Week 2 2 - 4

Wednesday, February 23, 2022 1:16 PM

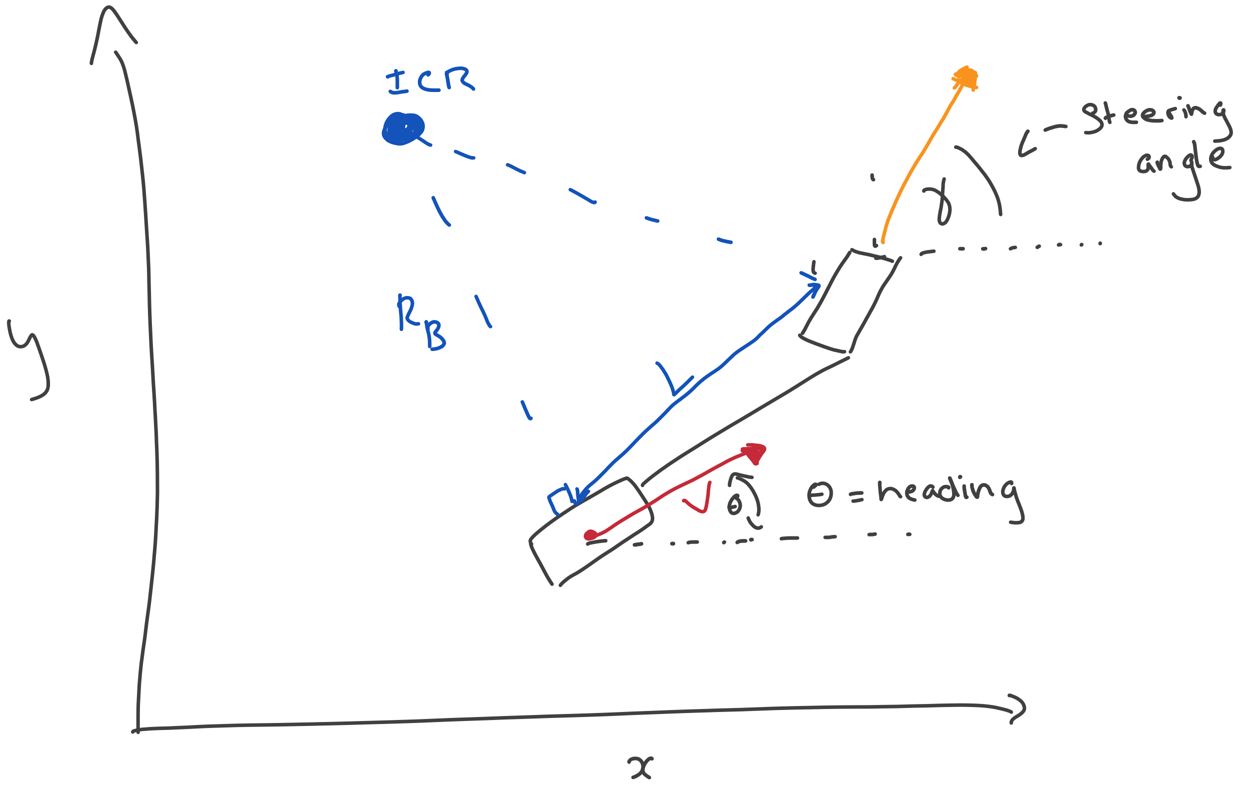
Remember:

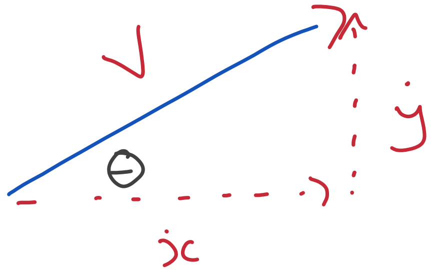
- Gamma = steering angle
- Theta = heading angle
- L = distance from axle to axle
- Back wheel and front wheel follow different curved paths
- R_b is the distance from the back wheel to the ICR

$\dot{x} =$

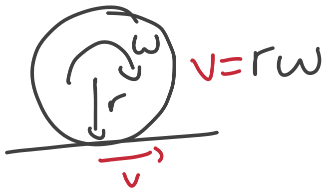
$\dot{y} =$

$\dot{\theta} =$



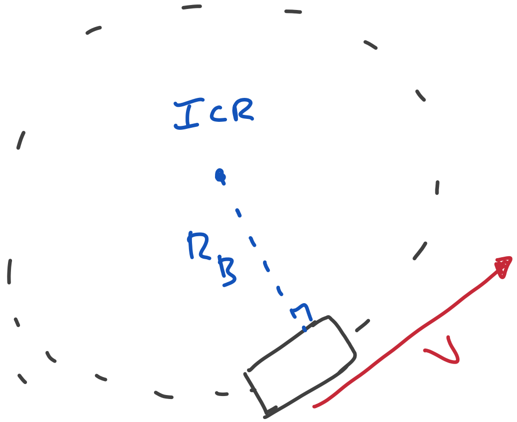


Given a wheels radius & angular velocity we can find the linear velocity.



We can use the same principle above:

$$\dot{x} = V\cos\theta$$
$$\dot{y} = V\sin\theta$$

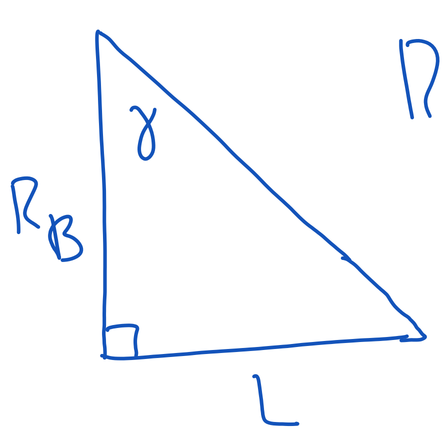


$$V = R_B\,\omega = R_B\,\dot{\theta}$$

$$\therefore\ \dot{\theta} = \frac{V}{R_B}$$

Now what is R_B?

→ This is where the length of axle to axle becomes important.



$$R_B = \frac{L}{\tan\gamma}$$

$$\therefore \dot{\theta} = \frac{V}{L}\tan\gamma$$

Euler approximations

$$x(t+1) = x(t) + dt \cdot \dot{x}(t)$$
$$= x(t) + dt \cdot v\cos(\theta(t))$$

$$y(t+1) = y(t) + dt \cdot v\sin(\theta(t))$$

$$\theta(t+1) = \theta(t) + dt \cdot \left(\frac{V}{L}\tan(\gamma(t))\right)$$

Equations

$$\dot{x} = V\cos\theta$$
$$\dot{y} = V\sin\theta$$
$$\dot{\theta} = \frac{V}{L}\tan\gamma$$

θ = heading angle

γ = steering angle

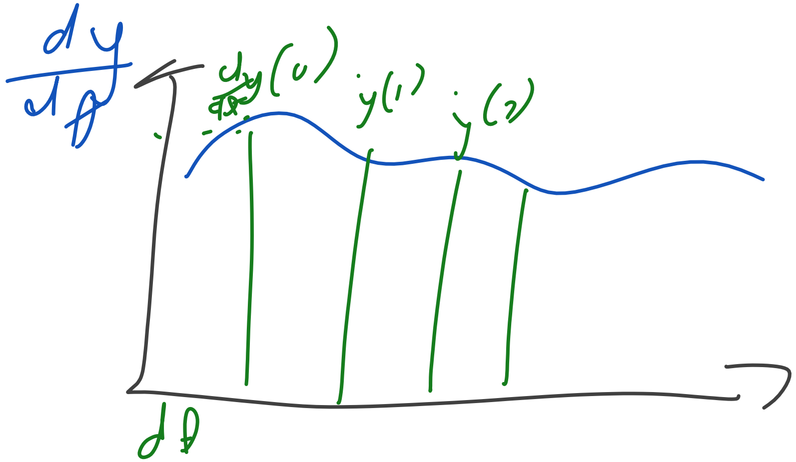
$V = 20\,km/h$

$\gamma = 20^\circ$

$$\dot{\theta} = \frac{20/3.6}{L} \times \tan(20^\circ)$$

E... Approximation

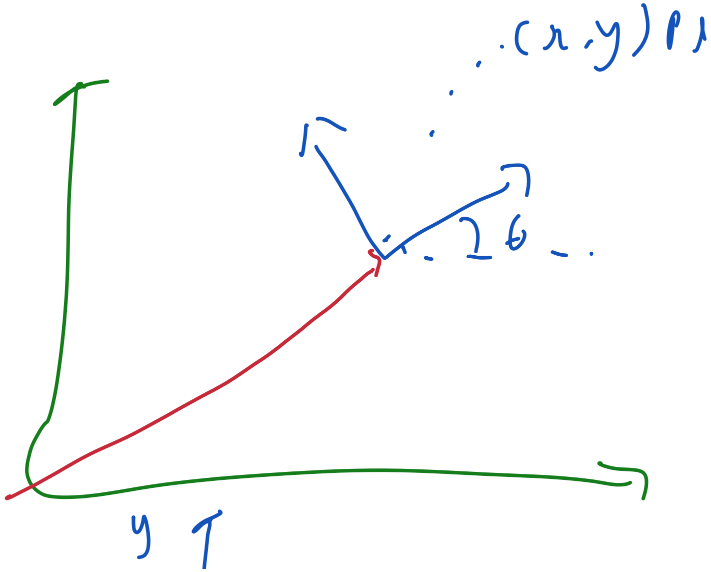
Euler Approxima



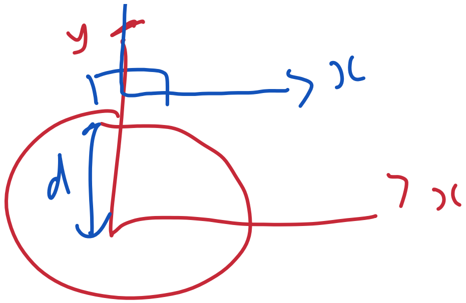
$$y = \int \frac{dy}{dt}\, dt$$

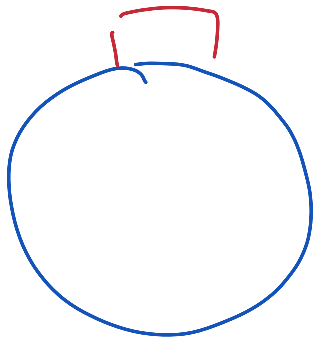
$$\approx \sum_{k=0}^{\infty} dt\, \frac{dy}{dt}(k)$$

$$X(k+1) = X(k) + dt \cdot \dot{x}(k)$$



$$P_G = R(\theta) \cdot P_l + T$$





steering angle of 20°

Q5 week 1

1. v = 1.2 m/s

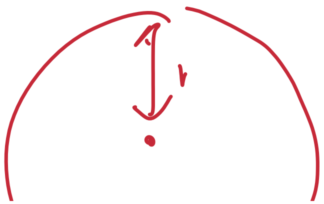
2) $\dot{\theta} = 0$

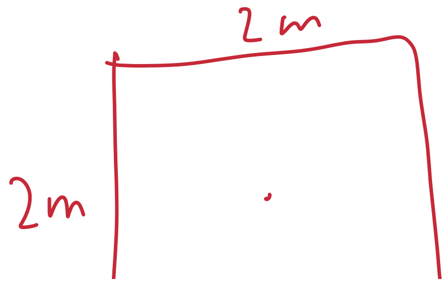
$$\dot{x} = \begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} v \cdot \cos\theta \\ v \sin\theta \\ 0 \end{bmatrix}$$

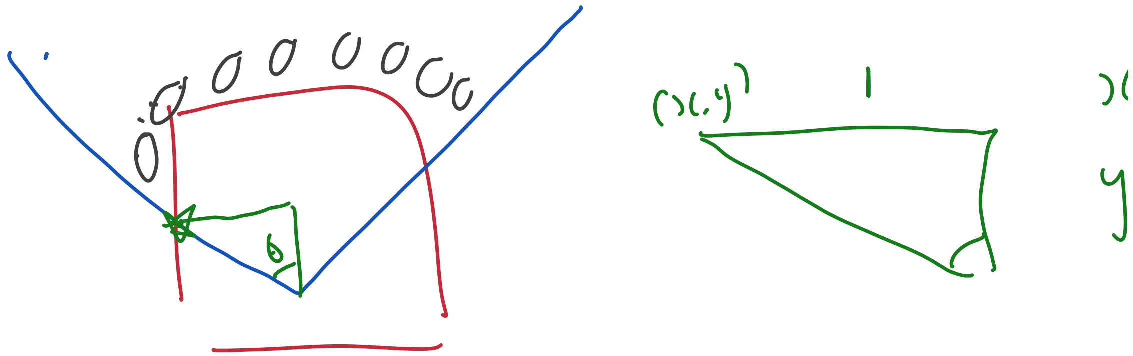
Q3 week 2

1. steering angle =

$$\dot{x} = \begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} v\ \mathrm{co} \\ v\ \mathrm{sin} \\ \frac{V}{L}\ \mathrm{tu} \end{bmatrix}$$






θ
(x, y)
1
y