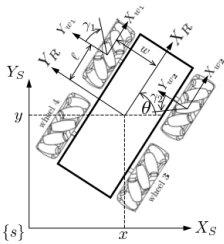


Ex5) Omniwheel Robot

- Find the equation for each wheel to drive the robot with (v, ω) at its G.C.



Roller angles:

$$\gamma_1 = \gamma_3 = -\frac{\pi}{4}$$

$$\gamma_2 = \gamma_4 = \frac{\pi}{4}$$

Mounting angle:

$$\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$$

Wheel radii: $r_i = r$

$$\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} = \begin{bmatrix} l \\ w \end{bmatrix}, \quad \begin{bmatrix} x_2 \\ y_2 \end{bmatrix} = \begin{bmatrix} l \\ -w \end{bmatrix}, \quad \begin{bmatrix} x_3 \\ y_3 \end{bmatrix} = \begin{bmatrix} -l \\ -w \end{bmatrix}, \quad \begin{bmatrix} x_4 \\ y_4 \end{bmatrix} = \begin{bmatrix} -l \\ w \end{bmatrix}$$

$$g_i(\theta) = \begin{bmatrix} \cos \theta & \sin \theta & -y_i \\ -\sin \theta & \cos \theta & x_i \end{bmatrix}, \quad \dot{q} = \begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{w} \end{bmatrix}$$

$$u_i = \frac{1}{r} \begin{bmatrix} 1 & \tan \gamma_i \end{bmatrix} g_i(\theta) \dot{q}$$

$$= \frac{1}{r} \begin{bmatrix} 1 & \sin(\gamma_i) \end{bmatrix} \begin{bmatrix} \cos \theta & \sin \theta & -y_i \\ -\sin \theta & \cos \theta & x_i \end{bmatrix} \dot{q}$$

$\tan(\gamma_i) = \sin(\gamma_i)$ here
because $|\gamma_i| = \frac{\pi}{4}$

$$u_1 = \frac{1}{r} \begin{bmatrix} \cos \theta + \sin \theta & \sin \theta - \cos \theta & -w - l \end{bmatrix} \dot{q}$$

$$u_2 = \frac{1}{r} \begin{bmatrix} \cos \theta - \sin \theta & \sin \theta + \cos \theta & w + l \end{bmatrix} \dot{q}$$

$$u_3 = \frac{1}{r} \begin{bmatrix} \cos \theta + \sin \theta & \sin \theta - \cos \theta & w + l \end{bmatrix} \dot{q}$$

$$u_4 = \frac{1}{r} \begin{bmatrix} \cos \theta - \sin \theta & \sin \theta + \cos \theta & -w - l \end{bmatrix} \dot{q}$$

$$u = \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \end{bmatrix} = \frac{1}{r} \begin{bmatrix} c_\theta - s_\theta & s_\theta - c_\theta & -w - l \\ c_\theta - s_\theta & s_\theta + c_\theta & w + l \\ c_\theta + s_\theta & s_\theta - c_\theta & w + l \\ c_\theta - s_\theta & s_\theta + c_\theta & -w - l \end{bmatrix} \begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{w} \end{bmatrix}$$