Robot Learning - Final Project
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1. Description of the task:
    The task is to reach for an object (5 cm wooden box) on the table using a Sawyer right arm. First, the arm is moved to a starting position. The location of the object is given as the goal position for the end effector. The trajectory from the starting position to the goal position is used as demonstration. The DMP learns from this trajectory. During reproduction, the goal of the object can be changed, and the end effector adapts to the new goal value and moves towards the new goal by computing the new trajectory points.

Screenshots

Fig. 1.1 The world with Sawyer, a cafe table, and two objects placed on the table.

Figures 2.a and 2.b show the world during and after demonstration respectively.
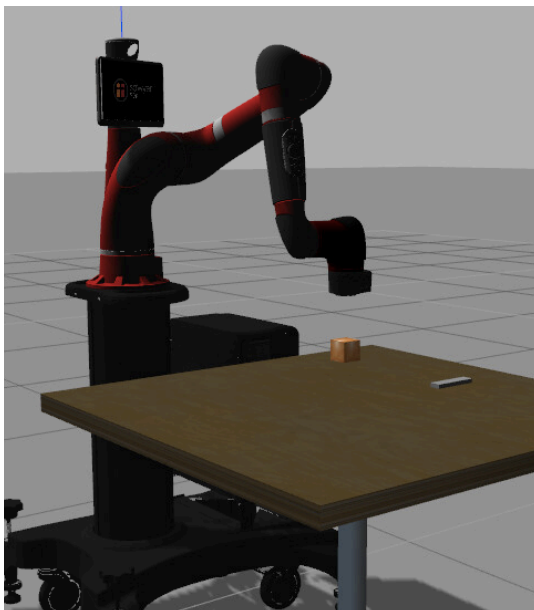

Fig. 2.a During demonstration.
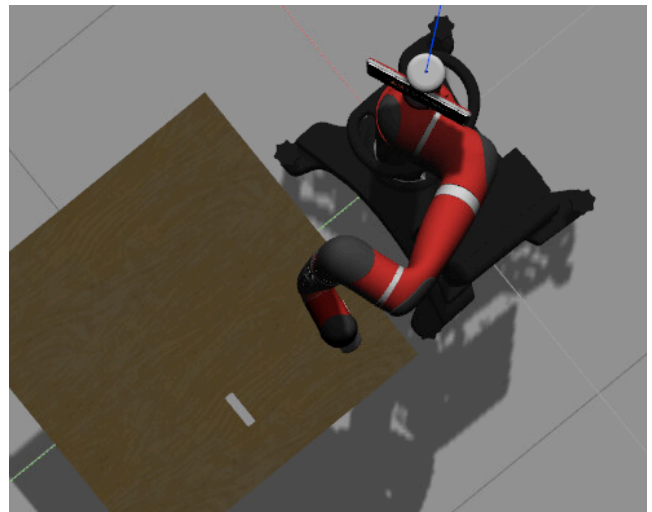

Fig. 2.b After demonstration

Fig. 2.b After demonstration

3. Snapshots of demonstrated trajectory and reproduced trajectory in Gazebo and RViz:
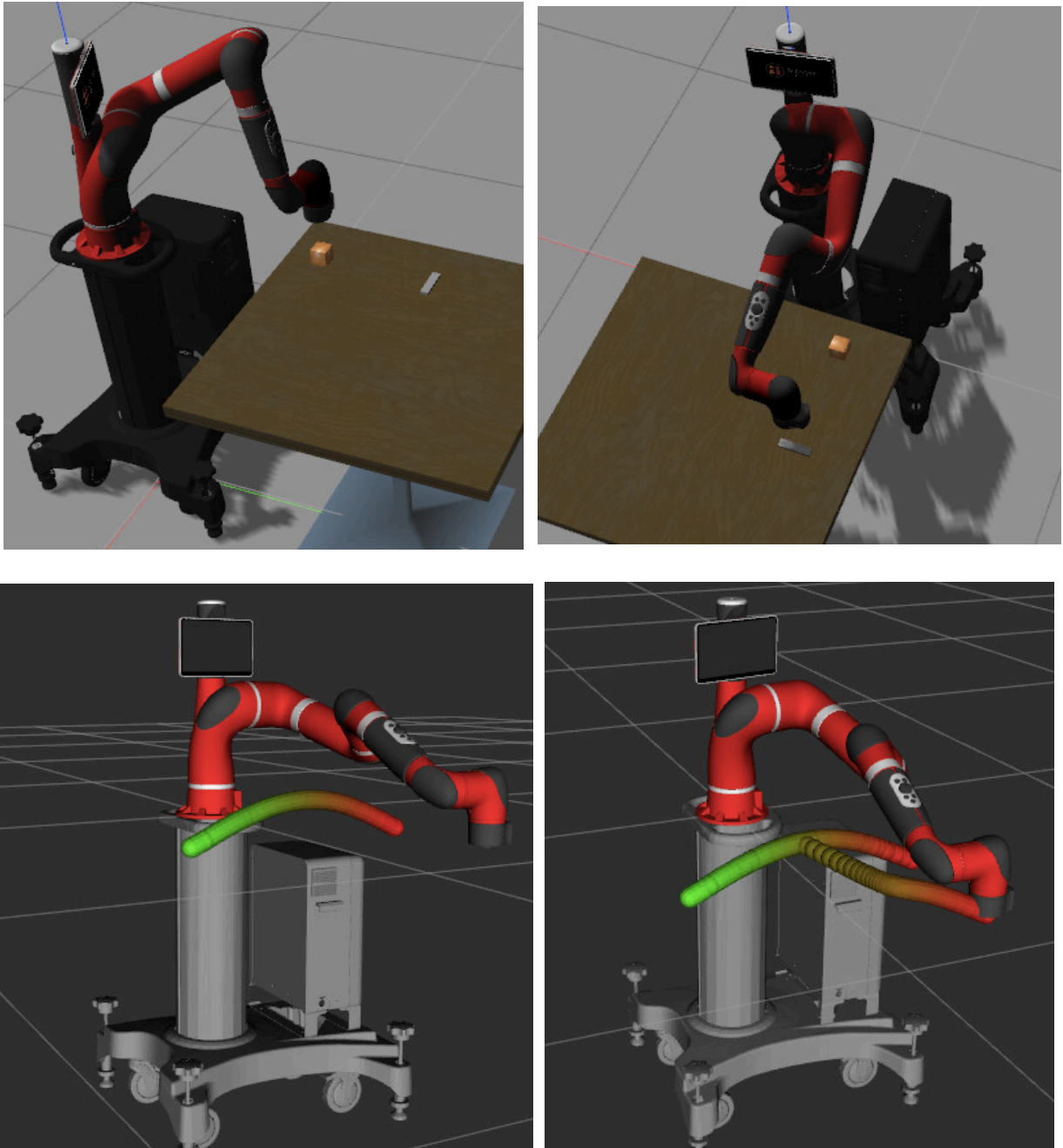

Fig. 3   Snapshots on the left show the demonstrated trajectory. Snapshots on the right show the reproduced trajectories (with two different goals).

4. Reproduction was made faster by changing the duration of reproduction to half the original duration; and made slower by increasing (by double) the duration of demonstration.

5. Cost function: It can be designed as the distance between the desired or set goal and the pose computed by the DMP reproduce function.

desired_goal = [x, y, z, qx, qy, qz, qw]
computed_pose = [cx, cy, cz, q_cx, q_cy, q_cz, q_cw]

cost = dist (desired_goal, computed_pose)

6.
a. Yes, the implemented DMP properly generalizes to new starts and goals. Yes it did execute the motion in the same style as demonstration.

b. Learning from multiple demonstration. Linear interpolation function approximation might work because the data from which the f is to be collected will be similar i.e. the f_target values for multiple demonstrations will also give a list of f_target like in the case of learning from single demonstration .

c. Cost function: mentioned earlier in answer to 5.

d. DMP that calculates commands on the fly: Instead of estimating the whole trajectory before reproduction, inverse kinematics must be computed for each tilmestep. Greater K and D values will be more robust to perturbation.

e. Yes, there are 'coupling terms' in Pastor et al. (2009). Coupling term for object avoidance will be helpful to generalize my task of reaching a goal.