CS4610/CS5335: Homework 1

Out: 1/23/15, Due: 1/30/15

Please turn in this homework to Rob Platt in class on the due date.

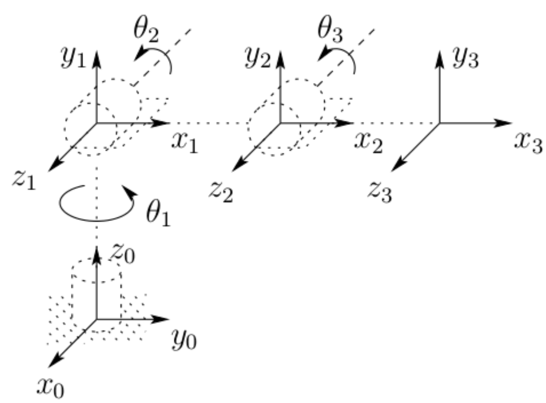

Figure 1: Used in Problem 1

Problem 1: Write the series of homogeneous transforms associated with each link in the manipulator shown above. Write the transform describing the end effector of the manipulator in the base reference frame (*i.e.* the 0^{th} reference frame).

Problem 2: (Spong, Problem 2-15) If the coordinate frame A is obtained from the coordinate frame B by a rotation of $\pi/2$ about the x-axis followed by a rotation of $\pi/2$ about the fixed y-axis, find the rotation matrix R representing the composite transformation. Sketch the initial and final frames.

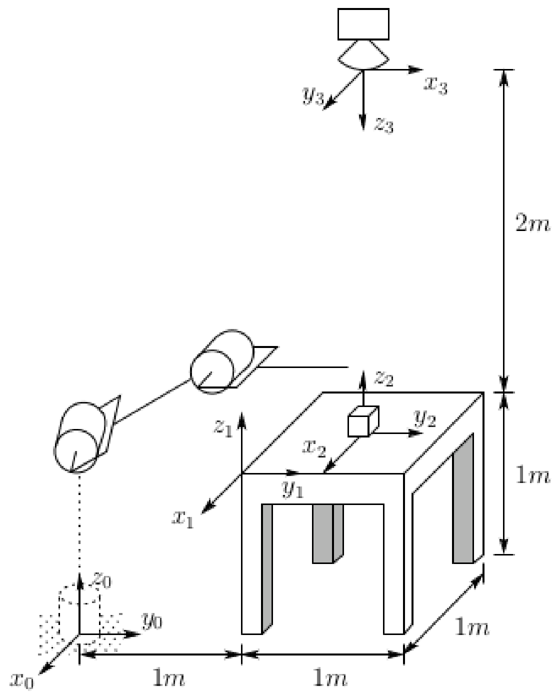

Figure 2: Used in Problem 3

Problem 3: (Spong, Problem 2-37) Consider the diagram above. A robot is set up 1 meter from a table. The table top is 1 meter high and 1 meter square. A frame $o_1\ x_1, y_1, z_1$ 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 $o_2\ x_2, y_2, z_2$ established at the center of the cube as shown. A camera is situated directly above the center of the block 2m above the table top with frame $o_3\ x_3, y_3, z_3$ attached as shown. Find the homogeneous transformations relating each of these frames to the base frame $o_0\ x_0, y_0, z_0$. Find the homogeneous transformation relating the frame $o_2\ x_2, y_2, z_2$ to the camera frame $o_3\ x_3, y_3, z_3$.

Problem 4: (Spong, Problem 2-38) In problem 3, suppose that, after the camera is calibrated, it is rotated 90 degrees about z_3. Recompute the above coordinate transformations.

Problem 5: (Spong, Problem 2-39) If the block on the table is rotated 90 about z_2 and moved so that its center has coordinates $(0, .8, .1)^T$ relative to the frame $o_1\ x_1, y_1, z_1$, compute the homogeneous transformation relating the block frame to the camera frame; the block frame to the base frame.