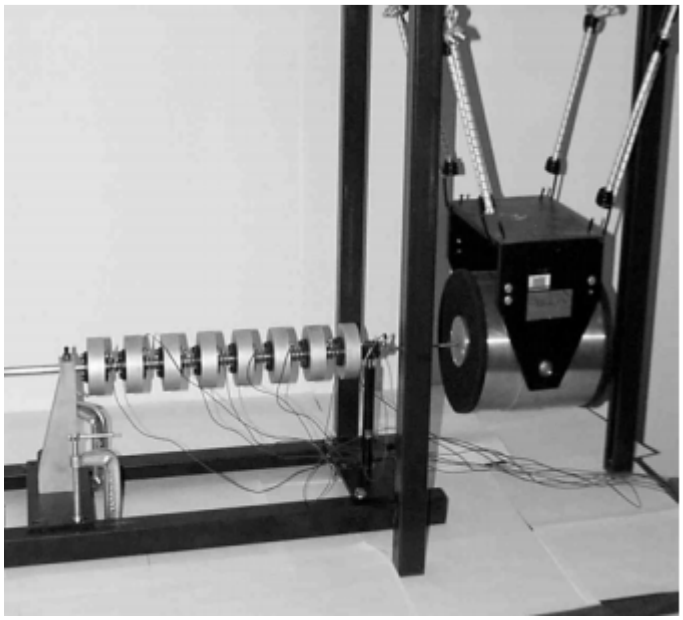
CE 8930 – Structural Health Monitoring, Spring 2014

3rd Class Exercise

In 2001, Hemez and Doebling completed a study on a laboratory system (for more information http://institutes.lanl.gov/ei/model_v/pubs/Hemez_00-0091.pdf.

"Our testbed for model validation in the context of nonlinear vibration is the LANL 8-DOF system (which stands for Los Alamos National Laboratory eight degrees of freedom system) illustrated in Figure 4. It is formed with eight translating masses connected by springs. Each mass is a disc of aluminum 25.4 mm thick and 76.2 mm in diameter with a center hole. The hole is lined with a Teflon bushing. There are small steel collars on each end of the discs. The masses all slide on a highly polished steel rod that supports the masses and constrains them to translate along the rod. The masses are fastened together with coil springs epoxied to the collars that are, in turn, bolted to the masses. The support rod introduces a source of friction that constitutes the first modeling challenge."



Study and run the driver m-file Spring8.m and report the values of the seven non-rigid resonant frequencies (in Hertz). Modify the driver m-file Spring8.m to simulate a damage case whereby the stiffness coefficient of the 5th spring is reduced by 14%. Report the values of the seven resonant frequencies (in Hertz).

Report results as a table with a first column listing frequencies of the undamaged structure, a second column listing frequencies of the damaged structure, and a third column listing the differences relative to the undamaged structure (in percent). You can get creative and display the results graphically using, for example, the plot or bar commands.

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Fill the table below where column 2 lists frequencies predicted by the finite element model of the undamaged mass-spring system. Column 3 lists frequencies of the damaged model, where the stiffness coefficient of the 5th spring is reduced by 14%. Column 4 lists the errors, $e = (f^{Damaged}/f^{Pristine}) - 1$, expressed in percent.

Mode Number	Undamaged Frequency (Hertz)	Damaged Frequency (Hertz)	Relative Difference (%)
1			
2			
3			
4			
5			
6			
7			