

Artificial intelligence in robotics 2019

Simultaneous localisation and mapping

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Navigation

- The art of getting from one place to another, safely and efficiently.
- The process of monitoring and controlling the movement of a craft or vehicle from one place to another.
- The activity of accurately ascertaining one's position and planning and following a route.



"Where am I?", "Where am I going?", "How do I get there?"

Navigation

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Localisation,

Mapping,

Motion planning

Lecture intro

Autonomous navigation in mobile robotics:

1. Map-less navigation

- observations translate to motion commands
- unknown, structured (roads, corridors, lanes) environments
- observations \rightarrow commands

2. Map-based navigation

- observations and map data translate to motion commands
- known (mapped), (un)structured environments
- (observations, map) \rightarrow commands

3. Map-building-based navigation

- observations and map data translate to both commands and map
- (un)known, (un)structured environments
- (observations) \rightarrow (commands, map)

What to remember

Probabilistic formulation of full SLAM

$$p(x_{0:T}, m | o_{1:T}, u_{1:T}). \quad (1)$$

Probabilistic formulation of 'online' SLAM

$$p(x_T, m | o_{1:T}, u_{1:T}). \quad (2)$$

- $x_{0:T}$ - trajectory
- m - map
- $o_{1:T}$ - sequence of observations
- $u_{1:T}$ - sequence of commands

What to remember

Map types

- topological,
- dense metric,
- sparse metric,
- hybrid.

Uncertainty models

- (extended) Kalman filter,
- mixture models,
- particle filter.

Further study

Further study

- Stachniss: Introduction to Robot Mapping
<https://www.youtube.com/watch?v=wVsfCnyt5jA>
- Cadena et al.: Past, Present, and Future of Simultaneous Localization and Mapping: Toward the Robust-Perception Age. IEEE T-RO 2018.
- Grisetti, Stachniss et al: Tutorial on Graph-Based SLAM. ITS Magazine