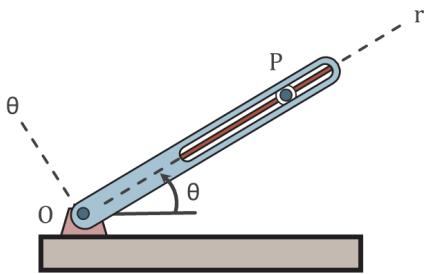


Sliding Block in Rotating Slot



The motion of a sliding block P in the rotating radial slot is controlled by a power screw. This slot is hinged at O. For the instant represented, $\dot{\theta} = 0.1 \text{ rad/s}$, $\ddot{\theta} = -0.04 \text{ rad/s}^2$, $r = 300 \text{ mm}$ and $\theta = 30^\circ$. The screw turns at a constant speed giving $\dot{r} = 40 \text{ mm/s}$. For this instant, determine the magnitude of the acceleration.

Using known expressions:

$$a_r = \ddot{r} - r\dot{\theta}^2 \quad (1)$$

$$a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta} \quad (2)$$

$$a = \sqrt{a_r^2 + a_\theta^2} \quad (3)$$

Given quantities:

$$r = 300 \text{ mm}$$

$$\dot{r} = 40 \text{ mm/s}$$

$$\dot{\theta} = 0.1 \text{ rad/s}$$

$$\ddot{\theta} = -0.04 \text{ rad/s}^2$$

Solution:

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

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

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

This results in a total acceleration a of:

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