$$\dot{i} = -\frac{R}{L}\, i - \frac{K_t}{L}\cdot \omega + \frac{1}{L}\cdot V$$

$$\dot{\omega} = \frac{K_t}{J}\, i - \frac{b}{J}\,\omega$$

$$\dot{\theta} = \omega$$

$$x = \begin{pmatrix} i \\ \omega \\ \theta \end{pmatrix} \leftarrow \text{output}$$

$$\dot{x} = \begin{pmatrix} \dot{i} \\ \dot{\omega} \\ \dot{\theta} \end{pmatrix} = \overbrace{\begin{pmatrix} -\frac{R}{L} & -\frac{K_t}{L} & 0 \\ \frac{K_t}{J} & -\frac{b}{J} & 0 \\ 0 & 1 & 0 \end{pmatrix}}^{A} \cdot \begin{pmatrix} i \\ \omega \\ \theta \end{pmatrix} + \overset{B}{\begin{pmatrix} \frac{1}{L} \\ 0 \\ 0 \end{pmatrix}} V$$

$$y = \overbrace{\begin{pmatrix} 0 & 0 & 1 \end{pmatrix}}^{C} \begin{pmatrix} i \\ \omega \\ \theta \end{pmatrix} + \overset{D}{\begin{pmatrix} 0 \end{pmatrix}} V$$

$$\dot{x} = Ax + Bu$$
$$y = Cx + Du$$

$$G(s) = \frac{Y(s)}{U(s)}$$

$$s X(s) = A X(s) + B U(s)$$

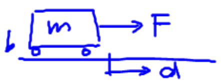
$$s X(s) - A X(s) = B U(s)$$

$$\underbrace{(sI - A)}\, X(s) = B U(s)$$

$$X(s) = (sI - A)^{-1} B\, U(s)$$

$$Y(s) = C\,(sI - A)^{-1} B\, U(s) + D\, U(s)$$

$$\boxed{G(s) = C\,(sI - A)^{-1} B + D}$$



$$G(s) = \frac{D(s)}{F(s)} = C\,\underbrace{(sI - A)}^{-1} B + D$$

$$A = \begin{pmatrix} -\frac{b}{m} & 0 \\ 1 & 0 \end{pmatrix}$$

$$\begin{pmatrix} s & 0 \\ 0 & s \end{pmatrix} - \begin{pmatrix} -\frac{b}{m} & 0 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} s + \frac{b}{m} & 0 \\ -1 & s \end{pmatrix}$$

$$B = \begin{pmatrix} \frac{1}{m} \\ 0 \end{pmatrix}$$

$$C\, \frac{1}{s^2 + \frac{b}{m} s} \begin{pmatrix} s & 0 \\ 1 & s + \frac{b}{m} \end{pmatrix} B =$$

$$C = \begin{pmatrix} 0 & 1 \end{pmatrix}$$

$$= \frac{\begin{pmatrix} 1 & s + \frac{b}{m} \end{pmatrix} \begin{pmatrix} \frac{1}{m} \\ 0 \end{pmatrix}}{s^2 + \frac{b}{m} s} = \frac{\frac{1}{m}}{s\left(s + \frac{b}{m}\right)}$$