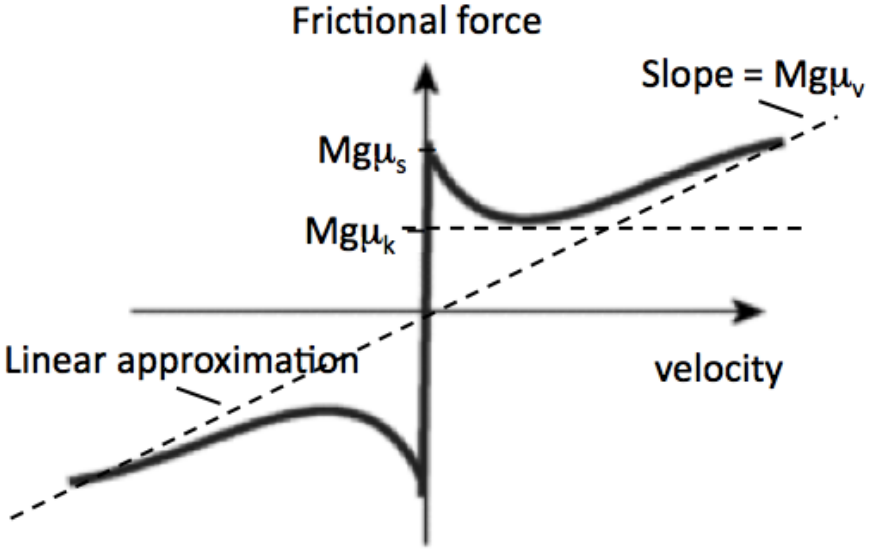
4. One approach to linearize a system is to pick an operating point and try to linearize about that point. As mentioned before, picking, say, some non-zero velocity, v_0,technically gives you a affine (non-linear system). However, if, for example, we also restrict ourselves to v(t) > 0 and only large input forces, i.e. and F(t) >> Mgμ, (or use F'(t)=F(t)- Mgμ) then the system looks like a simple capacitor.

My favorite approach is to grease the block! Although no one actually came up with this solution, greasing changes the system from having kinetic/static friction to one having viscous friction for which force is indeed linearly proportional to velocity. Adding some labels to the frictional model for a greased block...



μ_s = cofficient of static friction
μ_k = cofficient of kinetic friction
μ_v = cofficient of viscous friction

Now, one reasonable model would be just to use the linear approximation drawn on the plot, i.e. model using a capacitor and a resistor. This model would be accurate for intermediate velocities, breaking down for velocities near zero and at very high velocities where fiscous friction, or drag, becomes proportional to v^2 not v.