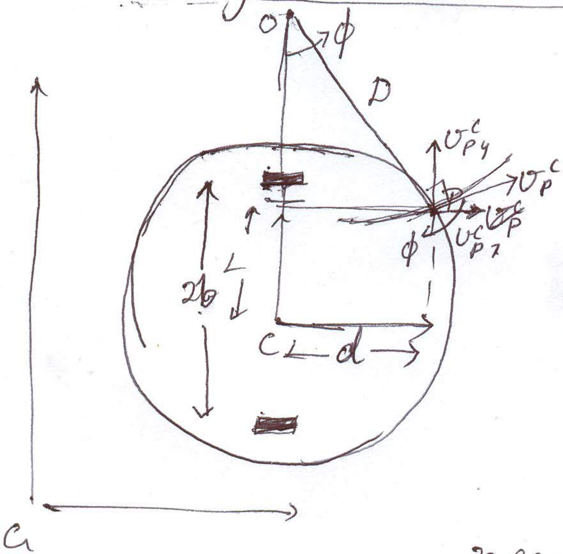
Velocity Obstacle method adapted for Differential Drive Bot.



Consider a point P on the robot, ~~A~~. Let P have a collision with another obstacle B. The velocity of P that allows it to come out of the collision cone of B is v_P^G, with respect to global frame G.

To effect this change the robot needs to undergo a change in orientation and hence an angular velocity about a point O, ω. Let C be the frame fixed to the center of the robot, not necessarily aligned with G.

$$v_P^c = \omega \times D = \omega D \sin 90 = \omega D.$$

$$v_{Px}^c = \omega D \cos\phi = \omega(R-L).\,; \quad v_{Py}^c = \omega D \sin\phi = \omega d.$$

$$\begin{bmatrix} v_{Px}^c \\ v_{Py}^c \end{bmatrix} = \begin{bmatrix} \omega R - \omega L \\ \omega d \end{bmatrix} = \begin{bmatrix} \frac{v_L + v_R}{2} - \left(\frac{v_R - v_L}{2b}\right) L \\ \left(\frac{v_R - v_L}{2b}\right) d \end{bmatrix} \quad \left[\begin{array}{l} 2b = \text{wheel base} \\ \text{and } b \neq L \end{array}\right]$$

$$= \begin{bmatrix} \frac{L}{2b} + 1/2 & 1/2 - \frac{L}{2b} \\ \frac{-d}{2b} & \frac{d}{2b} \end{bmatrix} \begin{bmatrix} v_L \\ v_R \end{bmatrix}$$

If frame C has a yaw of θ (robot's current heading in θ) with respect to G

then
$$\begin{bmatrix} v_{Px}^G \\ v_{Py}^G \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} \frac{L}{2b} + 1/2 & 1/2 - \frac{L}{2b} \\ \frac{-d}{2b} & \frac{d}{2b} \end{bmatrix} \begin{bmatrix} v_L \\ v_R \end{bmatrix}$$

Solve for v_L, v_R and hence ω that makes P come out of CC. Since θ keeps changing the eqn needs to be iteratively solved after every small interval δt, allowing robot to evolve with that v_L, v_R for δt.