Albert-Ludwigs-Universität Freiburg
Lecture: Introduction to Mobile Robotics
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Institut für Informatik

Prof. Dr. Wolfram Burgard
PD Dr. Cyrill Stachniss
Juniorprof. Dr. Maren Bennewitz
Dr. Gian Diego Tipaldi
Dr. Luciano Spinello

# Sheet 5

## Topic: Mapping with Known Poses

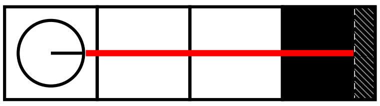
Submission deadline: June 3, 2013
Submit to: `mobilerobotics@informatik.uni-freiburg.de`

### Exercise 1: 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 $z_{t_3}$.

### Exercise 2: Occupancy Mapping

A robot has to build an occupancy grid map (cells $c_0, \ldots c_n$) of a simple one-dimensional environment using a sequence of measurements from a range sensor.



Assume a very simple 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. Calculate the resulting occupancy grid map using the inverse sensor model (see mapping lecture PDF, slide 10).

Use Octave. Use one array `m=0.5*ones(1,21)` for the belief values, and one array `c=[0:10:200]` for the cell coordinates. Use `plot(c,m)` to visualize the belief.

| | |
|---|---|
| grid resolution | $10cm$ |
| map length (1d only!) | $2m$ |
| robot's position | $c_0$ |
| orientation (of the sensor) | heading to $c_n$ (see figure) |
| measurements (in cm) | $101, 82, 91, 112, 99, 151, 96, 85, 99, 105$ |
| prior | 0.5 |

**Exercise 3: Occupancy Mapping**

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