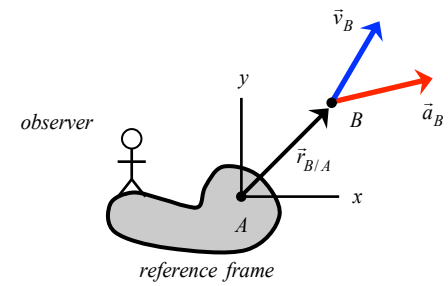
Summary: 2D Moving Reference Frame Kinematics 2

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

$$\vec{v}_B = \vec{v}_A + \left(\vec{v}_{B/A}\right)_{rel} + \vec{\omega} \times \vec{r}_{B/A}$$

$$\vec{a}_B = \vec{a}_A + \left(\vec{a}_{B/A}\right)_{rel} + \vec{\alpha} \times \vec{r}_{B/A} + 2\vec{\omega} \times \left(\vec{v}_{B/A}\right)_{rel} + \vec{\omega} \times \left(\vec{\omega} \times \vec{r}_{B/A}\right)$$



APPLICATION: Using 2D MRF equations in solving problems in the kinematics of mechanisms.

AP (rigid body):

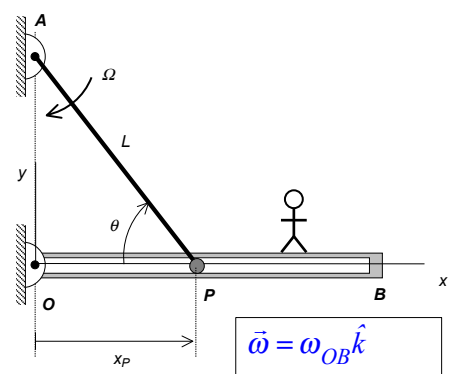
$$\vec{v}_P = \left(-\Omega\hat{k}\right) \times \vec{r}_{P/A}$$

$$\vec{a}_P = \left(-\dot{\Omega}\hat{k}\right) \times \vec{r}_{P/A} + \left(-\Omega\hat{k}\right) \times \left[\left(-\Omega\hat{k}\right) \times \vec{r}_{P/A}\right]$$

OP (<u>*not*</u> a rigid body):

$$\vec{v}_P = \dot{x}_P\hat{i} + \left(\omega_{OB}\hat{k}\right) \times \vec{r}_{P/A}$$

$$\vec{a}_P = \ddot{x}_P\hat{i} + \left(\alpha_{OB}\hat{k}\right) \times \vec{r}_{P/A} + 2\left(\omega_{OB}\hat{k}\right) \times \left(\dot{x}_P\hat{i}\right) + \left(\omega_{OB}\hat{k}\right) \times \left[\left(\omega_{OB}\hat{k}\right) \times \vec{r}_{P/A}\right]$$



With observer on OB:

$$\vec{\omega} = \omega_{OB}\hat{k}$$

$$\vec{\alpha} = \alpha_{OB}\hat{k}$$

$$\left(\vec{v}_{P/A}\right)_{rel} = \dot{x}_P\hat{i}$$

$$\left(\vec{a}_{P/A}\right)_{rel} = \ddot{x}_P\hat{i}$$