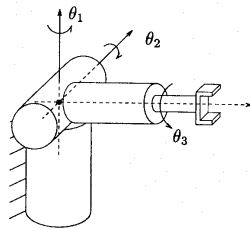


Homework # 4

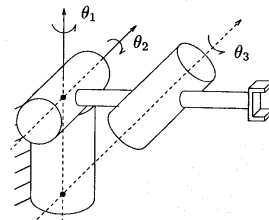
Due: March 1, 2007

The following problems are from Chapter 3 in Murray, Li, & Sastry (the chapter is available from the course webpage, under lectures).

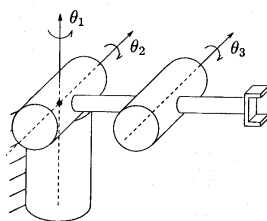
1. Consider the 4 3-DOF manipulators below and the 4 6-DOF manipulators below. Find the inverse kinematics solution by using the decomposition approach. Implement your solution numerically in hw MATLAB (by using subproblem 0.m, subproblem 1.m, subproblem 2.m, subproblem 3.m) and check it using the forward kinematics routine from the last homework.



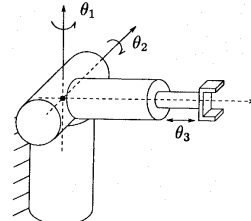
(i)



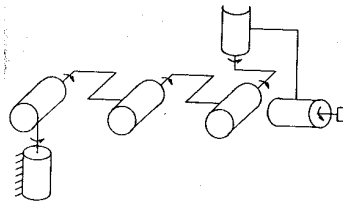
(ii)



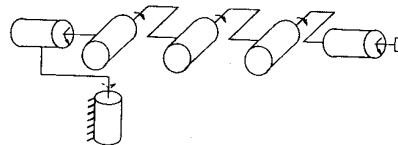
(iii)



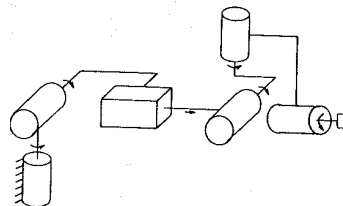
(iv)



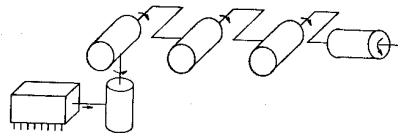
(i) Elbow manipulator



(ii) Inverse elbow manipulator



(iii) Stanford manipulator



(iv) Rhino robot

2. For the 4 6-DOF manipulators, derive the end effector Jacobian in both the coordinate free from and in the inertial frame (for the latter, feel free to use MATLAB symbolic toolbox). Characterize the singularities both geometrically and algebraically.