0.1 Chassis

This system models the chassis of the motorcycle including the velocity of the motorcycle and forces on the road.

0.2 Inputs and outputs

0.2.1 Inputs

Input	Symbol	Unit
Tire Force	F_t	N
Air Density	ρ	kg/m^3
Road Gradient	θ_r	rad

0.2.2 Outputs

Output	Symbol	Unit
Vehicle Velocity	v	m/s
Distance Traveled	d	m
Lean Angle	θ_l	rad

0.2.3 Background, rationale, modeling strategy

The Chassis is modeled point mass with drag.

$$F_a = \frac{1}{2}\rho C_d A v^2 \tag{1}$$

$$F_{c,long} = F_a + gm\sin(\theta_r) \tag{2}$$

$$F_{c,n} = mg\cos(\theta_r) \tag{3}$$

$$\dot{v} = mF_t \tag{4}$$

$$\dot{d} = v \tag{5}$$

0.2.4 States

State	Symbol	Unit
Distance	d	m
Velocity	v	m/s

0.2.5 Variables

Output	Symbol	Unit
Gravity	g	m/s^2
Mass of Motorcycle	m	kg

0.2.6 Parameters

Param.	Symbol	Unit
Drag Area	C_dA	$\frac{N}{rad/s}$

0.2.7 Look Up table

$\theta_l(d)$

Type	Description	Symbol	Unit
Input	Distance Traveled	d	m
Output	Lean Angle	n/a	rad

0.2.8 Assumptions

- The full weight of the motorcycle is always on the correct tire for breaking or acceleration. That is not a bad assumption because maximum braking or acceleration will happen at wheelie or stoppie when there is only one tire on the ground.
- Lean angle does not affect Aero Drag
- No lateral forces