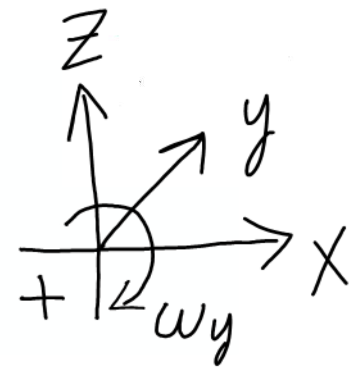
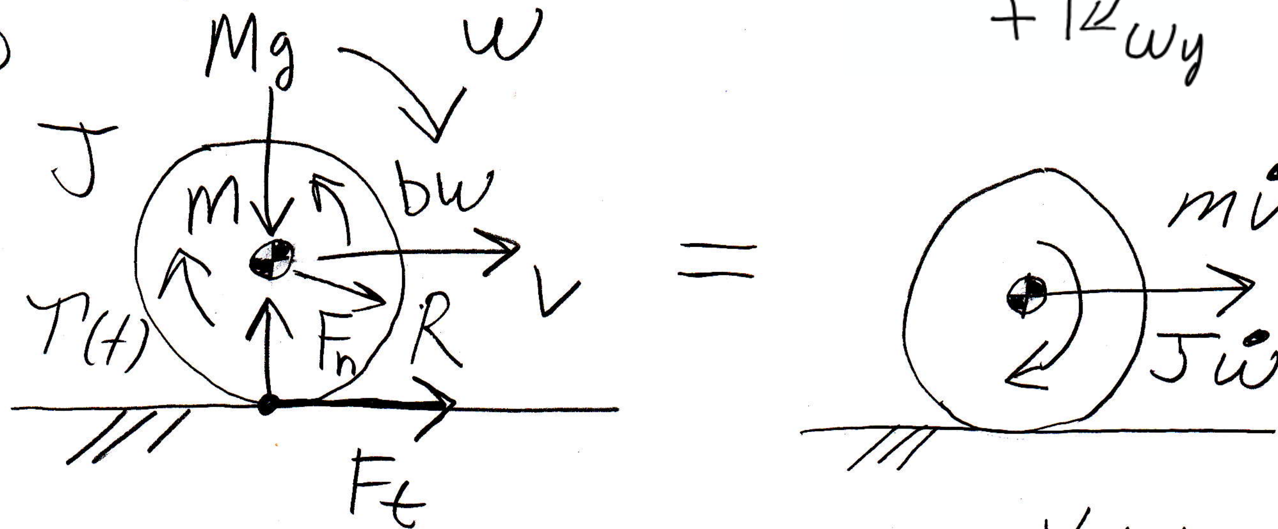


one wheel model:

FBD



V & w in compatible dir.

$T(t)$ - motor torque

F_n - normal force on wheel

F_t - tangential force on wheel

Newton's 2nd Law:

$$J\dot{\omega} = T(t) - b\omega - RF_t \quad (1)$$

$$m\dot{v} = F_t \quad (2)$$

$$F_t = \mu F_n \ , \quad F_n = mg$$

Tire friction model: $\mu = \mu(S)$

$\epsilon \ll 1$

Slip ratio S is defined by: $S = \dfrac{\omega R - V}{|V| + \epsilon}$

The slip ratio is a nondimensional measure of how much the wheel is slipping

For perfect rolling with no slipping S = 0

For complete slipping with no forward motion S = ∞

Negative slip ratios occur when braking ($S = -1$ locked brakes)

The friction coeffient function in general depends the road surface conditions and tires

A large number of tires are closely approximated by the semi-empirical "Magic Formula" (for tires).

A traction / braking / launch controller normally tries to achieve a good / optimal slip ratio (output y = S)