Measuring the speed of sound wave using standing waves

Lance Lu

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1 Data Analysis

This is the raw data of the experiment. It records the length value for positions of resonance.

Frequency f (Hz) ± 1	First maximum loudness L_1 (mm) ± 0.5	Second maximum loudness L_2 (mm) ± 0.5
860	40	223
1200	93	170
1500	99	232

Table 1: Raw data

The we can calculate the wavelength λ and sound speed v through the following formula:

$$\lambda = (L_2 - L_1) \cdot 2$$

$$v = f \cdot \lambda$$

Frequency f (Hz) ± 1	Wavelength λ (m) ± 0.001	Sound speed v (m/s)	Uncertainty of sound speed (m/s)
860	0.366	315	1.23
1200	0.154	185	1.35
1500	0.266	399	1.77

Table 2: Wavelength and sound speed

e.g. $\lambda_1 = (223 \cdot 10^{-3}m - 44 \cdot 10^{-3}m) \cdot 2 = 0.366m$

$\Delta\lambda = \Delta L_1 + \Delta L_2 = 0.5mm + 0.5mm = 0.001m$

$v_1 = f_1 \cdot \lambda_1 = 860Hz \cdot 0.366m \approx 315m/s$

$\Delta v_1 = 315m/s \cdot (\frac{0.001m}{0.366m} + \frac{1Hz}{860Hz}) \approx 1.23m/s$

Then, we calculate the average sound speed and the percentage difference between the experimental sound speed and the actual sound speed $343m/s$.

$$v_{average} = \frac{315 + 185 + 399}{3} \approx 300m/s$$

$$\%Difference = \frac{v_{average} - 343m/s}{343m/s} \approx -12.7\%$$

1.1 Graph

This is the graph of the vernier during the experiment.

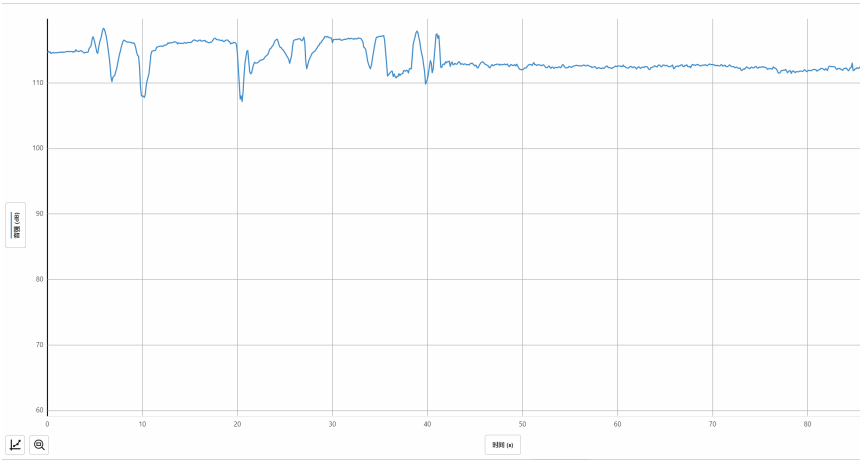

Figure 1: Sound intensity-Time graph

2 Conclusion

Based on the data collected and calculations made, we can conclude that the speed of sound in the air was measured by using standing waves and was found to be $315m/s$, $185m/s$, and $399m/s$, with an average of $300m/s$. However, the percentage difference between the experimental sound speed and the actual sound speed of 343 m/s was found to be quite high at about -12.7%.

The reason for such high percentage differences could be due to various factors such as experimental errors, uncertainties in measurements, and limitations of the equipment used. One of the

major sources of error in this experiment could be the difficulty in accurately measuring the distance between two antinodes of the standing waves. Additionally, the experimental setup may not have been completely free from external noise and disturbances, which could have affected the accuracy of our results.

To reduce such errors and improve the accuracy of our results, we can improve the experimental setup by using better-quality equipment and ensuring that the setup is completely isolated from external noise and disturbances.