

COEN 45, MATLAB Programming
Winter Quarter, 2011

Lab assignment #8
Experiments with a dynamic system
Mar. 1, 2, 3

In this lab you will experiment with a two-degree-of-freedom dynamic system. Two masses are connected by a spring and damper and are free to drop under gravity onto a rigid surface. Before hitting the surface, the equations of motion are

$$\begin{aligned}m_1\ddot{x}_1 + b(\dot{x}_1 - \dot{x}_2) + k(x_1 - x_2) &= -m_1g \\m_2\ddot{x}_2 + b(\dot{x}_2 - \dot{x}_1) + k(x_2 - x_1) &= -m_2g\end{aligned}$$

When the lower mass hits the ground, it stops moving and the system becomes a SDOF system. During the time it is grounded we must monitor the spring and damper forces $b(\dot{x}_1 - \dot{x}_2) + k(x_1 - x_2)$ to see if they are sufficient to cause liftoff.

Download the script `twomass.m` from the class web site along with the function it uses, `twomassfun.m`, which is incomplete. You will also need `drawbox.m`. Finish it by solving the equations above for \ddot{x}_1 (`x1ddot`) and \ddot{x}_2 (`x2ddot`). Then perform the following experiments with `twomass.m`:

1. Run it as is and count the number of times it lifts off. You can see this from either Figure 1 or Figure 2. (Three liftoffs.)
2. Try giving m_2 an initial upward velocity of 5 in/sec. Does this change the number of liftoffs?
3. Put the initial velocity back to zero and reduce mass m_2 to 9, 8, \dots 1. Record (by hand) the number of liftoffs for each mass value.
4. What happens to the number of liftoffs when you reduce the damping b , say from 25 to 10?