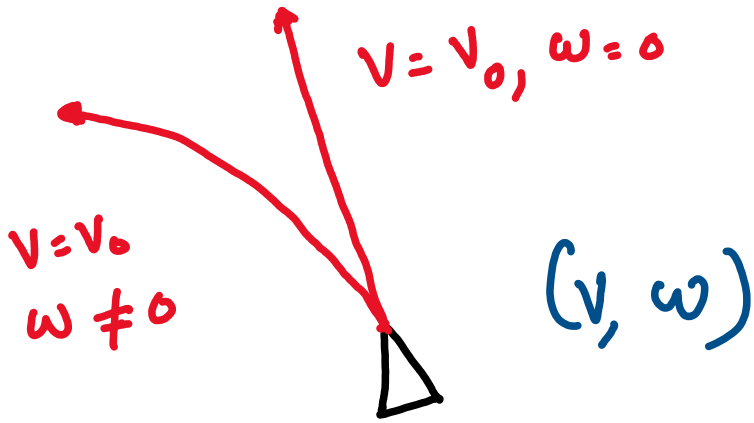
③ Dynamic Window Approach



- (v, ω) pair gives a curve
- over time t_h (prediction horizon)

set v, ω pairs ~ decision variables

compute v, ω pairs that avoid obstacles

compute v, ω pairs that get to the goal

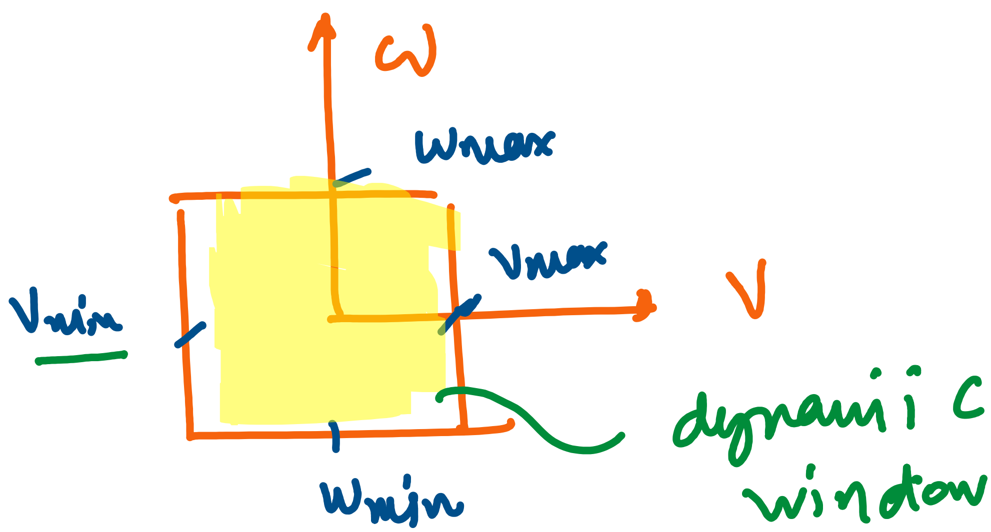
define a cost for getting to a goal / avoiding obstacles

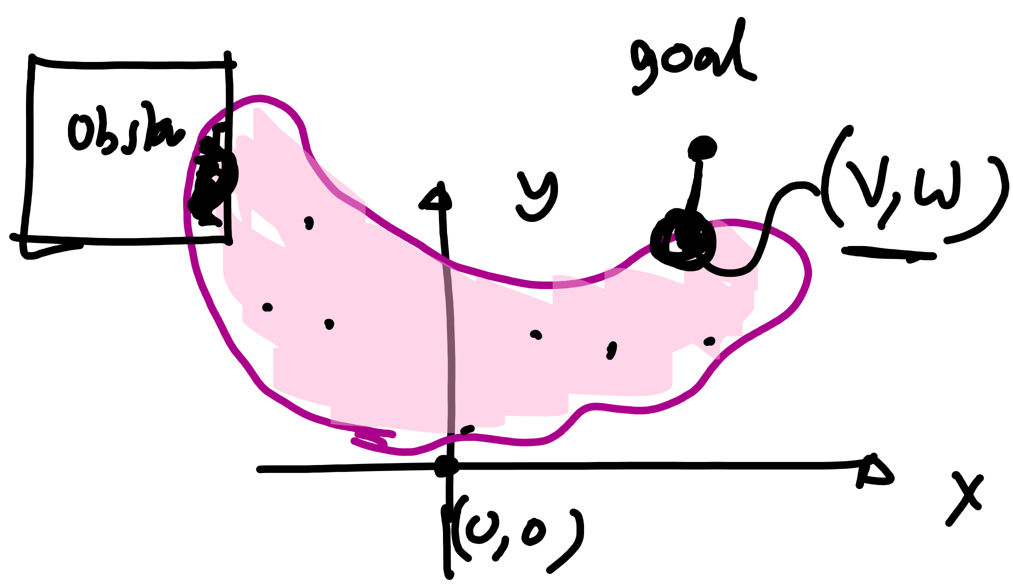
find v, ω that minimizes this cost.

(i) How to choose v, ω pairs:

$$v \equiv (\underbrace{v_0 - a_{min}\,dt}_{v_{min}};\ \underbrace{v_0 + a_{max}\,dt}_{v_{max}})$$

$$\omega \equiv (\underbrace{\omega_0 - \alpha_{min}\,dt}_{\omega_{min}};\ \underbrace{\omega_0 + \alpha_{max}\,dt}_{\omega_{max}})$$





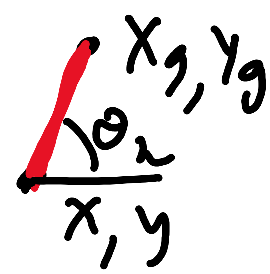
(ii) choosing a cost:

$$cost = c_1\,(cost\_to\_goal) + c_2\,(cost\_obstacle) + c_3\,(cost\_speed)$$

can add more

c_1, c_2, c_3 – user chosen constants.

$$cost\_to\_goal = \sqrt{(x-x_g)^2 + (y-y_G)^2}$$



$$= \tan^{-1}\left(\frac{y-y_G}{x-x_G}\right) = \theta_n$$

$$cost\_obstacle = \begin{cases} 0 & \text{no obstacle} \\ \infty & \text{there is an obstacle} \end{cases}$$

$$= \frac{1}{\sqrt{(x-x_{obs})^2 + (y-y_{obs})^2}}$$

cost_speed $= (V_{max} - V)^2$ favors driving fast

there are heuristics. Feel free to modify them.

(iii) Simulate the system over t_h and compute the cost for each (v, w)

Choose (v_0, w_0) corresponding to the minimum cost.