Lab 2: Forced Damped SDOF Vibration

Instructions:

- **Lab reports must be typed.**
- Prepare and submit your lab report as a single PDF file through eClass.
- Include an Excel file containing your data with your submission.
- Required plots can be made with any software of your choice (MATLAB, Excel, Mathematica, etc.).
- While you can discuss the problems with classmates, all submitted work must be your own to conform to academic integrity guidelines.

Preface

The objective of this lab is to understand and provide a hands-on experience with a SDOF system that is forced by a rotating imbalance.

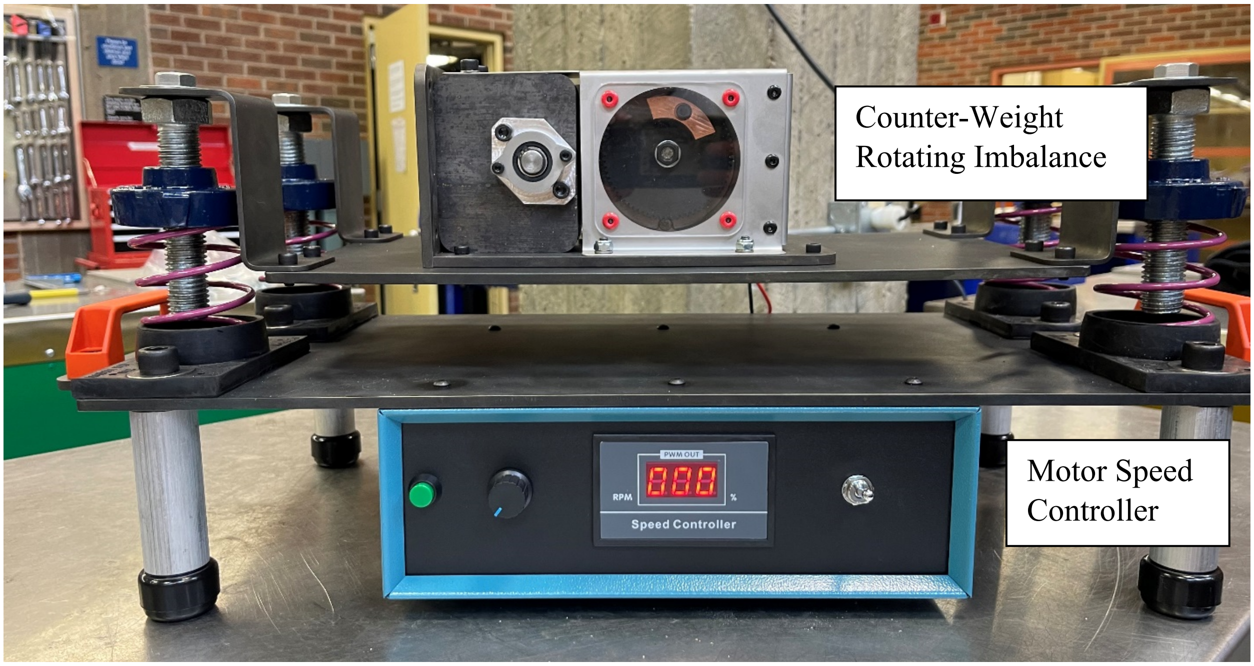
For this lab, you will be recording data using the built-in accelerometer on your phone. Before coming to the lab, please download the PhyPhox application on your phone. It is available for free and compatible with Android and iOS phones.

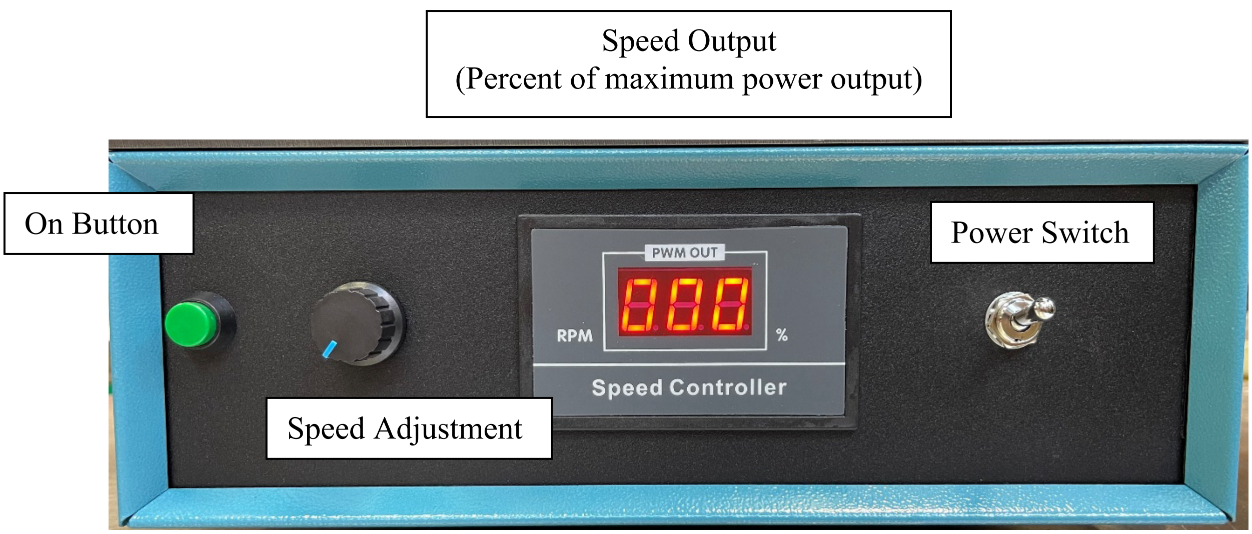
phyphox

physical phone experiments

Instructions

The apparatus is shown below.





Note: The power switch and on-button serve the same purpose. Use the power switch to turn the motor on and off. Although "RPM" is indicated on the controller, the number corresponds to the power output to the motor as a percentage of its maximum power output. As a result, you will have to calculate the frequency manually using the time interval between adjacent peaks,.

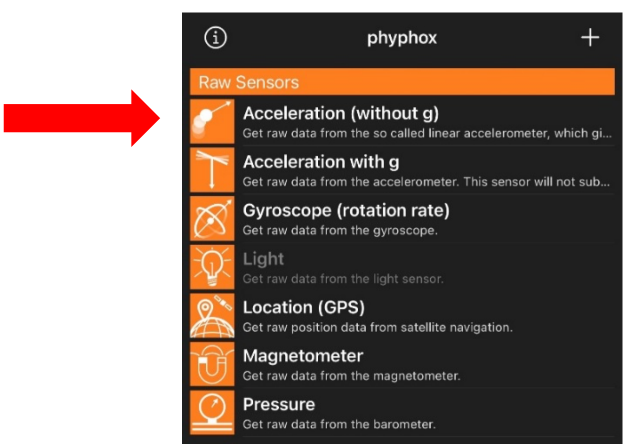
1. Ensure that the power is plugged in and that there are no loose parts on the platform before turning on the motor.

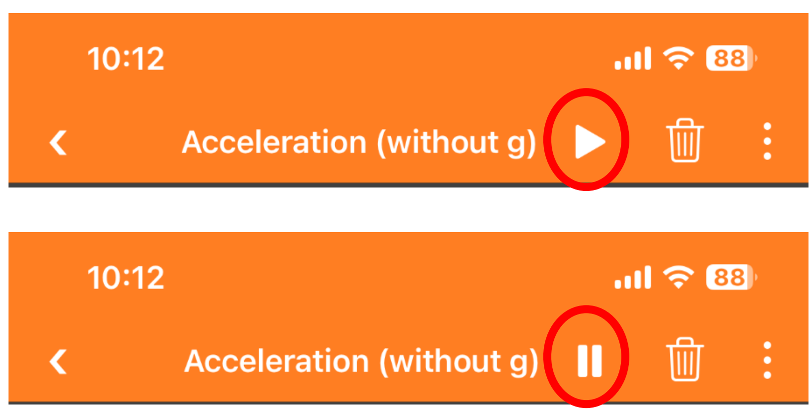
2. Turn on the motor and increase the power output to the motor until the gears begin to rotate (friction prevents the gears from spinning at lower power outputs). This point should be around 8 to 9 percent as indicated on the controller. Turn off the motor.

3. Place your phone on the platform and open the PhyPhox app. Select the "Acceleration (without g)" option.

4. Turn the motor on **and allow the platform to reach steady state before starting data collection. This step is important so that you only measure the steady state vibration without the transient response of the system.** The transient effects should sufficiently dissipate after around 10 seconds.

5. Press the "Start" button to initiate data collection for a few cycles. Afterwards, **pause data acquisition but do not export your data yet.**



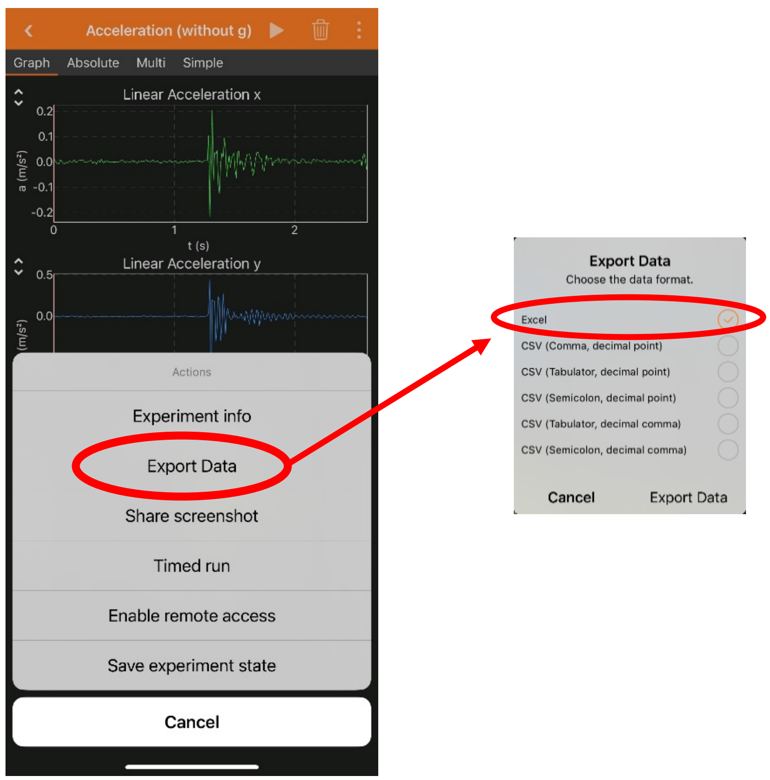


6. Increase the motor power output by 1% and run the motor. Allow the platform to reach steady state. Then, resume data collection by pressing the Start button again. Collect data for a few cycles, then pause data acquisition again.

7. Repeat Step 6 up to a power output of 30%.

<u>NOTE:</u> You may observe the platform resonating with a rotational motion at a motor power output of around 16 – 19%. Skip data collection for the power outputs in which the platform moves in this manner. This rotational motion should disappear around a motor speed of around 23 – 25%.

8. Export the data as an Excel file.



9. Locate the point of resonance and adjust the power output to be 1% higher or lower. You should observe beating in the vertical motion of the platform. Measure the acceleration (without g) of the platform and export your data. **Then, measure the frequency of the motor using the stroboscope (there is only one stroboscope to be shared amongst all groups, so ask the TA to use it).**

At the end of this lab, you should have:

1) The acceleration vs. time response corresponding to a range of motor power outputs from 8 – 9% to 30% power. You do not need to include the data corresponding to the range of motor speeds in which the platform exhibits a rotational motion in your analysis.

2) The acceleration vs. time response during beating of the platform.

3) The frequency of the motor measured with the stroboscope.