DiffDrive

- RobotState
  - x
  - y
  - theta
- WheelAngles
  - left
  - right
- WheelVelocities
  - left
  - right

Inverse Kinematics

left

$$\text{WheelVelocities} = \begin{bmatrix} \dot{\phi}_l \\ \dot{\phi}_r \end{bmatrix} = \frac{1}{r}\begin{bmatrix} -D & 1 & 0 \\ D & 1 & 0 \end{bmatrix}\begin{bmatrix} \dot{\theta} \\ v_x \\ v_y \end{bmatrix}$$

right

$$= \frac{1}{r}\begin{bmatrix} -D\dot{\theta} + v_x \\ D\dot{\theta} + v_x \end{bmatrix} = \begin{bmatrix} (-D\dot{\theta}+v_x)/r \\ (D\dot{\theta}+v_x)/r \end{bmatrix} \begin{matrix} ① \\ ② \end{matrix}$$

Forward Kinematics

$① + ② \Rightarrow \frac{2v_x}{r} = \dot{\phi}_l + \dot{\phi}_r$

$v_x = \frac{1}{2}r(\dot{\phi}_l + \dot{\phi}_r)$

$② - ① \Rightarrow \dot{\phi}_r - \dot{\phi}_l = \frac{2D\dot{\theta}}{r}$

$\dot{\theta} = \frac{r}{2D}(\dot{\phi}_r - \dot{\phi}_l)$

Given WheelAngles $\begin{bmatrix} \phi_l' \\ \phi_r' \end{bmatrix}$, we can get the WheelVelocities $\begin{bmatrix} \dot{\phi}_l \\ \dot{\phi}_r \end{bmatrix}$

now, $v_b = \begin{bmatrix} \dot{\theta} \\ v_x \\ v_y \end{bmatrix} = \begin{bmatrix} \frac{r}{2D}(\dot{\phi}_r - \dot{\phi}_l) \\ \frac{1}{2}r(\dot{\phi}_l + \dot{\phi}_r) \\ 0 \end{bmatrix}$

by integrating v_b, we get $T_{bb'}$

finally, $T_{wb'} = T_{wb} T_{bb'}$