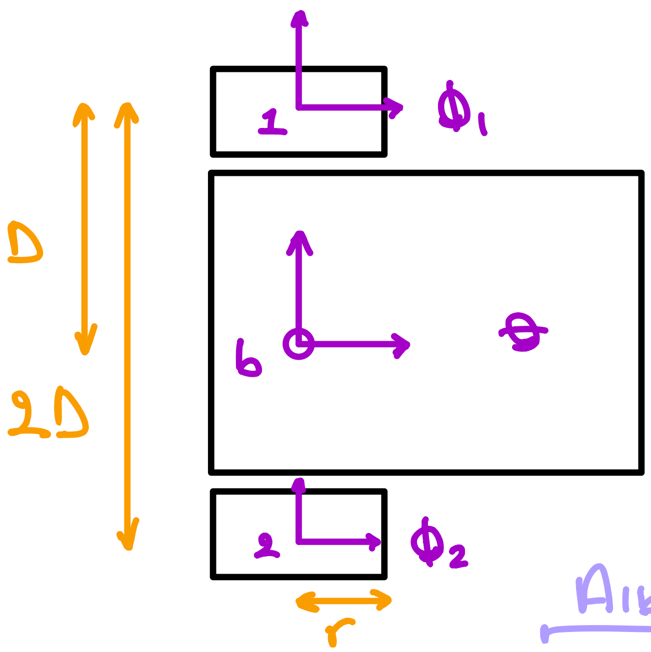
twistToWheels();



$T_{1b} = (0, 0, -D)$

$T_{2b} = (0, 0, D)$

$$V_1 = A_{1b} V_b = \overbrace{\begin{bmatrix} 1 & 0 & 0 \\ -D & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}}^{A_{1b}} \overbrace{\begin{bmatrix} \omega_z \\ V_x \\ V_y \end{bmatrix}}^{V_b} = \begin{bmatrix} \omega_z \\ -D\omega_z + V_x \\ V_y \end{bmatrix} = \begin{bmatrix} \omega_z \\ r\dot{\phi}_1 \\ 0 \end{bmatrix}$$

$$\Rightarrow \quad \dot{\phi}_1 = \frac{V_x - D\omega_z}{r}$$

Hence,

$$\begin{bmatrix} \dot{\phi}_1 \\ 0 \end{bmatrix} = \frac{1}{r} \begin{bmatrix} -D & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \omega_z \\ V_x \\ V_y \end{bmatrix}$$

$$\Rightarrow \quad \boxed{\dot{\phi}_1 = \frac{1}{r} \begin{bmatrix} -D & 1 & 0 \end{bmatrix} \begin{bmatrix} \omega_z \\ V_x \\ V_y \end{bmatrix}} \qquad \text{Eqn 1.1}$$

similarly,

$$\boxed{\dot{\phi}_2 = \frac{1}{r} \begin{bmatrix} D & 1 & 0 \end{bmatrix} \begin{bmatrix} \omega_z \\ V_x \\ V_y \end{bmatrix}} \qquad \text{Eqn 1.2}$$

wheelsToTwist();

$$\begin{bmatrix} u_L \\ u_R \end{bmatrix} = \begin{bmatrix} \dot{\phi}_1 \\ \dot{\phi}_2 \end{bmatrix} = \frac{1}{r} \begin{bmatrix} D & 1 & 0 \\ D & 1 & 0 \end{bmatrix} \begin{bmatrix} \omega_z \\ v_x \\ v_y \end{bmatrix}$$

$$\Rightarrow V_b = H^{+} u$$ pseudo-inverse

col-based: $H^{+} = (H^T H)^{-1} H^T$ × SINGULAR MATRIX

row-based: $H^{+} = H^T (H H^T)^{-1}$ ✓ OK

$$\text{so} \quad H^{+} = r \begin{bmatrix} -1/2D & 1/2D \\ 1/2 & 1/2 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \dot{\phi}_1 \\ \dot{\phi}_2 \end{bmatrix}$$

$$\boxed{\begin{bmatrix} \omega_z \\ v_x \\ v_y \end{bmatrix} = r \begin{bmatrix} -1/2D & 1/2D \\ 1/2 & 1/2 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \dot{\phi}_1 \\ \dot{\phi}_2 \end{bmatrix}}$$ Eqn 2