

Sampling Rate

Title: Sampling Rate trade study

Date: 2/12/2026

Author: Jack Brown

Summary / Key Takeaways

- Decreasing the sampling rate generally increases overshoot and RMSE, while faster sampling rates lead to improved estimation and performance but may require more computational resources.
-

Assumptions / Parameters

- Controller: PID, $T_s = 2.5$, $\zeta = 0.7$, $\tau = 0.2$
 - Sampling Rate: varied from 0.05 s to 0.5 s
 - Process Noise: $Q = \text{diagonal } [1e-4, 1e-4, 1e-3, 1e-3]$
 - Disturbances: [zero / step / impulse / bias / random]
-

Results Table

Parameter / Scenario	Overshoot [%]	RMSE [m]	Notes
Fast Sampling Rate (0.05 s)	25.95	1.59E-01	
Nominal Sampling Rate (0.1 s)	22.49	1.66E-01	
Slow Sampling Rate (0.2 s)	26.14	1.64E-01	
Very Slow Sampling Rate (0.5 s)	31.06	1.99E-01	

Observations / Analysis

- Percent Overshoot and RMSE both increase as the sampling rate becomes slower.
 - Percent overshoot is relatively stable from the slow sampling rate to faster, experiencing a large jump at the very slow sampling rate.
 - RMSE is similar for slow and nominal sampling rates, but experiences changes for fast and very slow sampling rates.
-

Conclusion

- Sampling rate should be balanced with computing power based on the accuracy requirements of the use.