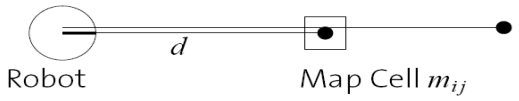
Cognitive Robotics

Assignment 6

6.1) Consider only one particular cell $m_{i\,j}$ of a map at a given and fixed distance d away from the robot. Assume the robot does not move while mapping and it uses a range sensor to build the map. Suppose the inverse sensor model is given as

$$p(m = occ \mid z = d) = 0.8$$
$$p(m = occ \mid z > d) = 0.2$$

and the prior probability of the cell being occupied is $p(m_{i\,j}) = 0.2$.



(a) Formulate the update rule of the map cell with these concrete numbers using the log-odds ratio.

6 points

(b) What is the log-odds ratio after measuring 100 times if 60 measurements return the value d and 40 a value $>d$? Compute also the resulting occupancy probability.

3 points

(c) What is the reflection probability of the cell?

3 points

(d) What are the benefits of the reflection map representation, and where are the problems?

3 points

6.2) 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 $z_{t0}, \ldots, z_{t3}$. After integrating these measurements, the resulting belief of the robot with regards to the occupancy of the four cells is $b_0 = 0.25$, $b_1 = 1/3$, $b_2 = 0.5$, $b_3 = 1$. Given the three measurements $z_{t0} = 0$, $z_{t2} = 3$, $z_{t3} = 1$, compute the value of the measurement z_{t1}.

5 points