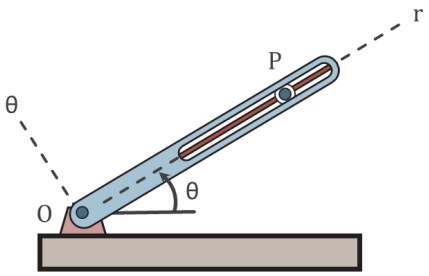
Sliding Block in Rotating Slot



Motion of the sliding block P in the rotating radial slot is controlled by a power screw. For the instant represented, $\dot{\theta}$ = 0.1 rad/s, $\ddot{\theta}$ = -0.04 rad/s^2 and r = 300 mm. Also the screw turns at a constant speed given $\dot{r}$ = 40 mm/s. Determine for this instant the magnitude of the acceleration a.

Using known expressions:

$$a_r = \ddot{r} - r \cdot \dot{\theta}^2 \tag{1}$$

$$a_\theta = r \cdot \ddot{\theta} + 2 \cdot \dot{r} \cdot \dot{\theta} \tag{2}$$

$$a = \sqrt{{a_\theta}^2 + {a_r}^2} \tag{3}$$

Given:
$r = 300mm$
$\dot{r} = 40mm/s$
$\dot{\theta} = 0.1rad/s$
$\ddot{\theta} = -0.04rad/s^2$

Since the speed at which the screw turns is constant, $\ddot{r} = 0$. a_r and a_θ can be calculated as follows:

$$a_r = \ddot{r} - r \cdot \dot{\theta}^2 \quad \Rightarrow \quad a_r = 0 - 300 \cdot 0.1^2 = -3mm/s^2 \tag{4}$$

$$a_\theta = r \cdot \ddot{\theta} + 2 \cdot \dot{r} \cdot \dot{\theta} \quad \Rightarrow \quad a_\theta = 300 \cdot -0.04 + 2 \cdot 40 \cdot 0.1 = -4mm/s^2 \tag{5}$$

This results in a total acceleration of:

$$a = \sqrt{{a_\theta}^2 + {a_r}^2} \quad \Rightarrow \quad a = \sqrt{-4^2 + -3^2} = 5mm/s^2 \tag{6}$$