ENPM661 - Spring 2023

Project 04

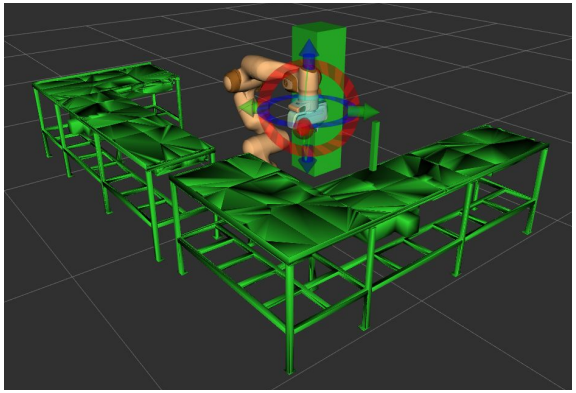
Implementation of MoveIt Motion Planning on the Panda Robotic Arm

Note: This is a group project

Due Date: April 16, 11:59 PM

Points/Weightage: 5

Project 04: Overview



- Demonstrate a pick and place operation of an object on the table avoiding the obstacles using the Franka Panda robotic arm in a simulated environment using the MoveIt Motion Planning Framework in ROS.
    - There are 2 blocks: one obstacle and one object. The object block should be picked from its start position of on the table (given) and placed safely on the ground while moving around/above the obstacle.

- In this document, the instructions to perform the simulation in RViz are provided, you may use Gazebo too if you wish to.

Project 04: Installation

Run the following to install MoveIt and setup the Panda Robot (for ROS Noetic):

```
1.  rosdep update
2.  sudo apt update
3.  sudo apt dist-upgrade
4.  sudo apt install ros-noetic-catkin python3-catkin-tools
5.  sudo apt install ros-noetic-moveit
6.  sudo apt install python3-wstool
```

The below steps are to create a new workspace called *ws_moveit* and install the *moveit_tutorials* and *panda_moveit_config* ***packages***:

```
7.  mkdir -p ~/ws_moveit/src
8.  cd ~/ws_moveit/src
9.  git clone https://github.com/ros-planning/moveit_tutorials.git -b master
10. git clone https://github.com/ros-planning/panda_moveit_config.git -b noetic-devel
11. rosdep install -y --from-paths . --ignore-src --rosdistro noetic
12. cd ~/ws_moveit
13. catkin_make
      a. (or) catkin build
14. source ~/ws_moveit/devel/setup.bash
15. roslaunch panda_moveit_config demo.launch
```

The above instructions can be found in: https://ros-planning.github.io/moveit_tutorials/doc/getting_started/getting_started.html.

Project 04: Steps

Step 1: Follow the installation instructions as given in the *Installation page*, previously.

Step 2: Go through this quick start guide to motion planning using MoveIt via RViz and the MoveIt plugin.

Step 3a: (ONLY for a team size of 3) Configure MoveIt for the Panda Robot

- Follow the instructions here to setup the Panda robot using the MoveIt Setup Assistant Tool.
- Also refer to Week 10's session from ENPM662 Software Session.
  - The video file ending in _ADARSH covers the Panda Robot whereas the file ending in _PAVAN covers the UR5 Robot.
- You MUST use the created *panda_moveit_config* package for the RViz demo and not the one as installed in the previous page.
  - Take reference from the existing package to define certain properties such as Collision Matrix.

Step 3b: (for team sizes of 2 and 3) Create a Pick and Place scenario in RViz

- Import the given table (*Table.stl*) and create the object to be picked and obstacle(s) with arbitrary size.
  - You may have to downsize the Table to match the robot's dimensions.
- Use Panda_arm and the arrows to move define the start and goal position of the robot/end-effector.
- The robot should pick up the object from the Table and place it anywhere on the ground wherein the robot should be seen to explicitly avoid/go around the obstacle (can be placed either on the table or on the ground).

Step 4: Write a C++/Python script to close the gripper at the start point and open the gripper at the end point.

- Check the openGripper function and closedGripper function here.
- https://answers.ros.org/question/313637/openclose-end-effector-with-moveit-rviz/

Project 04: Additional Information

- It is to be noted that doing this project in C++ would be significantly easier than that with Python due to the existence of an example pick and place code using C++ here.

- if (using C++) {
  a. MoveIt Move Group C++ Interface explanation.
  b. Modify the ***pick_place_tutorial.cpp*** file located at `ws_moveit/src/moveit_tutorials/doc/pick_place/src` and then '`cd`' to the `ws_moveit` folder and run `catkin_make`.
  c. After modifying the code, run the updated node using:
     - `rosrun moveit_tutorials pick_place_tutorial`

  }

- else:
  a. Move Group Python Interface Tutorial
     - Move Group Python Interface GitHub

Project 04: Deliverables

- **proj4_firstname#1_firstname#2_firstname#3.pdf** This PDF file should contain the following.
  - All team member names with UIDs.
  - (**for a team of 2 or 3**) Google Drive/YouTube link of screen recording of the pick and place simulation.
    - Video must clearly show the Panda robot executing a plan **around the obstacle(s)** between the start and goal poses.
  - (**ONLY for a team of 3**) Google Drive/YouTube link of screen recording of setting up the Panda robot using MoveIt Setup Assistant
    - Video must clearly show the steps taken to configure the Robot in the MoveIt Setup Assistant.
  - Make sure to set the *access* option appropriately in the case of a Google Drive link*;* for YouTube videos, set the visibility to either *Public* or *Unlisted*.
  - A brief write-up describing the contribution of each team member in this project.
  - You are NOT expected to either submit the code OR include the source code in the PDF.
  - Only ONE submission per team on Canvas/ELMS is enough.