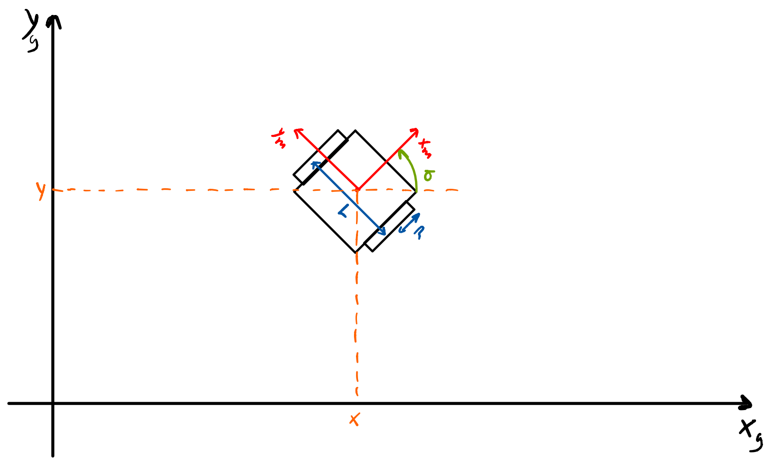
Differential Drive Kinematic Model

Acronyms

R = Wheel Radius   L = Distance between wheel σ = Angle of orientation

Robot World



Equation Model

$$\begin{cases} \dot{x} = \frac{R}{2}(V_R + V_L) \cdot \cos\sigma \\ \dot{y} = \frac{R}{2}(V_R + V_L) \cdot \sin\sigma \\ \dot{\sigma} = \frac{R}{L}(V_R - V_L) \end{cases}$$

This model makes use of both V_R and V_L. However, we want to receive linear velocity and angular velocity and output wheel velocities. We need to adapt it!

Unicycle Model

$$\begin{cases} \dot{x} = v \cdot \cos\sigma \\ \dot{y} = v \cdot \sin\sigma \\ \dot{\sigma} = \omega \end{cases}$$

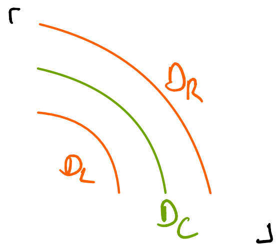
With the unicycle model, we now use a linear velocity v and the angular velocity ω which is what we want. To translate this into V_L, V_R, we need some more work.

$$\begin{cases} v \cdot \cos\sigma = \frac{R}{2}(V_R + V_L) \cdot \cos\sigma \\ v \cdot \sin\sigma = \frac{R}{2}(V_R + V_L) \cdot \sin\sigma \\ \sigma = \frac{R}{L}(V_R - V_L) \end{cases} \xrightarrow[\text{system for } V_L, V_R]{\text{solving the linear}} \begin{cases} V_R = \frac{2v + \omega L}{2R} \cdot \alpha \\ V_L = \frac{2v - \omega L}{2R} \cdot \alpha \end{cases}$$

α = scale factor

Robot Pose

We have both travelled wheel distances, D_L and D_R. We need to get the distance relative to the center of the robot.



$$\boxed{D_C = \frac{D_L + D_R}{2}} \quad (1)$$

Finally, we can compute the pose q with the following system:

$$q = \begin{cases} x = x_0 + D_C \cdot \cos \sigma \\ y = y_0 + D_C \cdot \sin \sigma \\ \sigma = \sigma_0 + \dfrac{D_R - D_L}{L} \end{cases}$$

where x_0, y_0, σ_0 is the initial pose