Quanser Aero 2 Recommended Assessment

Pitch Parameter Estimation

Note: These results are based on the Aero 2 hardware. The response between different Aero 2 units and the Virtual Aero 2 will vary. Please see the *virtual_aero2_pitch_parameter_estimation_instructor.mlx* Live Script for the virtual twin solutions.

1. Show how the pitch transfer function given in Equation 2 in the Parameter Estimation - Concept Review was derived from the equation of motion in Equation 1. Assume the Aero 2 system is motionless at the start, i.e. initial conditions are zero.
2. Show how the steady-state angle in Equation 11 in the Parameter Estimation - Concept Review was found. the pitch model transfer function. **Hint:** Use the Final-Value Theorem.
3. Plot the response of the pitch angle, rotor speed, and motor voltage in a MATLAB figure.
4. Measure the natural frequency of the free-oscillation response.
5. Measure the damping ratio of the free-oscillation response.
6. Find the stiffness and viscous damping based on the natural frequency and damping ratio measured.
7. Measure the steady-state pitch angle, θ_{ss}, of the step response and the input rotor speed amplitude, ω_0.
8. Calculate the thrust force gain parameter, K_{pp}, based on these measurements.
9. Plot the model validation response showing the pitch angle from both the hardware and the model, the measured rotor speed, and the input motor voltage.
10. Does the model with the parameters you found match the hardware response? Give one reason why there could be a mistmatch, i.e., why the model does not represent the system