SC602: Nonlinear Dynamical Systems Problem 2: Rotational Dynamics of a Rigid Body

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Problem Statement

The rotational dynamics are given by:

$$\dot{\rho} = [I + \rho^{\times} + \rho\rho^{\top}]\omega,$$

$$J\dot{\omega} = -(\omega \times J\omega) + u,$$

where:

- $\rho \in \mathbb{R}^3$ is the modified Rodrigues parameter,
- $J \in \mathbb{R}^{3\times3}$ is the inertia matrix,
- $\omega \in \mathbb{R}^3$ is the angular velocity,
- $u \in \mathbb{R}^3$ is the thrust.

The task involves:

1. Using the control law $u(t)$ to guarantee stabilization of $\rho(t)$ and $\omega(t)$.
2. Providing a stability analysis and simulation results with:
    - Plots of control inputs,
    - Time histories of $\rho(t)$ and $\omega(t)$.