Massachusetts Institute of Technology
Department of Mechanical Engineering
2.003 Modeling Dynamics and Control I
Spring 2005
Lab 3, week 3/07/05

In this lab, we explore the transient response of a second-order system as its stiffness and damping are varied. As always, be sure to show your work and attach a plot of each response that you obtain.

rod length (mm)	voice coil	s_{p1} (rad/sec)	s_{p2} (rad/sec)	k (N/m)	b (N·s/m)
50 mm	no magnet				
50 mm	closed				
100 mm	no magnet				
100 mm	closed				
165 mm	no magnet				
165 mm	closed				

1. For each of the conditions indicated in the table above, measure the response of the system to an initial displacement with zero initial velocity Note: Because of the way that the clamp is constructed, the length of the spring rod is measured from the end of the adjustable clamp to the *centerline* of the shaft.

2. From the measured responses, determine the poles s_{p1} and s_{p2}, stiffness k, and damping b. To get a hard copy of your data, first save the oscilloscope waveform in **Speadsheet** format onto the floppy disk provided. Then use the function **plotdata.m** to plot the data in MATLAB. Use **simdata.m** to simulate the response of a second-order system with your calculated poles and compare this with your experimental data (as a check). The necessary MATLAB files should already be loaded onto the floppy disk at your lab station.

3. Plot the poles that you obtained from your measurements on the same s-plane plot that you made in the prelab. Try to explain any discrepancies between the computed and measured values.

Extra-Credit

4. Tune the system to the "optimum" designs you found in Problem 5 of the prelab. Modify your design as necessary to obtain the best performance. If the actual "optimum" design varied from your predicted design, explain the variance. With the given specifications for Problem 5-b is there really an "optimal" design?