Robotic Manipulation Course

Exercise 3

February 4, 2020

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. The commits pushed after the deadline will be ignored.

4 Deadline

Deadline for this assignment is 18th of February at 23:59.

5 Resources

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