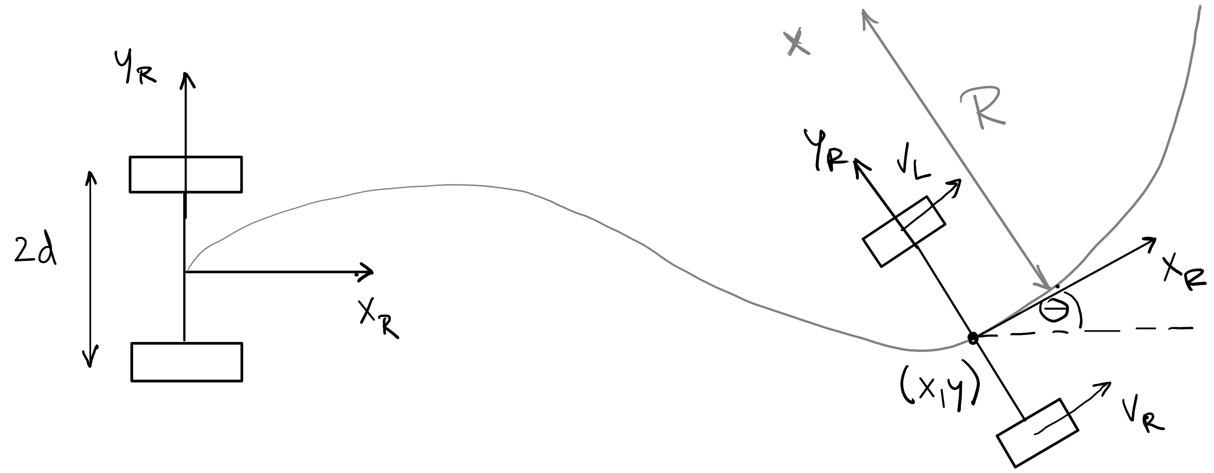
DIFF. DRIVE MR KINEMATIC MODEL



* robot pose defined as (x, y, θ)

$$V_R = \omega(R+d) \quad (1)$$
$$V_L = \omega(R-d) \quad (2)$$

$(1)-(2)$: $V_R - V_L = \cancel{\omega R} - \cancel{\omega R} + 2\omega d$

$$\boxed{\omega = \frac{V_R - V_L}{2d}}$$ MR angular velocity

$(1)+(2)$: $V_R + V_L = 2\omega R + \cancel{Rd} - \cancel{Rd}$

$$R = \frac{V_R + V_L}{2\omega} = \frac{V_R + V_L}{\frac{V_R - V_L}{d}}$$

$$\boxed{R = \frac{d(V_R + V_L)}{V_R - V_L}}$$ curvature radius

$$V = \omega R = \frac{\cancel{V_R - V_L}}{2\cancel{d}} \frac{d(V_R + V_L)}{\cancel{V_R - V_L}}$$

$$\boxed{V = \frac{V_R + V_L}{2}}$$ MR linear velocity

* V_R and V_L are whell lin. velocities $\Rightarrow$

$$V_R = \omega_R \cdot r_R \quad \text{and} \quad V_L = \omega_L \cdot r_L$$

wheel radii

we get from encoders

* final pose of the MR via integration

$$\boxed{\begin{aligned} \theta(t) &= \int_0^t \omega(t)\, dt \\ x(t) &= \int_0^t v(t) \cos\theta(t)\, dt \\ y(t) &= \int v(t) \sin\theta(t)\, dt \end{aligned}}$$

DISCRETE MR KINEMATIC MODEL

$$\dot{\theta}(t) = \omega(t)$$
$$\dot{x}(t) = v(t)\cos\theta(t)$$
$$\dot{y}(t) = v(t)\sin\theta(t)$$

$\Longrightarrow$ we will use Euler forward method $\Rightarrow$ $\dot{x}(t) \approx \dfrac{x(k+1) - x(k)}{T}$

sampling time between k and k+1

$$\frac{\theta(k+1) - \theta(k)}{T} = \omega(k) \Rightarrow$$
$$\frac{x(k+1) - x(k)}{T} = v(k)\cos\theta(k) \Rightarrow$$
$$\frac{y(k+1) - y(k)}{T} = v(k)\sin\theta(k) \Rightarrow$$

$$\boxed{\begin{aligned} \theta(k+1) &= \theta(k) + T\,\omega(k) \\ x(k+1) &= x(k) + v(k)T\cos\theta(k) \\ y(k+1) &= y(k) + v(k)T\sin\theta(k) \end{aligned}}$$

$\Uparrow$ final discrete MR kin. model

* we assume $x(k), y(k), \theta(k)$ to be given (from previous time step), if $k=0$ then $x(k) = y(k) = \theta(k) = 0$.