thws Technische Hochschule Würzburg-Schweinfurt

Faculty of Computer Science and Business Information Systems
5172080: Fundamentals of Mobile Robotics

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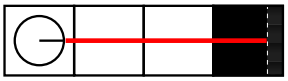
Tutorial 5

Topic: Grid Maps & Mapping with Known Poses

Solutions will be discussed in class Monday 12:10-13:10, Week 50 of the calendar year.

Q 1 – Occupancy Mapping

A robot has to build an occupancy grid map of a simple one-dimensional environment using a sequence of measurements from a range sensor.



Assume a simple inverse sensor model: every grid cell with a distance (based on its coordinate) smaller than the measured distance is assumed to be occupied with $p = 0.3$. Every cell behind the measured distance is occupied with $p = 0.6$. Every cell located more than 20cm behind the measured distance should not be updated. Additionally, the prior belief is set to 0.5.

Give the equation of the inverse sensor model $l(m_i \mid z_t, x_t)$ and the value of the prior $l(m_i)$ as used in the log-odds update equation.

Additionally, derive the equation to convert from log-odds to probabilities from the definition of the log odds ratio.

Q 2 – Occupancy Mapping

Prove that in the occupancy grid mapping framework the occupancy value of a grid cell $P(m_j \mid x_{1:t}; z_{1:t})$ is independent of the order in which the measurements are integrated.

Q 3 – Counting Model

A robot applies the so-called simple counting approach to build a grid map of a 1D environment consisting of the cells $c_0, \ldots, c_3$. While standing in cell c_0, the robot integrates four measurements $z_{t_0}, \ldots, z_{t_3}$. After integrating these measurements, the resulting belief of the robot with regards to the occupancy of the four cells is $b_0 = 0$, $b_1 = \frac{1}{4}$, $b_2 = \frac{2}{3}$, $b_3 = 1$. Given that the first three measurements are $z_{t_0} = 1$, $z_{t_1} = 2$, $z_{t_2} = 3$, compute the value of the last measurement z_{t_3}.