Name: Ben Young | Student ID: 918588465

Physics 9B Lab Report #3

I. Properties of the Simulator's Sound

1. Use the simulator to find the speed of the sound wave in the simulator. Explain how you did this, and provide the value, then compare it with the standardly-accepted value of the speed of sound in air.

$v = 337.38 m/s$

I found the speed of the wave by determing the width of the display area to be ~~XXX~~ 5m, using the tape measure and used the stopwatch to measure the time it takes for one wave to traverse this distance to be 14.82ms ~~XXXXXX~~. velocity = $\frac{\text{distance}}{\text{time}} = \frac{\text{~~XXX~~ 5m}}{0.01482} =$ 337.38m/s.

The agreed upon speed of sound is 343m/s, which is very close to the measured value of 337.38 (1.64%)

2. Compute the frequency of the sound, using each of the two methods given below.

a. by measuring the time per oscillation (explain your method and show the calculation)

Using the stopwatch in the simulator I measured 5 oscillations over the span of 18.41ms.

$f = \frac{\text{oscillations}}{\text{time}} = \frac{5}{0.01841} = 271.6\ Hz$

b. using the wavelength and speed of the wave (explain your method and show the calculation)

Rearranging the formula $v = \lambda f$ so that $f = \frac{v}{\lambda}$ relates velocity and wavelength to freq. I found the wavelength to be 150cm using the tape measure to measure the distance ~~to~~ between ~~be~~ ~~150~~ peaks. Thus: $f = \frac{337.38}{1.5} = 224.92\ Hz$

II. Beats

3. Compute the frequency of the second simulator with the method of your choice.

$f = \frac{5}{\text{~~0.01851~~ } 0.01854} = 269.87\ Hz$

Name: Ben Young | Student ID: 918588465

Physics 9B Lab Report #3

I. Properties of the Simulator's Sound

1. Use the simulator to find the speed of the sound wave in the simulator. Explain how you did this, and provide the value, then compare it with the standardly-accepted value of the speed of sound in air.

v = 337.38m/s

I found the speed of the wave by determing the width of the display area to be ~~XXX~~ 5m, using the tape measure and used the stopwatch to measure the time it takes for one wave to traverse this distance to be 14.82ms ~~XXXXXX~~. velocity = distance/time = ~~XXX~~ 5m/0.01482 = 337.38m/s.

The agreed upon speed of sound is 343m/s, which is very close to the measured value of 337.38 (1.64%)

2. Compute the frequency of the sound, using each of the two methods given below.

a. by measuring the time per oscillation (explain your method and show the calculation)

Using the stopwatch in the simulator I measured 5 oscillations over the span of 18.41ms.

f = oscillations/time = 5/0.01841 = 271.6 Hz

b. using the wavelength and speed of the wave (explain your method and show the calculation)

Rearranging the formula v = λf so that f = v/λ relates velocity and wavelength to freq. I found the wavelength to be 150cm using the tape measure to measure the distance ~~to~~ between ~~be~~ ~~150~~ peaks. Thus: f = 337.38/1.5 = 224.92 Hz

II. Beats

3. Compute the frequency of the second simulator with the method of your choice.

f = 5/0.01854 = 269.87 Hz

4. Confirm our understanding of beats.
   a. Use the timer on your smartphone to measure the frequency of the beats directly.

$$\frac{16 \text{ beats}}{4.85 \text{s}} = 3.30 \text{ Hz}$$

   b. Compute the beat frequency from what you know about the two individual sound waves, and compare it with the direct measurement of the beat frequency above.

$f_{beat} = 271.6 - 269.7 = 1.9 \text{ Hz}$

III. **Graphing**

5. Produce a graph of the superposition of the two sound waves as measured at a fixed position using the desmos graphing calculator.
   a. Attach a screen capture of the graph, including the formula panel.
   b. Use the graph to show/explain how it confirms the beat frequency you measured.

The graph shows a quiet ~~period~~ point every 0.52s, which lines up with the above measured beat frequency of 1.9 Hz

   c. Describe the effects of changing ("sliding") the phase angles of the two waves. In particular, is the beat frequency affected?

changing the phase of either wave only adjusts where the beats occur on the time axis, not how often. The frequency of beats is not affected because it is caused by the waves having different frequencies, they can never be "in-phase" or become more "out-of phase"

4. Confirm our understanding of beats.
   a. Use the timer on your smartphone to measure the frequency of the beats directly.

$$\frac{16 \text{ beats}}{4.85 \text{s}} = 3.30 \text{ Hz}$$

   b. Compute the beat frequency from what you know about the two individual sound waves, and compare it with the direct measurement of the beat frequency above.

$f_{beat} = 271.6 - 269.7 = 1.9 \text{ Hz}$

III. **Graphing**

5. Produce a graph of the superposition of the two sound waves as measured at a fixed position using the desmos graphing calculator.
   a. Attach a screen capture of the graph, including the formula panel.
   b. Use the graph to show/explain how it confirms the beat frequency you measured.

The graph shows a quiet ~~period~~ point every 0.52s, which lines up with the above measured beat frequency of 1.9 Hz

   c. Describe the effects of changing ("sliding") the phase angles of the two waves. In particular, is the beat frequency affected?

changing the phase of either wave only adjusts where the beats occur on the time axis, not how often. The frequency of beats is not affected because it is caused by the waves having different frequencies, they can never be "in-phase" or become more "out-of phase"