Assignment 11

Due: Thursday, 24th December at 5 pm

You used the Dynamic Matrix Control (DMC) algorithm to solve three cases: (i) set-point tracking; (ii) rejection of measured disturbance; and (iii) handling model-plant mismatch.

On similar lines, you will use MPC toolbox to solve the three cases in state-space MPC. Note that you do not need to write your own MPC code, but use MPC toolbox instead.

Use the following parameters (note that they are slightly different from Assignment-6): Sampling interval: $\Delta t = 0.25$; MPC horizons: $m = 4$, $p = 10$; setpoint: $r(k) = 1$; Output and input-rate weights $Q = 1$, $R = 0.1$; Constraints: $-0.4 \leq u(k) \leq 0.4, \quad |\Delta u(k)| < 0.025$.

Problem 1: SISO MPC **(6 points)**

Consider the following system, as in Assignment-6:

$$G(s) = \frac{5}{\tau s + 1} e^{-0.15s}, \qquad \tau = \frac{1 + a}{2} \quad \text{a = Last digit of roll number}$$

Starting at origin, find the set of input moves in order to control the system at a new setpoint $r = 1$.

Problem 2: Extension to Measured Disturbance Case **(8 points)**

Modify the above problem to simulate the case of measured disturbance:

$$y(s) = \frac{5e^{-0.15s}}{\tau s + 1} u(s) + \frac{0.4e^{-0.1s}}{2s + 1} d(s)$$

with a step disturbance of $d(k) = 0.5$ occurring at $k = 0$. Note the setpoint is $r = 1$ and the system is initially at the origin. There is no model plant mismatch for this problem.

Problem 3: Extension to Model-Plant Mismatch Case **(6 points)**

Now consider the case of Model-Plant Mismatch. Let us assume that the true *Plant* is:

$$y(s) = \frac{5.4e^{-0.12s}}{\tau s + 1} u(s)$$

Thus, the *model* used by MPC is as given in Problem-1, whereas the *true plant* is as given in this problem. The system is initially at the origin and needs to be controlled to the setpoint of $r = 1$.

Note: The gain and time delay are different, but the time-constant τ is kept the same.