16-662 Autonomy Homework 2

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1 Cuboid-Cuboid Collision Checking

In this section, I implemented a checker for detecting if two cuboids in 3D are in collision, given their dimensions, position, and orientation. Below is a table of the results I get when checking collisions on the test data.

Block #	Collision
0	False
1	False
2	True
3	True
4	True
5	False
6	True
7	True

Next I implemented robot bounding boxes for the Franka arm. My function uses the forward kinematics of the robot and the shapes of the bounding boxes to determine the bounding boxes pose and position given a robot configuration. Figure 1 shows the robot bounding boxes in the home position (all angles are zero).

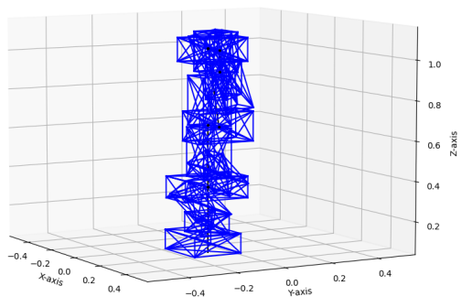

Figure 1: Franka robot bounding boxes for collision checking.

2 Franka RRT Motion Planning

In this section, I make a RRT algorithm for planning a path for the Franka robot arm. The algorithm relied on the collision checking and robot bounding boxes functions from section 1. The result of the algorithm is here. On top of this RRT algorithm, I made two different path shortening algorithms. The first algorithm randomly selects two vertices in the current path and attempts to connect them, thus shortening the path. This algorithm is limited in performance because it can only use vertices found in the RRT. The results of the RRT with this shortening method is here. The second algorithm randomly selects a point along the current path (can be on an edge) and attempts to connect them. Thus, the second algorithm isn't limited by the results of the RRT. The results of the RRT with this shortening method is here.

3 Franka PRM Motion Planning

In this section, I make a PRM algorithm for the same problem as section 2. The algorithm works by inserting random vertices into the q-space and connecting it to the vertices found within a small radius. This can be done offline. Online, the pre-computed PRM can be used to quickly find a path for any initial and final configurations in the q-space. The result of the algorithm is here.