Robot Autonomy Homework 4

By: Naman Kumar (namank),
Britta Ulm (bulm) &
Samarth Rajan (strajan).

Question 1.

The following control were chosen for this assignment:

- Moving forward
- Moving Backward
- Turning left on the spot
- Turning right on the spot

These were chosen as they were the minimum set of actions needed to allow the planner to move between the any start and any goal positions for the robots base. These actions can reach any position in the configuration space. This minimum set is not ideal, the generated path of the robot will be kinematically inefficient as the robot will repeatedly stop and start unless this is accommodated for in the cost to come part of the planner.

Each of the above mentioned controls were applied to different robot orientations (360 degrees in increments of the angular resolution) to generate a set of actions for any x and y location in the map. The duration of of these controls were chosen such that the robot moved one cell in configuration space, irrespective of resolution.

The duration of a turn to achieve a resolution of π/n for the given robot-parameters was $1.25*\pi/n$ seconds. The duration of forward and backward motion were chosen as the time to move one grid cell, i.e. resolution meters forward or backward.

The figures below show the resulting footprints:

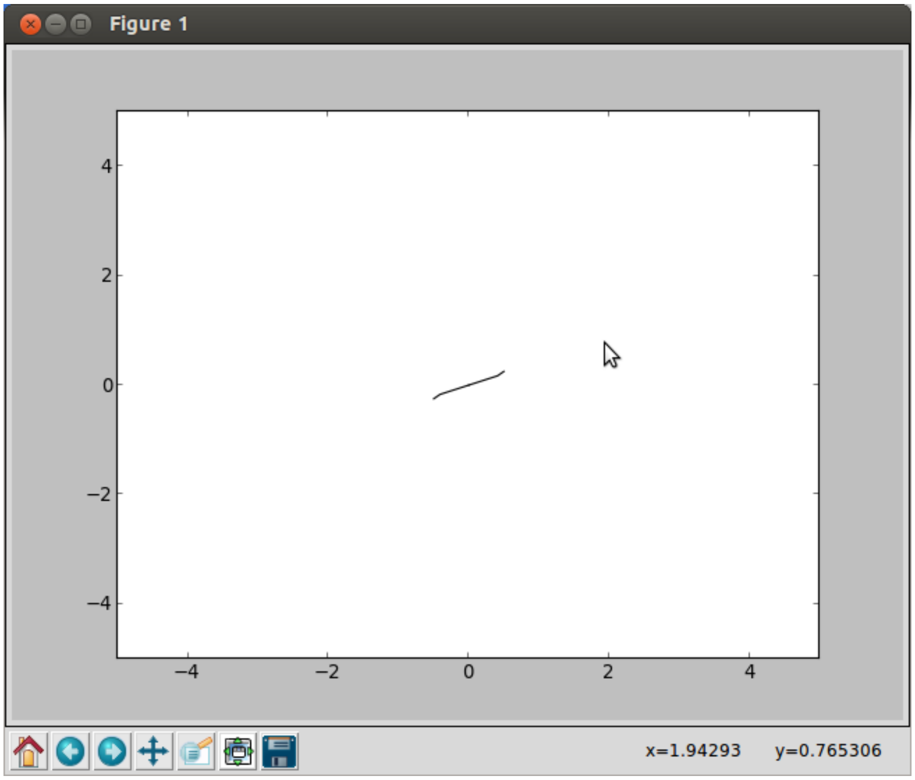
Figure 1
4
2
0
−2
−4
−4
−2
0
2
4
x=1.94293 y=0.765306

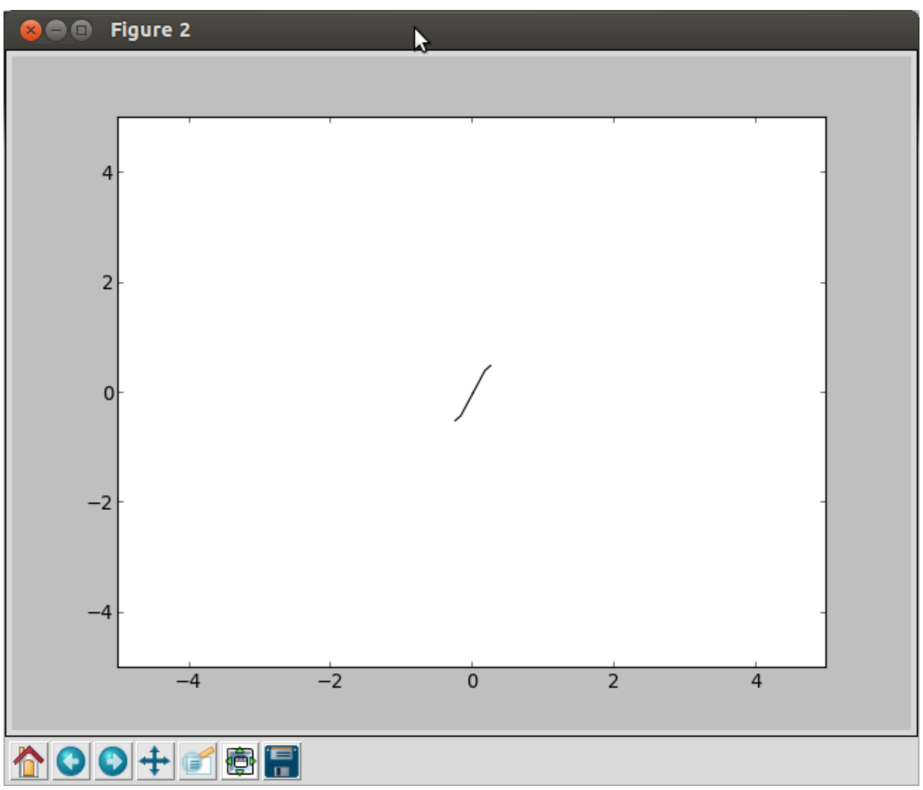
Figure 2
4
2
0
−2
−4
−4
−2
0
2
4

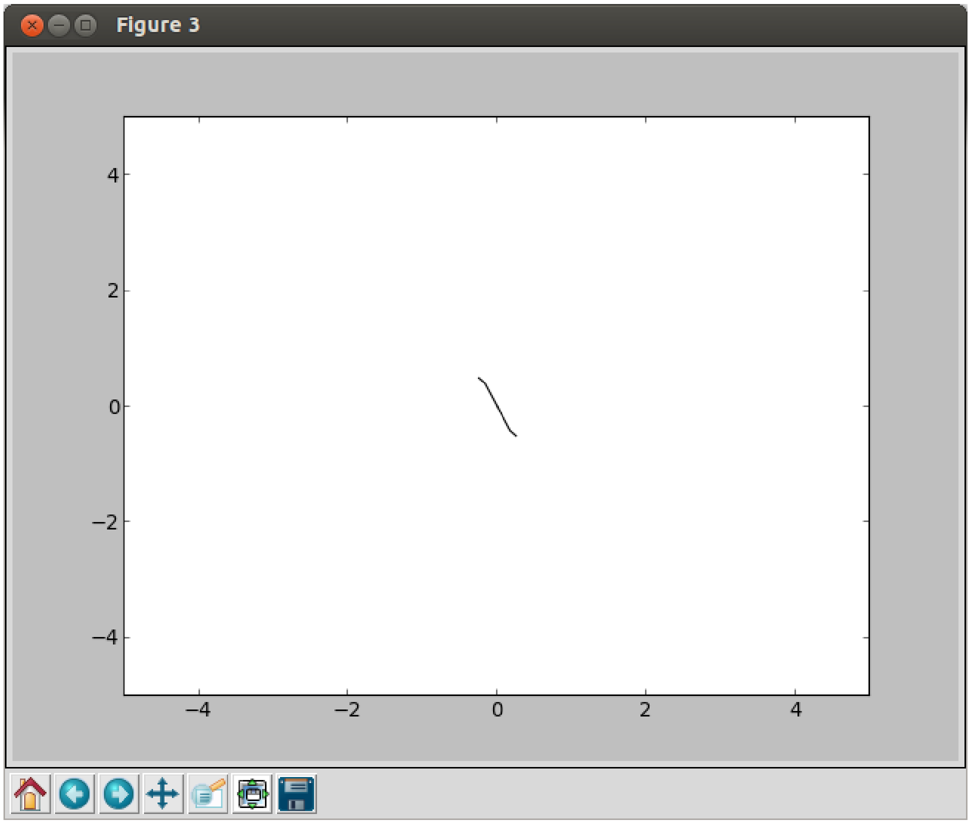
Figure 3
4
2
0
−2
−4
−4
−2
0
2
4

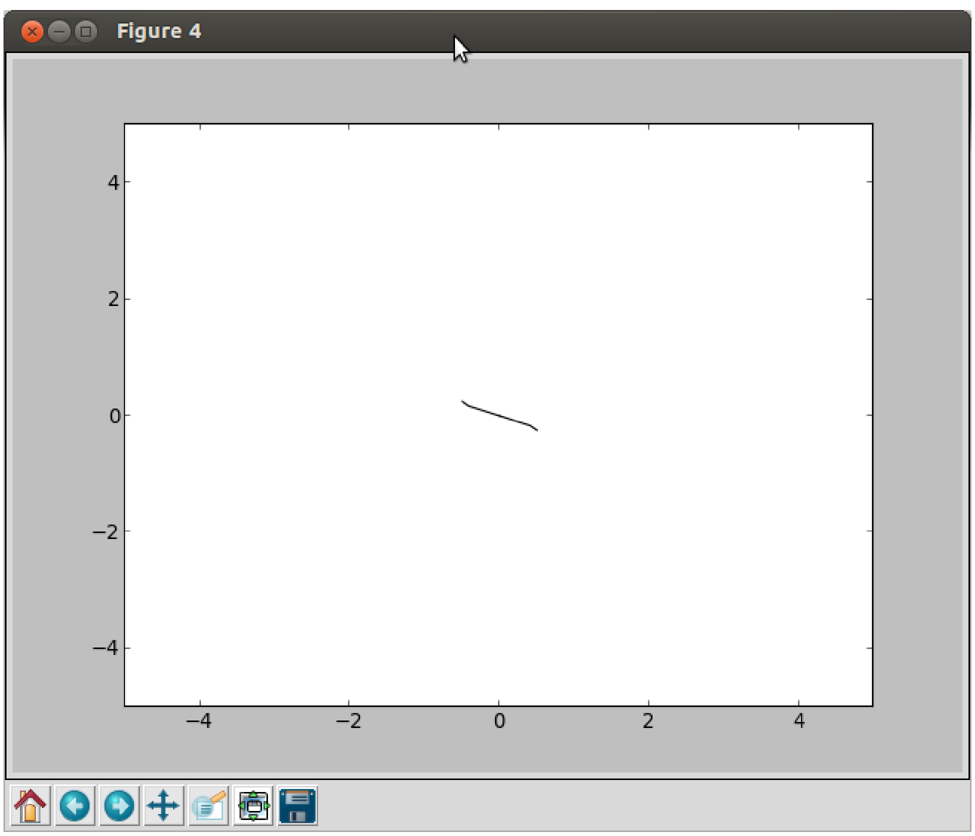
Figure 4
4
2
0
−2
−4
−4
−2
0
2
4

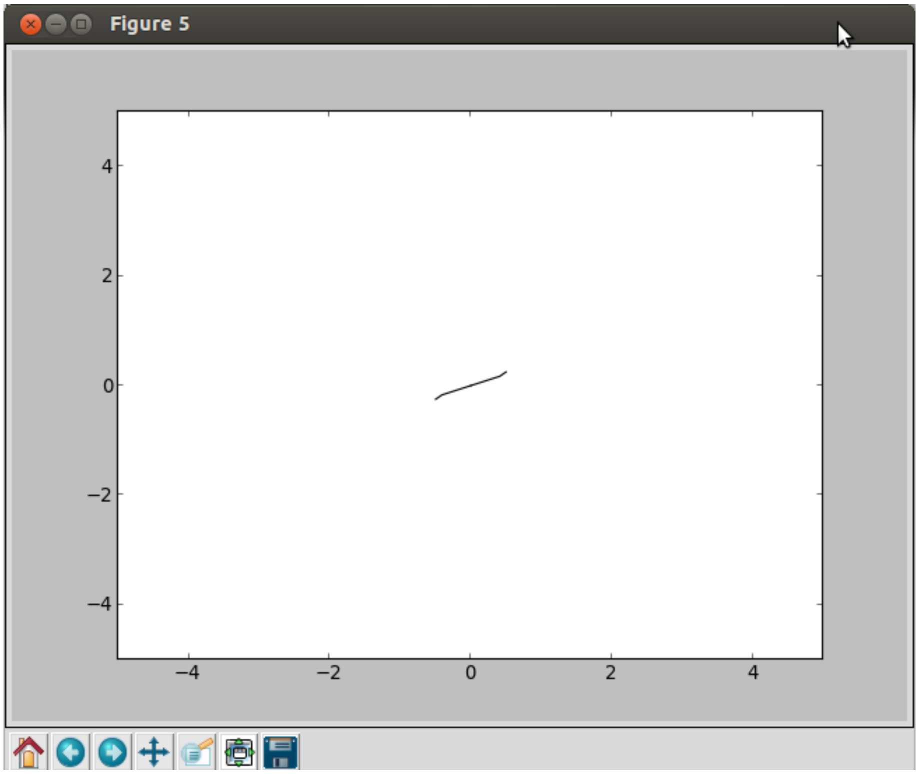
Figure 5
4
2
0
−2
−4
−4
−2
0
2
4

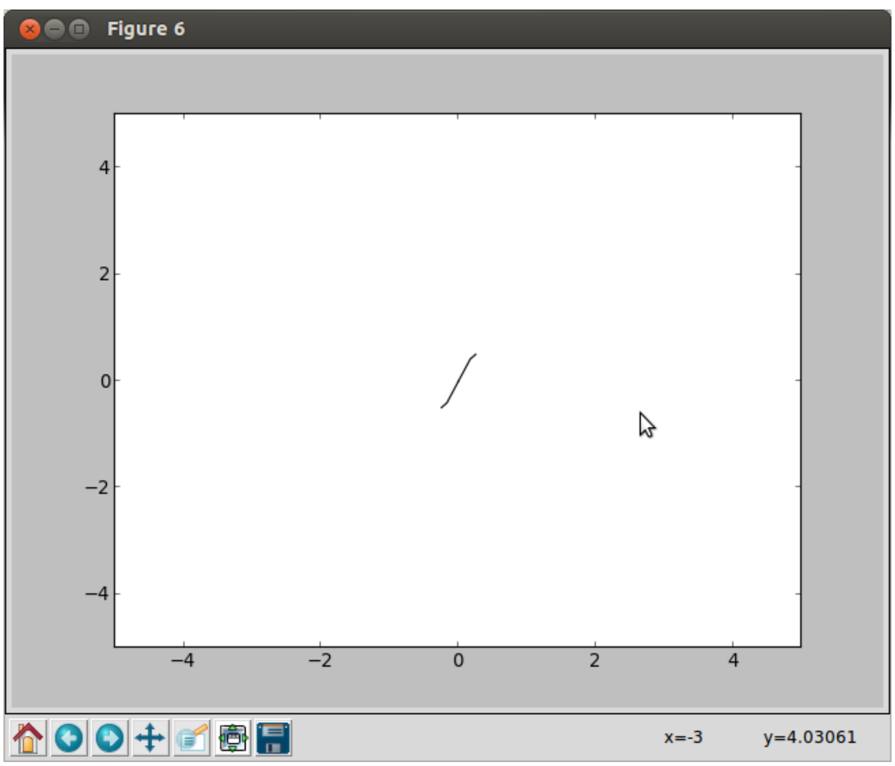
Figure 6
4
2
0
−2
−4
−4
−2
0
2
4
x=-3
y=4.03061

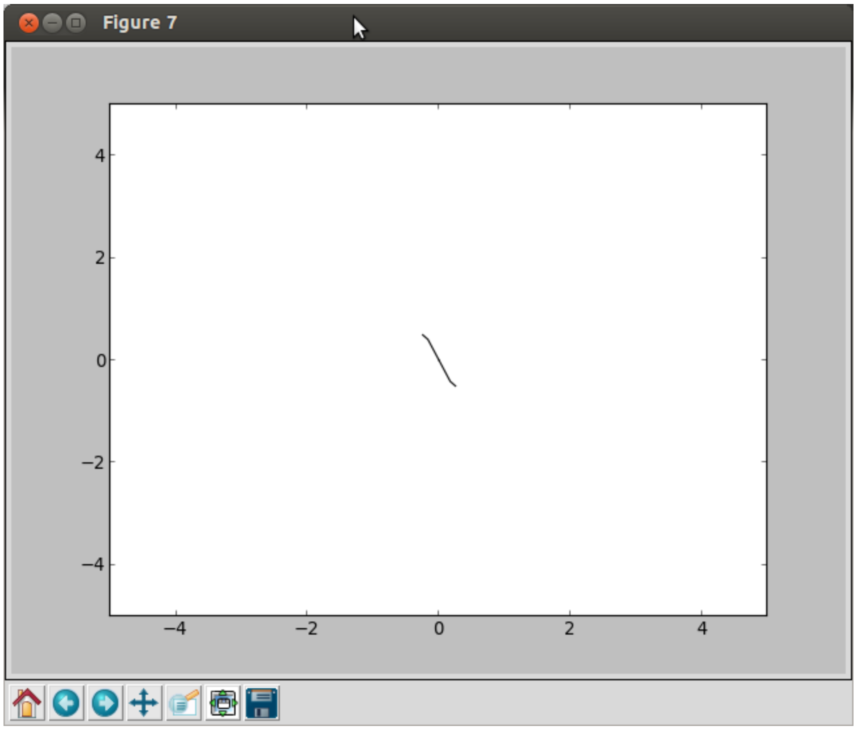
Figure 7
4
2
0
−2
−4
−4
−2
0
2
4

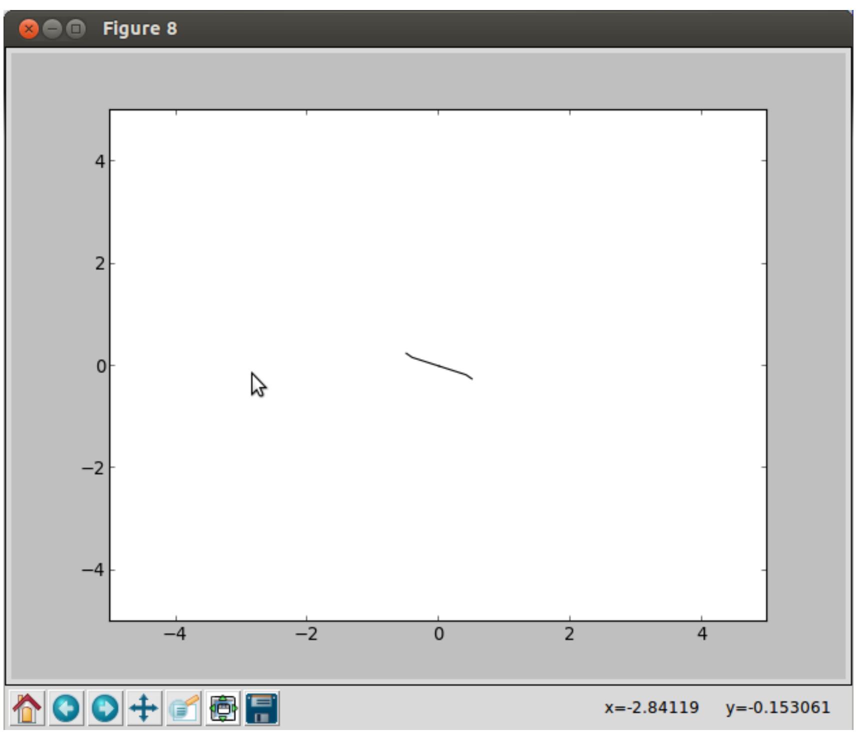
Figure 8
4
2
0
−2
−4
−4
−2
0
2
4
x=-2.84119 y=-0.153061

Question2

In the previous assignment we compared the performance of the Manhattan distance heuristic cost and a Euclidean. We found that the euclidean performed better, as it explored fewer nodes and preferred diagonal paths over paths following the z and y axis. So this assignment we chose to use the Euclidean heuristic. Also, we did not give equal weight to x, y and theta. We reduced the weight given to theta in the Euclidean distance calculation. The weight on theta was reduced as we did not want one radiant to be weighted equivalently to one meter, as they are not equal. The resulting paths can be found in the videos submitted along with this document.

Question3

First, we generated an Inverse Reachability model and loaded it into the environment. The base pose is selected based on an identified good grasp. The grasp was transformed into a 4x4 array which was used to find the bounds(maximum and minimum) of the base pose using the ComputeBaseDistribution function of the IK model. Once we found the bounds, sampling was performed to pick a suitable base pose.