

Differential Drive Systems

Transitions

Diff drive state transitions

Use definition of angular velocity:

$$\omega = \frac{v_r}{R + \frac{l}{2}} = \frac{v_l}{R - \frac{l}{2}}$$

Then solve (assuming for now $v_r \neq v_l$) for R and ω :

$$R = \left(\frac{l}{2} \right) \frac{v_r + v_l}{v_r - v_l}$$

$$\omega = \frac{v_r - v_l}{l}$$

Updating the state

Starting at state (x_k, y_k, θ_k) and executing action (v_l, v_r) .

What is the new state $(x_{k+1}, y_{k+1}, \theta_{k+1})$?

Location of ICC:

$$c = [x - R \sin(\theta), y + R \cos(\theta)]$$

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New state:

$$\begin{bmatrix} x_{k+1} \\ y_{k+1} \\ \theta_{k+1} \end{bmatrix} = \begin{bmatrix} \cos(\omega \Delta t) & -\sin(\omega \Delta t) & 0 \\ \sin(\omega \Delta t) & \cos(\omega \Delta t) & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x - c_x \\ y - c_y \\ \theta \end{bmatrix} + \begin{bmatrix} c_x \\ c_y \\ \omega \Delta t \end{bmatrix}$$