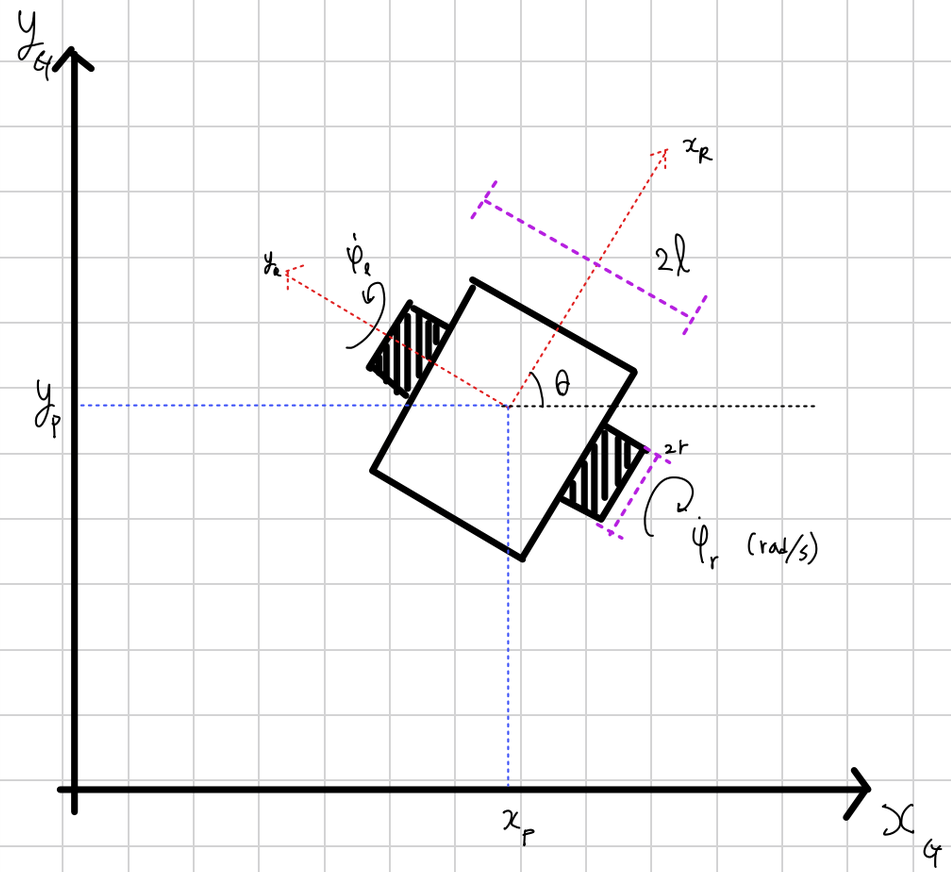
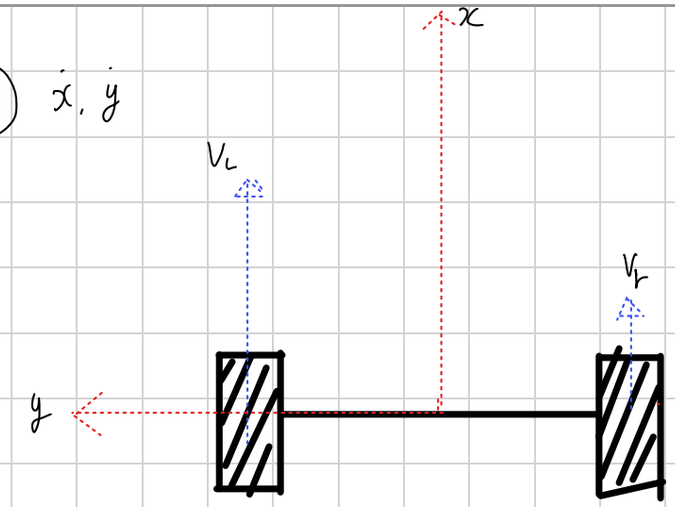


$$ {}^{G}P_R = \begin{bmatrix} x_P \\ y_P \\ \theta \end{bmatrix} $$

$$ {}^{G}\dot{P}_R = f(l, r, \theta, \dot{\varphi}_r, \dot{\varphi}_l) $$

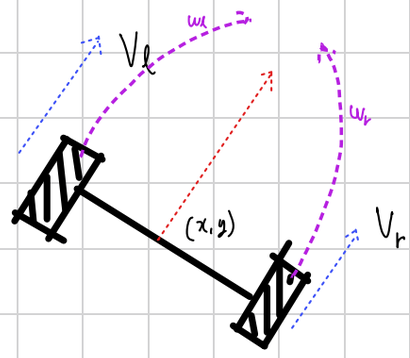
1) $\dot{x}, \dot{y}$



$$ \dot{x} = \tfrac{1}{2}(V_r + V_l) $$

$$ \dot{y} = 0 $$

2) $\dot{\theta}$



$$ \dot{\theta} = \omega_r + \omega_l $$

$$ = \frac{V_r}{2l} - \frac{V_l}{2l} $$

3) 로봇좌표계 기준

$$ \begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} \frac{1}{2}V_r + \frac{1}{2}V_l \\ 0 \\ \frac{1}{2l}V_r - \frac{1}{2l}V_l \end{bmatrix} = \begin{bmatrix} \frac{1}{2}r\dot{\varphi}_r + \frac{1}{2}r\dot{\varphi}_l \\ 0 \\ \frac{1}{2l}r\dot{\varphi}_r - \frac{1}{2l}r\dot{\varphi}_r \end{bmatrix} = r/2l \begin{bmatrix} l & l \\ 0 & 0 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} \dot{\varphi}_r \\ \dot{\varphi}_l \end{bmatrix} $$

4) 기준좌표계 기준

$$ {}^{G}\dot{P}_R = R^{-1}(\theta) \begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \dot{x} \\ \dot{\theta} \\ \dot{\theta} \end{bmatrix} = r/2l \begin{bmatrix} c & s & 0 \\ -s & c & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} l & l \\ 0 & 0 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} \dot{\varphi}_r \\ \dot{\varphi}_l \end{bmatrix} $$