

CMPE-633b : Robot Dynamics and Control

Problem Set # 1

Fall 2011

Due Date : Oct 20, 2010.

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 $[0, .8, .1]^T$ 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.

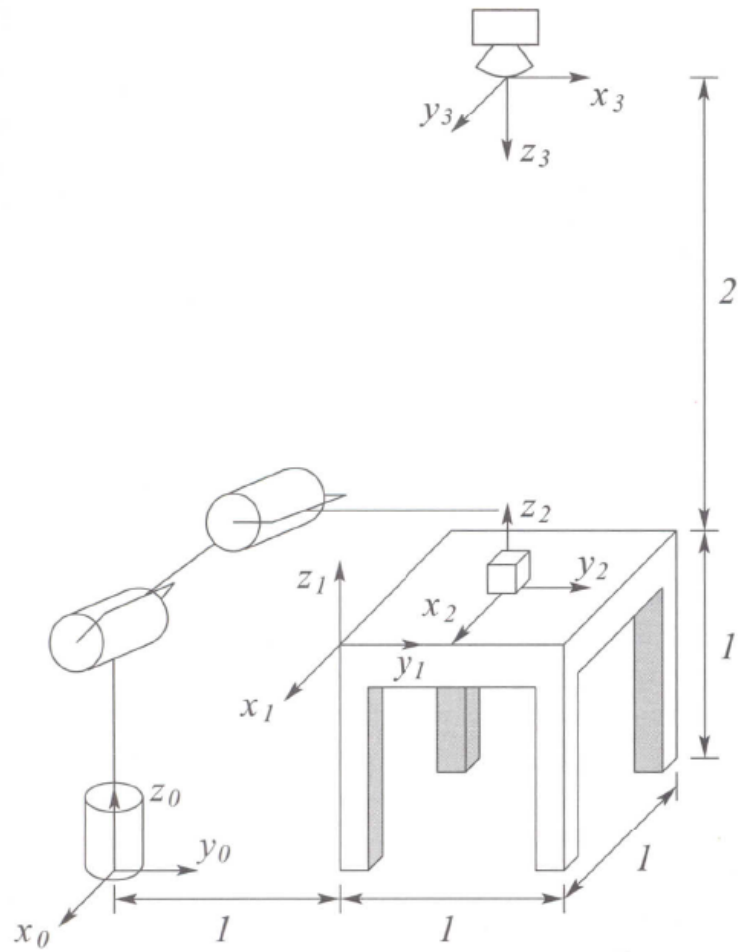


Figure 1: Table and cube setup.