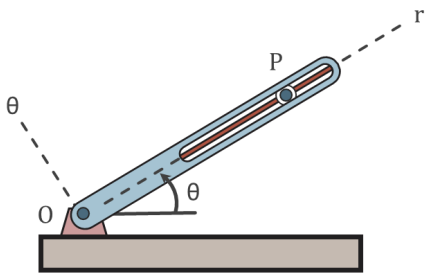
Sliding Block in a Rotating Slot



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, $\dot{\theta} = 0.1$ rad/s, $\ddot{\theta} = -0.04$ rad/s^2, $r = 300$ mm and $\theta = 30°$. The screw turns at a constant speed giving $\dot{r} = 40$ mm/s. For this instant, determine the magnitude of the acceleration.

Using known expressions:

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

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

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

Given quantities:

Distance between slider and O: $r = 300$ mm
Velocity of the slider: $\dot{r} = 40$ mm/s
Angular velocity of the slot: $\dot{\theta} = 0.1$ rad/s
Angular acceleration of the slot: $\ddot{\theta} = -0.04$ 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:

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

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

This results in a total acceleration a of:

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