0.1 Gearing and Chain

This system models the gear and chain in such a way to allow for wheel slip.

0.2 Inputs and outputs

0.2.1 Inputs

Input	Symbol	Unit
Motor Torque	τ_m	Nm
Tire Torque	τ_t	Nm

0.2.2 Outputs

Output	Symbol	Unit
Tire Velocity	ω_t	rad/s
Gear Torque	τ_g	Nm

0.2.3 Background, rationale, modeling strategy

The tire, chain, gear, and motor are modeled as a lumped inertia that is accelerated by the motor torque and tire torque(modeled as a load). The chain is modeled lossey through an efficiency map. Gearing is modeled as a ratio that linearly changes motor torque to gear torque. This method of modeling allows for wheel slip down the line.

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

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

0.2.4 States

State	Symbol	Unit
Tire Velocity	ω_t	rad/s

0.2.5 Variables

Output	Symbol	Unit
Motor inertia	J_m	$kg * m^2$
Gear inertia	J_g	$kg * m^2$
Chain inertia	J_c	$kg * m^2$
Tire inertia	J_t	$kg * m^2$
Gear Ratio	R_g	$\frac{\tau_m}{\tau_g}$

0.2.6 Functions

$\eta_c(\omega_t)$

Type	Description	Symbol	Unit
Input	Wheel Speed	ω_t	rad/s
Output	Chain Efficiency	n/a	%

The function is modeled as a look up table following the curve below described in the paper "Optimization of Chain Drives in Sports Motorcycles".

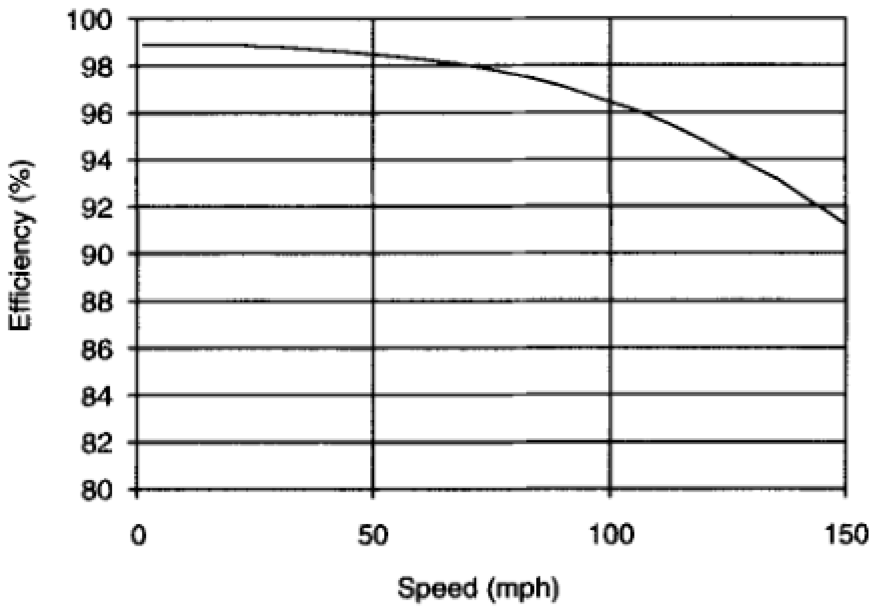

Figure 1: Estimated Chain Efficiency

0.2.7 Assumptions

- The chain and gearing is rigid (no chain/gear dynamics)
- Chain efficiency is only a function of wheel speed