Robotic Manipulation Course

Exercise 3

February 9, 2021

1 Assignment

The goal is to perform *pick and place* task with *lumi* robot in the simulated environment. We created a template in the course gitlab group which contains package configuration, and example of node which moves the robot. Your goal is to modify that node to perform following steps:

- from tf server, read the transformation of the frames named *pick* and *place*:
  - *pick* is the pose of the object to pick
  - *place* is the pose where to put the object
- compute and visualise following poses of the gripper:
  - pre-grasp pose (10 cm above the pick pose in z-axis of pick coordinate system)
  - grasp pose
  - place pose
- compute and visualise following trajectories:
  - plan between current pose and pre-grasp pose
  - cartesian path from pre-grasp pose to grasp pose
  - cartesian path from grasp pose to pre-grasp pose
  - plan to place pose
- execute visualised trajectories with appropriate gripper opening/closing

To test your code you need to launch the simulation and frame publishers by:

```
roslaunch exercise3 sim_with_box.launch
```

```
roslaunch exercise3 publish_frames.launch
```

and than run your node with

```
rosrun exercise3 pick_and_place
```

The same commands will be used for testing by TA. Therefore, do not change the package/node names.

2 Report

In addition to code, you are supposed to write a technical report (pdf) in which you will document the steps performed to fulfill the assignment. Your report should contains:

- your name, student number, date, exercise number and course name
- the equations which were used to compute the poses (use math instead of code), you can use following math symbols:
  - $T_x(\cdot), T_y(\cdot), T_z(\cdot)$ - 4x4 translation matrices (rotation is identity)
  - $R_x(\cdot), R_y(\cdot), R_z(\cdot)$ - 4x4 rotation matrices (translation is zero)
  - e.g. $T = T_z(0.25)R_z(\pi)$ will translate frame by 0.25 m and then rotate by π rad
- answers to following questions:
  - In which coordinate frame the MoveIt assumes the poses are specified and what should I do if my pose is specified with respect to another frame?
  - What are the differences between cartesian path computation and planning?
  - Is there any chance that the object will be moved by robot before grasping? Why yes/no?
  - Can robot collide with itself during execution of computed pick-and-place path?
- estimates of time spent on this exercise

3 Submission

To submit your code and report, fork a repository named *robotic_manipulation_2020/exercise3* to your gitlab subgroup that we created for you before. Then clone it and start working on it. Be sure to push your code before the assignment deadline. **Commits pushed after the deadline are ignored**

4 Deadline

Deadline for this assignment is 21st of February at 23:59.

5 Resources

- MoveIt `https://moveit.ros.org`
- ROS `https://www.ros.org`