

# CMPE185 Autonomous Mobile Robots

## Fall 2022 Homework 1

**Problem 1. (50 pts)** Suppose a two-wheel differential drive mobile robot equipped with a 2D range sensor starts at position  $x = 1.0\text{m}$ ,  $y = 2.0\text{m}$ , with heading  $\theta = \pi/4$ . A range sensor is attached to the center of the robot. The range sensor detects an obstacle and returns a reading of  $\alpha = -\pi/6$  and  $d = 1.0\text{m}$ .

- a. What is the position of the obstacle in the global coordinate frame?
- b. For the same robot, suppose the wheel radius is  $0.3\text{m}$  and the length of the axles is  $1.6\text{m}$ . For the wheel encoder, the total ticks per revolution is 50. After a while, 20 ticks were recorded for the left wheel, and 40 ticks were recorded for the right wheel, will the car collide with the obstacle? Write down all your work.

**Problem 2. PID Controller (50 pts)**

- a. Implement a PID go-to-goal controller to control a differential drive mobile robot to move from a starting position to a goal position. Open the “CMPE185\_HW\_1\_p2.m” file and implement the PID controller in the given place. Choose the proper values of the proportional gain  $K_P$ , the integral gain  $K_I$ , and the derivative gain  $K_D$ .
- b. Change the values of  $K_P$ ,  $K_I$ , and  $K_D$  and observe how the trajectory changes. Plot the corresponding trajectories of the mobile robot and discuss the results.

**Submission:**

Submit a single Pdf file for Problem 1 and Problem 2.b.

Submit the .m file for Problem 2.a. with the name “first\_name + last\_name + HW1.m”.

Note: the assignment should be completed individually. Do not share results and code with others.