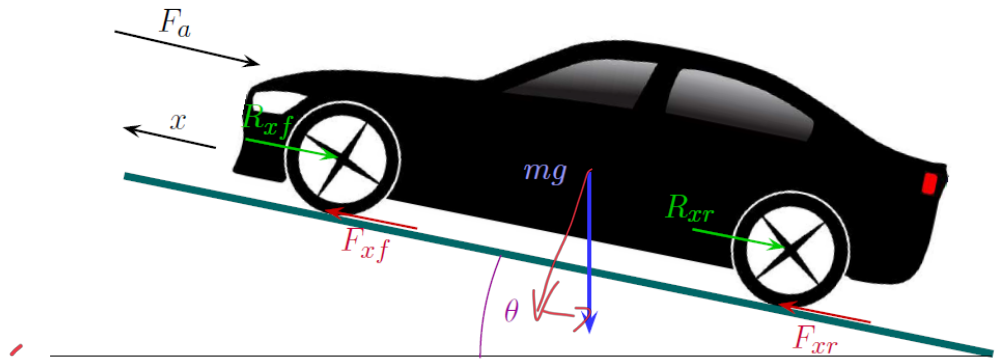

The model consists of the following equations:

- Longitudinal force on the wheels (in case of slipping): $F_{x_i} = \mu_i F_{z_i}$
- Total longitudinal force of the car: $F_x = 2F_{x_f} + 2F_{x_r}$
- Acceleration of the vehicle: $a = \frac{-F_x - F_d - R_{x,i}}{m}$
- Drag force: $F_a = \frac{1}{2}\rho A C_d v^2$
- Rolling resistance: $R_{x_i} = mgC_r$
- Slip: $\lambda_i = \frac{v - \omega r_i}{max(v, \omega r_i)}$
- Magic-formula for computing adhesion coefficient: $\mu_i = Dsin(Ctan^{-1}(B\lambda_i - E(B\lambda_i - tan^{-1}B\lambda_i)))$ where $D = 1$, $C = 3$, $B = 5$, $E = 0.97$
- angular acceleration of a wheel: $\dot{\omega}_i = \frac{\tau_{e_i} + \tau_{r_i} - \tau_{b_i} - \tau_{d_i}}{J_i}$, where τ_{e_i}: torque of the engine, τ_{b_i}: torque of the brake
- Tire traction force: $\tau_{r_i} = r_i F_{x,i}$
- Rolling friction: $\tau_{d_i} = \omega_i C_{f_i}$

The inputs of the system are the traction and the braking forces. The measured signal is the longitudinal velocity of the vehicle.

Prescribed performances: The tracking of the reference longitudinal velocity - using minimal input signal -
Parameters: A: front surface, m: total mass of the car, C_d: drag coefficient, C_r: rolling resistance coefficient, r_i: effective wheel radius, J_i: wheel inertia, C_{fi}: rolling friction coefficient, ρ: air density, v: longitudinal velocity.