

**[mex70] Stability of rigid body rotations about principal axes**

Consider a rigid body with principal moments of inertia  $I_1 < I_2 < I_3$  undergoing a torque-free rotation about one of the principal axes. Investigate the stability of this motion against small perturbations as follows: (a) Use the vector  $\vec{\omega} = \omega_i \hat{e}_i + \delta_j \hat{e}_j + \delta_k \hat{e}_k$  with  $\delta_j, \delta_k \ll \omega_i$  for  $\{i, j, k\} = \text{cycl}\{1, 2, 3\}$  in Euler's equations and linearize them in  $\delta_j, \delta_k$ . (b) Solve the linearized equations exactly. (c) Describe the motion of  $\vec{\omega}$  separately for  $i = 1, 2, 3$  in the range of the approximations made.

**Solution:**