Cognitive Robotics

Assignment 3

3.1) Let a robot be equipped with wheel encoders and on-board software that transforms the physical measuring data into time-discrete odometry measurements $\langle \hat{\delta}_{rot_1}, \hat{\delta}_{trans}, \hat{\delta}_{rot_2} \rangle$.

Let the robot start at pose $\langle x, y, \theta \rangle = \langle 0m, 0m, 0^\circ \rangle$ and obtain the following subsequent odometry measurements:

Motion 1		Motion 2	
$\hat{\delta}^1_{rot_1}$	$= -20^\circ$	$\hat{\delta}^2_{rot_1}$	$= 20^\circ$
$\hat{\delta}^1_{trans}$	$= 3m$	$\hat{\delta}^2_{trans}$	$= 10m$
$\hat{\delta}^1_{rot_2}$	$= -30^\circ$	$\hat{\delta}^2_{rot_2}$	$= 10^\circ$

Calculate the resulting pose of the robot, assuming exact measurements!

5 points

3.2) How would your pose estimate for the Motion 1 look like under the following simple error model?

$$\begin{aligned} \hat{\delta}_{rot_1} &= \delta_{rot_1} \pm \varepsilon_{rot_1}, & \varepsilon_{rot_1} &= 10^\circ \\ \hat{\delta}_{trans} &= \delta_{trans} \pm \varepsilon_{trans}, & \varepsilon_{trans} &= 0.5m \\ \hat{\delta}_{rot_2} &= \delta_{rot_2} \pm \varepsilon_{rot_2}, & \varepsilon_{rot_2} &= 5^\circ \end{aligned}$$

Please draw the movements and pose estimates into one diagram!

5 points

3.3) Visualize the likelihood of positions (x,y) after one, two, and three successive applications of the motion model from 3.2) for Motion 1 by computing the likelihoods on the grid (x,y,θ) and marginalizing out the heading direction θ.

5 points

3.4) Initialize 100 samples at $\langle x, y, \theta \rangle = \langle 0m, 0m, 0^\circ \rangle$

Show the (x,y)-positions of the samples after one, two, and three successive applications of the motion model from 3.2) for Motion 1.

5 points