Homework 1: Control

Active Learning for Robotics (ME 455), Spring 2023, Northwestern University.

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Due Monday, April 17th at 11:59pm

1 Differential Drive Vehicle

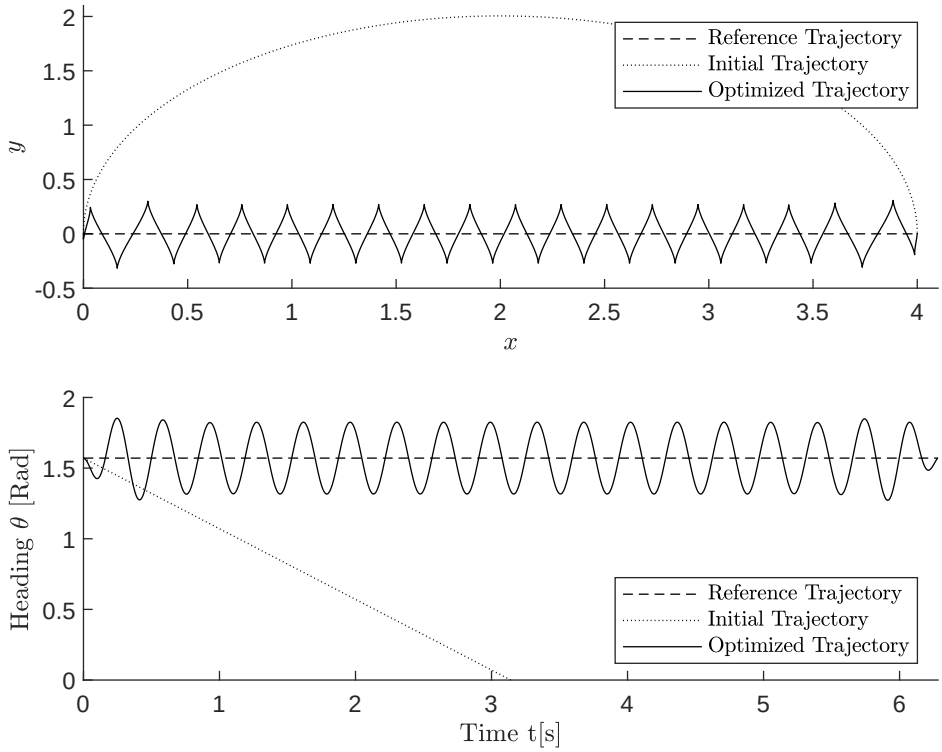

Figure 1.1: Reference trajectory, initial trajectory, and final optimized trajectory

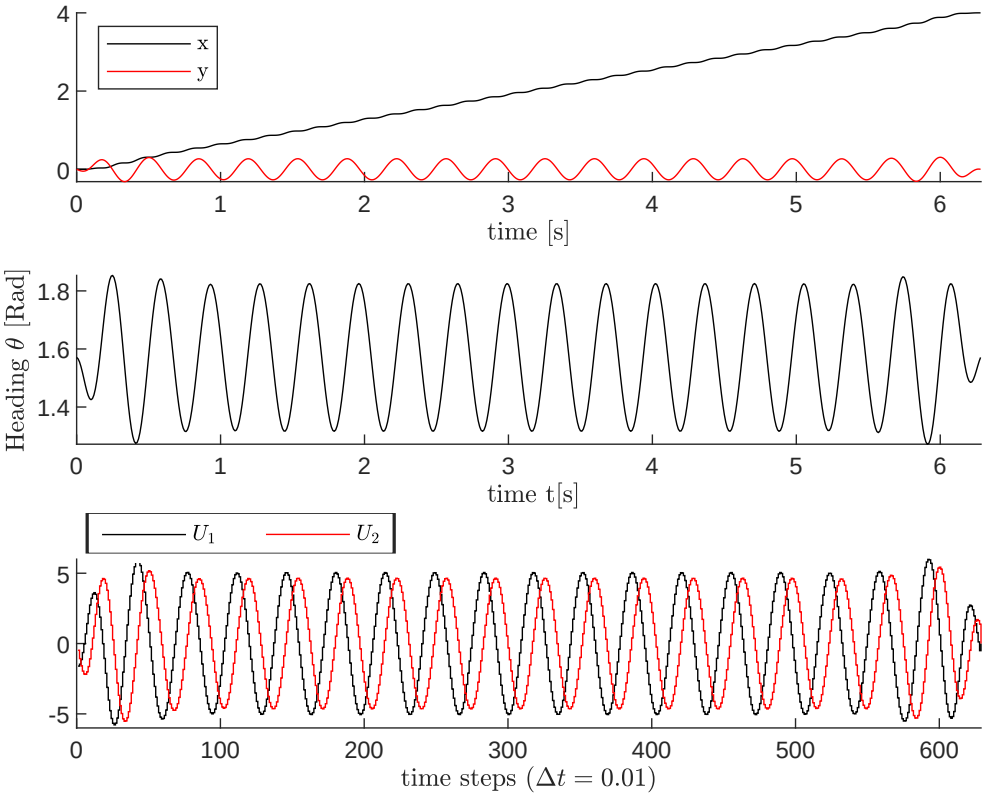

Figure 1.2: Final optimized state and input trajectory

2 Two Point Boundary Value Problem

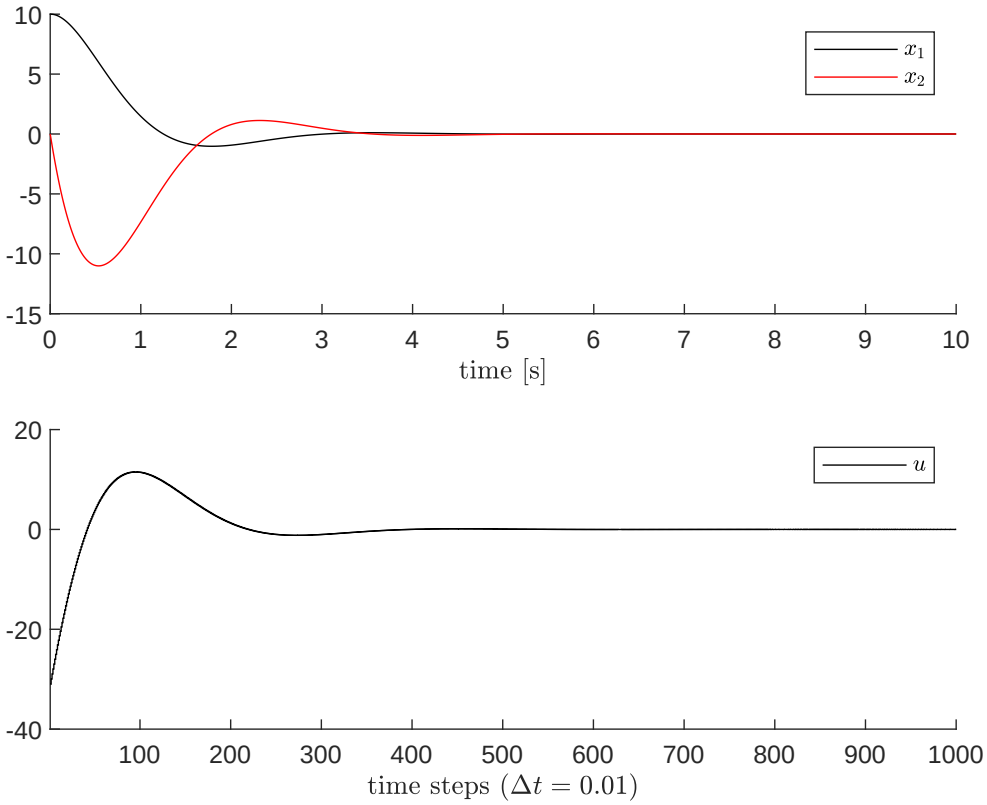

Figure 2.1: Plots of the resulting $x(t)$ and $u(t)$.

Pertubation $\zeta\,(z(t), v(t))$ and resulting directional derivative $DJ \cdot \zeta$ $v_i(t) = A_i \cdot \sin(B_i \cdot t + C_i) + D_i$ $dz/dt(t) = A \cdot z(t) + B \cdot v(t)$					
i	A_i	B_i	C_i	D_i	$DJ \cdot \zeta_i$
1	10.00	0.1	0	1	5.93E-05
2	5.00	0.2	$2\pi \cdot 1/9$	2	4.50E-05
3	$3.3\overline{3}$	0.3	$2\pi \cdot 2/9$	3	7.93E-07
4	2.50	0.4	$2\pi \cdot 3/9$	4	-9.05E-07
5	2.00	0.5	$2\pi \cdot 4/9$	5	4.11E-05
6	$1.6\overline{6}$	0.6	$2\pi \cdot 5/9$	6	5.86E-05
7	1.43	0.7	$2\pi \cdot 6/9$	7	3.05E-05
8	1.25	0.8	$2\pi \cdot 7/9$	8	2.60E-05
9	$1.1\overline{1}$	0.9	$2\pi \cdot 8/9$	9	7.70E-05
10	1.00	0.10	2π	10	1.07E-04

3 Ricatti Equation

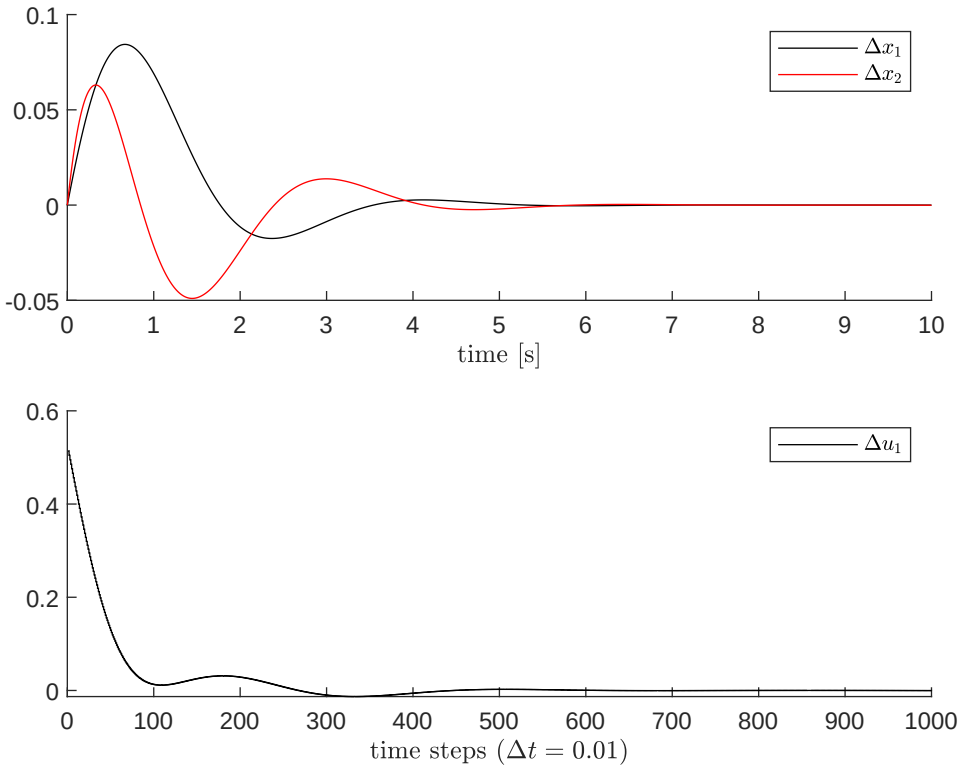

Figure 3.1: Plot of the state difference $\Delta x(t) = x_{\mathrm{TPBVP}}(t) - x_{\mathrm{RE}}(t)$ as well as input difference $\Delta u(t) = u_{\mathrm{TPBVP}}(t) - u_{\mathrm{RE}}(t)$