CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Danielle Nguyen; Michelle Xie

Project Number

31190

Project Title

Sonification: A Novel Approach to Data Representation

Abstract

Objectives/Goals

The purpose of this project is to determine the type of sound wave that is most differentiable to the human ear when layering multiple instances of that type of sound wave. Our hypothesis was that each variable would improve the differentiation accuracy of multiple sound streams; multiple-sine wave and sawtooth wave were expected to increase the accuracy the most.

Methods/Materials

A computer program was constructed using Jsyn, a Java API for audio synthesis. The program played trials for the control--a single sine wave--as well as for the experimental variables--amplitude, musical notes, multiple-sine wave, sawtooth wave, and location on the stereo panorama. Next, 66 subjects were asked to report the number of sound streams they could distinguish for each of the 24 trials for a total sample size (N) of 1584. The best differentiated type of sound wave was determined through statistical significance tests.

Results

Through multiple chi-squared and t-tests, the sawtooth sound type was found to be the most differentiable variable ($p=.0000$). The statistical tests also indicated that the multiple-sine wave had significantly greater differentiation rates than the control ($p=.0030$). The correlation drawn between musical background and the inaccuracy in distinguishing the correct number of sound streams indicated a very weak, negative relationship ($R^2=.0986$). An additional chi-squared test demonstrated that there was a significant difference in inaccuracy between males and females.

Conclusions/Discussion

The hypothesis was validated: the data indicates that increased complexity in timbre facilitates the differentiation of multiple streams of sound; in other words, subjects more accurately report the number of sound streams when the sound quality is richer.

Summary Statement

The project focuses on the psychoacoustics branch of sonification, specifically, the differentiation of multiple data streams.

Help Received

Joachim Gossman introduced us to Jsyn and sonification.