Vehicle Dynamics Modelling and Simulation

CHAPTER 10.1

Liniowy model jednośladowy

Stała prędkość środka ciężkości

Ruch toczny pominięty

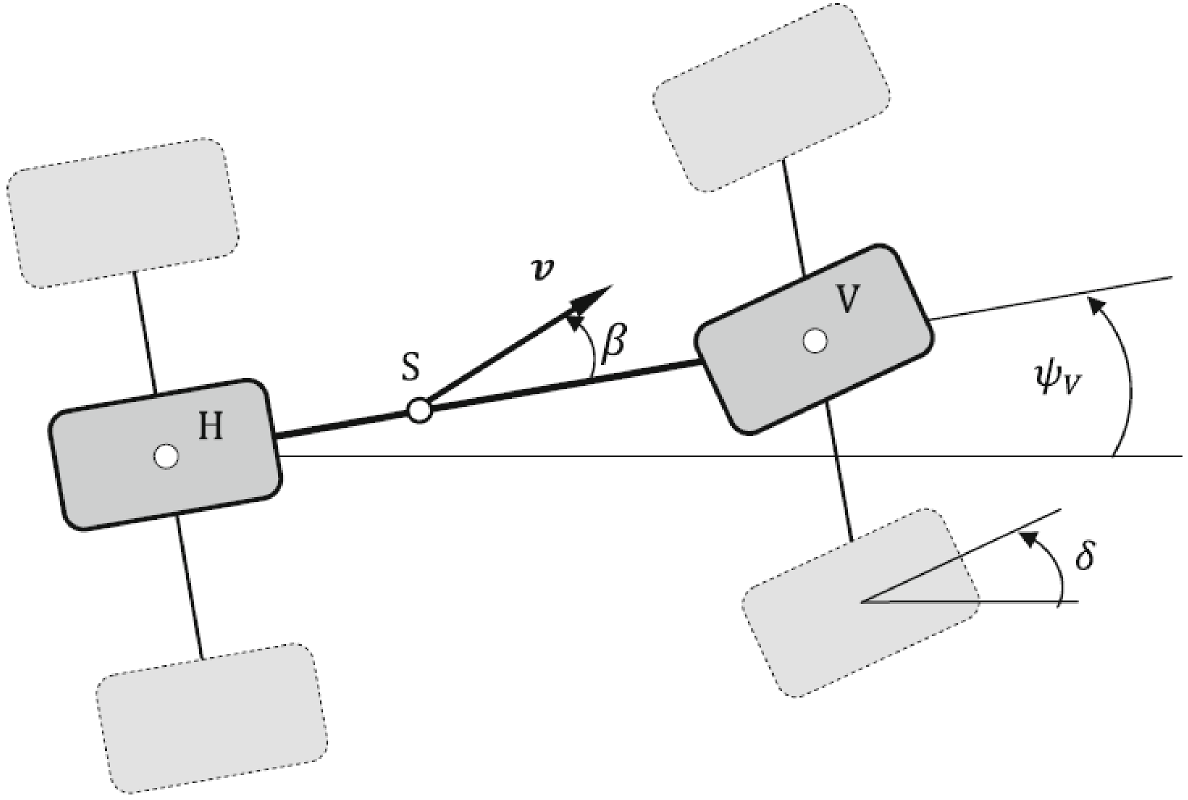
Masa w środku ciężkości

Przednie i tyle opony jako jedna opona na środku każdej z osi

Moment obrotowy wynikający z kąta poślizgu pominięty

Siły wzdłużne w oponach pominięte

$$a_y \leq 0,4g \approx 4\,\frac{\mathrm{m}}{\mathrm{s}^2}$$



Zależności

$$\tan \delta_A = \frac{l}{\sqrt{\rho_M^2 - l_h^2}}$$

$$\delta_A \approx \frac{l}{\rho_M}$$

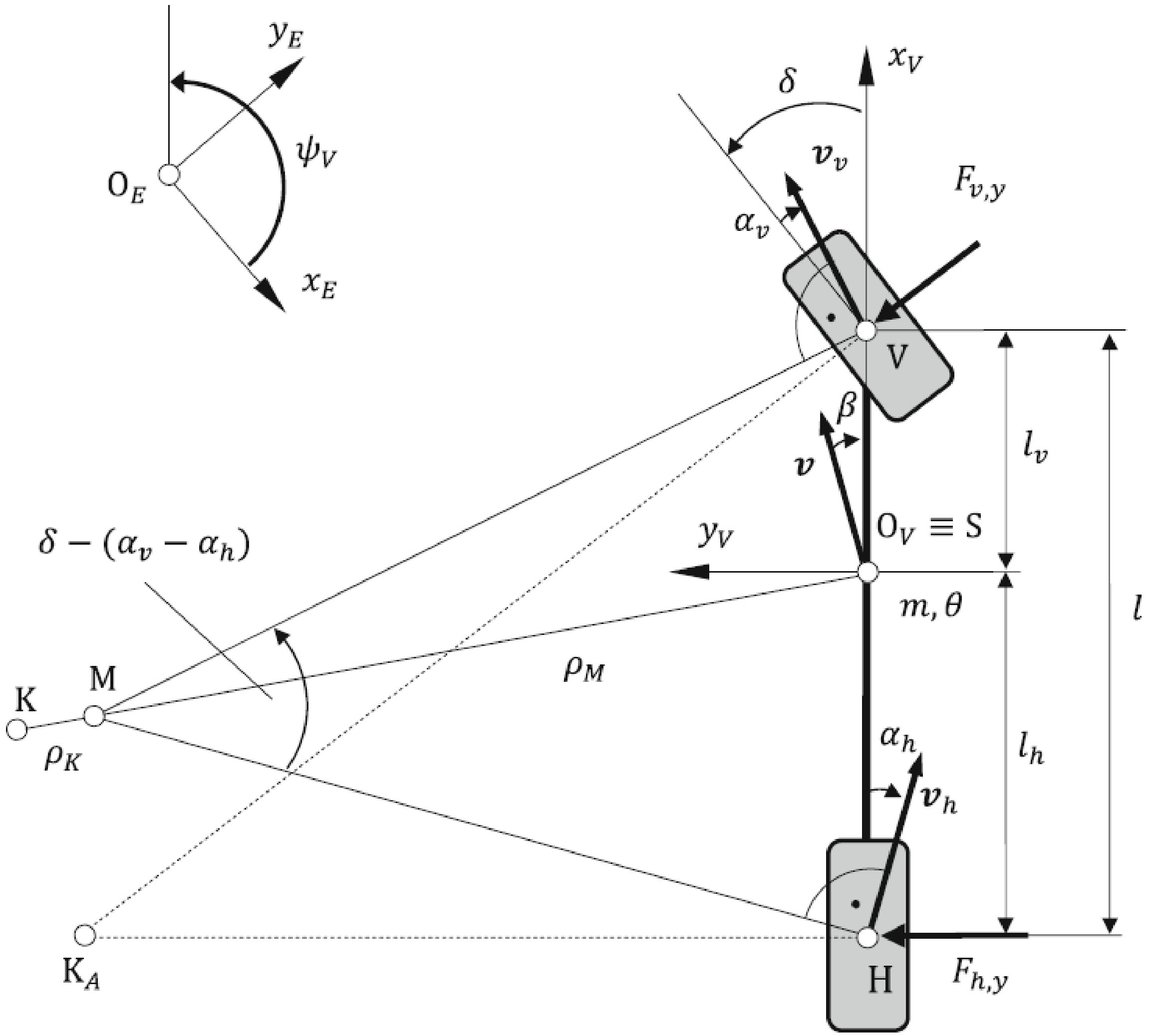
$$a_n = |\boldsymbol{a}_n| = v\left(\dot{\psi}_V + \dot{\beta}\right)$$

$$\rho_K = \frac{v}{\left(\dot{\psi}_V + \dot{\beta}\right)}$$

$$a_y = v\left(\dot{\psi}_V + \dot{\beta}\right)\cos\beta \approx v\left(\dot{\psi}_V + \dot{\beta}\right) = \frac{v^2}{\rho_K}$$

$$\alpha_v = \delta - \beta - l_v\frac{\dot{\psi}_V}{v}$$

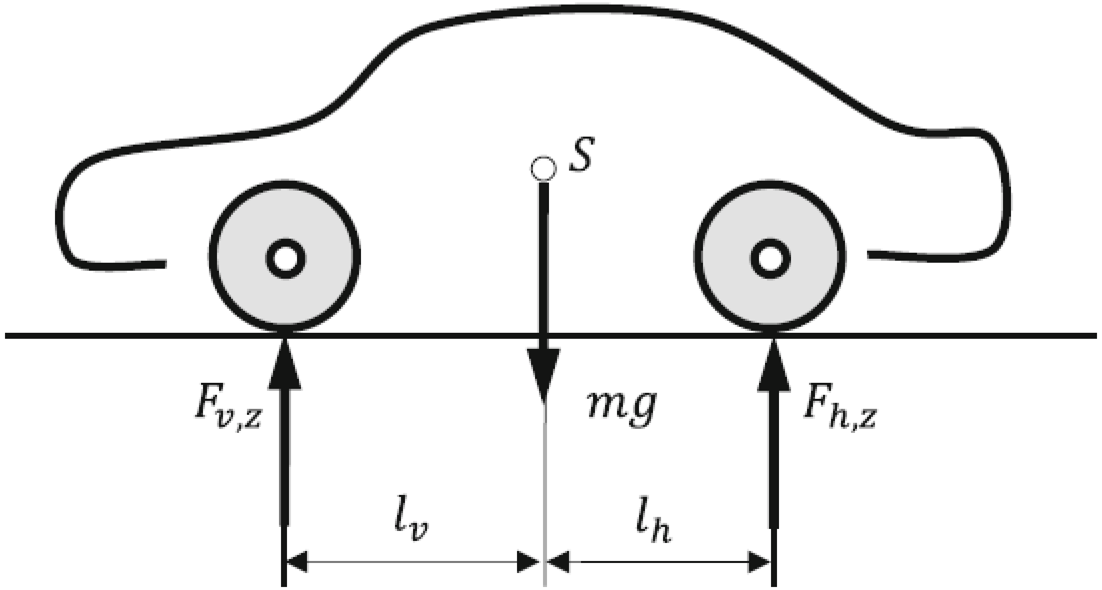
$$\alpha_h \approx -\beta + l_h\frac{\dot{\psi}_V}{v}$$



Obciążenia opon

$$F_{v,z} = mg\frac{l_h}{l} \quad \text{and} \quad F_{h,z} = mg\frac{l_v}{l}$$

$$F_{v,y} = c_{\alpha,v}\,\alpha_v \quad \text{and} \quad F_{h,y} = c_{\alpha,h}\,\alpha_h$$



Równania ruchu modelu

$$mv\left(\dot{\psi}_V + \dot{\beta}\right)\cos\beta = \cos\delta\, F_{v,y} + F_{h,y}$$

$$\theta\ddot{\psi}_V = F_{v,y}\cos\delta\, l_v - F_{h,y}\, l_h$$

$$mv\dot{\beta} + \left(mv^2 + c_{\alpha,v}l_v - c_{\alpha,h}l_h\right)\frac{\dot{\psi}_V}{v} + \left(c_{\alpha,v} + c_{\alpha,h}\right)\beta = c_{\alpha,v}\delta$$

$$\theta\ddot{\psi}_V + \left(c_{\alpha,v}l_v^2 + c_{\alpha,h}l_h^2\right)\frac{\dot{\psi}_V}{v} + \left(c_{\alpha,v}l_v - c_{\alpha,h}l_h\right)\beta = c_{\alpha,v}l_v\delta$$

Pokonywanie zakrętów

$$\delta = const, \dot{\delta} = 0$$

$$\dot{\psi}_V = const, \ddot{\psi}_V = 0$$

$$\beta = const, \dot{\beta} = 0$$

$$\rho_K = \frac{v}{\dot{\psi}_V + \dot{\beta}} = \frac{v}{\dot{\psi}_V} = \rho$$

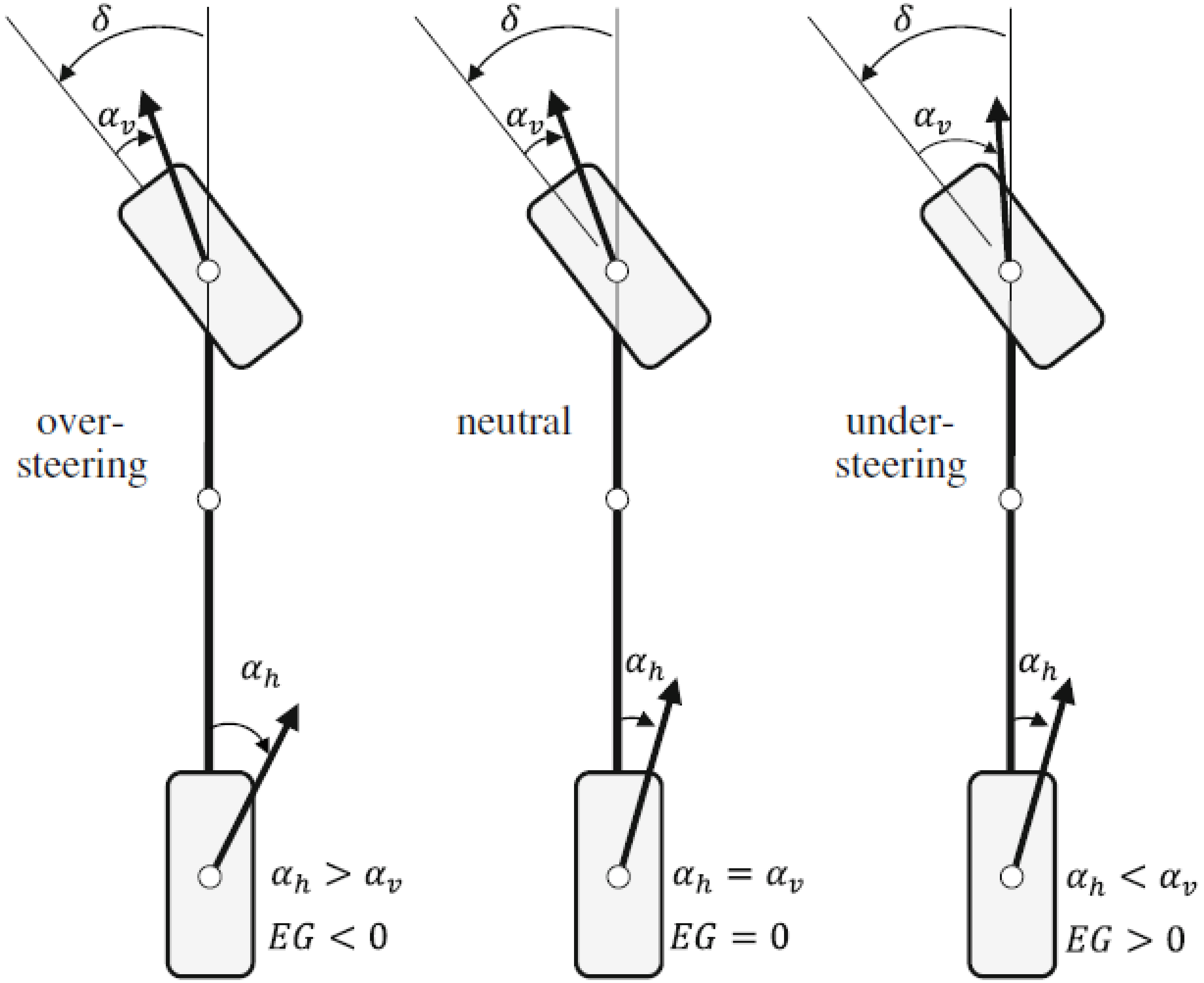
Sterowność

$$\beta = l_h \frac{\dot{\psi}_V}{v} - \alpha_h = \frac{l_h}{\rho} - \frac{m}{c_{\alpha,h}} \frac{l_v}{l} \frac{v^2}{\rho}$$

$$\delta = l_v \frac{\dot{\psi}_V}{v} + \alpha_v + \beta = \frac{l}{\rho} + \alpha_v - \alpha_h$$

$$= \underbrace{\frac{l}{\rho}}_{\delta_A} + \underbrace{\frac{m}{l}\left(\frac{l_h c_{\alpha,h} - l_v c_{\alpha,v}}{c_{\alpha,v} c_{\alpha,h}}\right)}_{EG} \underbrace{\frac{v^2}{\rho}}_{a_y} = \delta_A + EG \cdot a_y$$

$$EG \cdot a_y = \alpha_v - \alpha_h$$



Zależności

$$\dot{\psi}_V = \frac{v}{\rho} = const$$

$$F_{v,y} = m\frac{l_h}{l}\frac{v^2}{\rho} \qquad F_{h,y} = m\frac{l_v}{l}\frac{v^2}{\rho}$$

$$\alpha_v = \frac{F_{v,y}}{c_v} = \frac{m}{c_{\alpha,v}}\frac{l_h}{l}\frac{v^2}{\rho} \qquad \alpha_h = \frac{F_{h,y}}{c_h} = \frac{m}{c_{\alpha,h}}\frac{l_v}{l}\frac{v^2}{\rho}$$

$$v_{kr} = \sqrt{-\frac{l}{EG}}$$