

Initial Results

TeeJet Adaptive Controls Research Project 2020

Objective: Designing a reference-tracking control mechanism for the plant

Conclusions:

- The system was originally identified on a sampling time $10 [ms]$ unlike the original data which gathered at $50 [ms]$. The data, original state space, new state space are plotted in the following figure. It is noted how the data do not represent the dynamics and also how far the original state space model.

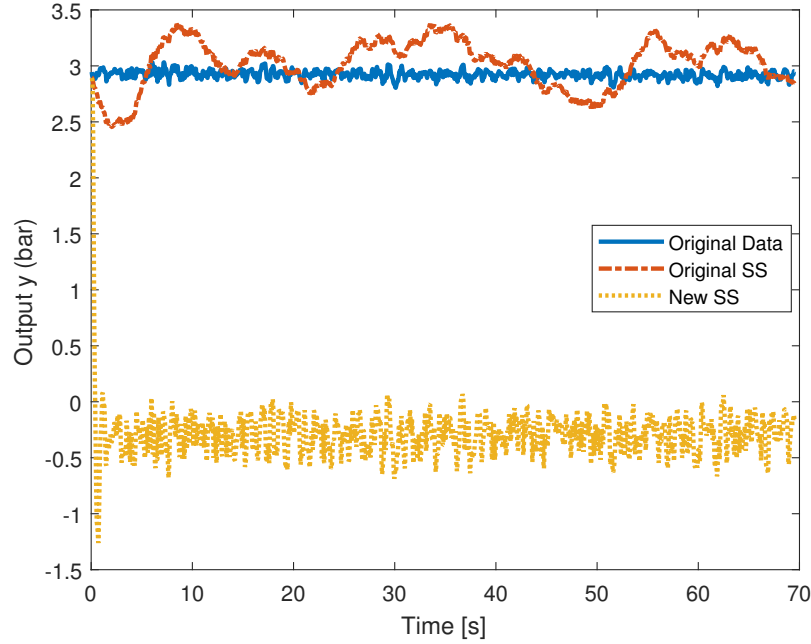


figure 1: Model Verification

- The control gains K_1, K_2, K_3 are determined using the Q-Learning process.
- The main control signal is decided by

$$u^{Total}(k+1) = \left(\sum_{i=1}^k \tilde{u}(i) \right) + 48.00, e(0) = e(-1) = 0$$

- Three simulation scenarios are considered (Case 1: Fixed Reference, Case 2: Staircase Reference, Case 3: Sinusoidal Reference). The final gains coming from the learning process are given by

Case 1:

$$K_1 = 0.0879, K_2 = 0.0895, K_3 = 0.0907$$

Case 2:

$$K_1 = -0.0563, K_2 = 0.1078, K_3 = 0.1209$$

Case 3:

$$K_1 = -0.0948, K_2 = 0.0976, K_3 = 0.1145$$

- The performance figures are listed as follows

Case 1: A fixed reference is introduced at $X_{ref} = 70$ Psi is considered

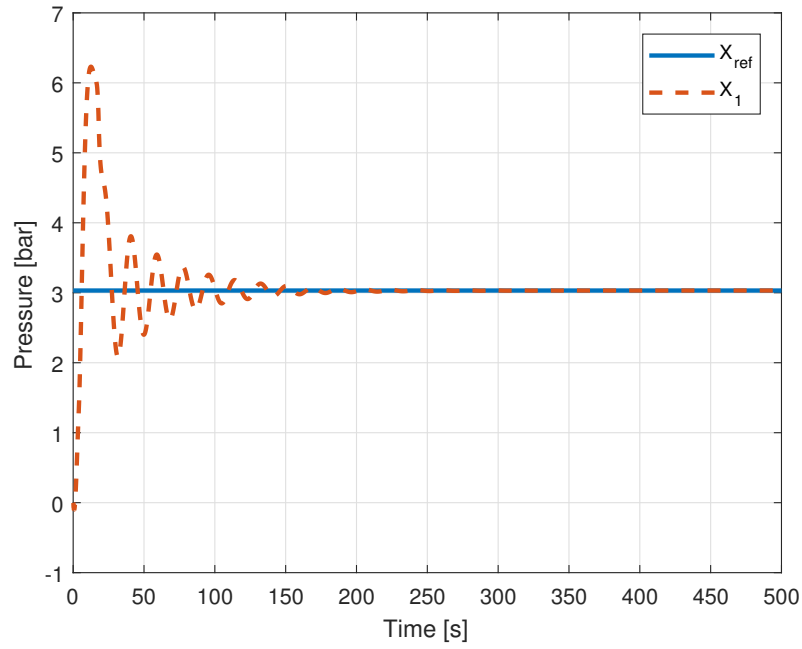


figure 2: Tracking Response

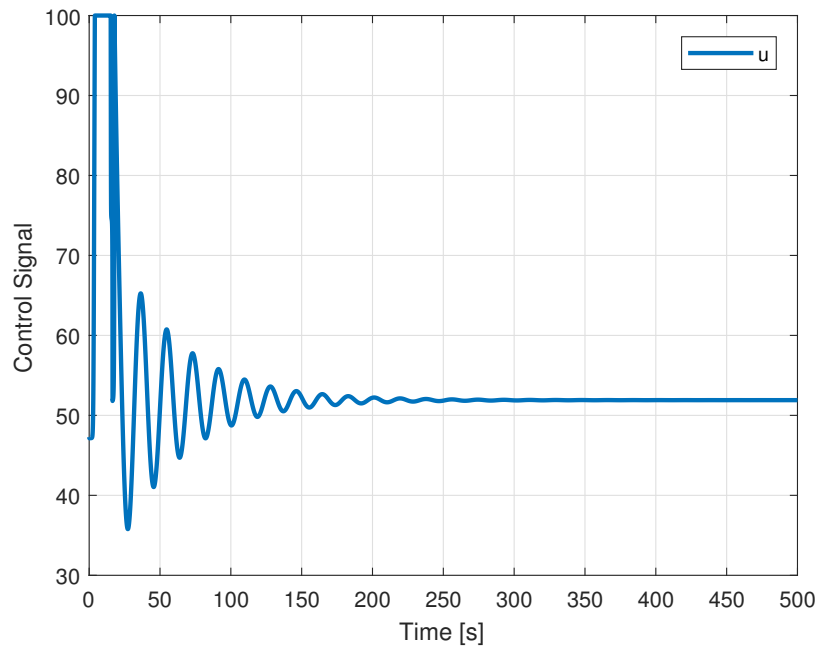


figure 3: Control Signal

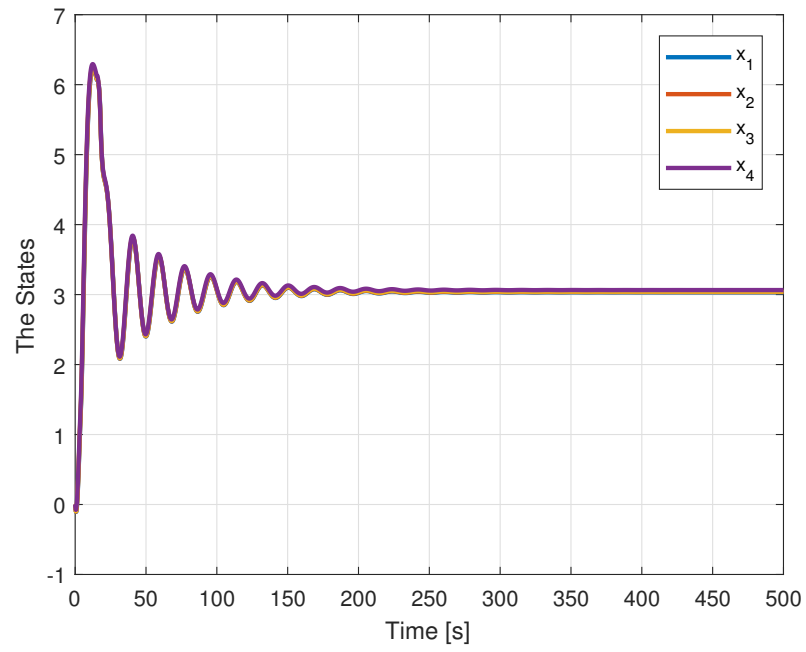


figure 4: Performance of the states

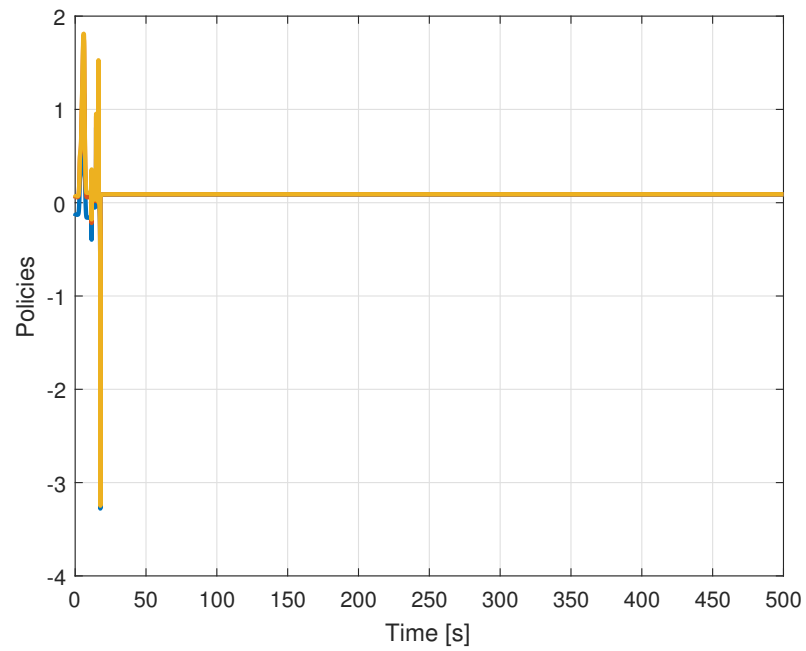


figure 5: Variations in the control law

Case 2: A stair-case reference is considered

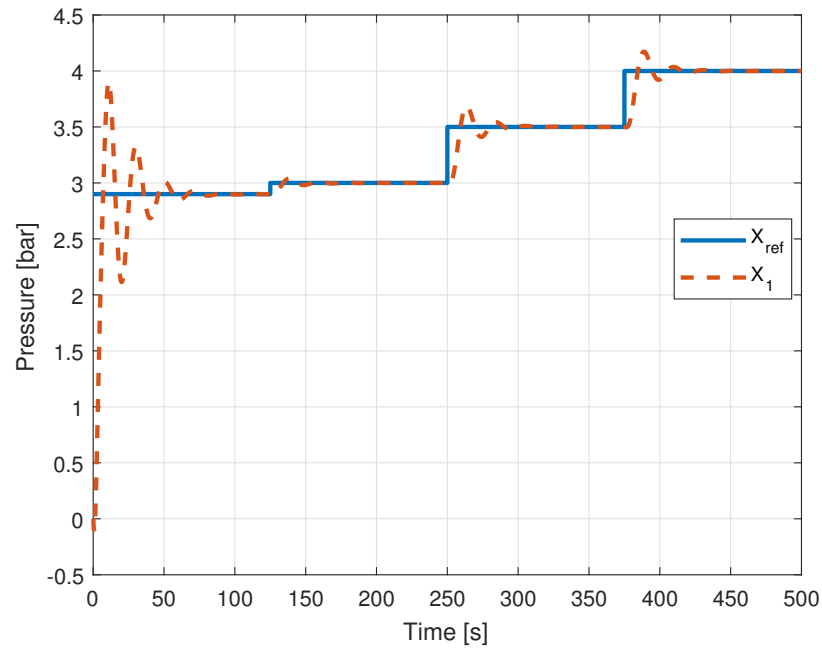


figure 6: Tracking Response

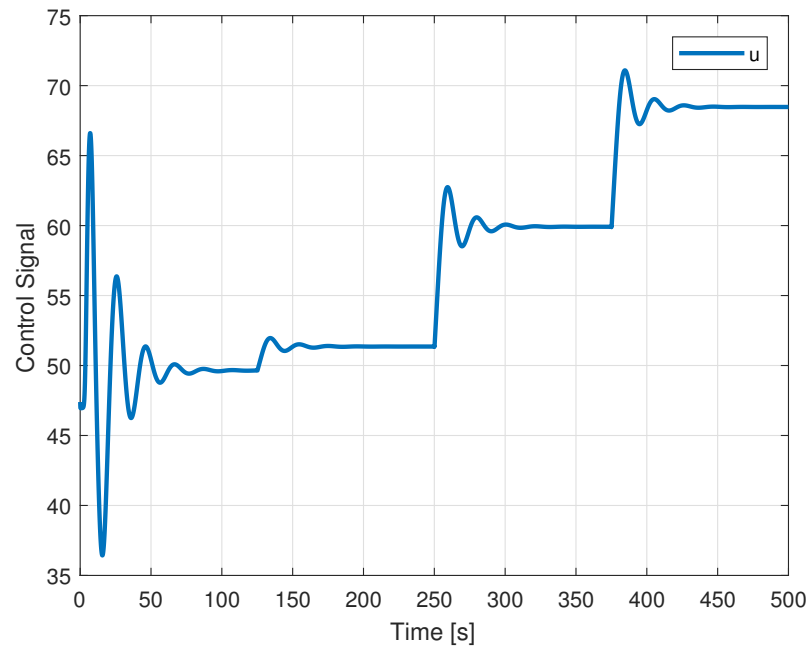


figure 7: Control Signal

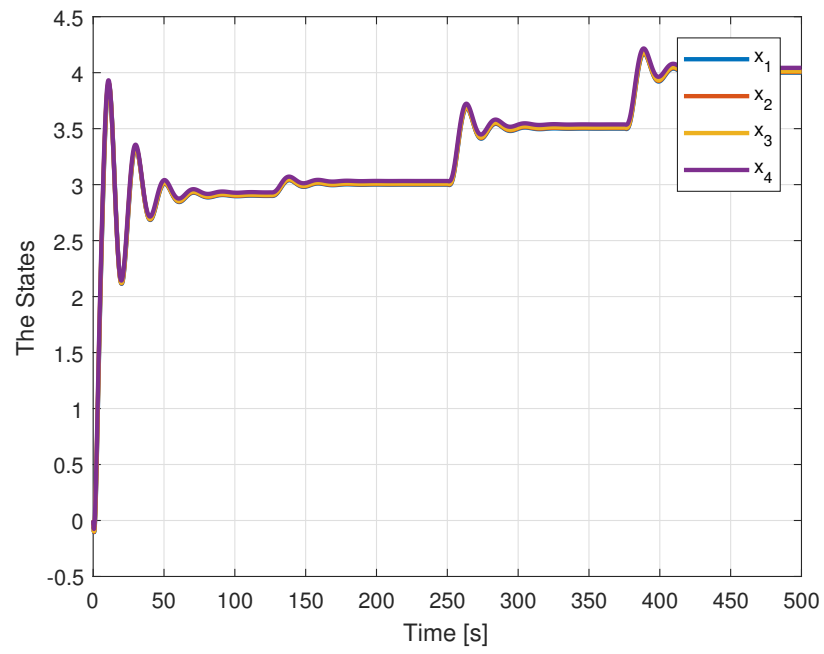


figure 8: Performance of the states

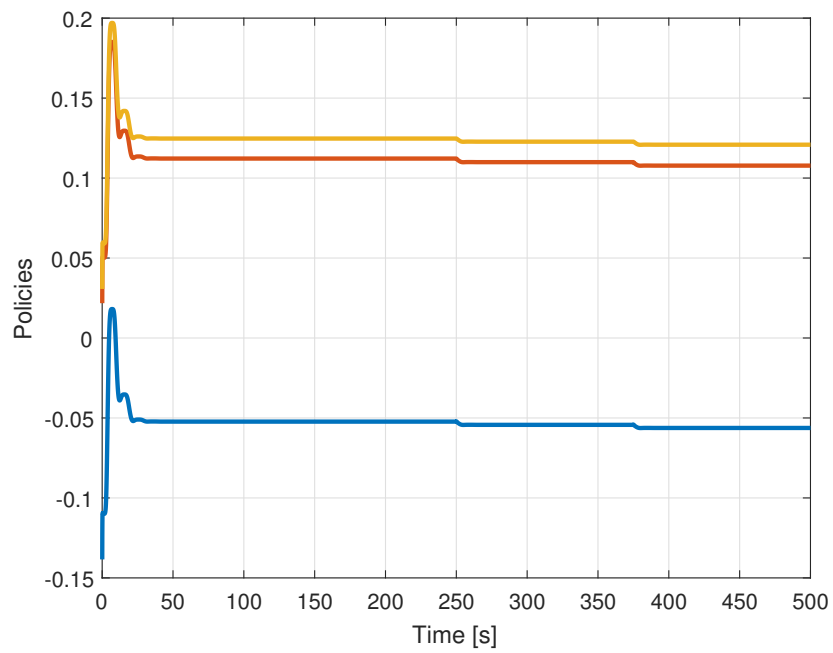


figure 9: Variations in the control law

Case 3: A sinusoidal reference is considered

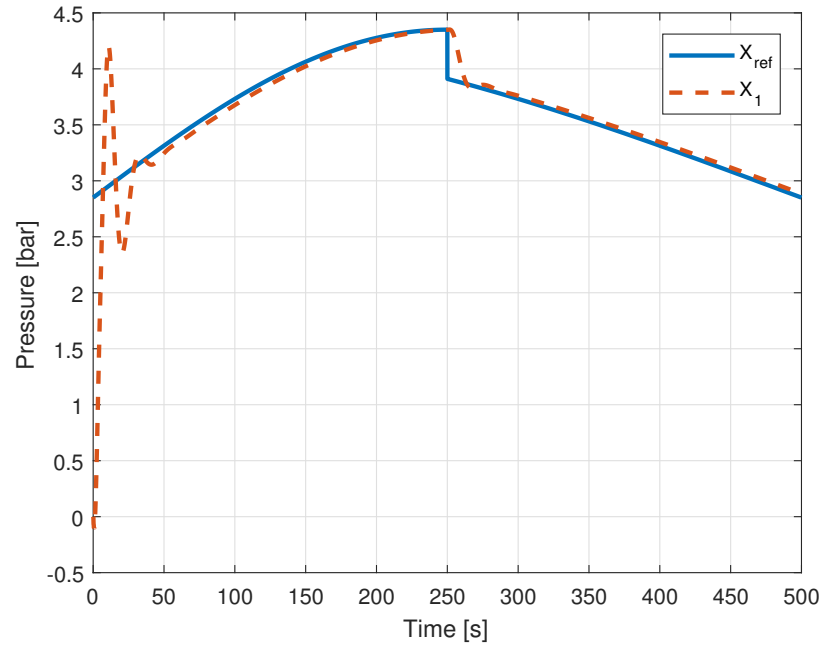


figure 10: Tracking Response

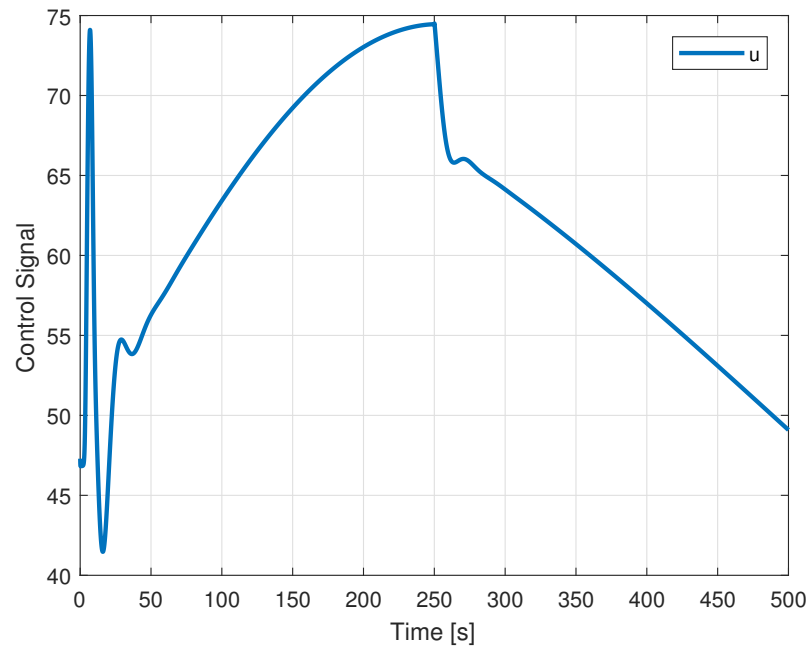


figure 11: Control Signal

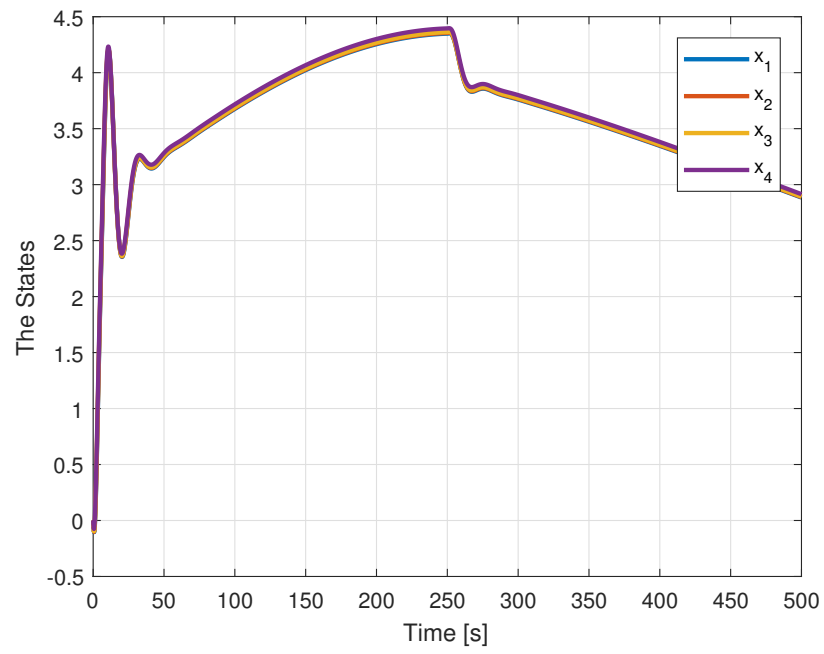


figure 12: Performance of the states

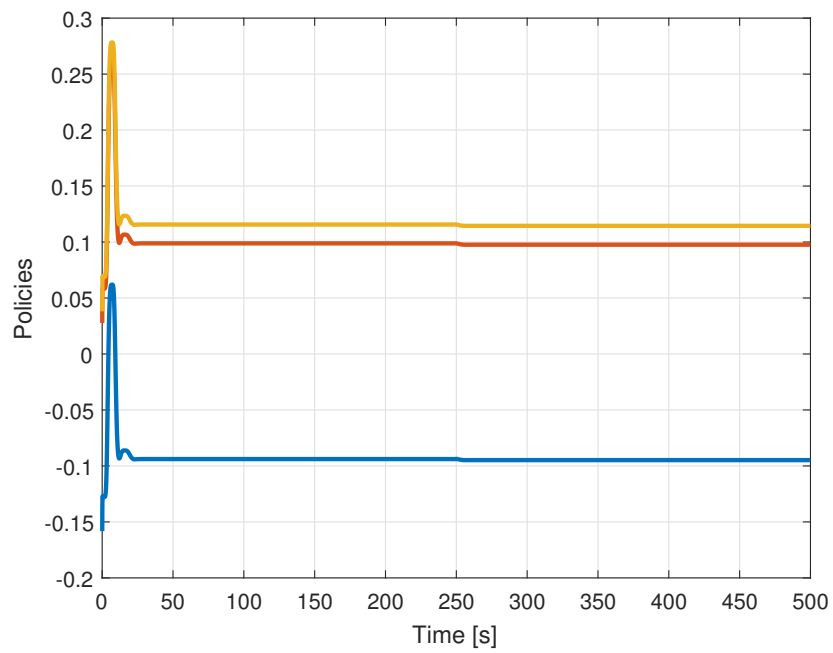


figure 13: Variations in the control law