29.1. Solve det |I - \lambda I| for three values of \lambda, then take
\Delta(\vec{\omega}) = \lambda(\vec{\omega}) for each case
and find a \vec{\omega}c. — Or more
simply, do the same thing by
using Eigensystem. The
eigenvalues are the principal
moments of inertia and the eigenvectors
point in the direction of the principal
directions.

29.2. \vec{L} = \vec{\omega} \vec{I} \vec{\omega} and \vec{T} = \frac{1}{2} \vec{\omega}^T \vec{I} \vec{\omega}

have particularly simple forms
30.1. \( \dot{\mathbf{L}} + \mathbf{\Omega} \times \mathbf{L} = \mathbf{\tau} \)

\[ \text{Real torques, in body axes.} \]

The rotation matrices that relate the body frame to the space frame are functions of time and are only known after the problem has been solved. Hence, it is usually impossible to know \( \mathbf{\tau} \).

30.2. \( I_{11} = I_{22} \)

\[ 0 = I_1 \omega_1 + \omega_2 I_{33} \omega_3 - \omega_3 I_3 \omega_1 \]
\[ 0 = I_1 \omega_2 + \omega_3 I_3 \omega_1 - \omega_1 I_{33} \omega_3 \]
\[ 0 = I_{33} \omega_3 + \omega_1 I_{11} \omega_1 - \omega_2 I_{11} \omega_2 \]

\( \Rightarrow \)
\[ 0 = I_1 \omega_1 + \omega_2 \omega_3 (I_{33} - I_{11}) \]
\[ 0 = I_1 \omega_2 + \omega_1 \omega_3 (I_{11} - I_{33}) \]
\[ 0 = I_{33} \omega_3 \]

\( \omega_3 \) is constant.