VISUALIZING SOUND

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Collins / Vizproto– ART 494 / Digital Culture / Spring 2017

Abstract

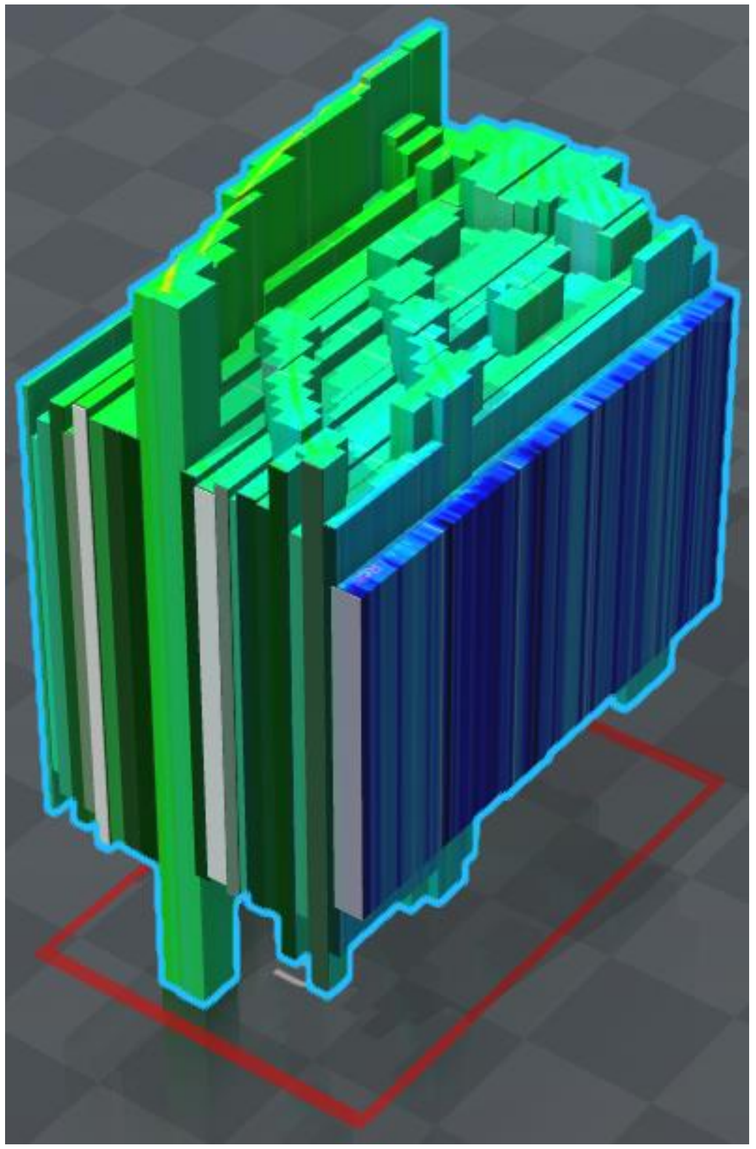
The characteristics of soundwaves were investigated by creating a 3D form that highlighted the relationship between frequency, time, and loudness. This physical representation of three separate soundwaves was modeled using a three step sound analysis process. Having a physical representation of sound is advantageous in mapping rooms, arenas and public spaces for sound technologies and the research of the visual analysis of sound serves as an important component in the advance of acoustic technologies.

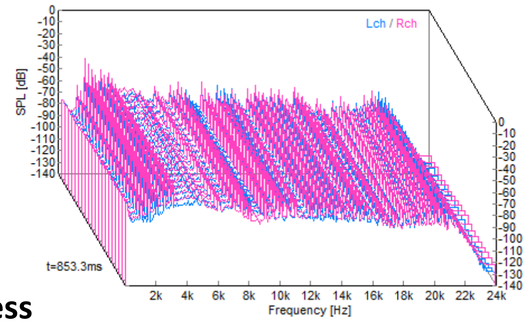
Research Question

By making sound visible through means of audio analysis, how can this digitally rendered three-dimensional form of sound be physically represented in a way that highlights the characteristics of soundwaves?

Precedents and Prior Research

- The CymaScope is an instrument that visualizes sound by using the vibrations from soundwaves to displace water. The final product is a mechanical wave pattern in two dimensions.
- Christian Greiffenhagen's research on the visualization of data has influenced the methodology of teaching applied mathematics by using observable data to help illustrate purely theoretical subjects.
- Visual analysis of sound is important in order to further sound technology for practical applications such as public installations and music performances as done in the research of Dr. Adrian Moore.





Process

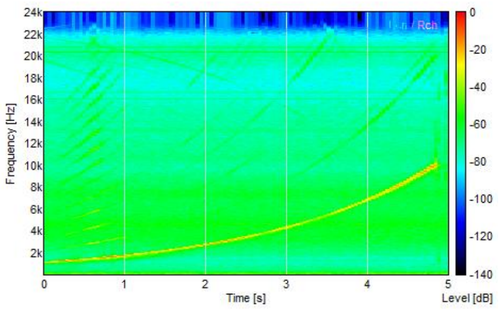
- A signal generator produced the input sound that was analyzed using Realtime Analysis software from YMEC inc. so that the frequencies of the incoming soundwaves could be measured over time on a decibel coordinate system
- This data, represented in a PNG file, was then put into the animation software Smoothie-3D 2.0 and was converted to a digital 3D representation of the original soundwave based on the three axes: frequency, decibels, and time
- The Smoothie file was then exported as an OBJ file and printed using a 3D printer

Results

A physical representation of a soundwave was created using a combination of audio analysis and animation software that shows the distinct relationships between time, frequency, and loudness in terms of decibels. The physical model represents every point of this relationship for a range of frequencies from 0-24 kHz over a course of five seconds.

Conclusion

By using visual analysis, soundwaves can be modeled to exist in a physical 3D environment. Moreover, because the innate properties of soundwaves, such as frequency and loudness, are easily measured simultaneously in relation to each other, a coherent dependency can be established in a 3D model that displays all these characteristics.



What is Audio Analysis?
Audio analysis focuses on the gathering and interpretation of audio signals produced by soundwaves by taking information such as frequency, wave amplitude, and waveform and organizing it in a coherent way. This project used audio analysis to describe soundwaves in terms of frequency and amplitude.

What is Smoothie-3D?
This is an open source animation software that excels at creating 3D objects from 2D pictures. For this project, the software was used to import a PNG file so that the data could be extruded from the graphical picture. The picture was used as a guide to draw the soundwaves in terms of its frequency and amplitude as found from audio analysis.

References

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Acknowledgements

I would like to thanks Dan Collins for providing templates, research, and ideas to this research project; I would also like to thank my groupmates and parents for their helpful insights and suggestions.

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