ME 418/518 – Data-Based Control

Problem Set 4

Deadline – December 5th, 2025

Employment of LLMs is strictly prohibited

Problem 1. Consider the plant dynamics in Problem Set 3. For the problems given below, simulate the system for 20 seconds. Submit your homework as a PDF file, both to Moodle and a printed version to the TA. Also, submit your MATLAB code to Moodle.

a) Design an MPC controller to track a step reference with a magnitude 5. Assume that there are no constraints given. Pick two sets of prediction and control horizons (different from the ones given in Problem Set 3) and compare and discuss their differences (if any) in terms of performance and control expenditure.

b) Now assume that the actuator has the following limits: $-1 \leq u \leq 1$, $-0.5 \leq \Delta u \leq 0.5$. Solve the same problem given in "a)". Discuss your results.

c) Assume that the mass of the system changes as $m = 1 + \ln\left(1 + \frac{t}{40}\right)$, where t is the time. This means that mass is increasing in time. Solve "a)" and "b)" with this increasing mass case. Discuss your results.
Note that we are NOT aware of the mass change as the control engineer. We still design our MPC using the model given in Problem Set 3. However, the control input we obtain will be implemented in the real plant, where the mass is increasing.