Actuator Saturation

Title: actuator saturation trade study
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Summary / Key Takeaways

Percent overshoot decreases with increased actuator limits, due to decreased actuator saturation. Hence higher actuator limits are advised.

Assumptions / Parameters

- Controller: PID, Ts = 2.5, zeta = 0.7, tau = 0.2
- Sampling Rate: 0.1 s
- Process Noise: Q = diagonal [1e-4, 1e-4, 1e-3, 1e-3]
- Disturbances: [zero / step / impulse / bias / random]

Results Table

Parameter / Scenario	Settling Time [s]	Overshoot [%]	Notes
Very Low Limit (± 1)	12.7	52.86	
Low Limit (± 3)	13	39.84	
Nominal Limit (± 5)	15.9	24.83	
High Limit (± 10)	13.7	14.54	

Observations / Analysis

- Overshoot decreases as the actuator limit increases.
- Settling time varies across actuator limits but does not follow a clear trend.

Conclusion

- Higher actuator limits are preferred