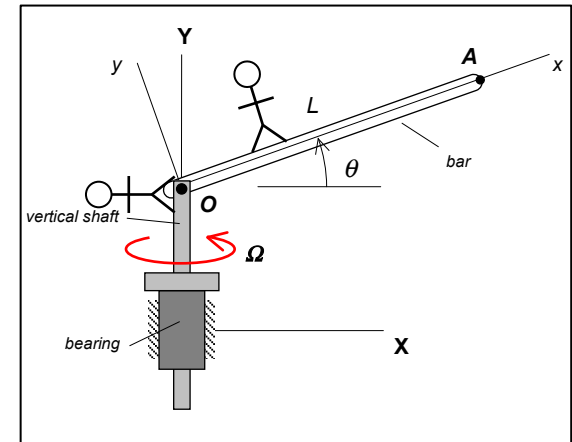


Summary: 3D Moving Reference Frame Kinematics 2

PROBLEM: A person attached to a moving body (reference frame) is observing the motion of point A.

$$\vec{v}_A = \vec{v}_O + (\vec{v}_{A/O})_{rel} + \vec{\omega} \times \vec{r}_{A/O}$$

$$\vec{a}_A = \vec{a}_O + (\vec{a}_{A/O})_{rel} + \vec{\alpha} \times \vec{r}_{A/O} + 2\vec{\omega} \times (\vec{v}_{A/O})_{rel} + \vec{\omega} \times (\vec{\omega} \times \vec{r}_{A/O})$$



CHANGING OBSERVERS: For constant rotation rates,

Observer on vertical shaft:

$$\vec{\omega} = \Omega \hat{j}$$

$$\vec{\alpha} = \frac{d\vec{\omega}}{dt} = \vec{0}$$

$$(\vec{v}_{A/O})_{rel} = L\dot{\theta} \hat{j}$$

$$(\vec{a}_{A/O})_{rel} = -L\dot{\theta}^2 \hat{i}$$

Observer on arm OA:

$$\vec{\omega} = \Omega \hat{j} + \dot{\theta} \hat{k}$$

$$\vec{\alpha} = \frac{d\vec{\omega}}{dt} = \dot{\Omega} \hat{j} + \Omega \dot{\hat{j}} + \ddot{\theta} \hat{k} + \dot{\theta} \dot{\hat{k}} = \dot{\theta} (\vec{\omega} \times \hat{k})$$

$$(\vec{v}_{A/O})_{rel} = \vec{0}$$

$$(\vec{a}_{A/O})_{rel} = \vec{0}$$

These give the same result! Try it.