Assignment-3

In the controller designed(if you have used siso tool to design a proper controller{in this case some of you might have used PID controller) that ensures the final angle of the pendulum to be zero} in the last task, you might have detected a problem with the total stability of the system. That was, though the input-output mapping of the system seemed to be stabilized using a proper controller and the angle of the pendulum converted to zero, the position of the cart diverged. Within this task, we will investigate the system features to find out the reason for this problem and how to avoid it.

1. Two important features of a dynamical system are controllability and observability. Check these features for the pendulum system using your solutions from the previous tasks!

2. Which difference does it make defining the cart position q1 as output?

3. Design a state feedback controller K to shift the poles of the closed loop to proper positions!

4. Create the closed loop using the system matrices and K and check if the poles are placed correctly. Investigate the step response of the closed loop!

5. Change the position of the desired closed loop poles and repeat the previous subtask!

6. Design an optimal controller using lqr and repeat the previous subtasks!

7. Verify your results by simulation of the closed loop in SIMULINK! Modify the LQR parameter and the desired poles and compare the affect of these entities on the system behaviour! Note the control input!

8. Test your controller on the ”real” non-linear system provided on-line! For which range of initial angles does the controller still stabilize the system? What could possibly make the controller work for a larger (or even every) angle?