F1TENTH Autonomous Racing **(Due Date:)**

Lab 6: Pure Pursuit

Instructor: INSTRUCTOR *Name:* STUDENT NAME, *StudentID:* ID

Course Policy: Read all the instructions below carefully before you start working on the assignment, and before you make a submission. All sources of material must be cited. The University Academic Code of Conduct will be strictly enforced.

THIS IS A GROUP ASSIGNMENT. Submit one from each team.

1 Learning outcomes

The following fundamentals should be understood by the students upon completion of this lab:

- Pure pursuit algorithm

2 Overview

The objective of this lab is to give you working experience with a powerful SLAM package, Cartographer, and with a basic yet well-behaved trajectory planner: the Pure Pursuit algorithm.

3 Running Cartographer on the car

Follow the instructions from the lecture to run Cartographer on your car, then map Levine second floor donut and save it.

4 Localization with Particle Filter

Follow the instructions in Section 'Localization with Particle Filter' of the Reference Manual and the instructions from the lecture to run particle filter on your car.
You have been supplied with a `waypoint_logger` node (pull the github repo), which logs information from the particle filter in Comma Separated Value (CSV) format (one column per piece of information, one row per estimate = one row per time step). You can modify the logger node so that it saves whatever you need. Drive the car manually and not terribly fast around Levine

donut while running the particle filter and `waypoint_logger`. You will use the generated CSV file as the path to be tracked by pure pursuit.

5 Pure Pursuit Implementation

We have provided a skeleton for the pure pursuit node (pull the github repo). As per usual, test your algorithm first in the simulator before you test it on the car. As shown in the lecture, the curvature of the arc to track can be calculated as:

$$\gamma = \frac{2|y|}{L^2} \tag{5.1}$$

6 Visualizing Waypoints

To visualize the list of waypoints you have, and to visualize the current waypoint you're picking, you'll need to use the *visualization_msgs* messages and RViz. You can find some information here: http://wiki.ros.org/rviz/DisplayTypes/Marker

7 Deliverables and Submission

You will be racing with your pure pursuit code in Race 1. Submit the following as `groupnumber_lab6.zip` (replace `number` with your groupnumber):

1. A ROS Package by the name of: `groupnumber_lab6`. **Make sure it compiles before you submit after changing the package name.**
2. The map of Levine loop you made with Cartographer (.pgm and .yaml)
3. The recorded .csv file youve logged

8 Grading

8.1 Rubric

Topics	**Points**
Compilation	10
Occupancy grid init and update	10
Correct sampling	10
Correct nearest	10
Correct steer	10
Correct collision check	10
Correct is goal	10
Correct find path	10
Correct overall structure	10
Written assignment	10
RRT* or equivalent (+10 pts)	0
Total	100