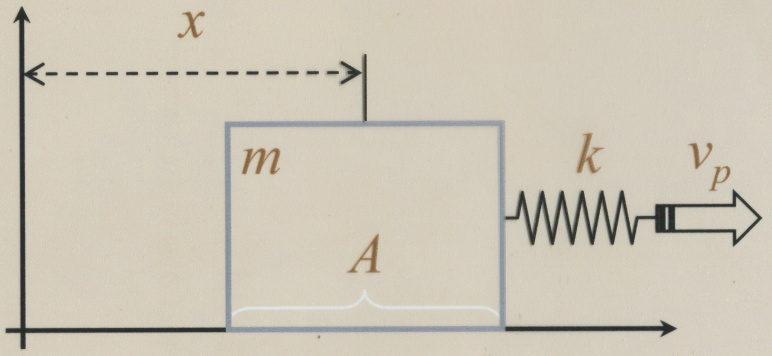
Slider-Block Model



- Equation of motion:

$$\left(\frac{\tau}{2\pi}\right)^2 \frac{dv}{dt} = v_p t - x - \frac{mg}{kA}\mu, \qquad v = \frac{dx}{dt}$$

v – block velocity
v_p – pulling velocity
k – spring constant
m – block mass
A – contact area
μ – coefficient of sliding friction
$\tau = 2\pi (m/k)^{1/2}$ – natural period of vibration

Rate and State Friction

$$\mu = \mu_0 + a \ln\left(\frac{v}{v_p}\right) + b \ln\left(\frac{v_p \theta}{L}\right)$$

- Slowness law

$$\frac{d\theta}{dt} = 1 - \frac{\theta v}{L}$$

- Slip law

$$\frac{d\theta}{dt} = -\frac{\theta v}{L} \ln\left(\frac{\theta v}{L}\right)$$

μ_0 – reference coefficient of sliding friction when $v = v_p$

θ – state variable; a, b, L - parameters

Nondimensional Equations of Motion

$$R\frac{dV}{dT} = T - X - KF, \qquad \frac{dX}{dT} = V$$

$$F = 1 + A\ln V + B\ln\Theta$$

$$\frac{d\Theta}{dT} = 1 - \Theta V, \qquad \text{slowness law}$$

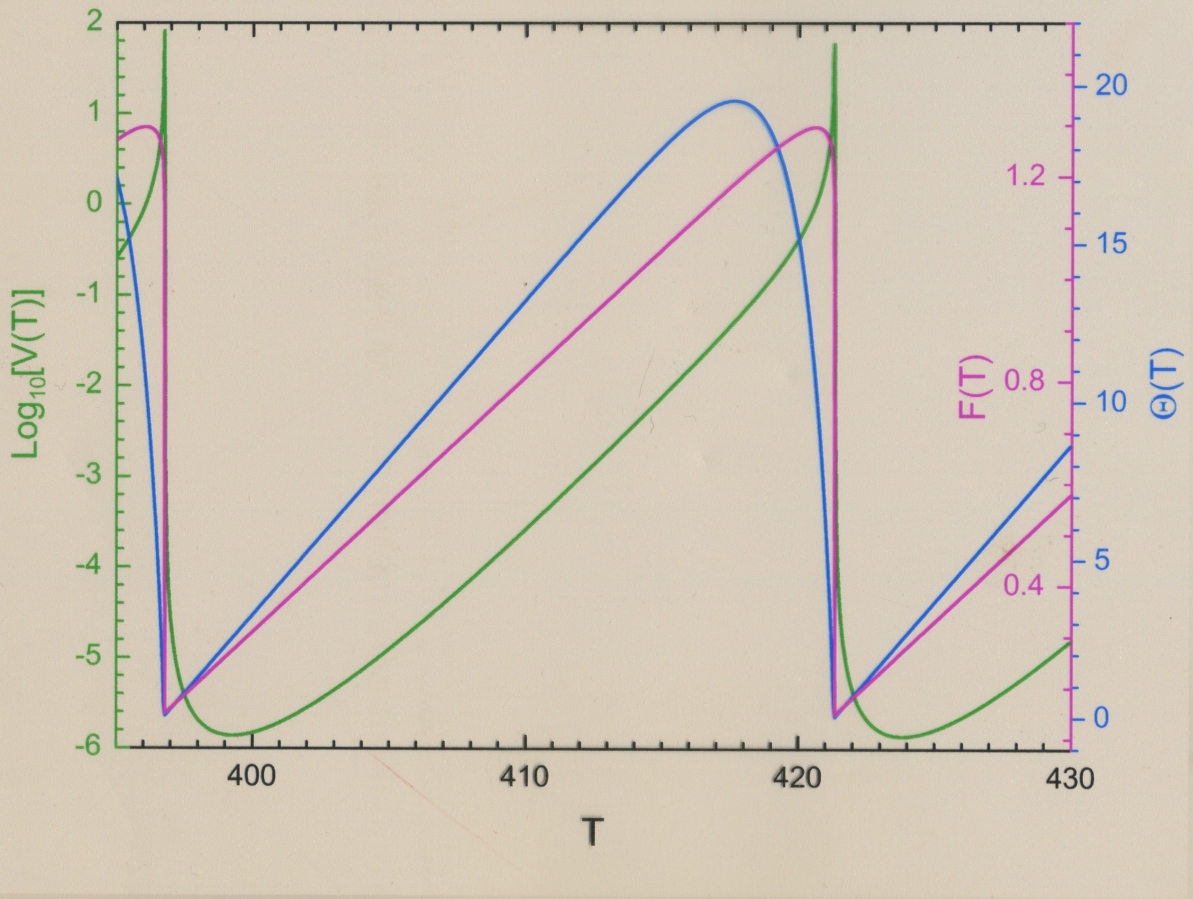
$$\frac{d\Theta}{dT} = -\Theta V\ln(\Theta V), \qquad \text{slip law}$$

- Nondimensional variables and parameters:

$$X = \frac{x}{L}, \quad V = \frac{v}{v_p}, \quad T = \frac{tv_p}{L}, \quad \Theta = \frac{\theta v_p}{L}, \quad F = \frac{\mu}{\mu_0}$$

$$R = \left(\frac{\tau}{2\pi}\frac{v_p}{L}\right)^2, \quad K = \frac{mg\mu_0}{kA}, \quad A = \frac{a}{\mu_0}, \quad B = \frac{b}{\mu_0}$$

Nondimensional Solutions



$R = 0.00001; K = 20.0; A = 0.0625; B = 0.125$