Exercise 9 (v1.0.3) January 15, 2022

Submission online until **Tuesday, 18 January 2022, 11:55 a.m.**

Assignment 9-1: Steering calibration (5 Points)

(a) (4 Points) Calculate the steering angle of the car (bicycle model) using different steering angles (at least $-1.0, 0.0, 1.0$). Let the car drive for approx. $2m$.

The steering motor reports its position as an analog signal on the topic `/sensors/arduino/steering_angle`. Subscribe to the topic and record the reported steering motor position and localization (`/simulation/odom_ground_truth`) during calibration.

The localization returns the car's position with respect to the center of the rear axle.

The car's axle distance is $0.27m$.

Calculate the turning radius R with respect to the center of the rear axle.

Calculate the steering angle ϕ of the virtual front wheel (in the middle).

Report your experimental results in a table (steering motor position, turning radius, steering angle) and include it in your Pdf.

(b) (1 Point) Create a node that subscribes to `/sensors/arduino/steering_angle` and calculates the steering angle in radians. You may publish the steering angle using the `autominy_msgs/SteeringAngle` message.

Assignment 9-2: Speed Controller - Part I (5 Points)

Use Ziegler-Nichols step-response method (from the given lecture slides) to calculate the values (K_p, K_i, K_d) for a speed-controller. Use the topic `/simulation/odom_ground_truth` to extract the current velocity.

Let the car accelerate from zero velocity to maximum speed and plot time vs. speed. Put this plot into your Pdf. Then extract the parameters for the Ziegler-Nichols method.

Feel free to do this graphically in a plot or via calculations - but in any case explain the calculation steps.

Which values for K_p, K_i, K_d did you extract using Ziegler-Nichols method?