CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
J1314

Project Title
I Don't Appreciate Your Tone!

Abstract

Objectives/Goals
Examine the digital sampling of music by evaluating the Nyquist Theorem. My hypothesis was "If a recorded sound is sampled at a rate below the rate recommended by the Nyquist Theorem then the sound will be distorted." I further identified the smallest sampling rate required to reproduce a sound with no distortion. (Point of Indifference -POI)

Methods/Materials
I used a computer tone generator (NCH Tone Generator), a music editing program (Audacity), a computer, and a few people#s ears to sense the sound/distortion. I generated a fixed tone (440A) in the tone generator, adjusted the sampling rates in Audacity, and evaluated the quality of the tone with my ears. I kept track of my data collection in MS-Excel.

Results
I disproved my understanding of the Nyquist Theorem by determining that the POI was significantly higher than 2X the frequency. Then I found that a sampling rate of approximately 24 times the frequency of the tone was the point where an audible distortion began. For points below this sampling rate the audible distortion increased, for points above this sampling rate there was little if any change in the quality of the sound. I then confirmed the results a 440A test by evaluating a 360Hz tone with similar results.

Conclusions/Discussion
I identified a POI of approximately 24 times the sampled frequency for tones near 440Hz.

Summary Statement
Find the smallest sampling rate in order to reproduce a sound with no distortion

Help Received
Grandfather explained Nyquist theorem and helped understand wave forms; father helped type report and obtain / install software