

$$\textcircled{1} \quad \delta_f = \frac{V + r_a}{U} \quad r = \frac{U(\delta_f - \delta_r)}{a+b}$$

$$\textcircled{2} \quad \delta_r = \frac{V - r_a}{U}$$

Solve \textcircled{1} or \textcircled{2} for V and plug in r.

$$V = \frac{U(\delta_f b + \delta_r a)}{a+b}$$

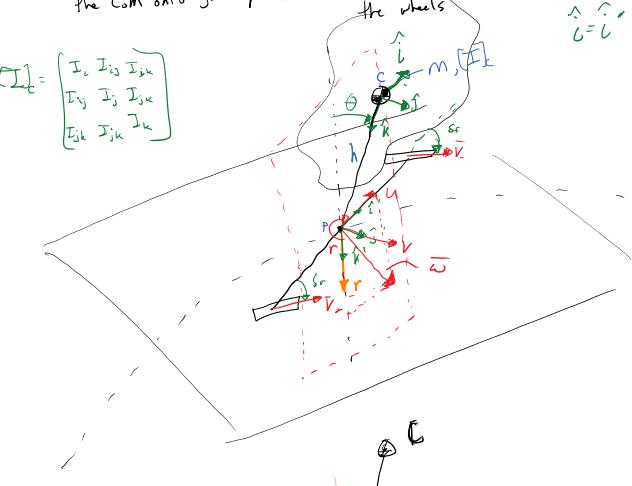
$$U, V = \frac{U(\delta_f b + \delta_r a)}{a+b}, \quad r = \frac{U(\delta_f - \delta_r)}{a+b}$$

Velocity components
of the projection of
the COM onto ground plane

yaw rate
of the
line connecting
the wheels

our vehicle is
symmetric
so

$$I_c = \begin{bmatrix} I_i & I_{ij} & I_{ik} \\ I_{ij} & I_j & I_{jk} \\ I_{ik} & I_{jk} & I_k \end{bmatrix}$$



in $\hat{i}, \hat{j}, \hat{k}$ plane

$$\bar{\omega} \rightarrow \dot{\theta}$$

$$\hat{i} : \dot{\theta}$$

$$\hat{j} : r \sin \theta$$

$$\hat{k} : r \cos \theta$$

$$\bar{V}_p$$

$$\hat{i} : U$$

$$\hat{j} : V \cos \theta$$

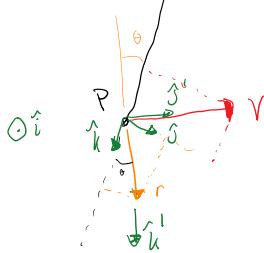
$$\hat{k} : -V \sin \theta$$

$$\bar{r} \text{ c/p}$$

$$\hat{i} : 0$$

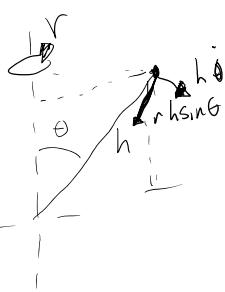
$$\hat{j} : 0$$

$$\hat{k} : -h$$



Two point theorem

$$\bar{V}_c = \bar{V}_p + \bar{\omega} \times \bar{r} \text{ c/p} \quad p \text{ to } c \quad \bar{r} \text{ c/p} = -h \hat{k}$$



$$\bar{V}_c$$

$$\hat{i} : U - rh \sin \theta$$

$$\hat{j} : V \cos \theta + \dot{\theta} h \cos \theta$$

$$\hat{k} : -V \sin \theta$$

$$V_c^2 = (U - rh \sin \theta)^2 + (V \cos \theta + \dot{\theta} h \cos \theta)^2 + (-V \sin \theta)^2$$

$$\bar{T} = \frac{1}{2} m V_c^2 + \frac{I_i \omega_i^2}{2} + \frac{I_j \omega_j^2}{2} + \frac{I_k \omega_k^2}{2}$$

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If $[J]_c$ is symmetric