

CiberRato

Robótica Móvel e Inteligente

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Challenge 4: Simultaneous Localization and Mapping

Main differences to previous challenges:

- No GPS

Problems raised:

- The mapping process needs to know the orientation and position
- Orientation and position information are extracted from compass and GPS, mainly.

Challenge 4: Localization

Movement Model :

$$out_t = in_i + out_{t-1} \cdot N(1, \sigma^2)$$

$$lin = outl_t + outr_t$$

$$x_t = x_{t-1} + lin \cdot \cos(\theta_{t-1})$$

$$y_t = y_{t-1} + lin \cdot \sin(\theta_{t-1})$$

Static θ assigned at the end of rotations

Noise ignored in the calculations, cleared with the help of front sensor

Challenge 4: Mapping

Same as before: Mapping coordinates rely on the arrival of the robot to the next cell

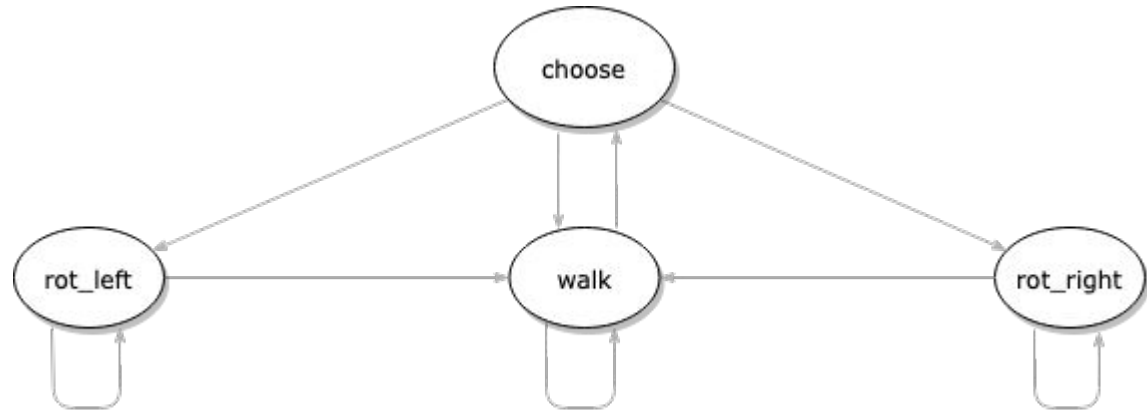
Method to store all the walls and passages: Bi-dimensional quadruple matrix

- $\text{MAPPINGCOLS} = ((\text{CELLCOLS} * 2) - 1) * 2 + 1$
- $\text{MAPPINGROWS} = ((\text{CELLROWS} * 2) - 1) * 2 + 1$
- Agent's starting position: $(\text{MAPPINGROWS} / 2, \text{MAPPINGCOLS} / 2)$

Challenge 4: State Machine

State machine:

- choose
- walk
- rot_left
- rot_right



Choose

Choose next cell based on:

1. If there's a unexplored cell right on its **right**
2. Or a unexplored cell on its **front**
3. Or a unexplored cell on its **left**
4. **Default:** **Euclidean distance** from the current cell

Choose

Computing the shortest path:

- **A* Search Algorithm**

- Path selecting based on the current **cost** of the path + **heuristic** (euclidean distance to the cell)
- **Never overestimates the cost** (estimates the cost of the cheapest path)
- Optimizations in comparison to Assignment 1:
 - Removed duplicated connections ex.: (c1, c2) and (c2, c1).

Walk

Only walks forward

Walks forward until the distance between the current position and the previous position is equal to 2

Uses left, right and front sensors to auxiliate the moviment

Rotation

Checks position to know when to stop

Same in both left and right, except the rotation capabilities, 90° to the left, 90° and 180° to the right

Rotates fast until around 20° close to the goal

Rotates slowly to stop on the goal, with a 5° range

Walks after rotation is completed