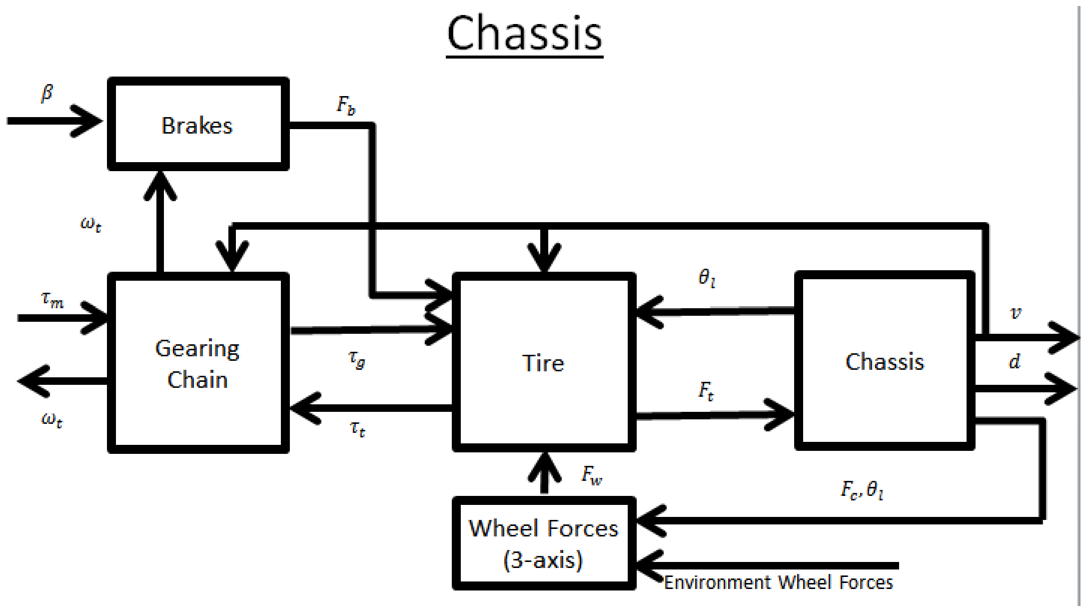

Figure 1: Vehicle Diagram

Vehicle

Gearing/Chain

$$\dot{\omega}_t = \frac{\tau_m - \tau_t}{J_m + J_g + J_t} \tag{1}$$

$$\tau_g = \frac{\tau_m \eta(\omega_t)}{R_g} \tag{2}$$

Brakes

$$F_b = \mu_b w_t \beta \tag{3}$$

Tire

$$\kappa_t = \begin{cases} 0.0085 + \frac{0.18}{p_t} + \frac{1.59*10^{-6}}{p_t} & : v_{kph} \leq 165(km/h) \\ \frac{0.18}{p_t} + \frac{2.91*10^{-6}}{p_t} & : v_{kph} > 165(km/h) \end{cases} \tag{4}$$

$$\tau_t = \tau_g - \frac{F_{w,long}}{r_t} - \frac{F_b}{r_b} - \kappa_t v_{kph}^2 \tag{5}$$

$$F_{max} = m_{t,gnd} F_{w,n} \tag{6}$$

$$F = \tau r_t \tag{7}$$

$$F_t = \begin{cases} F & : -F_{max} \leq F \geq F_{max} \\ F_{max} & : -F_{max} < F or F > F_{max} \end{cases} \tag{8}$$

$$\lambda = \frac{v - \omega_t r_t}{v} \tag{9}$$

The piece-wise function associated with F_t is an attempt to follow the curve below.

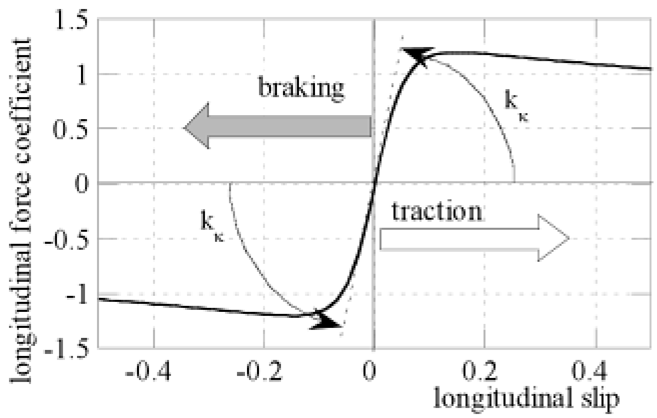

Figure 2: Force Coefficient Curve

Wheel Forces

$$F_{\omega,long} = F_{c,long} \tag{10}$$

$$F_{\omega,n} = F_{c,n} \tag{11}$$

Chassis

$$F_a = \frac{1}{2}\rho(d)C_d A v^2 \tag{12}$$

$$F_{c,long} = F_a + gm\sin(\theta_r(d)) \tag{13}$$

$$F_{c,n} = mg\cos(\theta_r(d)) \tag{14}$$

$$\dot{v} = mF_t \tag{15}$$

Environment

$$given : alt(d) \tag{16}$$

$$\theta_r = \frac{d}{dd}alt(d) \tag{17}$$

$$T_amb(d) = T_0 - Lalt(d) \tag{18}$$

$$P(d) = P_0\left(1 - \frac{Lalt(d)}{T_0}\right)^{\frac{gM}{RL}} \tag{19}$$

$$\rho(d) = \frac{PM}{1000RT} \tag{20}$$