UNIVERSITÄT BONN AIS

RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITÄT BONN

COMPUTER SCIENCE VI AUTONOMOUS INTELLIGENT SYSTEMS

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Friedrich-Hirzebruch-Allee 8

Cognitive Robotics

Assignment 3

Due Tuesday, November 7th, before class.

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 $\langle x, y, \theta \rangle = \langle 3m, -2m, -30° \rangle$ and obtain the following subsequent odometry measurements:

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

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?

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

Please draw the movements for noise $+\varepsilon_{movement}$ and $-\varepsilon_{movement}$ and the resulting eight pose estimates into one diagram!

5 points

3.3) Visualize the likelihood of positions (x, y) after
- Motion 1,
- Motion 1 followed by Motion 2,
- Motion 1 followed by Motion 2, followed by Motion 1

with the error model from 3.2) by computing the likelihoods on a grid (x, y, θ) and marginalizing out the heading direction θ!

5 points

3.4) Initialize 100 samples at $\langle x, y, \theta \rangle = \langle 3m, 2m, -30° \rangle$.

Show the (x, y) positions of the samples after
- Motion 1,
- Motion 1 followed by Motion 2,
- Motion 1 followed by Motion 2, followed by Motion 1

by applying a sampling-based motion model with parameters from 3.2)!
Compare your results to 3.3)!

5 points