$$F_R = \begin{cases} -\mu_g F_N & |\dot{x} > 0 \\ \mu_g F_N & |\dot{x} < 0 \end{cases}$$

$$= -\mu_g F_N \operatorname{sign}(\dot{x})$$

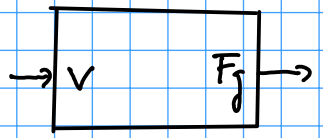
$$m\ddot{x} + \mu F_N \operatorname{sign}(\dot{x}) + cx = 0$$

$$\ddot{x} = -\alpha \operatorname{sign}(\dot{x}) - \omega_0^2 x$$

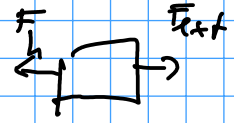
$$\alpha := \frac{\mu_g F_N}{m} \qquad \omega_0 = \sqrt{\frac{c}{m}}$$

$$\alpha = 1.1, \quad \omega_0^2 = 4$$

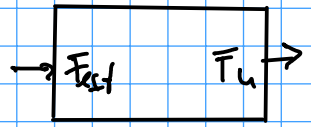
$$x_0 = 3 \quad v_0 = 0$$



$$F_g = -\mu_g F_N \operatorname{sign}(v)$$



$$F_h = \mu_h \cdot F_N =: \beta$$



$$F_h = \begin{cases} \beta & | \; F_{ext} < -\beta \\ -F_{ext} & | \; -\beta \le F_{ext} \le \beta \\ -\beta & | \; F_{ext} > \beta \end{cases}$$

$$F_h = -\operatorname{sign}(F_{ext}) \cdot \min(\beta, |F_{ext}|)$$