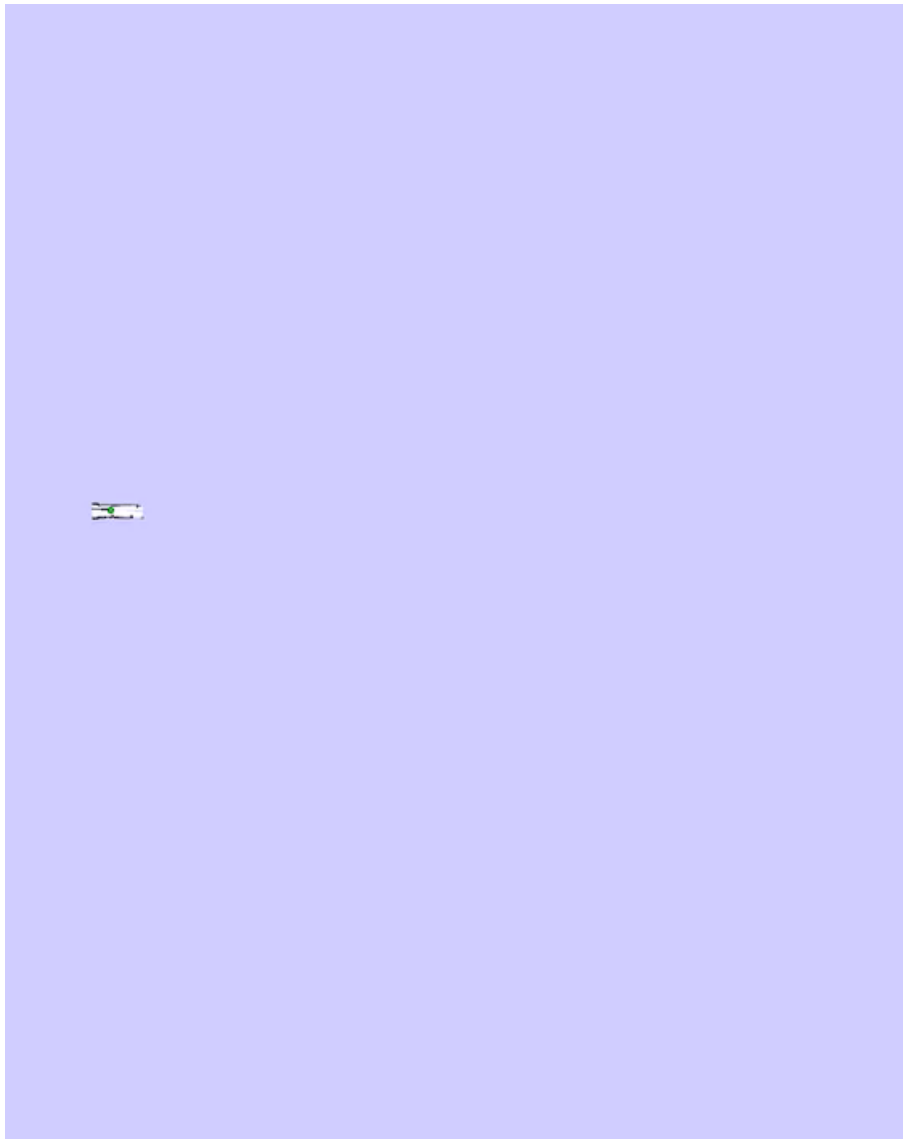


The Mapping Problem

- A conventional method for map building is incremental mapping.
  - Position Reference given by Dead Reckoning ➔ Map distorsion
- Bad maps → Poor localization

[Jensfelt]

1 Introduction



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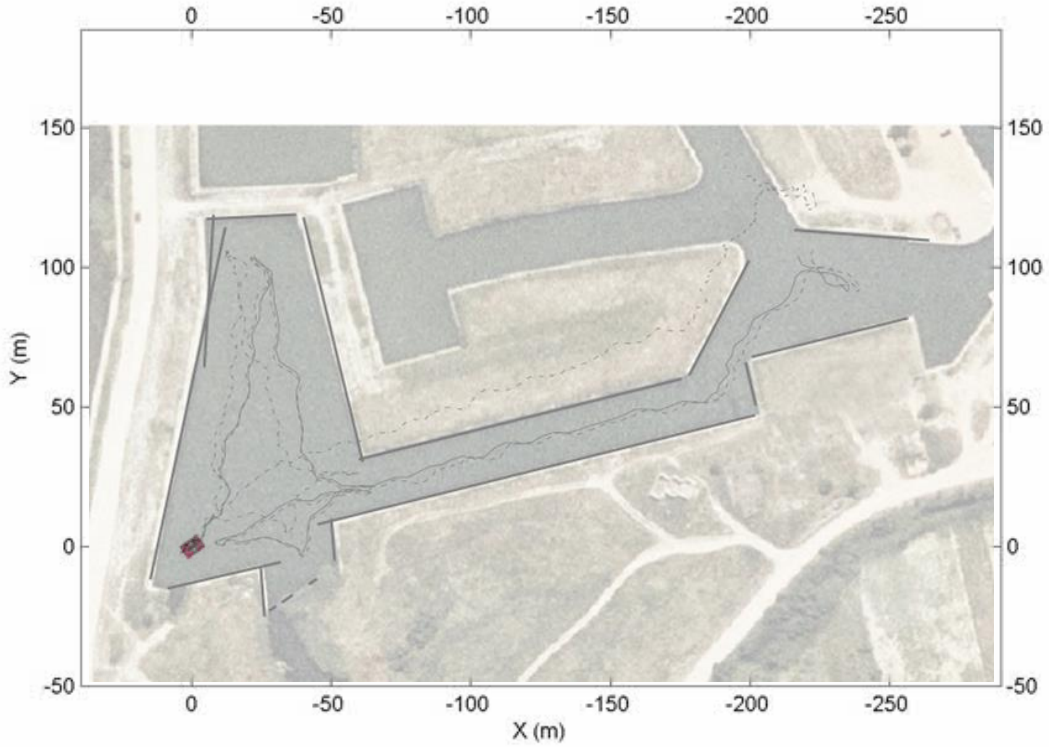

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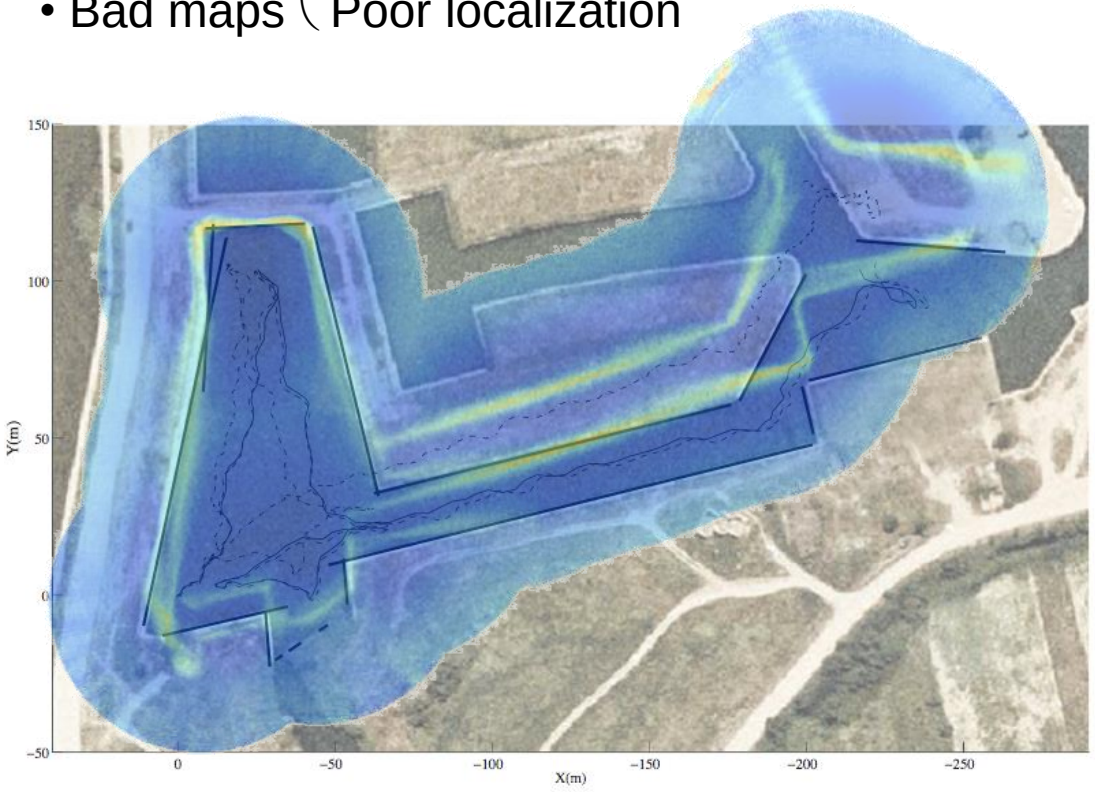

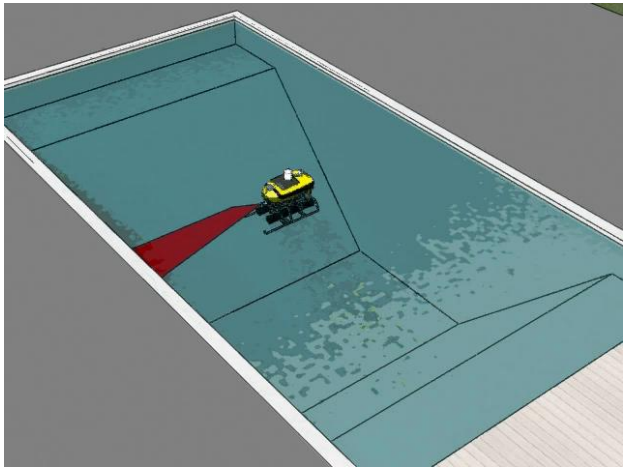

[Ribas 08]

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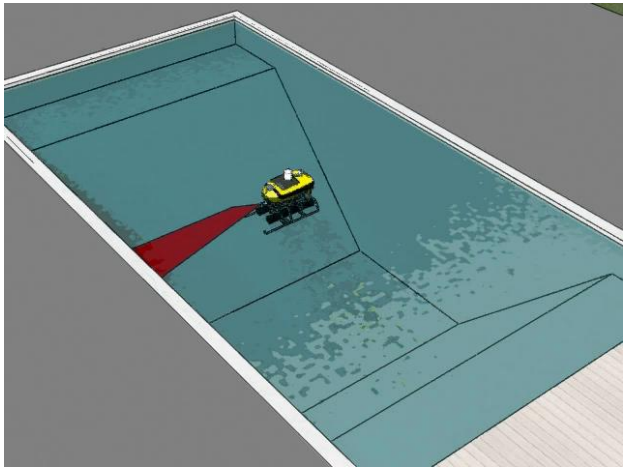


[Ribas 08]

1 Introduction

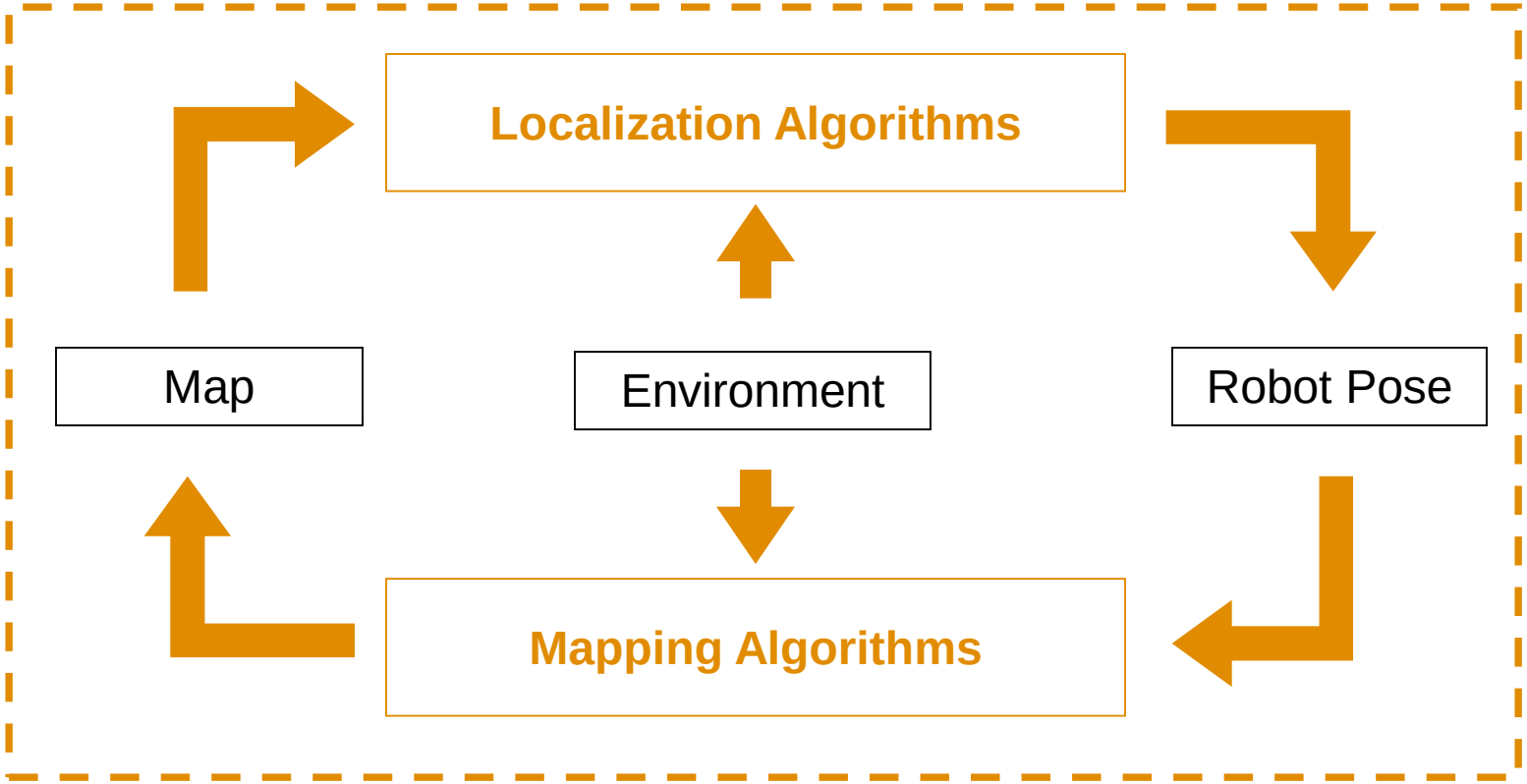
This is an old problem…

Ancient Europe. The **Catalan Atlas** of 1376.

This is an old problem…

1 Introduction

SLAM: Simultaneous Localization And Mapping



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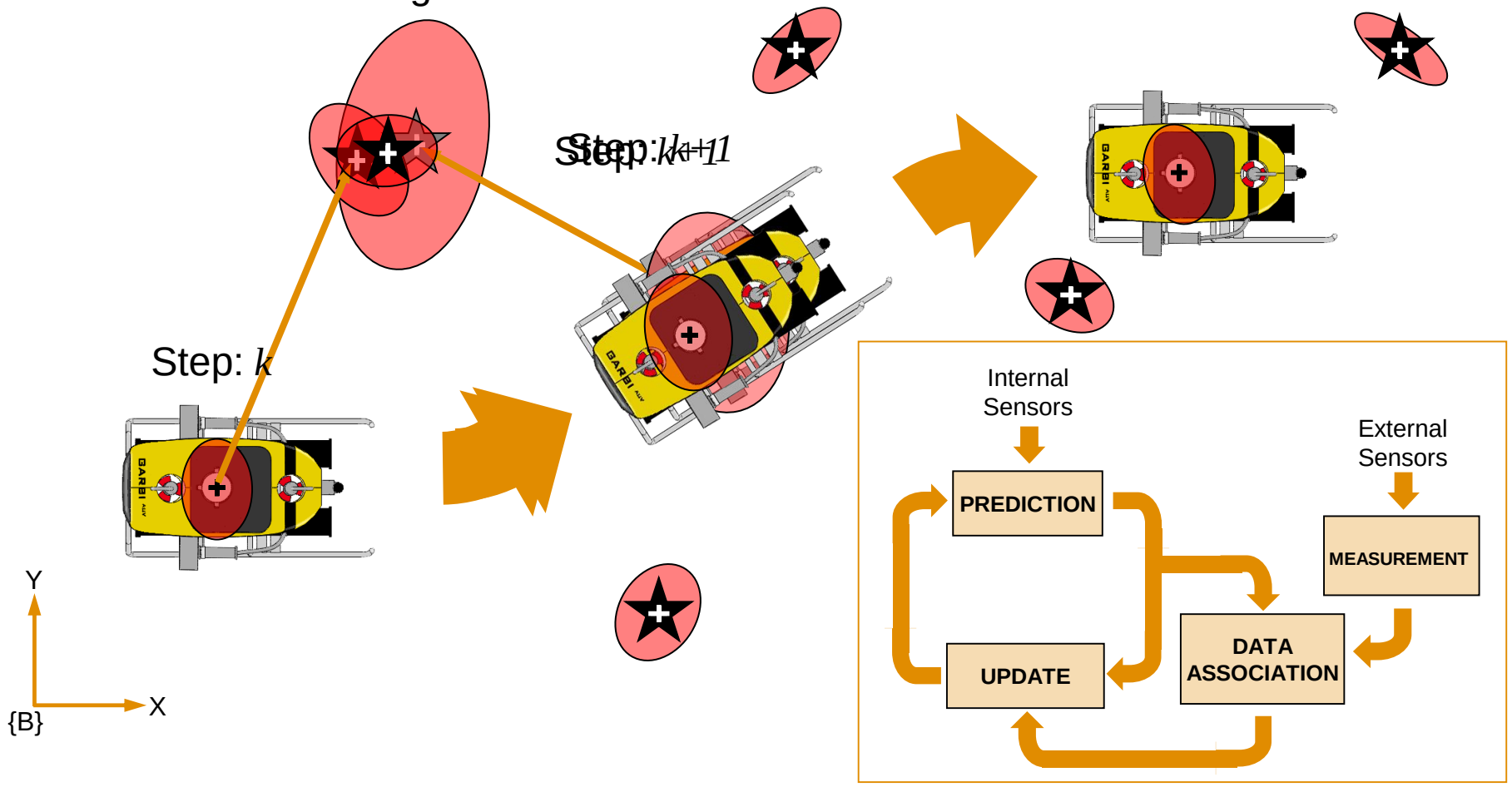

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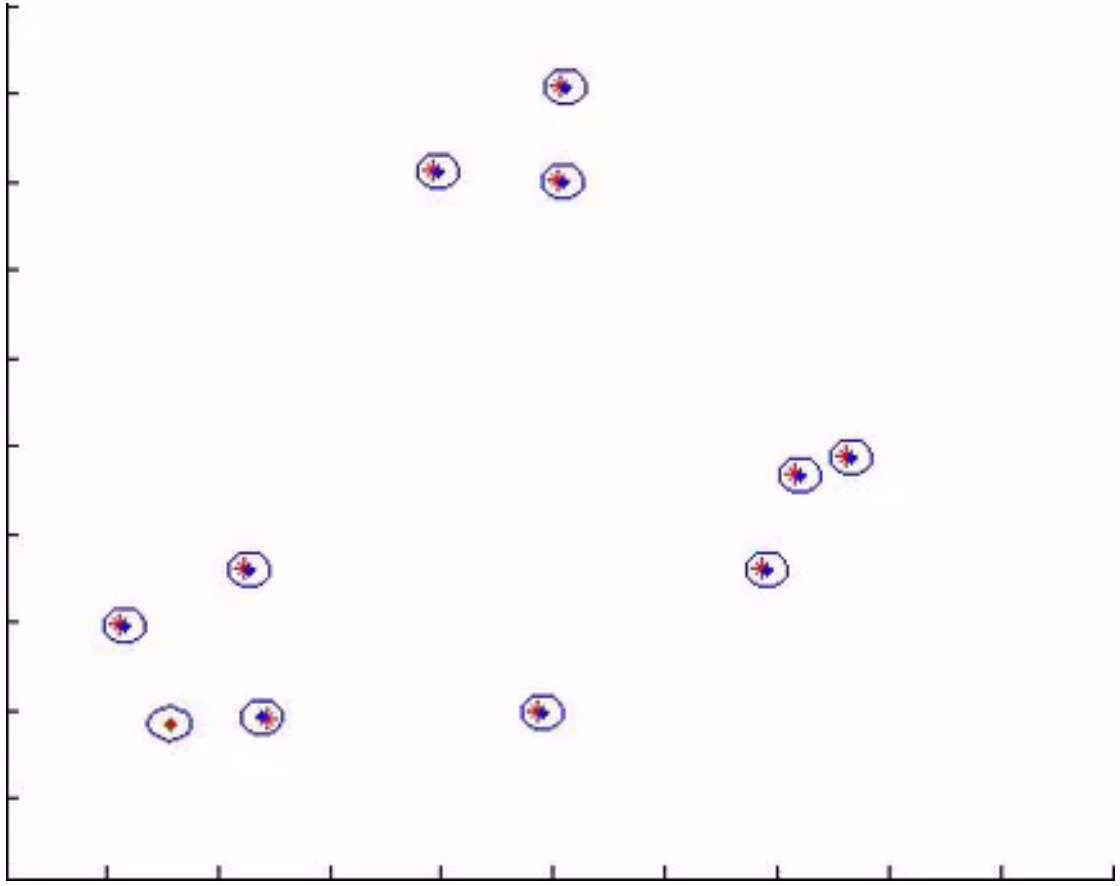

1 Introduction

> Localization Through **SLAM**: The Victoria Park (Sydney) Dataset

1 Introduction

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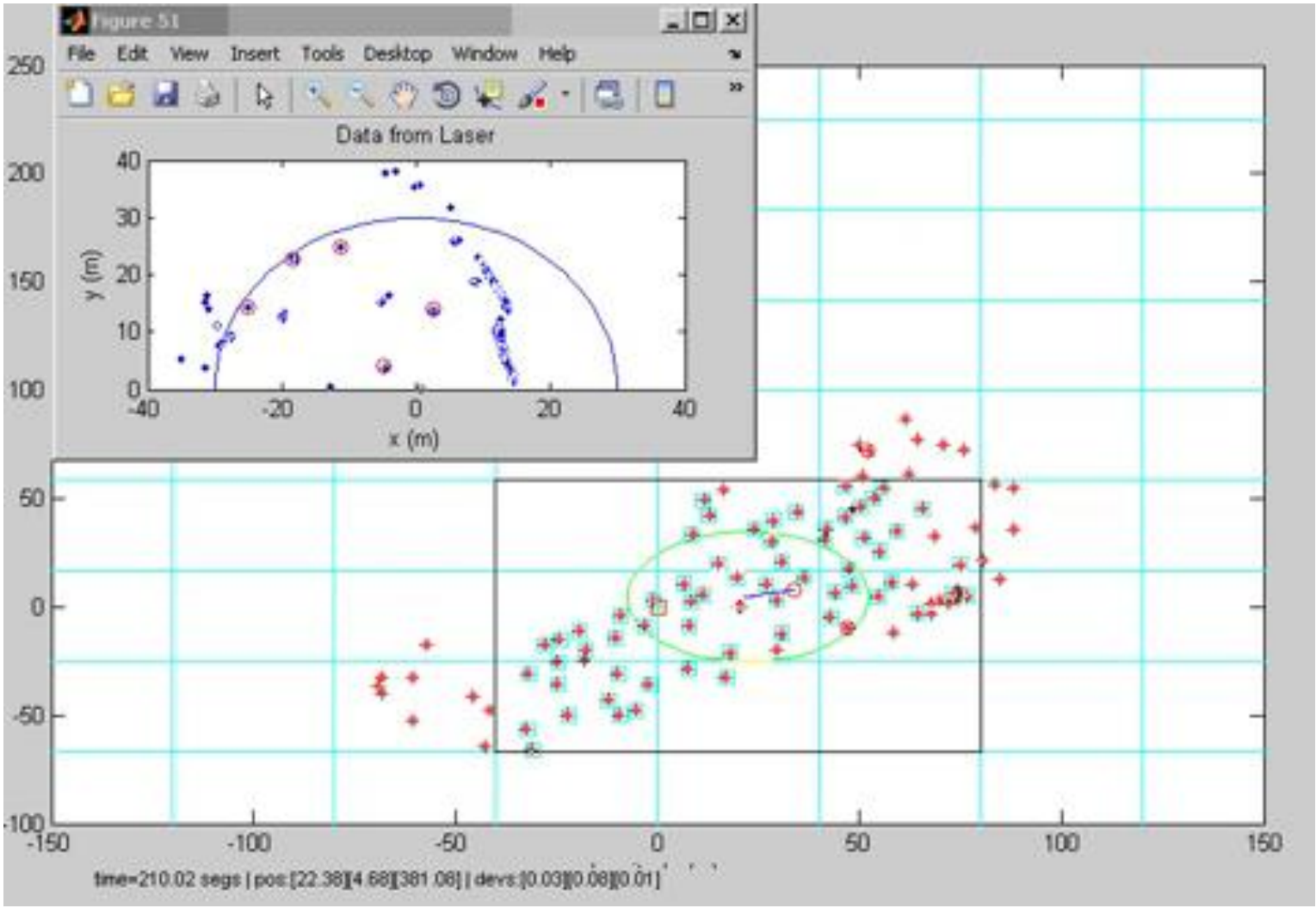
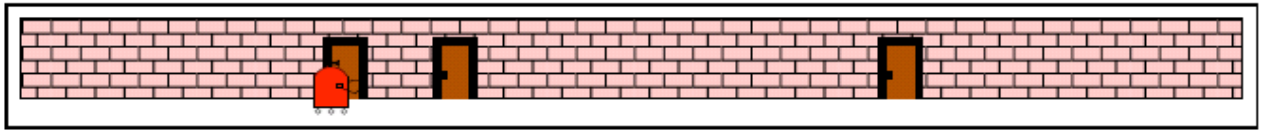


1.2 Localization Example

Example I: Mobile Robot Localization in a Hallway



- One dimensional hallway
- Indistinguishable doors
- Position of doors is known (Map)
- Initial position unknown
- Initial heading is known

- **Goal**: Find out where the robot is

1.2 Localization Example

- **Markov Localization**

Same probability of being in any x

The Robot senses a door

The belief over the position is updated

The Robot Moves

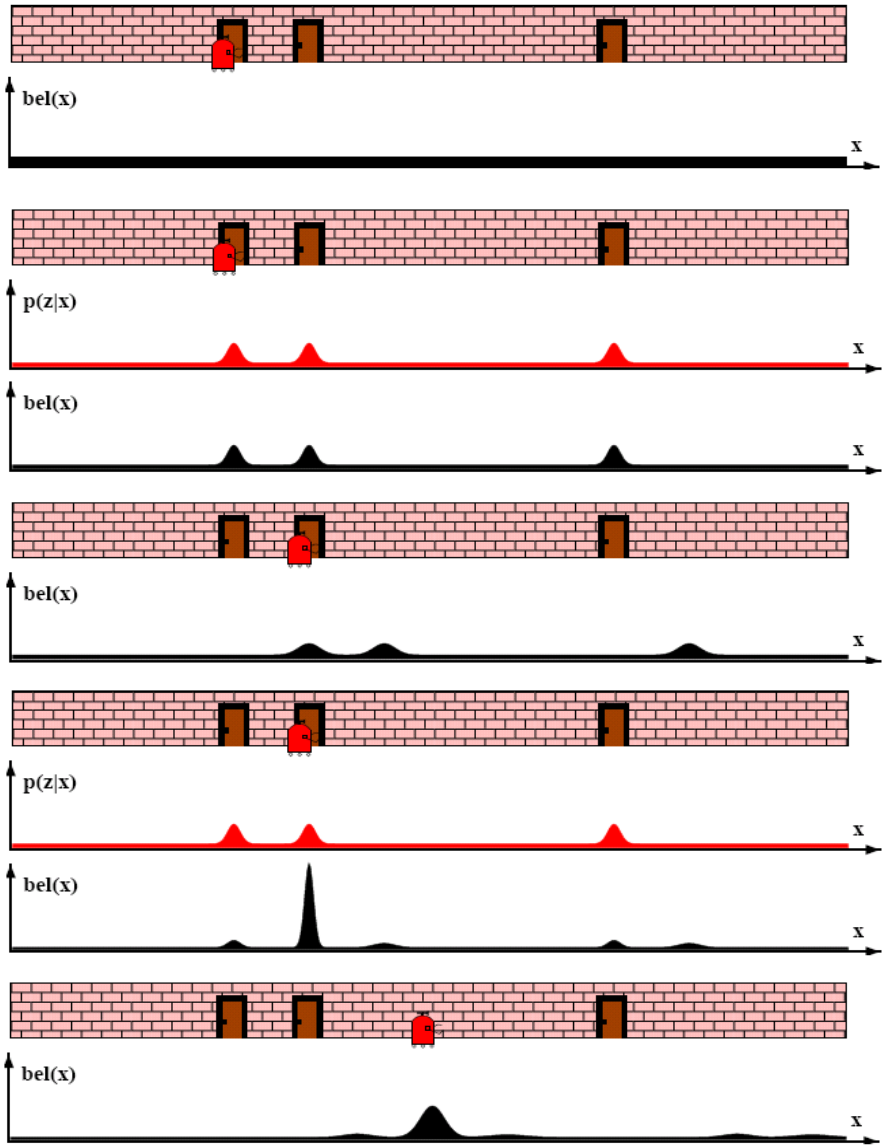
The belief over the position is updated

The Robot senses a door

The belief over the position is updated

The Robot Moves

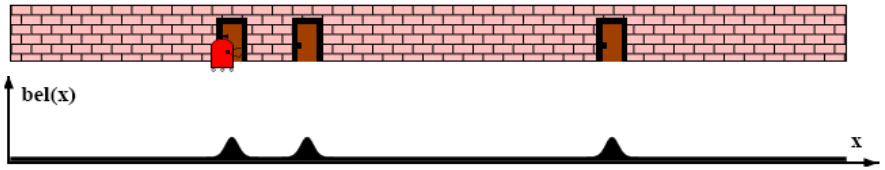
The belief over the position is updated



1.2 Localization Example

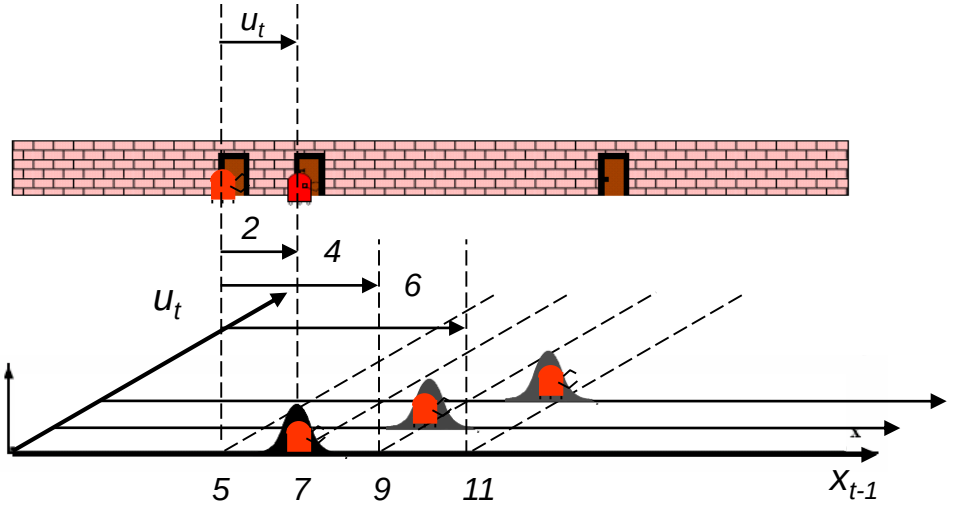
Robot belief of being at state x_{t-1}

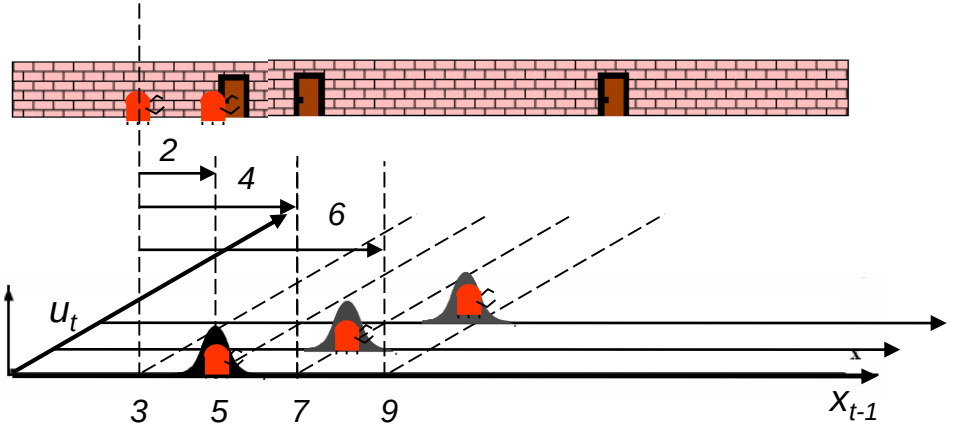
$$bel(x_{t-1}) = p(x_{t-1} \mid z_{1:t-1}, u_{1:t-1})$$



State Transition probability

$$p(x_t \mid u_t, x_{t-1})$$





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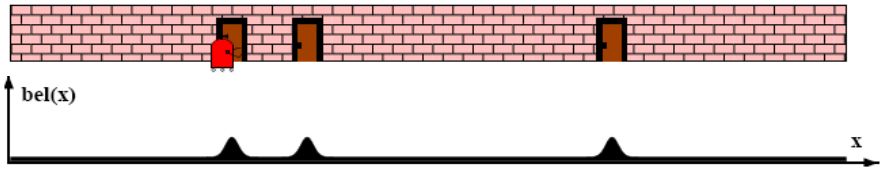
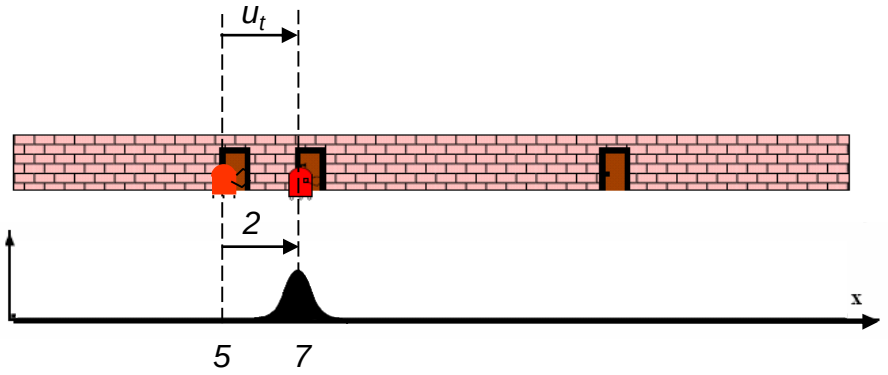


State Transition probability

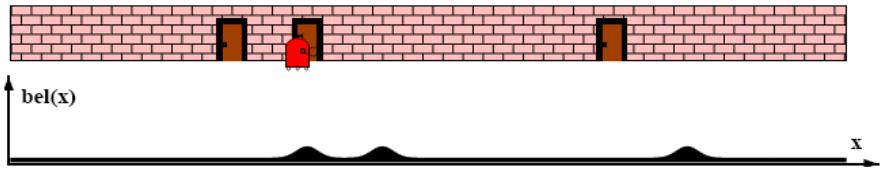
$$p(x_t \mid u_t, x_{t-1})$$

u_t=2 m, x_{t-1}=5 m



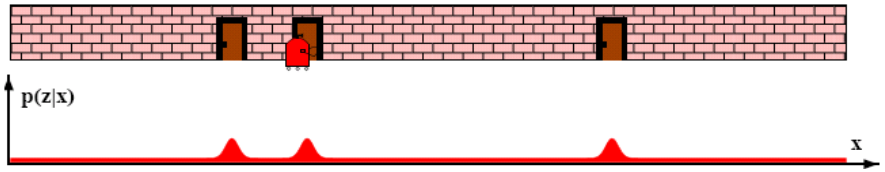
Prior Belief. Prediction of state x_t.

$$\overline{bel}(x_t) \quad = \quad p(x_t \mid z_{1:t-1}, u_{1:t})$$



Measurement probability

$$p(z_t \mid x_t)$$



Robot belief of being at state x_t

$$bel(x_t) \quad = \quad p(x_t \mid z_{1:t}, u_{1:t}) \; .$$

1.2 Localization Example