ROBOTICS ASSIGNMENT 5

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1 Solution

For a planar 2-DOF , 2R robot.
lengths are $l_1 = 1 and l_2 = 1$.
masses are $m_1 = 1 and m_2 = 1$.
Inertias are $I_1 = 1/12 and I_2 = 1/12$
Motor parameters are
$J_{m1} = J_{m2} = 0.4x10^{-4} kgm^2$
$K_{m1} = K_{m2} = 2.32x10^{-2} Nm/A$
$B_{m1} = B_{m2} = 4.77x10^{-5} Nm/(rad/sec)$
$R_1 = R_2 = 0.365 Ohm$
$K_{b1} = K_{b2} = 0.0232V/(rad/sec)$
$Gearration : r1 = r2 = 1/100$
$Intialstate[0000]$
$Finalstate[\pi/6\pi/300]$
Joint positions are denoted by q_i
Joint velocities are denoted by q_{di}
Joint acceleration are denoted by q_{ddi}, where i = 1,2.
We know,
For the following initial condition at t=0. $IC = [q_1 q_2 q_{d1} q_{d2}]$
$l_1 = l_2 = 1$
$m_1 = m_2 = 1$
$I_1 = I_2 = 1/12$
$[t_i t_f] = [010]$
$K = K_m/R$
Equation to be solved:
$[D(q) + J]\ddot{q} + C(q, \dot{q})\dot{q} + B\dot{q} + g(q) = u$
D(q) is a inertia matrix.
$J = diag(1/r_k^2 J_{m_k}) isadiagnolmatix$
$C(q, \dot{q}) aredefinedbyChritophorsymbols,$
$C = [c_{kj}]_{nxn}$
$c_{kj} = \sigma ijk(q)\dot{q}$
D(q)
$d_{11} = m_1 l_{c_1}^2 + m_2(l_1^2 + l_{c_2}^2 + 2l_1 l_{c_2} cosq_2 + I_1 + I_2$
$d_{12} = d_{21} = m_2(l_{c2}^2 + l_1 l_{c2} cos(q_2)) + I_2$
$d_{22} = m_2 l_{c_2}^2 + I_2$
$\psi_1 = (m_1 l_{c_1} + m_2 l_1) gcosq_1 + m_2 l_{c_2} gcos(q_1 + q_2)$
$\psi_2 = m_2 l_2 gcos(q_1 + q_2)$
$B = diag(B_{m_k} + K_b K_m/R) isadiagonalmatrix$
$u = K_p\tilde{q} - K_d\dot{q} + g(q)$
$\tilde{q} = q^d - q$
Final equation to be solved,
$[D(q) + j]\ddot{q} + C\dot{q} + B\dot{q} = K_p\tilde{q} - K_d\dot{q}$
$[D(q) + J]\ddot{q} = k_p\tilde{q} - (c + b + k_d)\dot{q}$
$\ddot{q} = (D + J)^{-1}[K_p\tilde{q} - (c + b + k_d)\dot{q}]$

By substituting the above equation in,
By using the above obtained equation we solve and get the resultsfor.

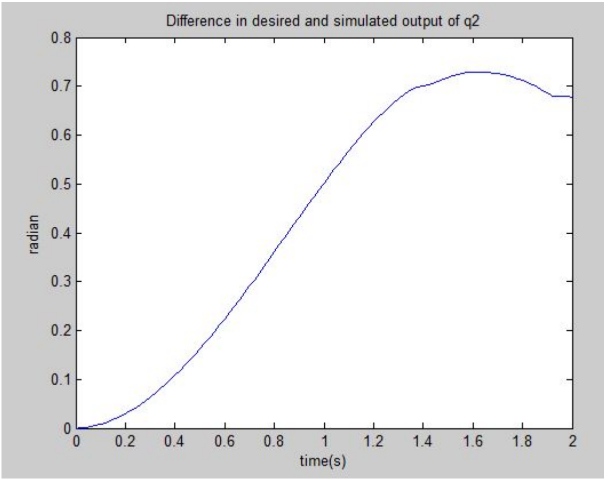

Figure 1: Plot represents the error in q2 values when Kp=5 and Kd=10

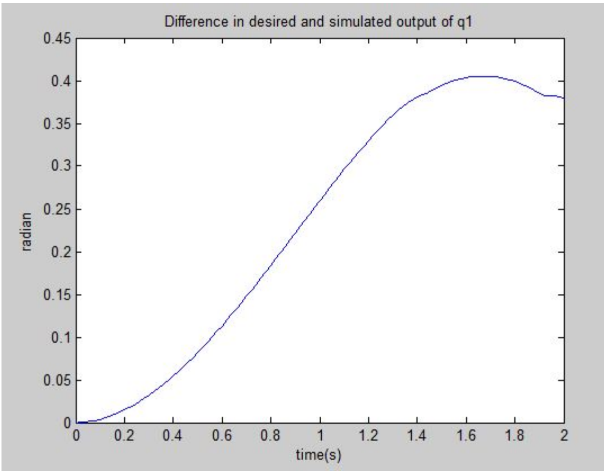

Figure 2: Plot represents the error in q1 values when Kp=5 and Kd=10

From the results obtained from the figures 1,2,3,4,5 and 6, we can observe the error in the values obtained by simulating the 2 R manipulator and there is considerable difference between the desired and simulated values we observe that increasing KP value and keeping KD value optimally minimum makes it more error-less system.

2 Solution

The results obtained are shown below.

From the results in figures 7,8,9,10,11,12. Of Cases where: (K0,K1) = (25,10),(100,10) and (25,100). We observe that increasing the values of K1 makes it errorless along with the increased perturbation.

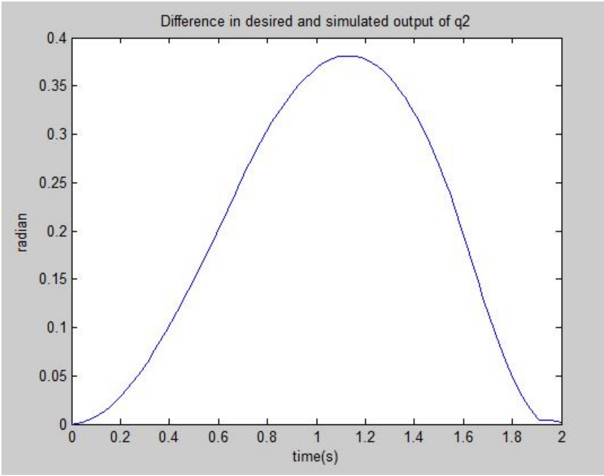

Figure 3: Plot represents the error value in q2 when Kp=100 and Kd=10

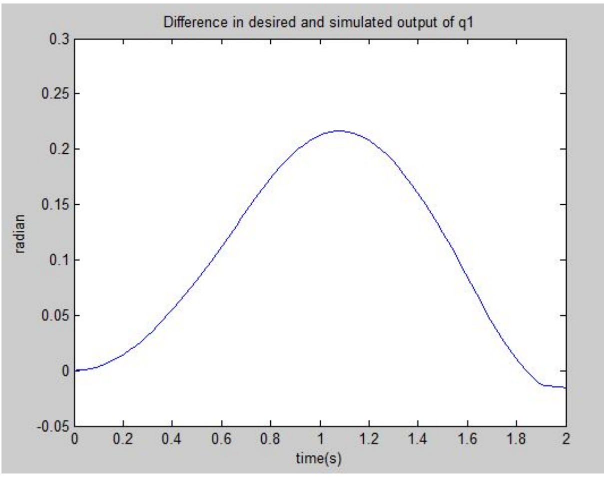

Figure 4: Plot represents the error in q1 when Kp=100 and Kd=10

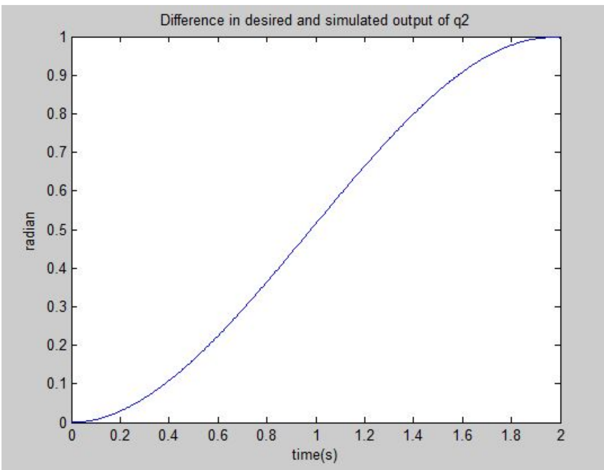

Figure 5: Plot represents the error in q2 when Kp=5 and Kd=100

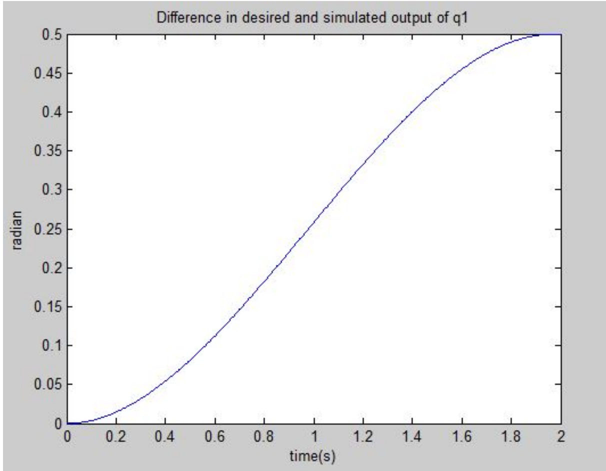

Figure 6: Plot represents the error in q1 when Kp=5 and Kd=100

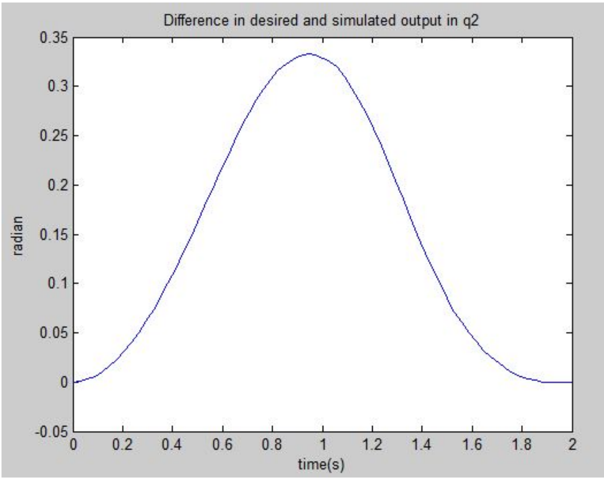

Figure 7: Plot the error in value q2 when K0 = 25 and K1 = 10

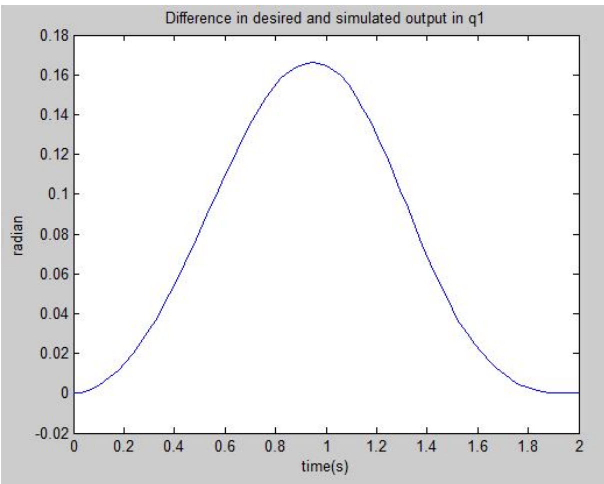

Figure 8: Plot represents the error in q1 when K0=25 and K1=10

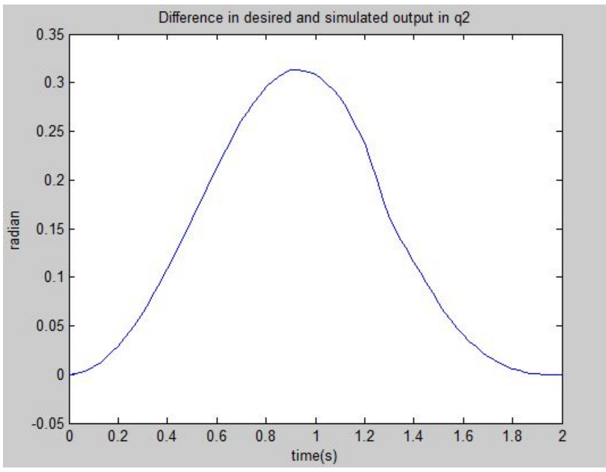

Figure 9: Plot represents the error in q2 when K0=100 and K1=10

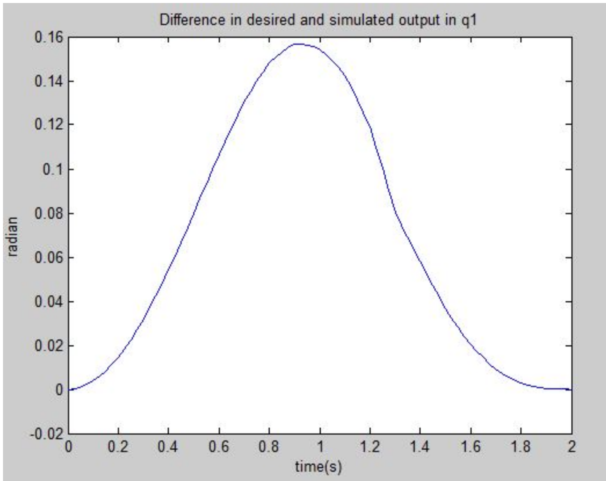

Figure 10: Plot represents the error in q1 when k0=100 and K1=10

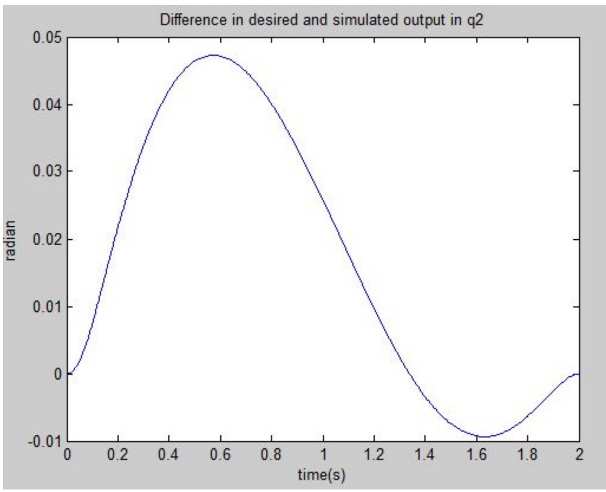

Figure 11: Plot represents the error in q2 when K0=25 and K1=100

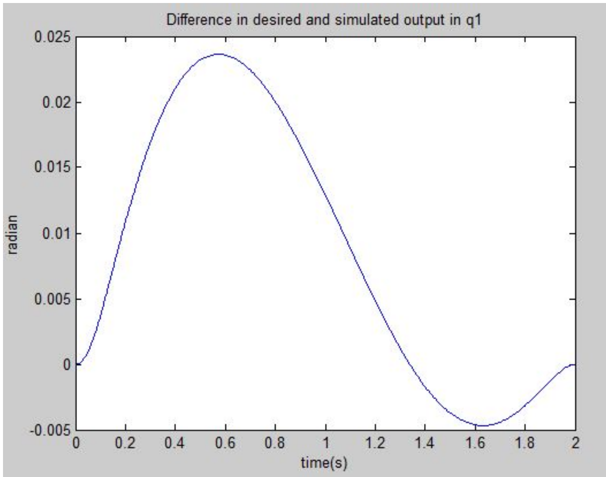

Figure 12: Plot represents the error in q1 when K0=25 and K1=100