Simple Harmonic Motion: PIETER'S GROUP

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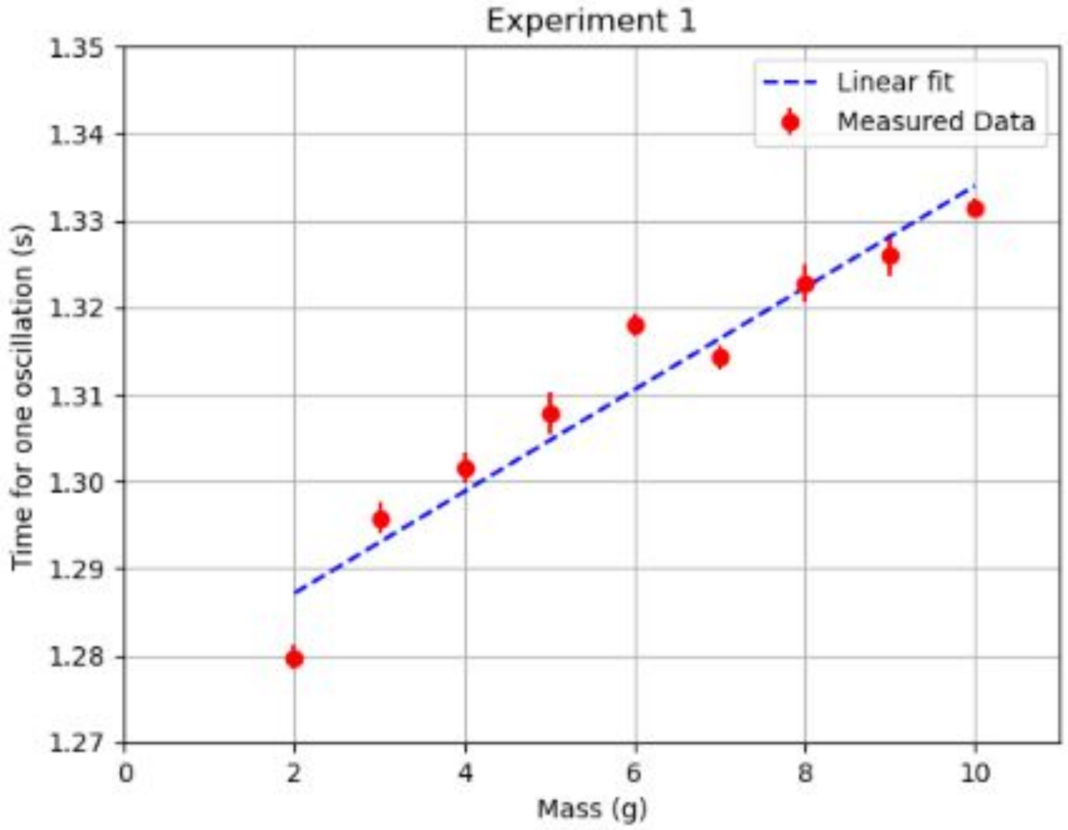
Experiment 1 Methodology & Data

- Linear fit T = m*a + b
    - a = 0.006 ± 0.001
    - b = 1.275 ± 0.004
- Small gradient **a**, confirming hypothesis of no mass dependence
- Slight upward trend due to moving centre of mass and friction

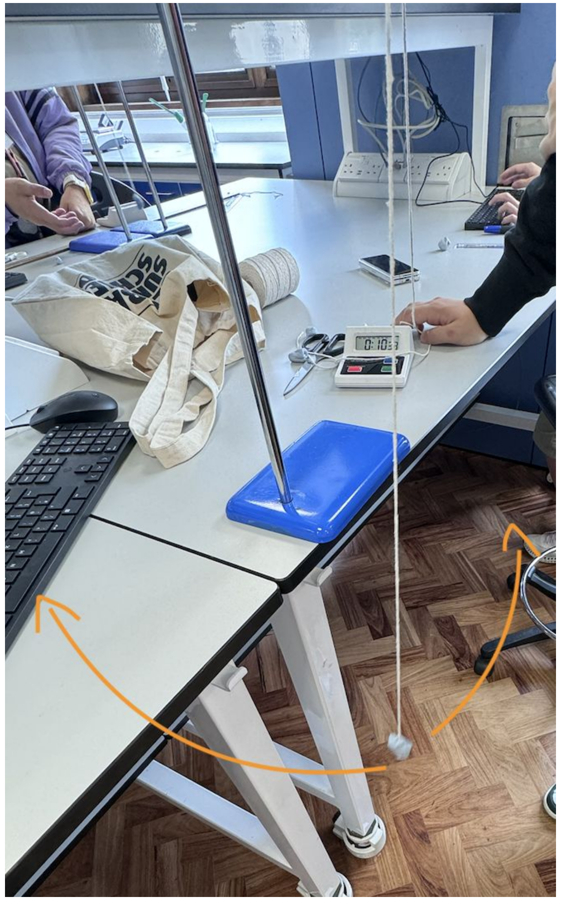


Experiment 2 Methodology

How we took the data(setup):

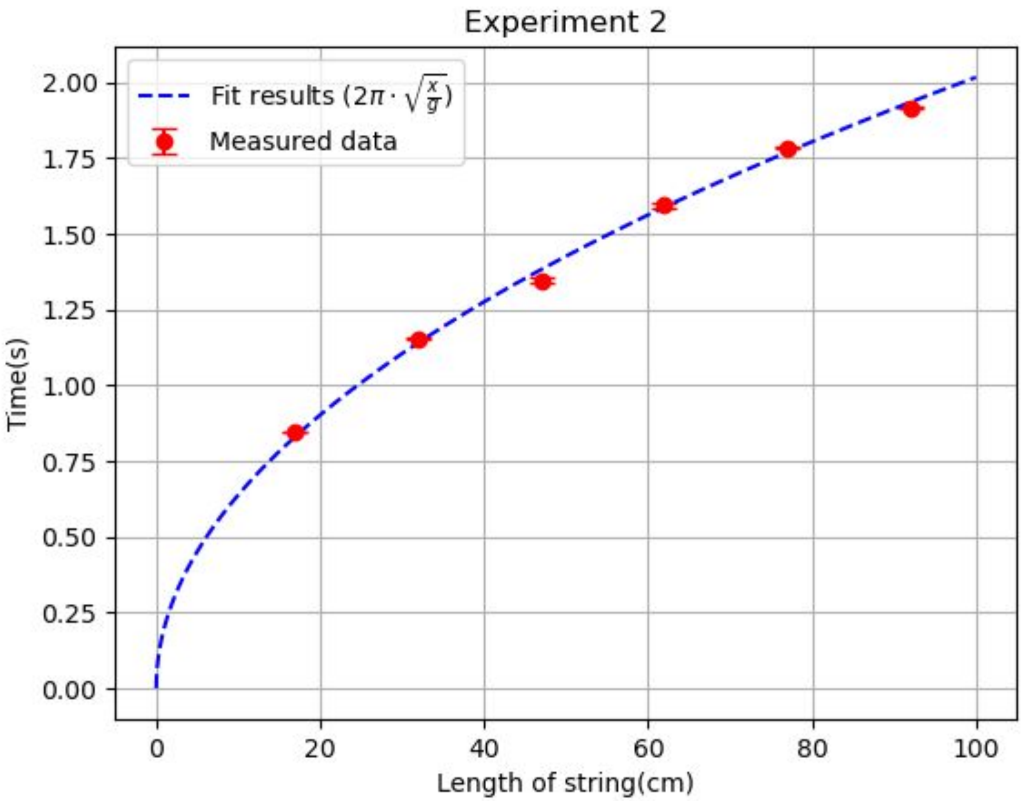
- Setup:
- 1.Centre Of Mass is ensured by making a round ball
- *2.Ball hanged off the table to allow for greater string lengths
- *3.Make sure to include the distance from the top of the ball to the Centre Of Mass

- Reducing uncertainty:
- 1.Record TEN oscillations and divide to get time of one oscillation
- 2.Repeat five trials at every length of the string and take AVERAGE



Experiment 2 Data

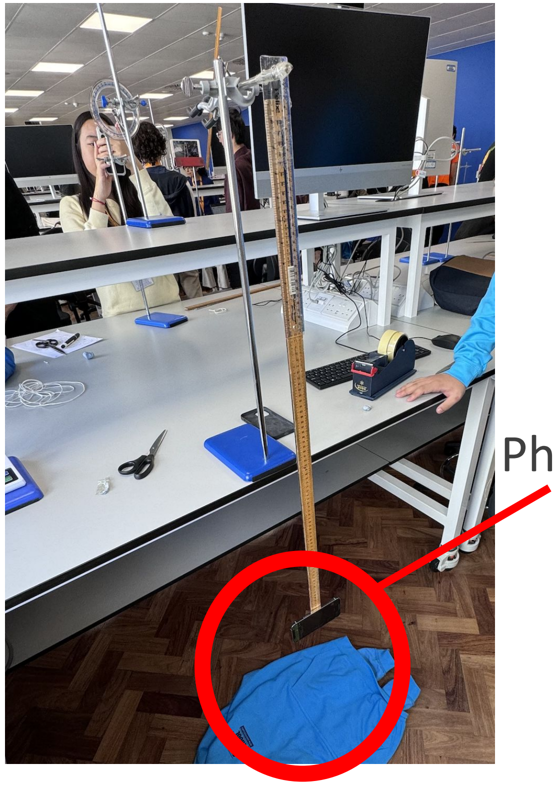
- Error bars
    - Calculated the standard deviation across the 5 trials
    - Divided the standard deviation by the √5 for error on mean
- g = 9.70 ± 0.09 ms^{-2}
- Reasons for discrepancy
    - Friction
    - Center of mass



EXPERIMENT 3 SETUP

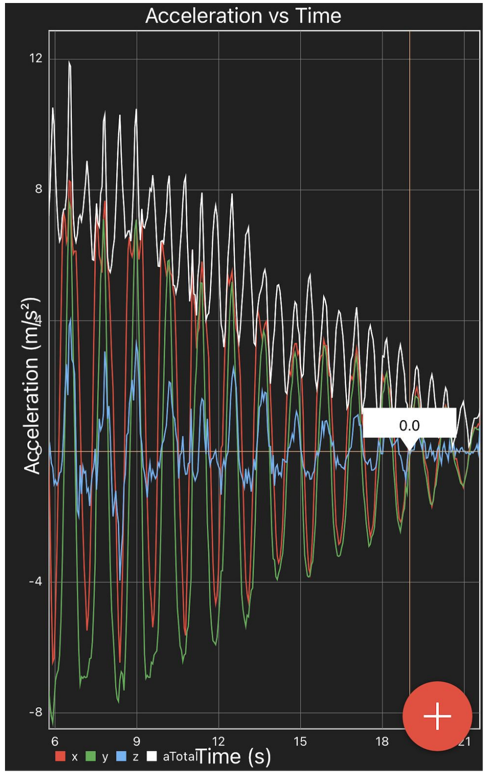
Method 1

Method 2

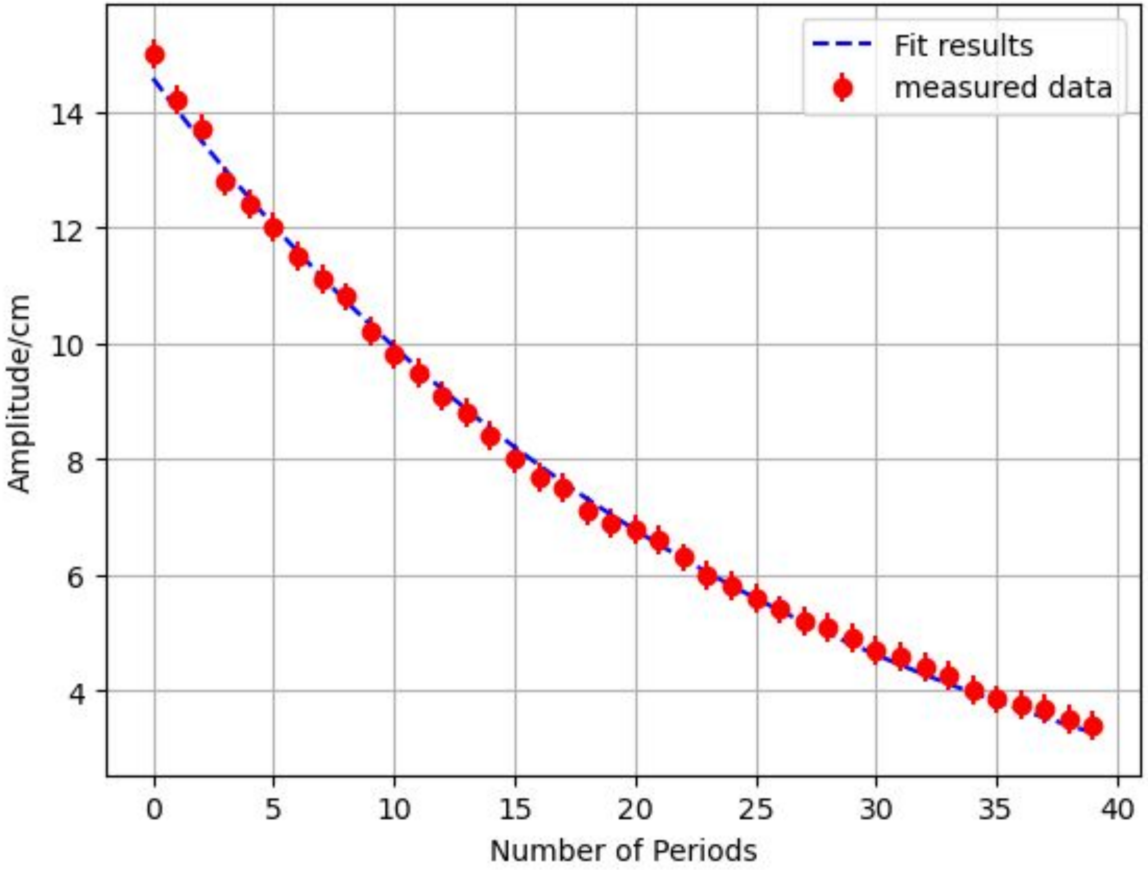


Phone

Data of method 2



Experiment 3 Method 1



$$f(x) = a \cdot e^{-b \cdot x} \cdot \cos(\omega x + \phi)$$

$$f(x) = a \cdot e^{-b \cdot x}$$

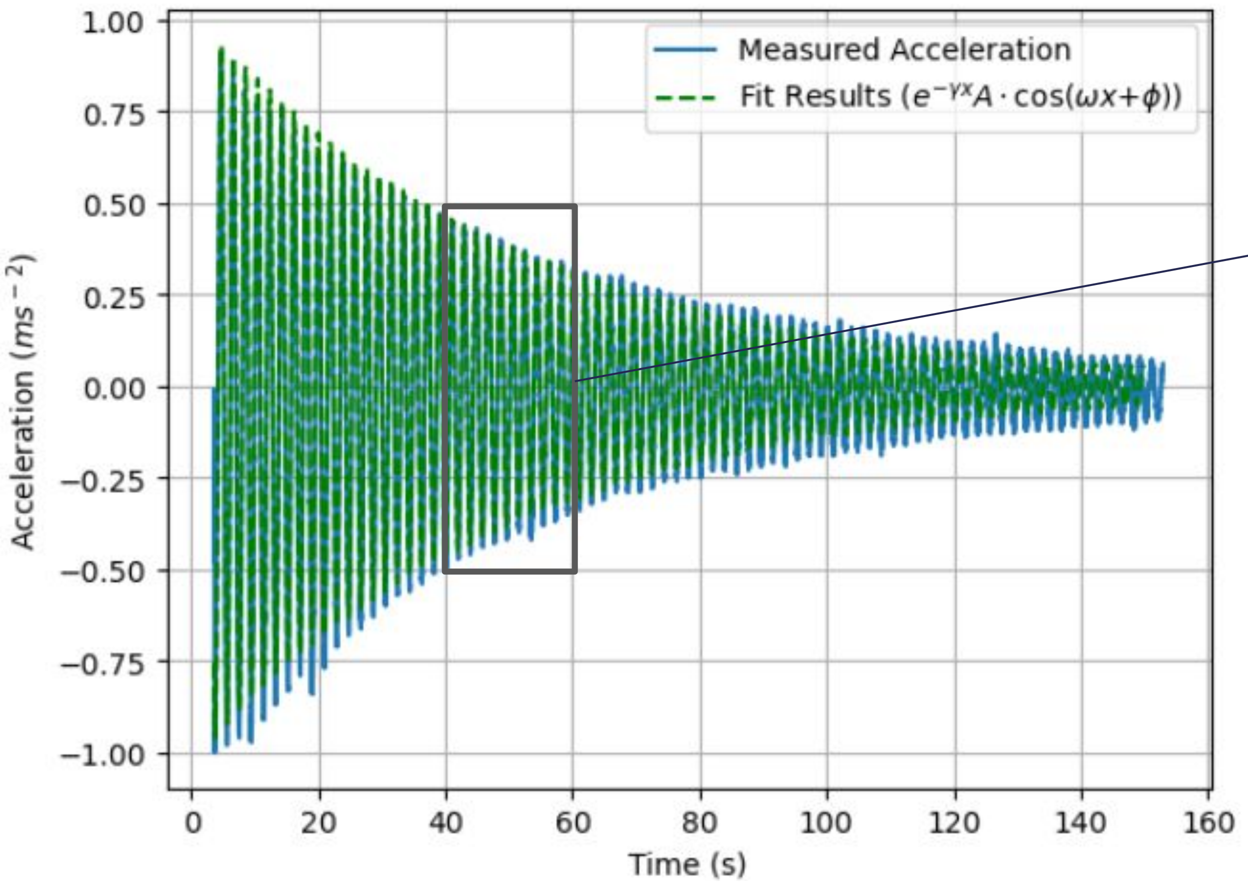
So the values with errors are:

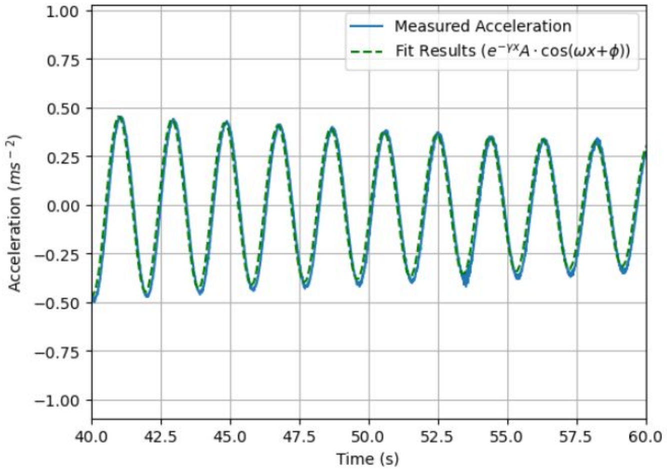
a= 14.57 ± 0.06 cm

b= 0.0383 ± 0.0003

Indicates the trend of exponential decay.

Experiment 3 Method 2





ω = 3.2904 ± 0.00008 s^{-1}

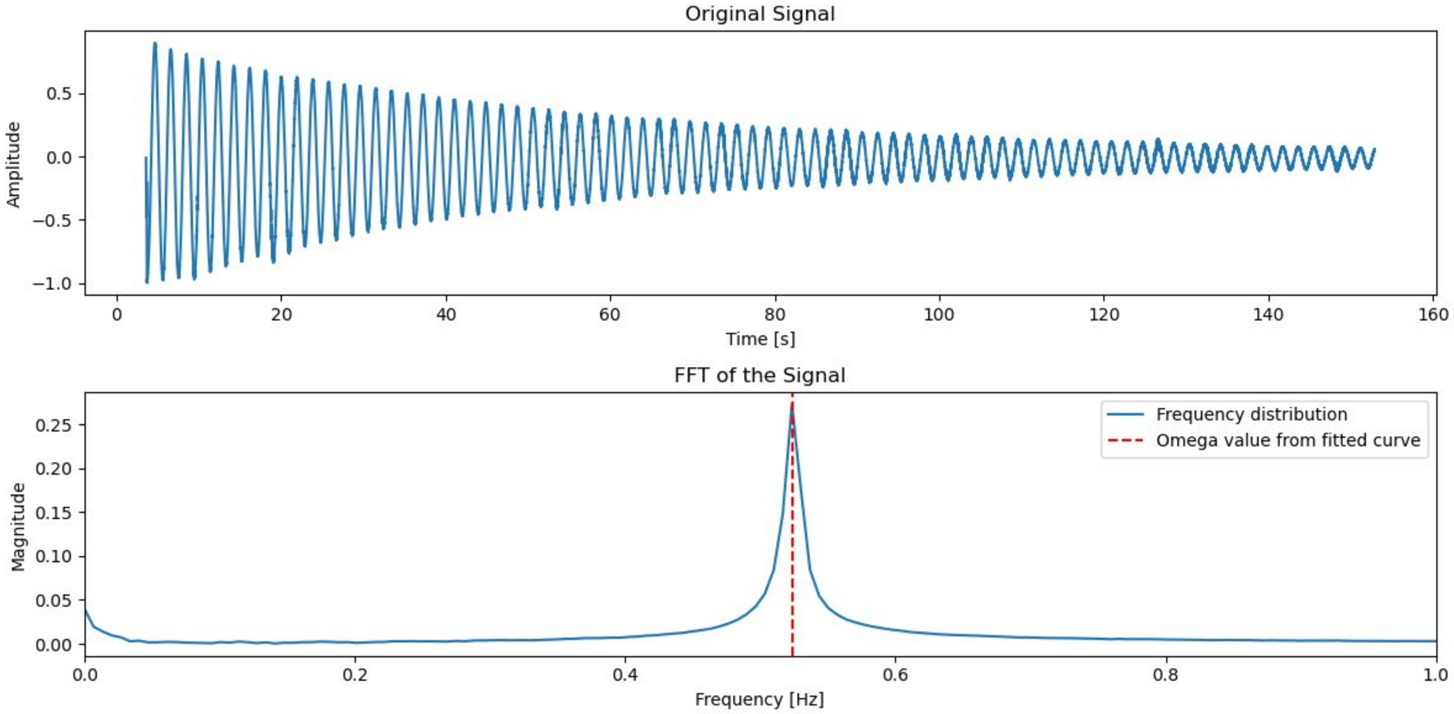
A = 1.032 ± 0.003 s^{-2}

ϕ = -1.44 ± 0.003 rad

γ = 0.01986 ± 0.00008 s^{-1}

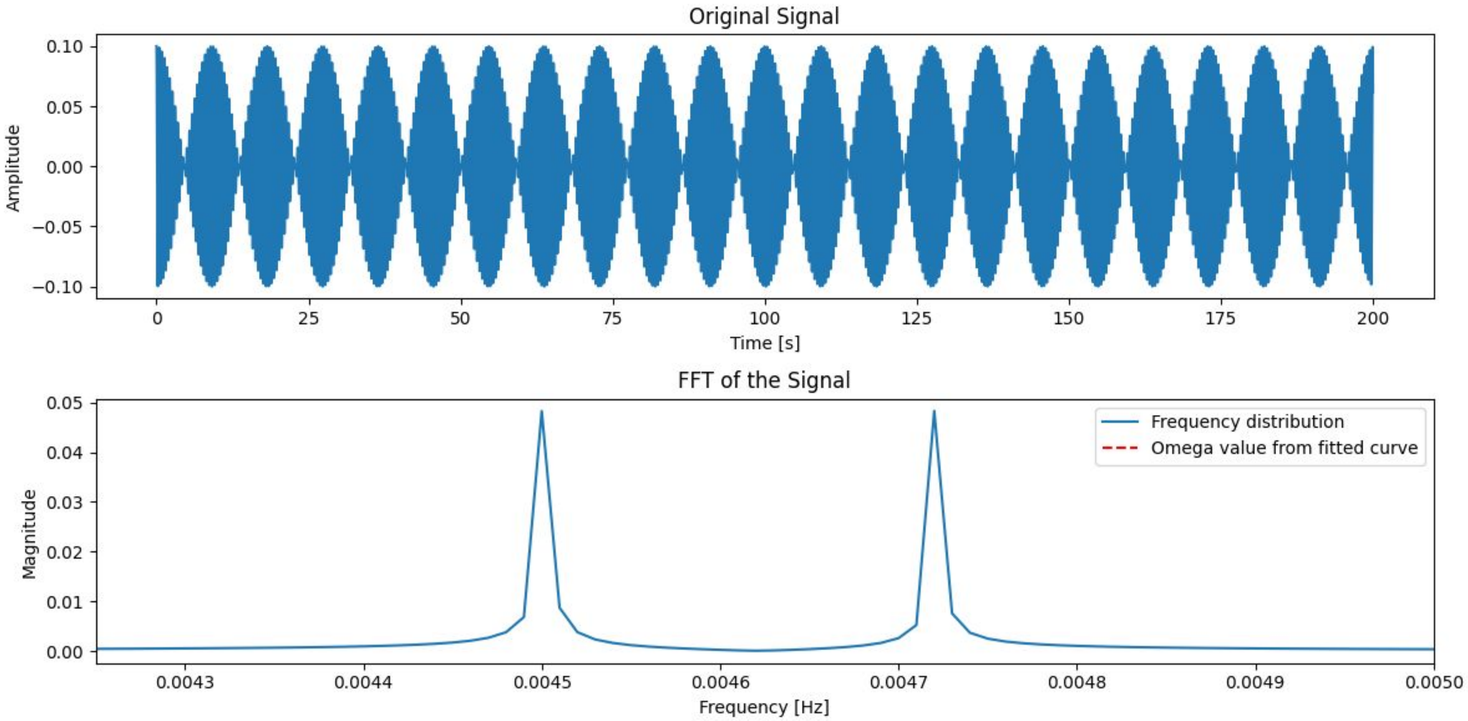
Experiment 3 Fourier Transform

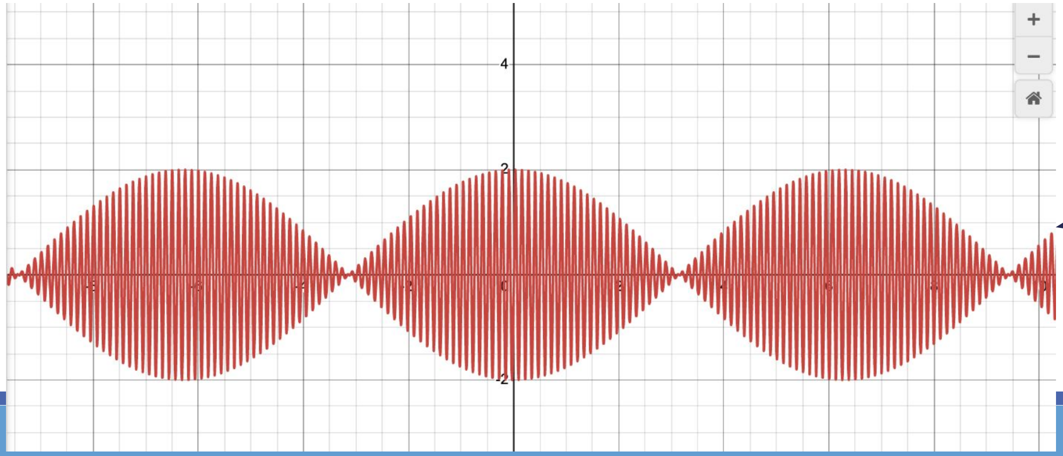
- Fourier Transform of measured data.
- Peak at F = $3.2904/2\pi\ s^{-1}$
- Matches ω value from curve fit
- Width of peak determined by decay



Simulation 1

- Fourier Transform of coupled oscillators
- Expected sum of 2 Sinusoidal functions
- Transform confirms
- Confirmed 2 sinusoidal waves with similar frequencies
- Mean is the smaller frequency
- Difference is larger frequency

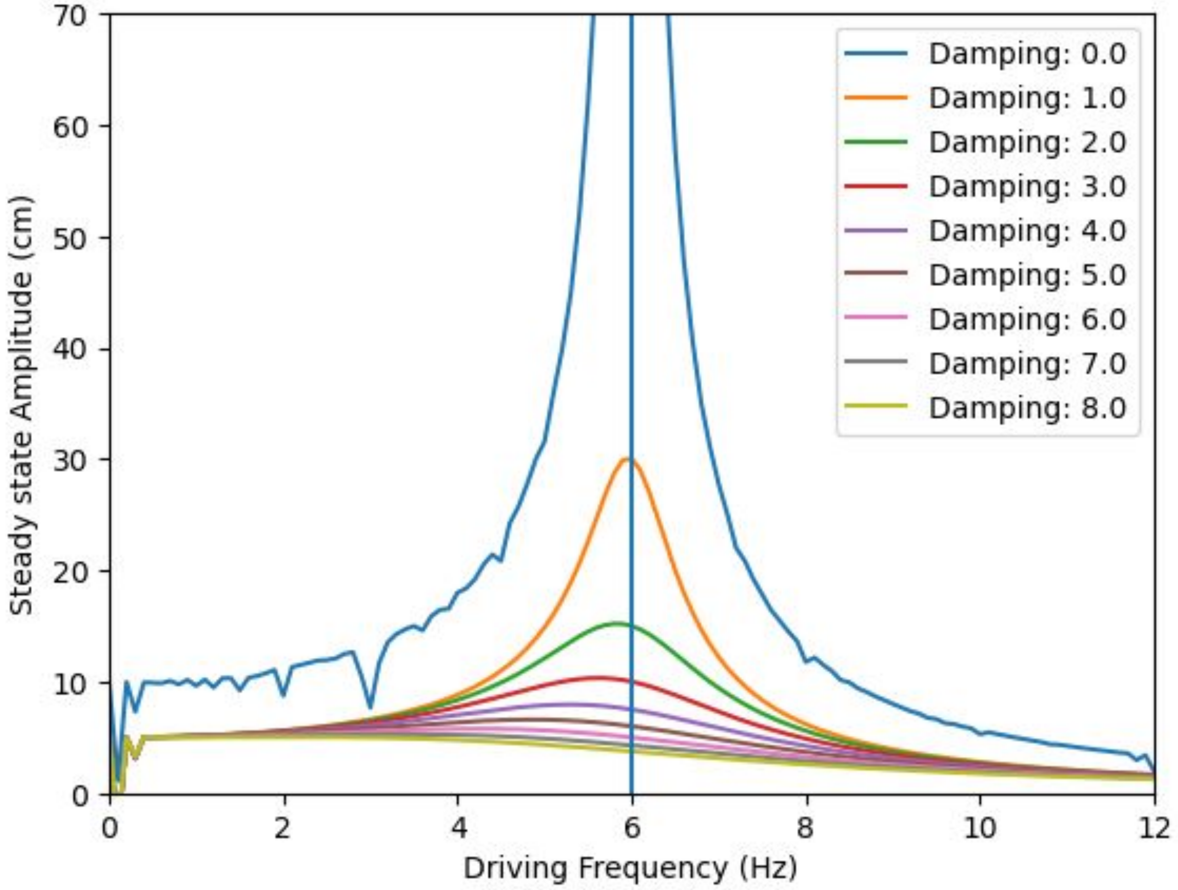




sin(50x) + sin(51x) (on desmos)

Simulation 2

- Steady states amplitude from ODE solver
- Changing frequency from driver/piston
- Large resonance at and around natural frequency
- Resonance peak moves down, left and becomes broader with larger damping
- Damping coefficients are in Nsm^{-1}



Thanks for listening, any questions?