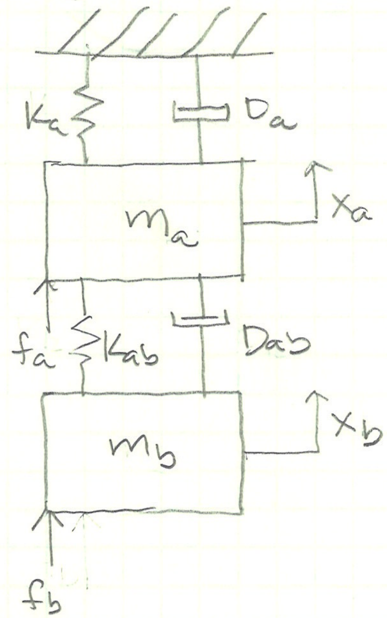
Spring/Mass Damper Systems are Even Easier

I have a somewhat unorthodox method for writing the equations of motion for these simple mechanical systems. An example might clarify.



Step-by-Step

(1) Assume that the system is hanging in gravitational equilibrium and that at this point $x_1 = x_2 = 0$. (I know they are not, but we assign the frame of reference!)

(2) Write the equations of motion for each mass as follows

for mass m_a connected to mass m_b

$$f_a = m_a \ddot{x}_a + D_a \dot{x}_a + D_{ab}(\dot{x}_a - \dot{x}_b) + k_a x_a + K_{ab}(x_a - x_b)$$

$$f_b = m_b \ddot{x}_b + D_{ab}(\dot{x}_b - \dot{x}_a) + K_{ab}(x_b - x_a)$$

Note that the relative terms, $\dot{x}_b - \dot{x}_a$, $x_a - x_b$ have the first term associated with the mass you are writing the equation for, e.g. for mass m_b the relative terms are

$D_{ab}(\dot{x}_b - \dot{x}_a)$ and $K_{ab}(x_b - x_a)$

for mass m_a

$D_{ab}(\dot{x}_a - \dot{x}_b)$ and $K_{ab}(x_a - x_b)$