MODEL OF CAR

JOHANNES MILZ

CONTENTS

NOTATION

β	steering angle
$\mu(s) = \sum_{k=0}^{2} \bar{\mu}_k s^k$	static friction
r	osculating circle
ω	velocity of steering angel
w	weather

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$$
\begin{aligned}
\dot{y} &= v(t)\cos(\beta(t)) \\
\dot{z} &= v(t)\sin(\beta(t)) \\
\dot{v} &= \frac{1}{m}\left(\frac{M(t)}{R} - F_B(t) - \frac{1}{2}c_w \rho A v(t)^2 - \left(f_{R0} + f_{R1}v(t) + f_{R4}v(t)^4\right) mg\right) \\
\dot{\beta} &= \omega_\beta
\end{aligned}
$$

The maximum static friction is

$$\left(\frac{mv(t)^2}{r(t)}\right)^2 + (m\dot{v})^2 \leq (\mu(t)mg)^2$$

$$\dot{\beta} = \frac{v(t)}{r(t)}$$

$$\phi(t) = \left(\frac{v(t)^2}{r(t)}\right)^2 + \dot{v}^2 - (\mu(t)g)^2$$

Define penalty function

$$P(s; v; \beta) = \begin{cases} 0 & \text{if } s \leq 0 \\ -\text{sign}(\beta) v s^4 & \text{if } s > 0 \end{cases}$$

$$\dot{\beta} = \omega_\beta + P(\phi(t); v(t))$$