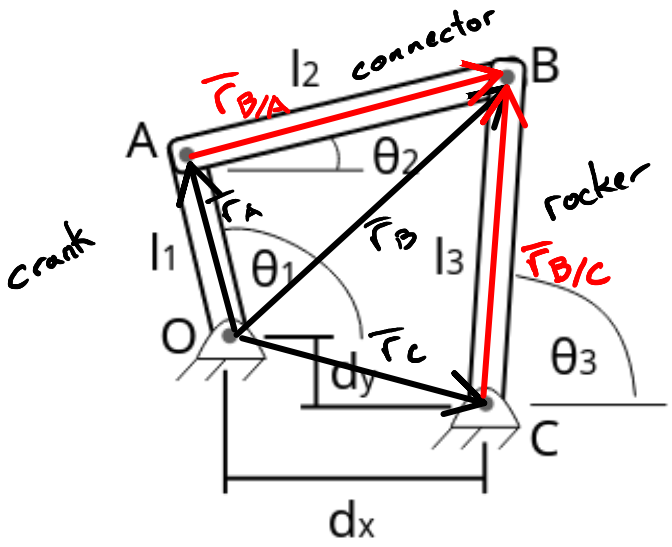


4-bar linkage general form

HW part 1

$\bar{r}_A = ?$

$\bar{r}_B = ?$

$\bar{r}_C = ?$

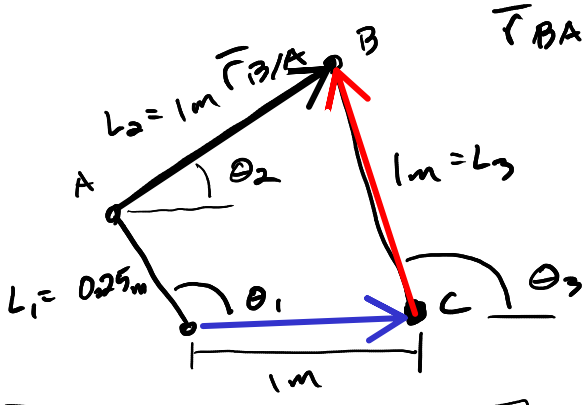
$\dot{\theta}_1 = 10 \frac{rad}{s}$

$\bar{r}_O = 0\hat{i} + 0\hat{j}$

$\bar{r}_A = -0.2\hat{i} + 0.15\hat{j}$

$\bar{r}_B = 0.5\hat{i} + 0.86\hat{j}$

$\bar{r}_C = 1\hat{i}$



$\bar{r}_{BA}$

$\bar{r}_{B/A} = L_2 = 1m$

$\bar{r}_A = L_1(\cos\theta_1 \hat{i} + \sin\theta_1 \hat{j})$

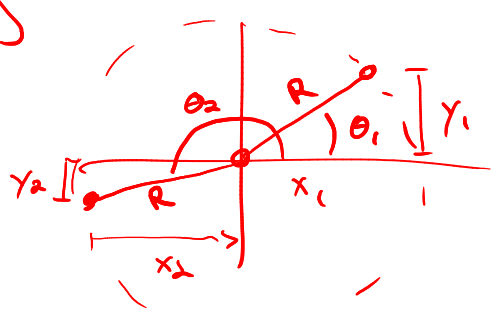
$\bar{r}_{B/A} = L_2(\cos\theta_2 \hat{i} + \sin\theta_2 \hat{j})$

$\bar{r}_{B/C} = L_3(\cos\theta_3 \hat{i} + \sin\theta_3 \hat{j})$

$\bar{r}_C = 1\hat{i}$

$$\bar{r}_A + \bar{r}_{B/A} = \bar{r}_C + \bar{r}_{B/C}$$

Trig Review



$x_1 = R\cos\theta_1$

$y_1 = R\sin\theta_1$

$x_2 = R\cos\theta_2$

$y_2 = R\sin\theta_2$

$$\bar{r}_A + \bar{r}_{B/A} = \bar{r}_C + \bar{r}_{B/C}$$

position constraint equation

$$\bar{r}_A = L_1(\cos\theta_1 \hat{i} + \sin\theta_1 \hat{j})$$
$$\bar{r}_{B/A} = L_2(\cos\theta_2 \hat{i} + \sin\theta_2 \hat{j})$$
$$\bar{r}_{B/C} = L_3(\cos\theta_3 \hat{i} + \sin\theta_3 \hat{j})$$
$$\bar{r}_C = 1\,\hat{i}$$

$\hat{i} \rightarrow L_1\cos\theta_1 + L_2\cos\theta_2 = 1 + L_3\cos\theta_3$

$\hat{j} \rightarrow L_1\sin\theta_1 + L_2\sin\theta_2 = 0 + L_3\sin\theta_3$

2 eqns × 2 unknowns

e.g. given $\theta_1 \Rightarrow$ get θ_2, θ_3

velocity constraint

$\bar{v}_A, \bar{v}_{B/A}, \bar{v}_C, \bar{v}_{B/C}$?

$$\frac{d}{dt}\left(\bar{r}_A + \bar{r}_{B/A} = \bar{r}_C + \bar{r}_{B/C}\right)$$

$$v_x \rightarrow L_1\dot{\theta}_1\sin\theta_1 + L_2\dot{\theta}_2\sin\theta_2 = 0 + L_3\dot{\theta}_3\sin\theta_3$$
$$v_y \rightarrow L_1\dot{\theta}_1\cos\theta_1 + L_2\dot{\theta}_2\cos\theta_2 = 0 + L_3\dot{\theta}_3\cos\theta_3$$

$$\frac{d}{dt}(\cos 3t) = \frac{d}{d(3t)}\frac{d(3t)}{dt}(\cos 3t) = -3\sin 3t$$

$$\frac{d}{dt}(\cos x) = \frac{dx}{dt}\cdot\frac{d}{dx}(\cos x) = \dot{x}(-\sin x)$$

$x = f(t)$