7MR10040: Medical Robotics: Theory and Applications
Semester 1

Assignment 5

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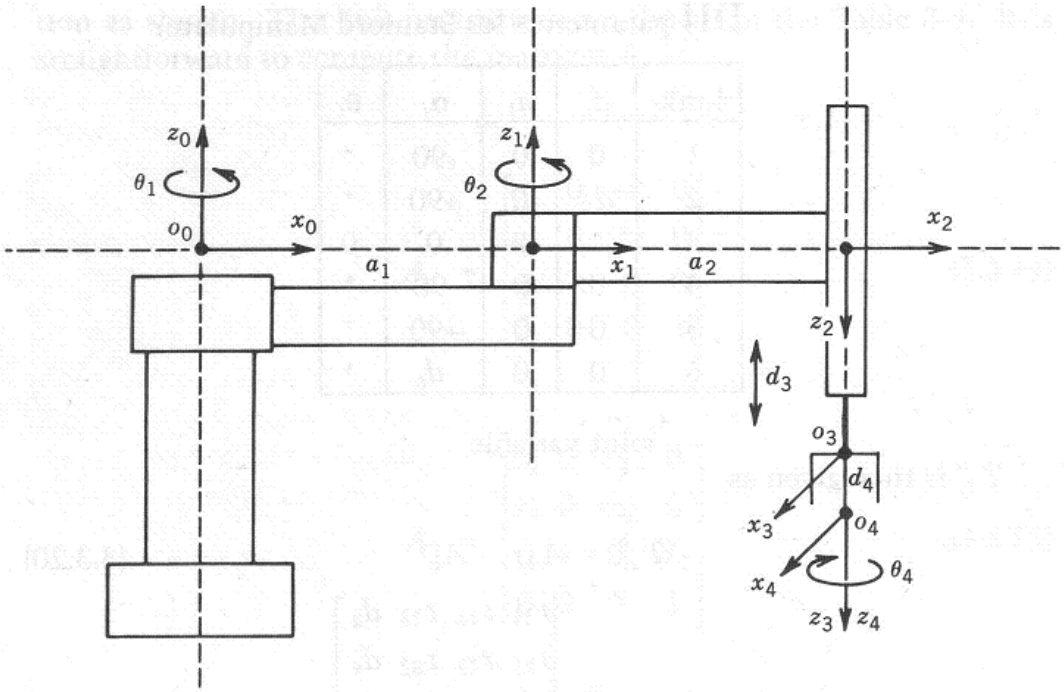


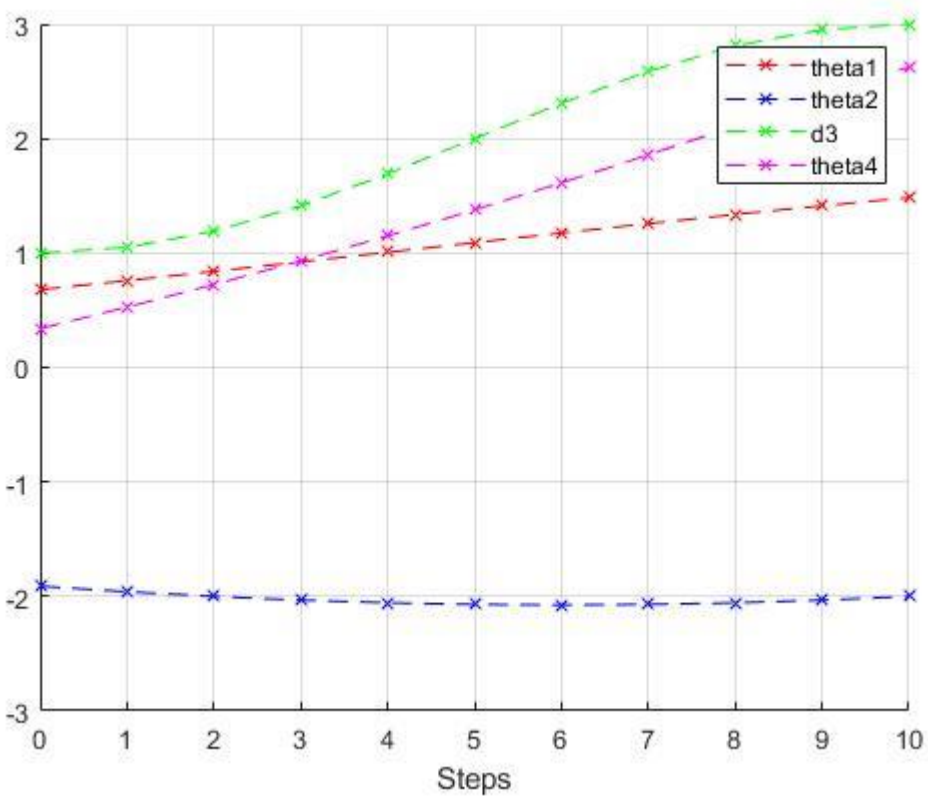
Any required code was uploaded along with this document

Question 1

Assuming a1=1.5 and a2=1, we want the end-effector to follow the motion:

$$x = 1.5 - \frac{t}{20}, y = \frac{t}{10}, \varphi = -\frac{\pi}{2} - \frac{\pi t}{20}, z = -2 + \cos(\frac{\pi t}{10})$$

Where is the angle between and x_0 and x_4 is t between 0 and 10. Using the analytical inverse kinematics, plot a graph for the values of $\vartheta_1, \vartheta_2, d_3, \vartheta_4$ and for this motion. You can choose one of the multiple solutions.



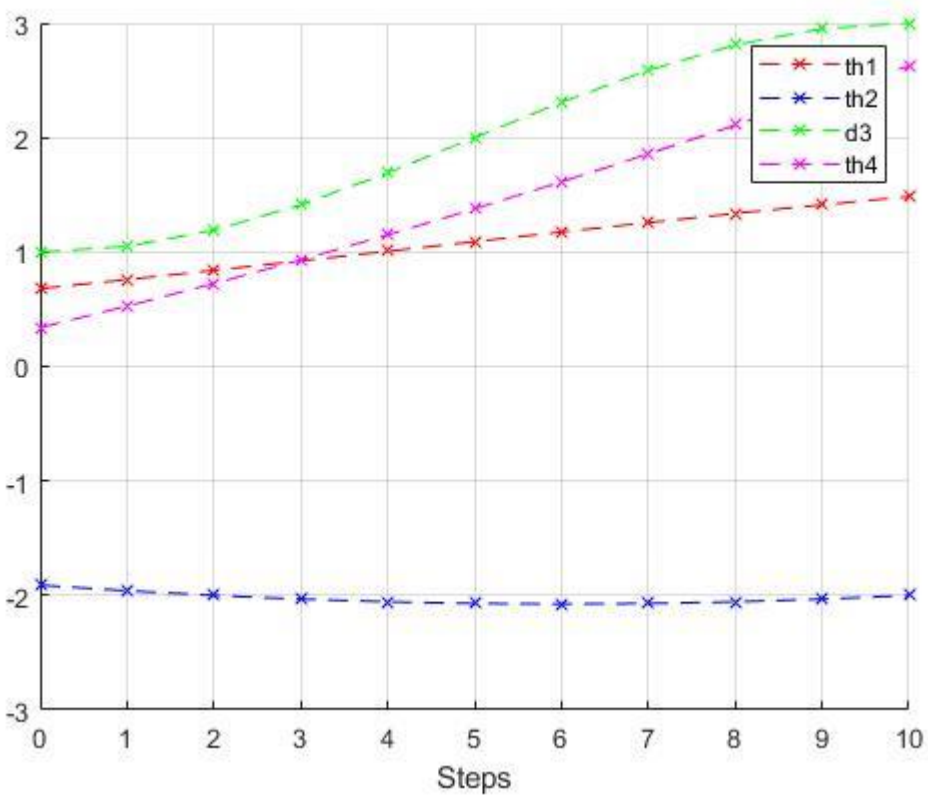
Question 2

Using Matlab, write a function script that takes the joint values as inputs and derives the spatial Jacobian matrix as output. You will need to use the forward kinematics to derive the configuration of the robot. Remember that screws be calculated numerically based on the screw axis and its distance to the end-effector. Show your Matlab code with comments and give the numerical value of the Jacobian for the inputs $\theta_1 = -0.2, \theta_2 = 0.5, d_3 = 1, and\ \theta_4 = 0.4$

	1	2	3	4
1	0	-0.2980	0	0.0025
2	2.5000	1.0299	0	-0.0746
3	0	0	-1.0000	0
4	0	0	0	0
5	0	0	0	0
6	1.0000	1.0000	0	-1.0000

Question 3

Using the forward kinematics and the pseudo-inverse of the Jacobian, write a function script that solves the inverse kinematics numerically. Apply your script to the trajectory with increment of $Dt = 0.1$ and precision of 0.001 and length 0.001. Verify that the numerical kinematics correspond to the solution in 1 and show your Matlab code with comments.



This solution matches with the one in Question 1 and so this seems correct.