Precessional Motion

Situation in which an axially symmetric body is seen to rotate (spin) about its own fixed axis of inertial symmetry from some intermediate, body following reference frame $F$.

The angular velocity of this intermediate (precessional) frame is referred to as the bodies precession rate vector

$$\vec{\Omega} = \vec{\omega}_F \; ; \; \text{precession rate vector}$$

and the angular velocity of the body relative to that frame

$$\vec{p} = p\vec{a} = \vec{\omega}_{B/F} \; ; \; \text{spin rate vector}$$

is referred to as the bodies spin rate vector.
Simple Steady State Precession

Rigid Body seen to rotate (spin) about a fixed axis of rotational (inertial) symmetry with constant angular velocity $\vec{\omega}$ by an observer in a reference frame which itself rotates (precesses) with a constant angular velocity $\vec{\Omega}$ relative to the ground.

$$\vec{\omega}_{\text{body}} = \vec{\omega}_{2} = \vec{\omega}_{2/1} + \vec{\omega}_{1} \quad \left\{ \begin{array}{l} \vec{\omega}_{2/1} = \vec{\omega} \\ \vec{\omega}_{1} = \vec{\Omega} \end{array} \right.$$  

$$\vec{\omega}_{\text{body}} = \vec{\Omega} + \vec{\omega}$$

$$\vec{\alpha}_{\text{body}} = \vec{\alpha}_{2} = \vec{\alpha}_{2/1} + \vec{\alpha}_{1} + \vec{\omega}_{1} \times \vec{\omega}_{2/1} \quad \left\{ \begin{array}{l} \vec{\alpha}_{2/1} = \vec{\alpha} \\ \vec{\alpha}_{1} = \vec{\Omega} \end{array} \right.$$  

$$\vec{\alpha}_{\text{body}} = \vec{\Omega} \times \vec{\omega}$$

The wheel depicted at right is in a state of simple steady precession.