

ME 455 – Active Learning

Homework 2, due date: March 26, 2023.

Joris Chomarat, jorischomarat2024@u.northwestern.edu

Problem 1

The following cost function was chosen for optimization:

$$J(x, u) = \int_0^T ((x - x_d)^T Q (x - x_d) + u^T R u) dt + (x(T) - x_d(T))^T P_1 (x(T) - x_d(T))$$
$$Q = \begin{pmatrix} 100 & 0 & 0 \\ 0 & 100 & 0 \\ 0 & 0 & 0.1 \end{pmatrix}, R = \begin{pmatrix} 0.1 & 0 \\ 0 & 0.1 \end{pmatrix}, P_1 = \begin{pmatrix} 10 & 0 & 0 \\ 0 & 10 & 0 \\ 0 & 0 & 10 \end{pmatrix}.$$

Optimization was run until $DJ(x, u, \zeta)$ reached a tolerance of $\epsilon = 1e^{-3}$. Armijo parameters were chosen to be $\alpha = 0.1$ and $\beta = 0.5$.

The following figures show the trajectories and inputs of the initial and optimized system response. Figure 2 is a zoomed in view of the optimized system response. Figure 3 shows the cost of the system response at every iteration.

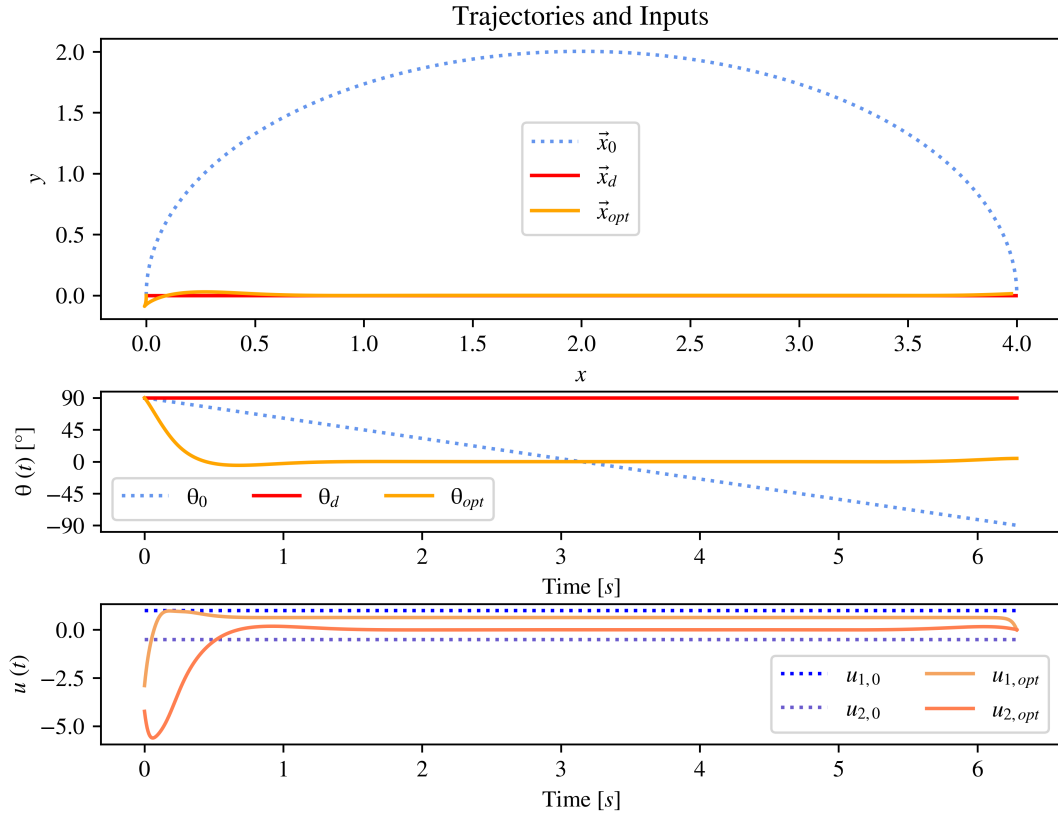


Figure 1: Initial, goal and optimized trajectories are displayed in the first two subplots. The third subplot shows the initial and optimized inputs.

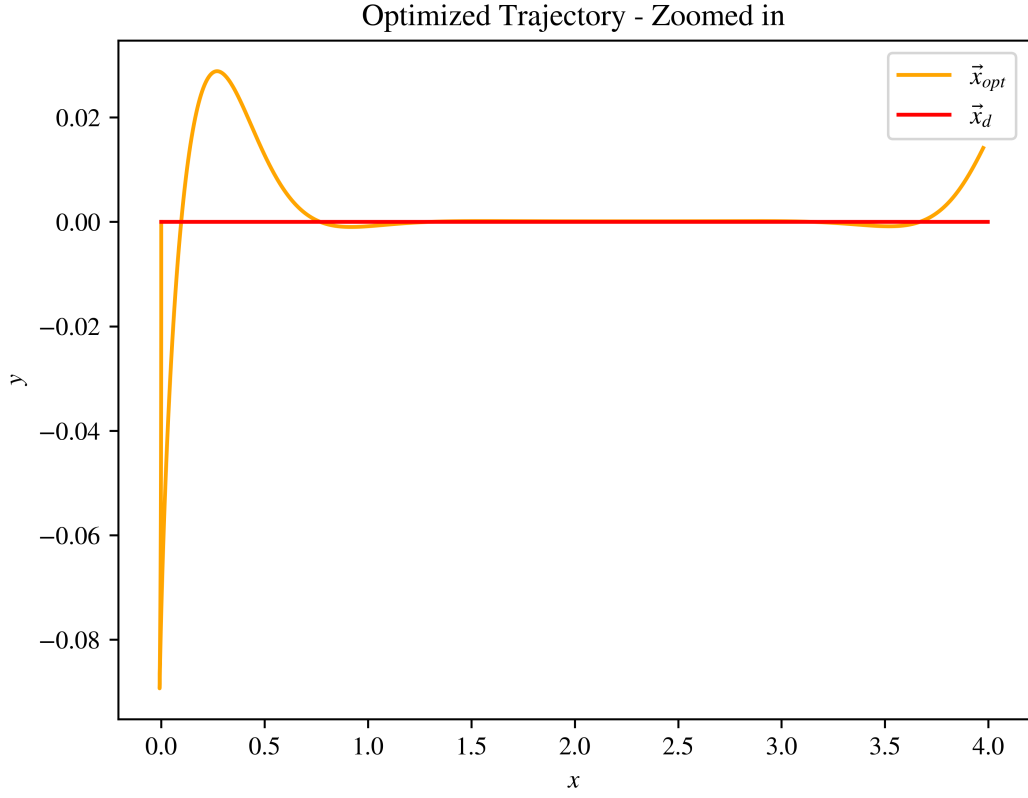


Figure 2: Zoomed in view of the optimized trajectory in orange, as well as the goal trajectory in red.

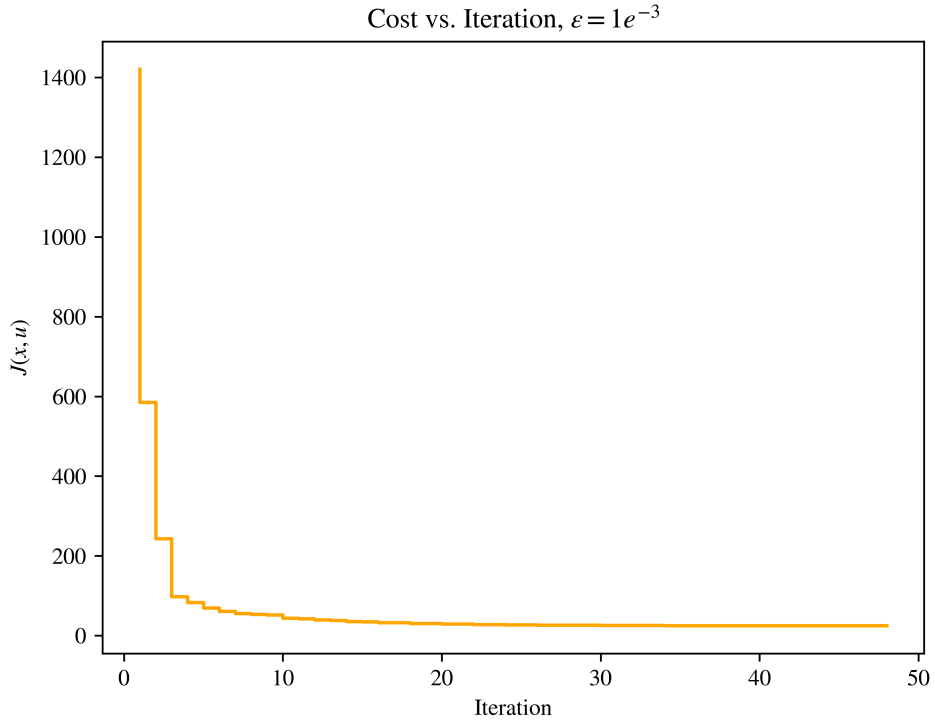


Figure 3: Cost function evaluations at every iteration of the iLQR algorithm.