CS4610/CS5335: Homework 3

Out: 2/17/15, Due: 2/27/15

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

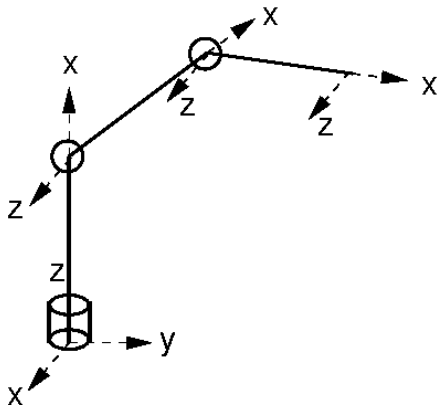

Figure 1:

The DH parameters for the robot shown above are as follows:

a	α	d	θ
0	$\frac{\pi}{2}$	1	$q_1 + \frac{\pi}{2}$
1	0	0	$q_2 + \frac{\pi}{2}$
1	0	0	q_3

Problem 1: Calculate the three homogeneous transforms associated with the DH parameters described above. Write matlab/python code that calculates the position of the second and third joints and the position of the end-effector. Submit the output of this function for the following sets of input joint angles: $(10, 20, 30)$, $(110, 120, 130)$, and $(50, 40, 30)$.

Problem 2: Using the function written in Problem 1, write a function that calculates the velocity Jacobian of the end effector for the robot in Figure 1. Submit the calculated Jacobians for the three sets of joint angles given in Problem 1.

Problem 3: Using the above functions, write a Cartesian controller that uses the Jacobian pseudoinverse to move this manipulator to an arbitrary (x, y, z) position. Submit joint trajectories (an iterative sequence of joint angles) and end-effector Cartesian trajectories that move the manipulator starting at joints angles $(q_1, q_2, q_3) = (0, 45, 90)$ to the Cartesian position $(x, y, z) = (1, -1, 1)$. Submit another set of joint and end-effector trajectories that use Jacobian transpose control instead. (Note that the pseudoinverse is implemented in Matlab by the function *pinv(.)*).