MPC-MAP Assignment No. 4

The goal of this assignment is to implement a working localization algorithm based on the Extended Kalman Filter.

Create a single A4 report that will describe your approach to the exercise (3-6 sentences for each task and picture, if makes sense).

Task 1

Load the `map_1` from the `resources` and manually design a trajectory between the start pose $[1,1,\pi/2]$ and the goal location $[9,9]$.
Examine the noisy positioning data $[x, y, \theta]$ provided by the `gnss_measure` function; you will employ the x and y measurements for the correction step within the following tasks.

Task 2

As you use a differential wheeled robot, there is a nonlinearity in the state and control transition (nonlinear function $g(x)$); thus, you must employ the EKF for the prediction step. Implement `ekf_predict` function for given drive type.
On the other hand, the KF is appropriate for the correction phase, since there is a linear relation between the state and measurement. Implement `kf_correct` function.

Task 3

Use the known initial pose $x = [1,1,\pi/2]$ and Σ with zeros (i.e., high certainty) as the initial belief for the KF algorithm and navigate the robot along your trajectory to the goal location. Only the KF-based estimated pose can be utilized for the control. You know the standard deviation of the GNSS measurements is $0.5\ m$ for both x and y coordinates (important for the Q matrix); for the process noise, apply variances 0.01 to all variables and tune the R matrix to reach an optimal performance. Capture the result.

Task 4

Verify the algorithm behavior with inaccurate initial beliefs and observe, how the estimated pose converges to the real pose values. Capture the result.

Submission

Send the report and zip archive comprising the simulator with your solution at petr.gabrlik@vut.cz.
MATLAB script (`main.m`) must be executable without errors and must generate a graphical output illustrating a successful navigation.
Deadline: 13th Mar 2022, 23:59.