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

4.10.2023
Due date: 18.19.2023 9:00

Project 1

The goal of this project is to further familiarize you with ROS-C-C++ based programming.

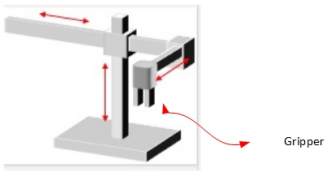

Figure 1: Prismatic robot.

(a) Write a package to simulate and control a PPP robot as shown in Fig. 1 without any obstructions in the world scene using Gazebo and ROS. For this, you will first need to design your robot, implement it using your own URDF or xacro files and then add it to your workspace. During the designs, you can use the URDF visualizer shared under useful links. You can also use Solidworks to do the designs and use Solidworks URDF exporter if you prefer. You are free to set the limits for each prismatic joint as long as the robot is capable of doing the tasks given to it.

To implement controllers for the joints of your robot, please follow the ROS Control Tutorial of Gazebo, shared under useful links. You should implement joint position controllers and be able to control the joint positions of the robot using ROS topics.

(b) Now consider the point $p \in R^3$ corresponding to the tip of the last link of this robot. Determine its coordinates expressed with respect to the base coordinate frame (oxyz).

(c) Write code to spawn a cube (with an edge length of 0.1m) randomly within the space defined by $x \in [0.5, 1], y \in [0.5, 1], z = 0.05$

(d) Write code to push the cube from its initial location by 10 cm in a random direction $\{[1, 0, 0]^T$, $[-1, 0, 0]^T$, $[0, 1, 0]^T$, $[0, -1, 0]^T\}$ using the tip of your robot

Submit all the packages you wrote required to simulate and control your robot containing C/C++ code, design files (including Solidworks if applicable), urdf, xacro. Provide a readme file that explains how to run your code. Also please make sure that your code is well-commented.

- Please use header - source files.
- Your code should not have any numbers explicitly embedded. Rather, define them either as constants in your header file or define them as class data member. For example, if you want to define the first joint to be between $[5cm, 20cm]$, then in your header file

```
#define PRISMATIC_JOINT1_LOWER_LIMIT 5
#define PRISMATIC_JOINT1_HIGHER_LIMIT 20
```