Edward Venator

EECS 489 Problem Set 3b

My approach to this problem was to start at an arbitrary starting position/orientation (all joint angles equal to 0) and move from that position to the desired position/orientation using gradient descent.

For each iteration, the error between the tool’s position/orientation and the desired position/orientation is calculated as a six-dimensional vector containing the difference between the current and desired x-y-z coordinates of the tool tip and its orientation as z-y-z Euler angles.

If the 2-norm of the error vector is greater than a threshold, a virtual force/torque vector is calculated that will pull the tool tip to its desired position/orientation. This force/torque is equal to a constant k<<1 multiplied by the error vector. I then calculate a step change in theta by multiplying this force by the inverse of the Jacobian. This should incrementally move the arm towards its goal.

In practice, I found that the arm would approach the goal, then oscillate around it, with the norm of the error never dropping below about 30. For this reason, I increased my error threshold to 28, and decided to accept the results, even though they are not perfect.

I suspect my poor results are because I used the geometric rather than the analytical Jacobian, which would be cumbersome to calculate for a 7-DOF arm. I also suspect that I could have taken advantage of the spherical wrist to move the arm to its desired position and orientation separately.