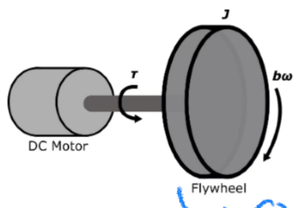
Agenda

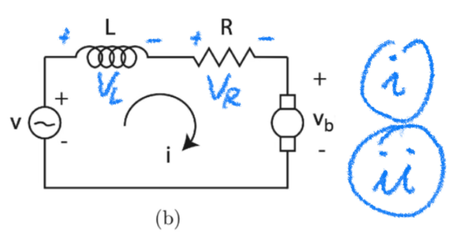
4/11/25

1. Modeling a DC Motor
   - Governing Eqs & Block Diagrams
2. "Car" Matlab Example (github.com/cnick1)
   - Matlab introduction
   - Creating & simulating simple control systems (P control, PI control)
   - Block diagrams

Modeling a DC Motor



(a) $\rightarrow \theta, \omega$

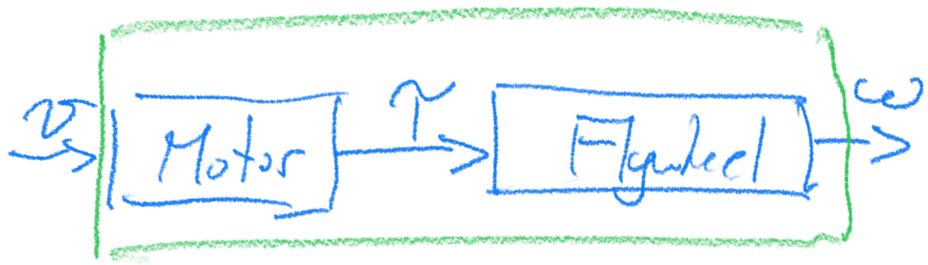


(b)

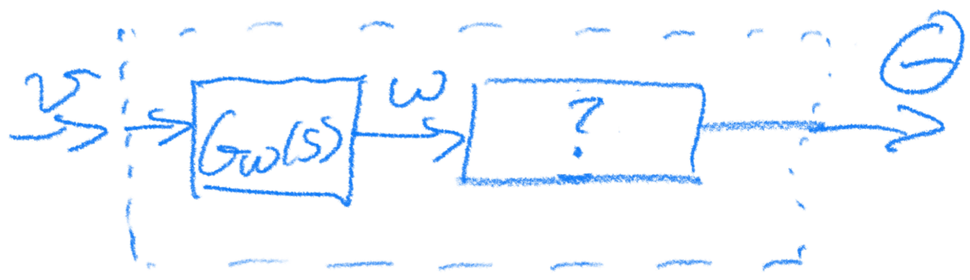
Figure 1: *(a) Simplified schematic of the mechanical motion of the system, including the critical modeling parameters. (b) Electrical circuit for a DC motor.*

(i) $v_b = K_v \omega$

(ii) $\tau = K_m i$



$G_\omega(s)$



$G_\theta(s)$

Equations of Motion: (Newton's 2nd Law)

$$J\dot{\omega} = \sum M$$
$$= \tau - b\omega$$
$$J\dot{\omega} + b\omega = \tau \quad (1) \quad \star$$

What if we include the electrical dynamics?

KVL: $v = v_L + v_R + v_b$

$$= L\frac{di}{dt} + Ri + K_v\omega$$
$$v = Ri + K_v\omega \quad (2)$$

$\rightarrow$ Rearrange (2) for $\dot{i}$

$$\dot{i} = \frac{v}{R} - \frac{K_v}{R}\omega$$

$$\rightarrow J\dot{\omega} + b\omega = K_m\left(\frac{v}{R} - \frac{K_v}{R}\omega\right)$$

$$J\dot{\omega} + \left(b + \frac{K_m K_v}{R}\right)\omega = \frac{K_m}{R}v \quad \star\star$$

$s\Omega(s)$ $\quad$ $\Omega(s)$ $\quad$ $V(s)$