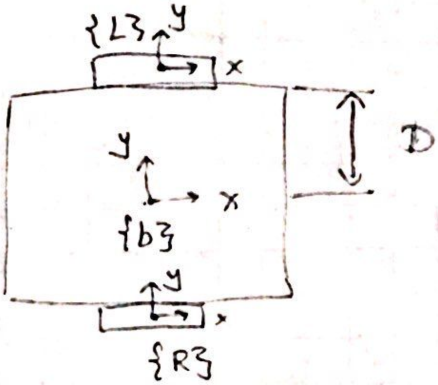
wheel base $D = 0.08$

wheel radius $r = 0.033$



$$T_{Lb}(0, 0, D) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & -D \\ 0 & 0 & 1 \end{bmatrix}$$

$$T_{RL}(0, 0, -D) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & D \\ 0 & 0 & 1 \end{bmatrix}$$

$V_L = A_{Lb} V_b$

$$\begin{bmatrix} \dot\theta \\ V_{xL} \\ V_{yL} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ -D & 1 & 0 \\ D & 0 & 1 \end{bmatrix} \begin{bmatrix} \dot\theta \\ V_x \\ V_y \end{bmatrix}$$

$V_R = A_{Rb} V_b$

$$\begin{bmatrix} \dot\theta \\ V_{xR} \\ V_{yR} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ D & 1 & 0 \\ D & 0 & 1 \end{bmatrix} \begin{bmatrix} \dot\theta \\ V_x \\ V_y \end{bmatrix}$$

$$\begin{bmatrix} \dot\theta \\ r\dot\phi_L \\ 0 \end{bmatrix} = \begin{bmatrix} \dot\theta \\ -D\dot\theta + V_x \\ V_y \end{bmatrix}$$

$$\begin{bmatrix} \dot\theta \\ r\dot\phi_R \\ 0 \end{bmatrix} = \begin{bmatrix} \dot\theta \\ D\dot\theta + V_x \\ V_y \end{bmatrix}$$

$$\boxed{\dot\phi_L = \frac{1}{r}(-D\dot\theta + V_x) \quad (1)}$$

$$\boxed{\dot\phi_R = \frac{1}{r}(D\dot\theta + V_x) \quad (2)}$$

From (1) : $\boxed{V_x = r\dot\phi_L + D\dot\theta \quad (3)}$

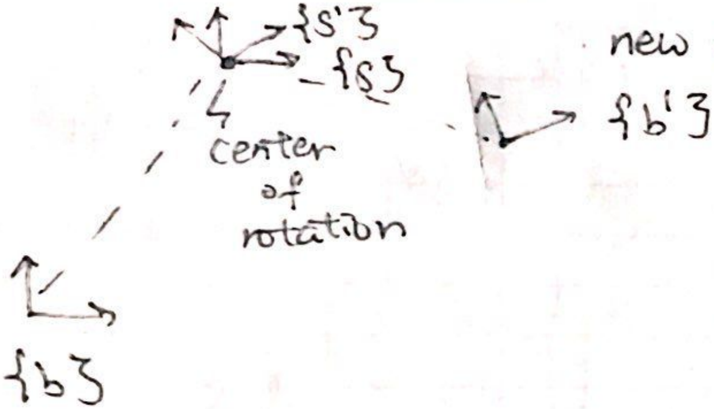
Put Into (2) : $\dot\phi_R = \frac{1}{r}(D\dot\theta + r\dot\phi_L + D\dot\theta) = \frac{2D}{r}\dot\theta + \dot\phi_L$

Then, $\boxed{\dot\theta = (\dot\phi_R - \dot\phi_L) \cdot \frac{r}{2D} \quad (4)}$

twist $V_b = \begin{bmatrix} \Delta\dot{\theta} \\ \Delta x_b \\ \Delta y_b \end{bmatrix}$ Use equation $V_b = H^{+} \dot{u}$, assuming $\Delta t = 1$

H is the config of the robot.

Translation + Rotation:



$$\begin{bmatrix} \dot{\theta} \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ y_s & 1 & 0 \\ -x_s & 0 & 1 \end{bmatrix} \begin{bmatrix} \Delta\theta \\ \Delta x_b \\ \Delta y_b \end{bmatrix}$$

$0 = y_s \Delta\theta + \Delta x_b$ $\quad$ $0 = -x_s \Delta\theta + \Delta y_b$

$\boxed{y_s = -\frac{\Delta x_b}{\Delta\theta} \quad (5)}$ $\quad$ $\boxed{x_s = \frac{\Delta y_b}{\Delta\theta} \quad (6)}$

$T_{bs} (0, x_s, y_s)$ $\quad T_{ss'} = (\Delta\theta, 0, 0)$

Since $\{b'\}$ is $\{b\}$ rotating around $\{s\}$, then $T_{b's'} = T_{bs}$.

Using Transformations: $\quad T_{bb'} = T_{bs} T_{ss'} T_{s'b'}$

$$T_{bb'} = T_{bs} T_{ss'} T_{bs}^{-1}$$

new config $\boxed{T_{wb'} = T_{wb} T_{bb'} \quad (7)}$

old config