Spring 2017

Laser Microphone

Michael McKee
University of Southern Maine

UNIVERSITY OF SOUTHERN MAINE

PORTLAND • GORHAM • LEWISTON • ONLINE

Laser Microphone

Michael McKee USM Electrical Engineering, Dr. James Smith Associate Professor of Engineering USM

Abstract

The laser microphone is a multifaceted project. The main objective of this project is the design and construction of a laser microphone. This device is able to detect sound via variations in light waves. Production of this device being one obvious outcome of the project, observation and experimentation comprise the primary focus of the venture. Experiments reveal exactly how well this device is able to function and if it is able to be used in specific engineering applications. To function appropriately, this device should handle the translation from soundwaves to light waves with little to no alteration. Full signal analysis uncovers this device's true effectiveness and determines exactly how much is lost in translation.

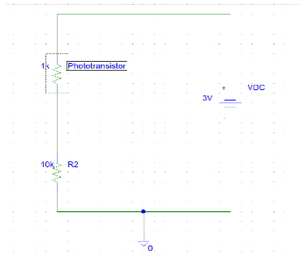
Design

This remained fairly simple, only three stages made up the majority of the device.

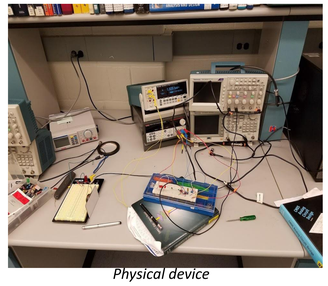
- Stage one: a standard pen laser provided the light needed to operate the device
- Stage two: wanting to receive the best signal possible (thus isolating variables), a highly reflective mirror was used to bounce light off of.
- Stage three: voltage division was achieved by placing the photosensor in series with a standard resistive component

Operation and Data Collection

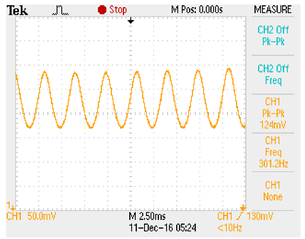
Laser light was bounced off the mirror which was being exposed to a pure sinusoidal sound. This reflected light was then directed at the photosensor. Changes in the photosensor cause fluctuations in the DC supply voltage. These fluctuations were probed with an oscilloscope.



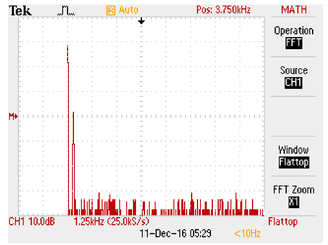
Computer model



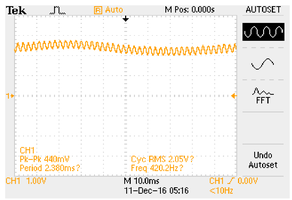
Physical device



Stage three results



Fourier analysis of results



Some transience

Results

After some revisions, the device was able to detect fluctuations in light. Under somewhat idyllic conditions, this device was able to recreate a sinusoidal signal produced from a soundwave. Fourier analysis shows very pure recreation of the signal.

Discussion

This device did operate as intended by detecting sound waves via light. While this was a positive result, there is further work that could be done to have this device meet its full potential. Capabilities such as sound reproduction could be added. This would allow the device to play the signals that it receives through a speaker. Signal processing devices could also improve the quality of the signal received and reduce sound and light interference.

References

Paschotta, Dr. Rüdiger. "Coherence." *Encyclopedia of Laser Physics and Technology - Coherence, Coherent, Light, Spatial and Temporal Coherence, Monochromaticity*. N.p., n.d. Web. 11 Dec. 2016.

Ravaioli, Umberto. "Chapter 8: Wave Reflection and Transmission." *Fundamentals of Applied Electromagnetics*. By Fawwaz T. Ulaby. Seventh ed. Boston: Pearson, 2010. 352-69. Web.

Paschotta, Dr. Rüdiger. "Coherence." *Encyclopedia of Laser Physics and Technology - Coherence, Coherent, Light, Spatial and Temporal Coherence, Monochromaticity*. N.p., n.d. Web. 11 Dec. 2016.

"LIGO Lab | Caltech | MIT." *LIGO Lab | Caltech*. National Science Foundation, 16 Feb. 2016. Web. 08 Dec. 2016.

"LASER Microphone." *LASER Microphone*. N.p., n.d. Web. 12 Dec. 2016.

Oberg, James. "Shaking on Space Station Rattles NASA." *NBCNews.com*. NBCUniversal News Group, 04 Feb. 2009. Web. 12 Dec. 2016.

"Photo Resistor - Light Dependent Resistor (LDR)." *Resistor Guide*. N.p., n.d. Web. 12 Dec. 2016.

"Photodiode Light Detector." *Photodetectors*. N.p., n.d. Web. 12 Dec. 2016.