CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
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Project Number
S1719

Project Title
Examining Far and Near-Field Doppler Shifts

Abstract

Objectives/Goals
The objective of this project was to be able to determine how observed frequency shifts in a practical, classical Doppler effect setting at different distances between the emitter and moving observer (me, on my bicycle) and why.

Methods/Materials
I essentially attached my phone to the handlebars of my bicycle with the spectral analysis app opened, and rode my bike in a straight line in a parking lot. On that straight painted line I set up tape markers at different distances and later on I set up little clothes pin nubs on those markers to make a clicking sound as I rode over them. I set up my keyboard away from that line at different distances and would ride past as my father held a key on the board. I repeated multiple trials for different distances and saved the data on my phone before I transferred it to my computer.

Results
In the end, my results supported my hypothesis that larger, faster-appearing shifts would happen with the smaller observation distances and the opposite for the larger observation distances within each test distance. I had slightly off kilter results between some of the different test distances because of the fact that I'm a human and I was riding a bicycle, so I couldn't keep my speed exactly the same the entire time. I wrote a simple equation heavily based upon the classical Doppler Effect equation that I first used approximate the results from my individual runs. Once I saw that it worked accurately for these, I then used it to generalize what happens for different test differences and constant hypothetical speeds and it proved my hypothesis true.

Conclusions/Discussion
Today there are already tons of implementations of the Doppler Effect. Whether it's taking readings and measurements from blood, using redshift and blueshift to measure the spin of a galaxy, or navigation undersea, the Doppler Effect is extremely important. The experiment I have conducted this year demonstrates some of the basic principles of this phenomenon, and I discovered how sound frequency from our perspective shifts when you or the object making the sound is moving at different distances. This could be potentially important as I plan on using this new knowledge to find a way for police cars to track down illegal firework usage on July 4th.

Summary Statement
In this project I used sound from a keyboard, spectral analysis software on my phone, and the motion from my bike to analyze Doppler shifts at different distances from my frequency emitter.

Help Received
My father helped me in transporting me to conduct my experiment, in pressing the key on the keyboard to provide the sound for my experiment, and in providing the materials for my experiment.