A graph with lines and numbers

Description automatically generated with medium confidence

|  |  |  |  |
| --- | --- | --- | --- |
| **Acceleration vs Time** | | | |
| **Axes** | **X** | **Y** | **Z** |
| **Mean** | 0.01532 | 0.01727 | 1.02405 |
| **Standard Deviation** | 0.00125 | 0.00130 | 0.00142 |

A graph of a sound wave

Description automatically generated with medium confidence

|  |  |  |  |
| --- | --- | --- | --- |
| **Gyro Data vs Time** | | | |
| **Axes** | **X** | **Y** | **Z** |
| **Mean** | 0.01347 | 0.10185 | -0.11313 |
| **Standard Deviation** | 0.03071 | 0.01072 | 0.01011 |

**2-G Calibration Test**

A graph of a graph

Description automatically generated

**Schematic of Circuit and Beam System:**

A diagram of a breadboard

Description automatically generated

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Table of Measured and Calculated Values** | | | | | | |
| **Characteristic** | Length | Height | Width | Young’s Modulus (€) | Moment of Inertia | Density (ρ) |
| **Value** | 0.36 m | 0.0025 m | 0.025 m | 68.9 GPa |  | 2700 |

A graph of a graph

Description automatically generatedA graph with blue dots and a red line

Description automatically generated

A screenshot of a computer

Description automatically generatedA screenshot of a computer

Description automatically generated

1. We first measured the length, width, and height of the beam, and from there we were able to calculate its moment of inertia. Knowing the beam’s material, we found its density and Young’s Modulus. With these values, we were able to calculate the mass of the beam. For the theoretical K value, we used the relationship below:

A math equation with numbers and symbols

Description automatically generated

Using equations derived in lecture, I was able to calculate the Zeta value using the slope of the regression for the following equation:

A mathematical equation with numbers and symbols

Description automatically generated

The slope of this equation is represented as Beta, in the python script “beamanalysis.py” and is equal to the following equation, as shown below:

A mathematical equation with numbers and symbols

Description automatically generated

From the linear regression graph, Beta = 0.056856, and using these relationships, I was able to solve for Zeta = 0.009049. From this, since we knew the experimental damped frequency, I used this to calculate the experimental natural frequency with the relationship below:

A drawing of a line with writing

Description automatically generated with medium confidence

Now that we have obtained the natural frequency value of 60.5547, we can use this to solve for the effective mass, as shown below:

A math equation with numbers and symbols

Description automatically generated

We can use the effective mass to solve for the damping ratio, b, for the system, with the following relationship:

A black text on a white background

Description automatically generated

With the effective mass, mass of the beam, and mass of the accelerometer/gyroscope, we can solve for gamma, the percentage of the beam’s mass that is accounted for in the effective mass, using the following relationships:

A black arrows pointing to a number

Description automatically generated with medium confidence

We found that gamma = -0.48, which is significantly different from the expected result of 0.23, or 23%. This could be due to human error from the calibration of the accelerometer during part 1 of the lab.

See “Table of Measured and Calculated Values” in section 3 for summary of the setup data.