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Problem 4: SoJ 8.13

assume CLD of $[I]\delta\dot{\vec{\omega}} = -[P]\delta\vec{\omega} - K\vec{\sigma}$

using $\vec{\sigma} = \vec{\omega}/4$, use linear control theory to find critically damped response about each B axis. Tracking errors σ_1, ω_1 have $T_i = 100s$

$I_{11} = 10\ kgm^2$

$P_1 = 2I_{11}/T_i = \frac{20}{100} = 0.2$

$\xi_{11} = 1 = \frac{P_1}{\sqrt{kI_{11}}} \Rightarrow k = \frac{P_1^2}{I_{11}} = \frac{0.04}{10} = 0.004$

$\xi_{12} = 1 = \frac{P_2}{\sqrt{kI_{22}}} \Rightarrow P_2 = \sqrt{kI_{22}} = \sqrt{0.004 \cdot 20} = \sqrt{0.08}$

$\xi_{13} = 1 = \frac{P_3}{\sqrt{kI_{33}}} \Rightarrow P_3 = \sqrt{kI_{33}} = \sqrt{0.004 \cdot 30} = \sqrt{0.12}$

$$[P] = \begin{pmatrix} 0.2 & 0 & 0 \\ 0 & \sqrt{0.08} & 0 \\ 0 & 0 & \sqrt{0.12} \end{pmatrix}$$

The Linearized Model seems to be underdamped

Nonlinear Model looks overdamped. Linearization about $\vec{\sigma} = 0$, and decoupling, would cause this.