Massachusetts Institute of Technology
Department of Mechanical Engineering
2.003 Modeling Dynamics and Control I
Spring 2005
Lab 1, Feb/2/05

Part One. (Idealized spring-damper system.)

1. Based on the value of k you computed in the prelab, how much force should be required to displace the tip of the cantilever 2.5 cm? Using the lab setup,does this feel about right?

2. Adjust the damping by rotating the knob at the back of the Airpot so that it takes the spring roughly 1 second to return "most of the way" to its initial position after being released. Using the digital camera, Matlab, and the methods you developed in the prelab, take data for this setting. Use your data to determine the time constant. Attach a print-out of your plots.[1]

3. From your data, determine a value (or values) for the damping coefficient b associated with the Airpot. Repeat for at least one other significantly different Airpot setting.

Part Two. For the remainder of this lab, we will study two screen door closing mechanisms and compare their behaviors with that of the idealized spring-damper system in Part One. One of the screen door mechanisms uses an oil-based damper, and the other uses a gas cylinder (similar to the Airpot we used in Part One).

Play with both the air-damper and oil-damper mechanisms. (The lab instructors can show you how to swap the two mechanisms and how to adjust the damping in each.)

4. Describe the difference(s) in behavior you notice between the two (air vs. oil) screen door mechanisms. Which mechanism do you feel has a dynamic response which is more similar to the idealized cantilever-Airpot system from Part One? Propose modification(s) to our first-order model (e.g. additional spring, mass and/or damper elements) which capture some of the unmodeled dynamics you observe. (Specify to which system(s) these modifications apply!)

[1]Your lab instructors will show you how to setup the video data capture and how to get plots made

5. Use a force gauge to measure the force needed to hold the door open in various positions. As mounted in the fixture, does this force seem to be linearly related to the displacement? Does this make sense? (Why or why not?)

Extra Credit.

6. From your own observations, do you find that the dynamic response of the cantilever-Airpot system in Part One depends at all on either the direction from which you release the cantilever or the amplitude of the displacement? Discuss *briefly*.

7. There is significantly more Coulomb friction in the screen door setup than in the idealized cantilever-Airpot hardware. (If you are not sure what the difference is between viscous damping and Coulomb friction, ask a lab instructor to help clarify this!) How can you observe the effects of Coulomb friction, and where do think most of this friction comes from?

8. Do you think the camera used in Part One would accurately capture all of the dynamic behavior you observed in the screen door mechanism and/or in the cantilever-Airpot hardware? (What can you say about the motion (if any) of the cantilever in each of three camera images below?)