Experiment #6  Speed of Sound and Light

About this experiment

In this week’s experiment, we will cover part 1, 3, 4, 5, 6 and 7.

Some requirements on Lab Report

1 Apply a sinusoidal voltage to the loudspeaker, and then use the microphone to receive the sound waveform at a certain distance from the source. Use the oscilloscope to observe the signal at the source and the microphone at the same time. Find out the distance $\Delta x = \lambda$ between two adjacent points where the phase shift change $2\pi$. Repeat this part at frequency around $f=5.0, 10.0, 15.0, 20.0kHz$.

3 Apply a $V=3.00V$ voltage to the potentiometer. Use a ruler to do the calibration (what is the unit for this calibration parameter?) so that we can convert voltage signal to the distance. Create a standing wave between the reflector and the source at frequency about $f=1.5kHz$. Use ADC to measure the amplitude at microphone (in CH2) and the distance (actually the output voltage from potentiometer, in CH1). In your lab report:
   - Convert voltage at CH1 to distance, and then draw a figure about the relation.
   - Calculate the speed of sound based on this figure.

4 Similar to part 3, but we substitute the source with a cordless phone ($f=2.4GHz$). Put the Yagi antenna between the reflector and the wave source as an signal receiver. Repeat the work we did in the previous part.

5 Apply a $V=2.00V$ voltage to the potentiometer. Use ADC to measure the amplitude at antenna (in CH2) and the angle (actually the output voltage from the antenna, in CH1). In your lab report:
   - Convert voltage at CH1 to angle, and then draw a figure about the relation.
   - Calculate the ratio $V_{out}(0)/V_{out}(180)$ based on your data, comments on the quality of the antenna.

6 Measure the dimensions of the waveguide. Send a signal in to the waveguide, measure the output signal strength at the other end of the waveguide in two different setups. Report your result and explain your results by calculating the cutoff frequency in these two configurations.

7 Measure the dimensions of the cavity. Apply the cordless phone signal into the cavity. Measure the length at which the resonance happens (you have two resonance points). Do not forget the offset value. In your report:
   - Assume the frequency of the signal is known ($f=2.4GHz$), calculate the speed of light.

Questions

1. In the standing sound wave part, consider exactly the setup we have in the lab, actually, in the microphone we received a propagating wave, rather than a standing wave as said in lab manual. Explain why. Based on a mathematical calculation, explain why the amplitude for this propagating wave still varies with a period of half wave length as standing wave case.
Other requirements on Lab Report

1. In your lab report, try to derive all the equations used in your analysis part.
2. When reporting a data, do not forget its unit, and pay attention to the effective digit.
3. Error estimation and propagation are not required. However, percentage difference has to be calculated while verifying equations; and you should discuss the origin of errors.