Process Noise

Title: Process noise trade study
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Summary / Key Takeaways

- The balance of the trust the state estimator places between the model and the measurements should be decided based on the project requirements.

Assumptions / Parameters

- Controller: PID, Ts = 2.5, zeta = 0.7, tau = 0.2

- Sampling Rate: 0.1 s

- Low Process Noise: Q = diagonal [1e-6, 1e-6, 1e-5, 1e-5]

- Nominal Process Noise: Q = diagonal [1e-4, 1e-4, 1e-3, 1e-3]

- High Process Noise: Q = diagonal [1e-2, 1e-2, 1e-1, 1e-1]

- Disturbances: [zero / step / impulse / bias / random]

Results Table

Parameter / Scenario	Overshoot [%]	RMSE [m]	Notes
Low Process Noise	29.6	8.27E-02	
Nominal Process Noise	24.99	1.50E-01	
High Process Noise	21.46	4.28E-01	

Observations / Analysis

- Percent Overshoot decreased with increased process noise

- RMSE increased with increased Q

Conclusion

- A balance should be struck based on project requirements between the smoothness of the control, low RMSE, and the responsiveness of the control, low percent overshoot.