EE 451 Intro. to Robot Control
Bogazici University, Electric Electronic Eng.,

06.12.2023
Due date: 20.12.2023

Project 4

This project aims to familiarize you with mobile robot control. Consider a differential drive mobile robot that acts as a cargo delivery robot in an environment with obstacles. There will be M obstacles in the workspace that your robot needs to avoid. Consider each obstacle to be a cylinder positioned at oj_x, oj_y with radius ρ_j and height h_j, $j = 1, \ldots, M$.

The robot should move from its initial position $[0, 0]^T$ to an arbitrary goal position $[g_x, g_y]$ without colliding with any of the obstacles.

Part 1

You will be given the ROS package to simulate and move your robot along with a sample code to get the position of your robot and move it. You are to deliver the ROS package so that your robot can accomplish the following tasks in Gazebo simulations:

1. In order to control your robot, you need to know where it is. One way to do so is to use the velocities of the wheels of the robot to estimate how much it moved - rotated relative to its starting position. Use the left/right wheel velocities of your robot to compute the current position of it while moving. Compare the result with the true position that you get from Gazebo.

2. Generate workspaces varying in number of obstacles and positional complexity by reading the obstacle positions and sizes from a file. Use the APF(artificial potential field) approach to navigate your robot from the initial position to an arbitrary goal position in such an environment.

   Your program should read the task from a file as follows:

   $$\begin{array}{cccc} g_x & g_y & & \\ o1_x & o1_y & \rho_1 & h_1 \\ \vdots & & & \\ oM_x & oN_y & \rho_M & h_M \end{array}$$

Part 2

Once you are done with the simulation part, you will employ real robot tests at the Intelligent Systems Laboratory at designated times. You are expected to implement your solution to **Part 1.2** on the given robot. Note that there will be differences between your simulation program and the real robot program, such as the source of your robot's position and the destination of your robot's velocity. On the demo day, you will make a demo with a real mobile robot on a given demo scenario. There will be a presentation about the robots in the laboratory to familiarize you.