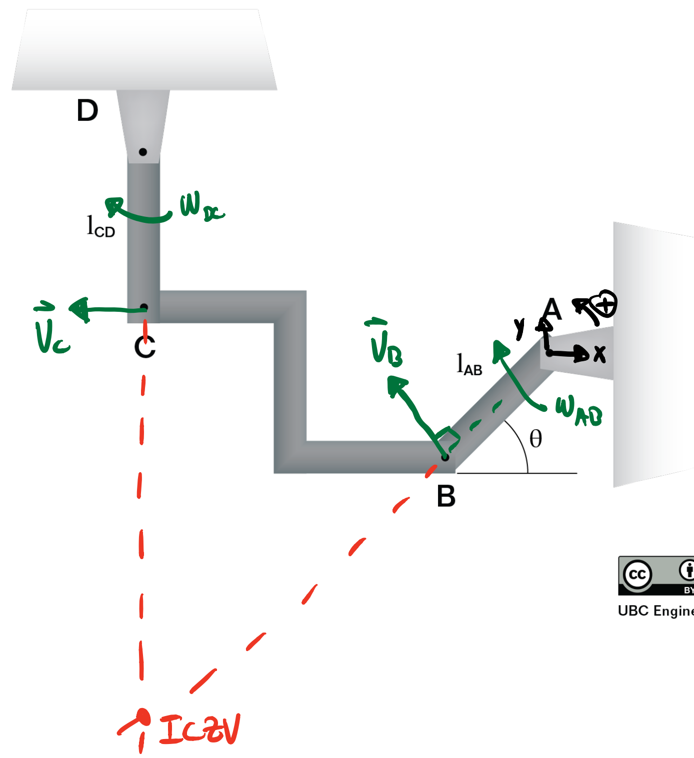
Several arms are linked to form the system shown. Link AB has a length of $l_{AB} = 0.5m$, link CD has a length of $l_{CD} = 0.5m$, and the distance from B to C is $r_{C/B} = -1\hat{i} + 1\hat{j}\ m$. If the angle between link AB is $\theta = 45\ deg$, determine the angular velocity of link CD. Locate the ICZV. The angular velocities of the links are given as $\omega_{AB} = -3\ rad/s$ and $\omega_{BC} = 3/4\sqrt{2}\ rad/s$.

① Diagram



$$\vec{V} = \vec{\omega} \times \vec{r}$$

$$\vec{V}_B = \vec{\omega}_{AB} \times \vec{r}_{B/A} = -3\hat{k} \times (-0.5\cos 45^\circ \hat{i} - 0.5\sin 45^\circ \hat{j})$$

$$\vec{V}_B = 1.5\,(\cos 45^\circ \hat{j} - \sin 45^\circ \hat{i})$$

$$\vec{V}_C = \vec{\omega}_{CD} \times \vec{r}_{C/D} = \omega_{CD}\hat{k} \times (-0.5\hat{j}) = 0.5\,\omega_{CD}\hat{i}$$

$$\vec{V}_C = \vec{\omega}_{BC} \times \vec{r}_{C/IC} \Rightarrow 0.5\,\omega_{CD}\hat{i} = \frac{3\sqrt{2}}{4}\hat{k} \times \vec{r}_{C/IC}$$

$$\vec{V}_B = \vec{\omega}_{BC} \times \vec{r}_{B/IC}$$

$$1.5\left(\cos 45^\circ \hat{j} - \sin 45^\circ \hat{i}\right) = \frac{3\sqrt{2}}{4}\hat{k} \times \left(r_{B/IC}\cos 45^\circ \hat{i} + r_{B/IC}\sin 45^\circ \hat{j}\right)$$

$$\hat{i}: \quad -1.5\sin 45^\circ = -\frac{3\sqrt{2}}{4} r_{B/IC}\sin 45^\circ \Rightarrow r_{B/IC} = \sqrt{2}$$

$$\hat{j}: \quad 1.5\cos 45^\circ = \frac{3\sqrt{2}}{4} r_{B/IC}\cos 45^\circ \Rightarrow r_{B/IC} = \sqrt{2}$$

$$\vec{IC} = \vec{r}_{IC/B} + \vec{r}_{B/A} = -\vec{r}_{B/IC} + \vec{r}_{D/A} = -\left(\frac{4+\sqrt{2}}{4}\right)\hat{i} - \left(\frac{4+\sqrt{2}}{4}\right)\hat{j}$$

$$\boxed{\vec{IC} = -\left(\frac{4+\sqrt{2}}{4}\right)\hat{i} - \left(\frac{4+\sqrt{2}}{4}\right)\hat{j}}$$

$$\hat{j}: \quad \vec{r}_{C/IC} = \vec{r}_{B/IC}\sin 45^\circ + 1 = \sqrt{2}\sin 45^\circ + 1$$

$$\vec{r}_{C/IC} = 1 + \sqrt{2}\sin 45^\circ \hat{j}$$

$$0.5\, w_{CD} = \frac{3\sqrt{2}}{4}\hat{k} \times \left(1 + \sqrt{2}\sin 45^\circ\right)\hat{j}$$

$$\boxed{\vec{w}_{CD} = -3\sqrt{2}\,\hat{k}}$$