

Problem Set #3 – Part 2

Issued: Wed 10/15/2025

Due: Thu 10/23/2025

Problem 4:

Consider the following dynamics equation from the lecture

$$\underbrace{J}_{a_1} \ddot{q} + \underbrace{b}_{a_2} \dot{q} |\dot{q}| + \underbrace{mgl}_{a_3} \sin q = \tau$$

with unknown but constant parameters $a = [a_1 \ a_2 \ a_3]^\top$. From the lecture and the previous problems, you should be able to design a control law and an adaptation law for this system, assuming no prior knowledge of the actual values of a_1, a_2, a_3 .

Now assume that we know that parameters a_1, a_2 satisfy $a_1, a_2 > 0$ and parameter a_3 satisfies $a_3 > c$ for some known constant $c > 0$. How can we exploit this knowledge in the adaptation law? State the adaptation law, and show that the controller will still force the tracking error \tilde{q} to zero.