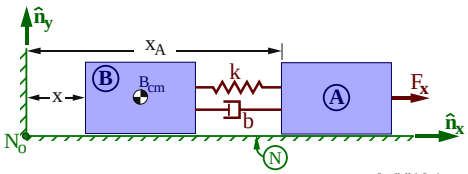
11.19 Optional redux: Stick-slip of mass-spring-damper system.

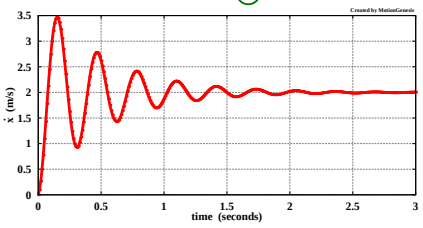
$\vec{\mathbf{F}} \;\Rightarrow\; \vec{\mathbf{F}} = m\,\vec{\mathbf{a}} \;\Rightarrow\; \ddot{x},\ F_{\text{static}}$

The following shows a block A that pulls a light (massless) linear spring/damper, attached to a uniform-density rectangular block B that slides on a rough horizontal table N (a Newtonian frame).

Description	Symbol	Value
Mass of block B	m	1 kg
Earth's gravitational acceleration	g	9.8 $\frac{\text{m}}{\text{s}^2}$
Spring constant	k	400 $\frac{\text{N}}{\text{m}}$
Natural length of spring	L_n	4 m
Damper constant ($b = 2\,\zeta\,\sqrt{m\,k},\ \ \zeta = 0.1$)	b	4 $\frac{\text{N s}}{\text{m}}$
Coefficient of kinetic friction between B and N	μ_k	0.2
Coefficient of static friction between B and N	μ_s	0.4
$\hat{\mathbf{n}}_\text{x}$ measure of A's position from N_o (**specified**)	x_A	$L_n + 2\,t$
$\hat{\mathbf{n}}_\text{x}$ measure of B's position from N_o	x	**Variable**

Unit vectors $\hat{\mathbf{n}}_\text{x}$ and $\hat{\mathbf{n}}_\text{y}$ are fixed in N.
$\hat{\mathbf{n}}_\text{x}$ is horizontally-right.
$\hat{\mathbf{n}}_\text{y}$ is vertically-upward.





Plot $\dot{x}(t)$ for $0 \le t \le 3$ sec when $x(0) = 0,\ \ \dot{x}(0) = 0$.

Simulation: To avoid divide by zero and numerical integrator problems, approximate sliding with the ***Continuous Friction Law*** in equation (21.6) and $\epsilon_v = 1 \times 10^{-5}$, (a number smaller than a characteristic value of $\left|{}^N\vec{\mathbf{v}}^B\right|$).

Solution at **www.MotionGenesis.com** ⇒ **Get Started** ⇒ **Stick-slip**.