RO2102: Dynamics and Simulation

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Final - Project

Problem 5 3 **Due** : 15 - May - 2025

Time Spent : 5 Hours

Given: $\vec{N}_{/A} = \underline{\underline{I}} \cdot \dot{\vec{\omega}} + \vec{\omega} \times (\underline{\underline{I}} \cdot \vec{\omega})$

To Find: Animation of object

Assume, $\underline{\underline{I}} = \begin{bmatrix} I_1 & 0 & 0 \\ 0 & I_2 & 0 \\ 0 & 0 & I_3 \end{bmatrix}$, $\vec{\omega} = \begin{bmatrix} \omega_1 \\ \omega_2 \\ \omega_3 \end{bmatrix}^B$, $\dot{\vec{\omega}} = \begin{bmatrix} \dot{\omega}_1 \\ \dot{\omega}_2 \\ \dot{\omega}_3 \end{bmatrix}^B$

$$\underline{\underline{I}} \cdot \dot{\vec{\omega}} = \begin{bmatrix} I_1 & 0 & 0 \\ 0 & I_2 & 0 \\ 0 & 0 & I_3 \end{bmatrix} \cdot \begin{bmatrix} \dot{\omega}_1 \\ \dot{\omega}_2 \\ \dot{\omega}_3 \end{bmatrix}$$

$$= \begin{bmatrix} I_1\dot{\omega}_1, & I_2\dot{\omega}_2, & I_3\dot{\omega}_3 \end{bmatrix}'_B$$

$$\underline{\underline{I}} \cdot \vec{\omega} = \begin{bmatrix} I_1\omega_1, & I_2\omega_2, & I_3\omega_3 \end{bmatrix}'_B$$

$$\vec{\omega} \times (\underline{\underline{I}} \cdot \vec{\omega}) = \begin{vmatrix} \hat{e}_i & \hat{e}_j & \hat{e}_j \\ \omega_1 & \omega_2 & \omega_3 \\ I_1\omega_1 & I_2\omega_2 & I_3\omega_3 \end{vmatrix}$$

$$= \omega_2\omega_3(I_3 - I_2)\hat{e}_i - \omega_1\omega_3(I_3 - I_1)\hat{e}_j + \omega_1\omega_2(I_2 - I_1)\hat{e}_j$$

$$\underline{\underline{I}} \cdot \dot{\vec{\omega}} + \vec{\omega} \times (\underline{\underline{I}} \cdot \vec{\omega}) = \begin{bmatrix} I_1\dot{\omega}_1 + \omega_2\omega_3(I_3 - I_2) \\ I_2\dot{\omega}_2 - \omega_1\omega_3(I_3 - I_1) \\ I_3\dot{\omega}_3 + \omega_1\omega_2(I_2 - I_1) \end{bmatrix}_B$$