Forward Kinematics → Modern Robotics Eqn 13.15

$$\dot{q} = \begin{bmatrix} \dot{\theta} \\ \dot{x} \\ \dot{y} \end{bmatrix} = \begin{bmatrix} -\frac{r}{2d} & \frac{r}{2d} \\ \frac{r}{2}\cos\theta & \frac{r}{2}\cos\theta \\ \frac{r}{2}\sin\theta & \frac{r}{2}\sin\theta \end{bmatrix} \begin{bmatrix} \dot{\phi}_l \\ \dot{\phi}_r \end{bmatrix}$$

where d is track_width

Inverse Kinematics

- we know the wheels are offset from eachother by the track_width
- body twist → wheel twist

$$V_i = A_{ib} V_b$$

so we get the following for each wheel:

RIGHT $$\begin{bmatrix} \dot{\theta} \\ v_{x_r} \\ v_{y_r} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ +d & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \dot{\theta} \\ v_x \\ v_y \end{bmatrix} = \begin{bmatrix} \dot{\theta} \\ v_x + d\dot{\theta} \\ v_y \end{bmatrix}$$

LEFT $$\begin{bmatrix} \dot{\theta} \\ v_{x_r} \\ v_{y_r} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ -d & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \dot{\theta} \\ v_x \\ v_y \end{bmatrix} = \begin{bmatrix} \dot{\theta} \\ v_x + d\dot{\theta} \\ v_y \end{bmatrix}$$

with rotation we get

RIGHT $$\begin{bmatrix} \dot{\theta} \\ r\dot{\phi}_r \\ 0 \end{bmatrix} = \begin{bmatrix} \dot{\theta} \\ v_x + d\dot{\theta} \\ v_y \end{bmatrix} \Rightarrow \dot{\phi}_r = \frac{v_x + d\dot{\theta}}{r}$$

LEFT $$\begin{bmatrix} \dot{\theta} \\ r\dot{\phi}_l \\ 0 \end{bmatrix} = \begin{bmatrix} \dot{\theta} \\ v_x - d\dot{\theta} \\ v_y \end{bmatrix} \Rightarrow \dot{\phi}_l = \frac{v_x - d\dot{\theta}}{r}$$