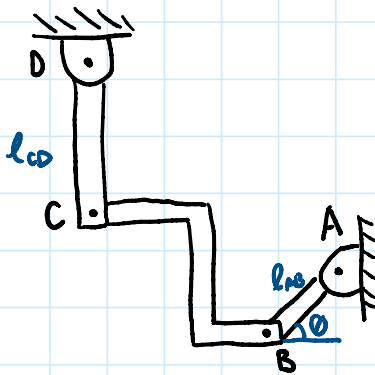


Inspiration: 16-112 Hibbeler

Several arms are linked to form the system shown. Link AB has a length of $l_{AB} = 0.5 \text{ m}$, link CD has a length of $l_{CD} = 0.5 \text{ m}$, and the distance from B to C is $r_{C/B} = -1 \hat{i} + 1 \hat{j} \text{ m}$. If the angle between link AB is $\theta = 45 \text{ degrees}$, determine the angular velocity of link CD.

Locate the ICZV. The angular velocities of the links are given as $\omega_{AB} = -3 \text{ rad/s}$ and $\omega_{BC} = (3\sqrt{2})/4 \text{ rad/s}$.



$$\vec{r}_{B/A} = (-0.5 \cos 45 \hat{i} - 0.5 \sin 45 \hat{j})$$

$$\vec{r}_{C/B} = (-1 \hat{i} + 1 \hat{j})$$

$$\vec{r}_{D/C} = (0.5 \hat{j})$$

$$\vec{v}_B = -3 \hat{k} \times (-0.5 \cos 45 \hat{i} - 0.5 \sin 45 \hat{j}) = 1.5 \cos 45 \hat{j} - 1.5 \sin 45 \hat{i}$$

$$\vec{v}_C = \omega_{CD} \hat{k} \times (-0.5 \hat{j}) = 0.5 \omega_{CD} \hat{i}$$

unknown, but know direction

$$\vec{v}_C = \omega_{BC} \times \vec{r}_{C/B}$$

$$0.5 \omega_{CD} \hat{i} = \frac{3\sqrt{2}}{4} \hat{k} \times \vec{r}_{C/B}$$

unknown, but know direction

$$\vec{v}_B = \omega_{BC} \times \vec{r}_{B/C}$$

$$1.5 \cos 45 \hat{j} - 1.5 \sin 45 \hat{i} = \frac{3\sqrt{2}}{4} \hat{k} \times (\vec{r}_{B/C} \cos 45 \hat{i} + \vec{r}_{B/C} \sin 45 \hat{j})$$

$$1.5 \cos 45 \hat{j} - 1.5 \sin 45 \hat{i} = \frac{3\sqrt{2}}{4} \vec{r}_{B/C} \cos 45 \hat{j} - \frac{3\sqrt{2}}{4} \vec{r}_{B/C} \sin 45 \hat{i}$$

$$\hat{i}: -1.5 \sin 45 = -\frac{3\sqrt{2}}{4} \vec{r}_{B/C} \sin 45$$

$$\hat{j}: 1.5 \cos 45 = \frac{3\sqrt{2}}{4} \vec{r}_{B/C} \cos 45 \quad \vec{r}_{B/C} = \sqrt{2}$$

$$\vec{r}_{B/C} = \sqrt{2} \cos 45 \hat{i} + \sqrt{2} \sin 45 \hat{j}$$

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

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

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

$$0.5 \omega_{CD} = \frac{3\sqrt{2}}{4} \hat{k} \times (1 + \sqrt{2} \sin 45 \hat{j})$$

$$\omega_{CD} = -3\sqrt{2} \hat{k}$$