EE-562. Robot Motion Planning
Problem Set # 4

Spring 2014

Due Date : March 17, 2014
Total Points : 100.

Problem 1

Consider the diagram in Fig. 1. A robot is set up 1 meter from a table. The table top is 1 meter high and 1 meter square. A frame $o_1x_1y_1z_1$ is fixed to the edge of the table as shown. A cube measuring 20 cm on a side is placed in the center of the table with frame $o_2x_2y_2z_2$ established at the center of the cube as shown. A camera is situated directly above the center of the block 2 meters above the table top with frame $o_3x_3y_3z_3$ attached as shown. Find the homogeneous transformation relating each of these frames to the base frame $o_0x_0y_0z_0$. Find the homogeneous transformation relating the frame $o_2x_2y_2z_2$ to the camera frame $o_3x_3y_3z_3$.

Problem 2

In Problem 1 above, suppose that, after the camera is calibrated, it is rotated 90° about z_3. Recompute the above coordinated transformations.

Problem 3

If the block on the table in Fig. 1 is rotated 90° about z_2 and moved so that its center has coordinates $[0, .8, .1]^{\mathbf{T}}$ relative to the frame $o_1x_1y_1z_1$, compute the homogeneous transformation relating the block frame to the camera frame; the block frame to the base frame.

Problem 4

Give configuration space, workspace and DOF of the following mechanisms.

1. An aircraft to aircraft refueling system.

2. An adjustable office chair with 5 rolling wheels.

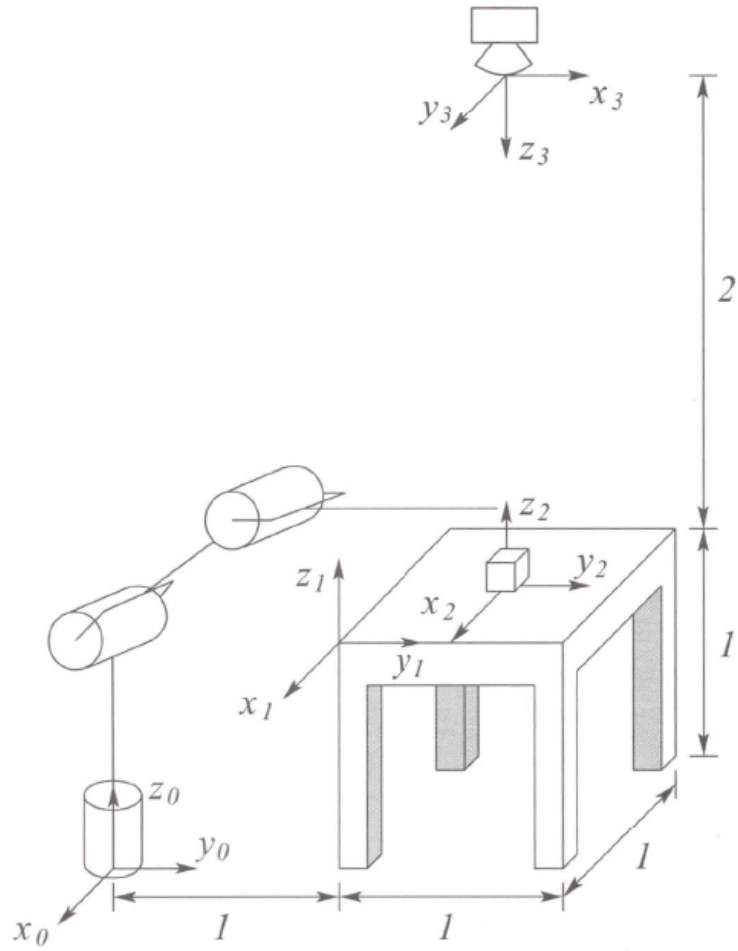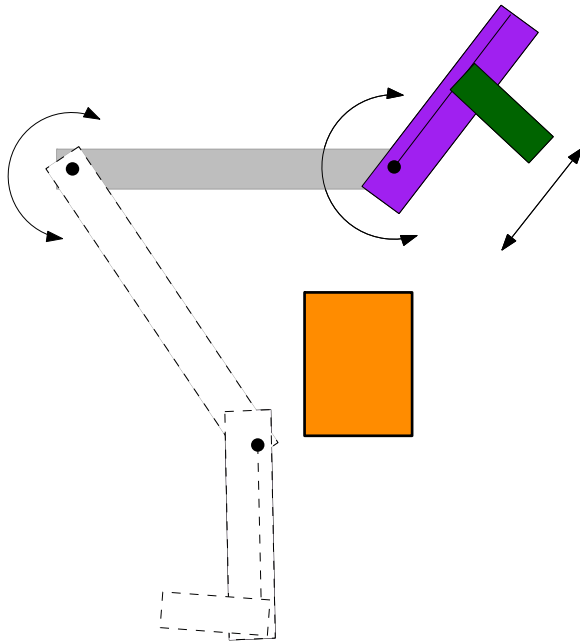3. An underwater ship hull inspection robot.

4. A door handle.

Figure 1: Table and cube setup.

Problem 5

Consider a 2D robot as depicted in the Figure below. It has two revolute and one prismatic joints.

1. Sketch the configuration space of this robot. Determine degrees of freedom and an appropriate coordinate system.

2. Clearly indicate the topology of this configuration space.

3. Map the obstacle shown in the workspace to the configuration space.

4. Briefly discuss the issues in implementing navigation potential functions, Bug algorithms or graph based searches on this configuration space.