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Faculty of Computer Science and Business Information Systems
5172080: Fundamentals of Mobile Robotics
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Tutorial 4

Topic: Localization - Extended Kalman Filter

Solutions will be discussed in class Monday 12:10-13:10, Week 49 of the calendar year.

Q 1 – Theoretical Considerations

The EKF is an implementation of the Bayes Filter.

1.a

The Bayes filter processes three probability density functions, i. e., $p(x_t \mid u_t, x_{t-1})$, $p(z_t \mid x_t)$, and $\text{bel}(x_t)$. State the normal distributions of the EKF which correspond to these probabilities.

1.b

Explain in a few sentences all of the components of the EKF, i. e., μ_t, Σ_t, g, G_t, h, H_t, R_t, Q_t, K_t and why they are needed. What are the differences and similarities between the KF and the EKF?

Q 2 – EKF Prediction Step

We assume a differential drive robot operating on a 2-dimensional plane, i.e., its state is defined by $\langle x, y, \theta \rangle$. Its motion model is defined in the lecture "'Probabilistic Motion Models - 2"', slide 13, lines 4 - 6. Derive the Jacobian matrix G_t of the noise-free motion function g.

Q 3 – EKF Correction Step

Derive the Jacobian matrix H_t of the noise-free measurement function h of a range-only sensor.