ME 4440 Mechanical Vibrations
Department of Mechanical Engineering
Idaho State University Fall Semester 2018

Vibration Project

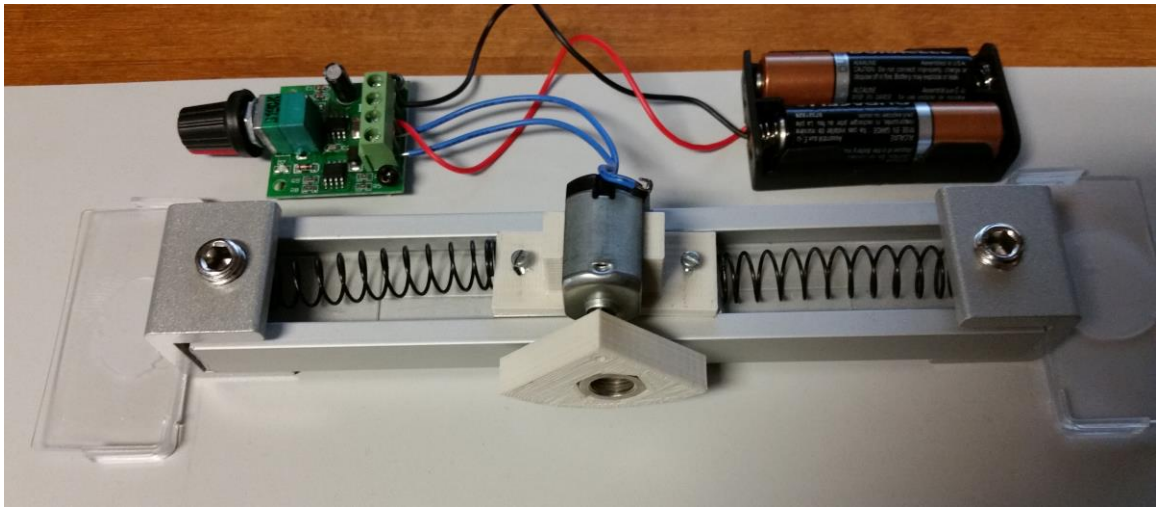
Due December 7, 2018

Goal:

Develop, model, analyze, design, and build a mechanical vibration test setup and investigate one DOF, two DOF vibration as well as vibration absorber designs.

Introduction:

Consider a one DOF linear vibration test set up, as depicted in Figure 1 a):



b)

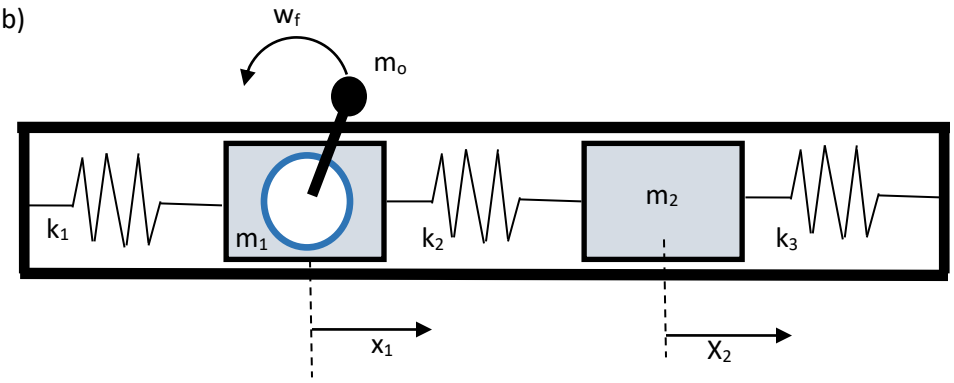


Figure 1: a) Picture of 1 DOF prototype, b) schematic of 2DOF system including vibration absorber.

The linear vibrational system is composed of a slider and a track, where the slider is fixed by elastic elements (the figure shows springs, however you will be using rubber bands). The system shown in Figure 1a) is a one degree of freedom system with an eccentricity driven by a DC motor. The motor's speed is controlled by a voltage regulator. You will be mathematically modelling this system, simulate the resulting model, construct the system based on the simulation parameters and compare the response of the constructed system with the simulation results. Following the successful construction and operation of your 1DOF system, you will design a vibration absorber that mitigates the vibration of the original sliding mass (m_1) by adding a second 1 DOF system to it.

The itemized steps and due dates for your semester project are as follows:

1. Develop the governing equation of motion in parametric form.
2. Find the closed form solution of the governing differential equation in parametric form.
3. Using Matlab™ simulate the dynamics as described in step 2 and generate plots that show the system behaves as desired. To find the desired response, vary the parameters of the system. Have a draft report (technical memo) ready on Monday October 22nd, and turn in a final technical memo, October 24th, 2018, class time.
4. Generate a complete frequency response plot (magnitude and phase).
5. Using the extracted parameters of the system, construct a physical system using the parts provided as well as any additional parts you may find helpful.
6. Wire the system to provide a variable speed drive and test the system. Finalize your system construction by November 2nd, 2018, class time (demo in class by your group).
7. Calibrate the speed control for RPM and corresponding voltage (potentiometer position). Record the response of the system and compare this response with the simulation results. Make comments on the outcome and the comparison.
8. Generate a complete frequency response plot of the physical system (magnitude and phase). Turn in a short memo detailing the system and its corresponding frequency response, November 9th, 2018, class time.
9. Design a vibration absorber.
10. Simulate the vibration absorber using Matlab™ and change any parameters in order to obtain a zero amplitude for resonance frequency of the one DOF system. Complete the simulation and hand in your simulation notes and graphs on November 16, class time.
11. Build the vibration absorber and incorporate this into the vibration system.
12. Test the resulting two DOF system by recording the amplitudes of the different masses. Demonstrate your system in class on November 30th.
13. Comment on the outcomes, the comparisons, the improvements or modifications, etc.

14. Develop a full technical memorandum for this project, using project format as outlined in class. Submit your completed technical memorandum by December 7th, 5:00 PM

Organization:

To accomplish the given tasks and to meet the given time lines/ milestones, you will work in teams of two students. I will need your group information emailed to myself as well as the TA's (Ryan moelryan@isu.edu and Golam jamagola@isu.edu) by October 15, 5:00 PM. Your team will be responsible for all the parts, elements and answers sought by this project. Although, this is a team project, your team is required to work on its own, i.e. since this is a design project, you will find that each team will have a different design or different parameters.

Regarding parts for the project, the TA's will provide the track, two sliders, end blocks, motor controller (DC voltage regulator), battery holder, DC motor, and if you so choose, printed eccentric loads. You can use other parts on your own, as well as make use of the craft shop in the PUB building at ISU.

Grades and Evaluation Criteria:

Grades are based on the accuracy and the details included in your report and your design. You will turn in a technical memorandum with all your assumptions, simplifications, calculations, simulations, and designs, experimental data, experimental outcomes, etc. attached. Do not write a project report, a concise description of your design and calculations is sufficient. The Memorandum, including the design and computations should be done in a professional manner.