Assignment 6

Figure 1 shows a 4-DOF SCARA robot. Derive the Inverse Kinematic description of the x,y position of the end-effector using the Inverse Velocity.
In the robot's zero configuration, all four x-axes are parallel to x_0. The third joint is a prismatic joint with joint variable d_3, which is defined as 0 when the origin of Frame 3 is aligned with the origin of Frame 2 (= zero configuration), and is defined as positive when the gripper is moved below that position (i.e. d_3 is always positive during operation). Frame 0 is a stationary frame.

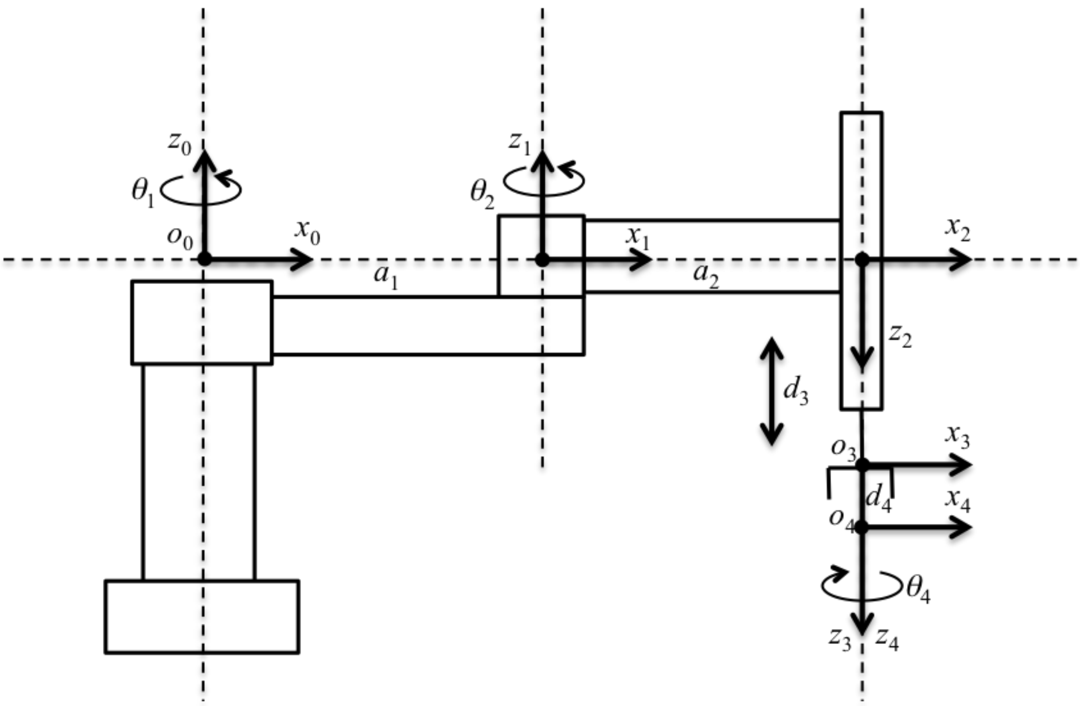

Figure 1

Numerically compute the inverse kinematics. Assume that $a_1 = 3$, $a_2 = 4$. *We will only look at the (x,y)-position of the end-effector; we will not consider its z-position and its orientation*

Write a MATLAB script to do the following:

- Generate a circular trajectory of radius $r = 2$ centered at [5, 0] with n points.
- Implement the numerical inverse kinematics discussed in class to determine the θ positions required to visit all points on the trajectory. Use a step size β. Record the changes in θ over all the iterations. Use an error criterion of 0.01.
- In a figure, plot the (x,y)-position of the desired points as well as the actual trajectory over all the iterations.
- For each converged position, include the eigenvectors of the manipulability ellipsoid showing the "best" and "worst" direction the robot can move along
- In another figure, plot θ_1 and θ_2 vs. the number of iterations, i.e. to see how θ's change at each iteration (for the whole trajectory).
- In the last figure, plot the manipulability measure W for the n points along the trajectory

Make these plots for two different n (n=50, n=10) and two different β (β=0.8, β=0.08), so that you have four sets of plots.

How does the smaller number of points n affect the convergence? How does the smaller step size β affect the trajectory and the convergence?