$C_{1000}^{10000}$

摩擦不考虑 $b_b = 0$

$$\begin{cases} I_{so}\cdot\ddot{\theta} = k_{mgl}\cdot\theta - b_b\cdot\dot{\theta} - \tau \\ I_R\cdot\dot{\omega}_{In} = \tau \end{cases}$$

$$\left.\begin{aligned} Ri + L\cdot\frac{di}{dt} &= u - k_e\omega_R \\ \omega_R &= \omega_{In} - \dot{\theta} \end{aligned}\right\} \text{带}$$

$$I_{so} = I_{bo} + I_{ro} + I_{mo}$$

杆 轮 电机

$$= \frac{1}{3}mL^2 + ML^2 + \frac{1}{2}MR^2 + M_mL^2 + \frac{1}{2}M_mR_m^2$$

~~$= \frac{1}{3}mL^2 + \cdots$~~

$$k_{mgl} = \left(m\frac{L}{2} + M_mL + ML\right)g$$

$b_b$

$$\left(\frac{1}{3}mL^2 + ML^2 + M_mL^2 + \frac{1}{2}MR^2 + \frac{1}{2}M_mR_m^2\right)\ddot{\theta} = \left(\frac{m}{2} + M_m + M\right)Lg\theta - \tau$$