

I will use subscripts of 1 and 2 for motors 1 and 2 and use ω for speed, V for voltage, τ for torque, I for current, K_v for the motor velocity constant, and K_t for the motor torque constant.

We start with the known equations:

$$V = IR + \frac{\omega}{K_v}$$

$$\tau = IK_t$$

The speeds must always be equal:

$$\omega_1 = \omega_2 = \omega$$

And the torques just sum:

$$\tau_{net} = \tau_1 + \tau_2$$

And we have our laws, where J is the moment of inertia of whatever the motors are spinning:

$$\tau_{net} = J \frac{d\omega}{dt}$$

And we can substitute in using all our previous equations:

$$\frac{d\omega}{dt} = \frac{\tau_1 + \tau_2}{J} \tag{1}$$

$$\frac{d\omega}{dt} = \frac{I_1 K_{t1} + I_2 K_{t2}}{J} \tag{2}$$

$$\frac{d\omega}{dt} = \frac{\frac{V_1 - \frac{\omega}{K_{v1}}}{R_1} K_{t1} + \frac{V_2 - \frac{\omega}{K_{v2}}}{R_2} K_{t2}}{J} \tag{3}$$

$$\frac{d\omega}{dt} = \frac{\frac{V_1 K_{t1}}{R_1} + \frac{V_2 K_{t2}}{R_2} - \omega \left(\frac{K_{t1}}{K_{v1} R_1} + \frac{K_{t2}}{K_{v2} R_2} \right)}{J} \tag{4}$$

$$\tag{5}$$

And the torque will just be:

$$\tau_{net} = J \frac{d\omega}{dt}$$