<u>Dragt 94 cont</u>

translational part! Since we are only interested in small oscillations, and hence small rotations, let us write

$$\mathcal{R} = e^{\sum_1^3 \epsilon_i J_i} = I + \sum_i \epsilon_i J_i + \frac{1}{2} \sum_{ij} \epsilon_i \epsilon_j J_i J_j + O(\epsilon^3)$$

where the ϵ_i are small. Then, to find ω_i^* we use

$$\sum \omega_i^* J_i = \mathcal{R}^{-1} \dot{\mathcal{R}} = \left\{ I - \sum \epsilon_i J_i + O(\epsilon^2) \right\} \left\{ \sum_k \dot{\epsilon}_k J_k + O(\epsilon^2) \right\}$$

$$= \sum \dot{\epsilon}_k J_k + O(\epsilon^2). \quad \text{Thus} \quad \boxed{\omega_i^* = \dot{\epsilon}_i + O(\epsilon^2)}$$

Here we used the fact that $\dot{\epsilon}_k = O(\epsilon)$ if the oscillation frequency is finite. Thus, using

$$T = \frac{1}{2} m \dot{\vec{R}}_{CM}^2 + \frac{1}{2} \vec{\omega} \cdot \vec{\vec{I}} \cdot \vec{\omega}, \quad \text{we get}$$

$$\boxed{T = \frac{1}{2} m \dot{\vec{R}}_{CM}^2 + \frac{ma^2}{48} \left[\dot{\epsilon}_1^2 + \dot{\epsilon}_2^2 + 2 \dot{\epsilon}_3^2 \right] + O(\epsilon^3)}$$