Artificial intelligence in robotics 2019

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Simultanneous localisation and mapping

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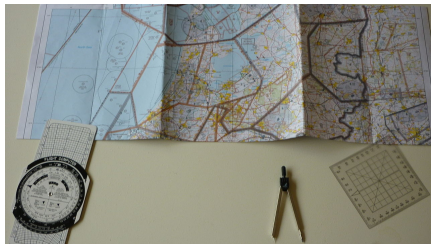
Navigation

- 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

- The art of getting from one place to another, safely and efficiently.
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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 → commands
2. Map-based navigation
   - observations and map data translate to motion commands
   - known (mapped), (un)structured environments
   - (observations, map) → commands
3. Map-building-based navigation
   - observations and map data translate to both commands and map
   - (un)known, (un)structured environments
   - (observations) → (commands, map)

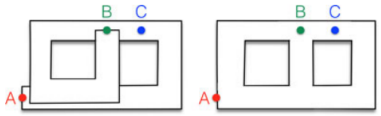
What to remember

Overview

- (observations, map, position) ↔ (map, position)
- essential component of navigation systems
- but it does not solve navigation by itself.

Odometry vs. SLAM

- the drift issue
- loop closure is the difference!



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.
- Grissetti, Stachniss et al: Tutorial on Graph-Based SLAM. ITS Magazine