Creating a visual model of audio quality in rooms/venues

By

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A report on project work carried out for the degree of

BSC (Hons) Music Technology and Audio systems

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# Abstract

Understanding room acoustics intuitively is quite hard for humans to do especially as you change environment variables. This project intends to investigate methods of visualising audio quality in a dynamic environment to grant a sound technician a greater understanding of the room and help them evaluate different possible setups.

My approach finding a solution has two main segments:

• Firstly, I will conduct research into which audio characteristics I should incorporate into an index by which to judge audio quality at any discrete point. This could be qualities like RT60, DRR or deviation of the frequency spectrum from the source point (constructive/destructive interference, standing waves etc.).

• Once I have created an algorithm which gives an index score for any point in a room, I will build a software tool to visualise this within a 3D computer model of the room. This will require further research into 3D audio simulation methods and other software challenges like using GPU acceleration and other optimisations as the larger and more complex the model gets the longer it will take to run (linear – O(n)), however, there might be a way to reduce calculations and interpolate.

^first person

Contents

[Abstract 2](#_Toc119972184)

[Introduction 4](#_Toc119972185)

[Background Research 5](#_Toc119972186)

[Defining an Index Score 5](#_Toc119972187)

[Ideas On visualisation of Index Score 6](#_Toc119972188)

[Plan of Work 7](#_Toc119972189)

[Creating an Algorithm 7](#_Toc119972190)

[Design Methods and Optimisations 7](#_Toc119972191)

[Creating the UI/Visualisation 7](#_Toc119972192)

[Deployment 7](#_Toc119972193)

[Prototype Code Examples 7](#_Toc119972194)

[References 8](#_Toc119972195)

[Appendix 9](#_Toc119972196)

# Introduction

To include the background to and nature of the problem, aims and objectives.

Summary of the report structure.

Research methodologies, data collection methodologies, qualitative, quatitative

# Background Research

## Defining an Index Score

Remember – “the most appropriate research methodology is highlighted and fully justified”

Research on:

DRR, Standing waves, C80, speech intelligibility index.

The point of this project is to create a visual model of audio quality throughout a room, so to do that we must first define a formula by which to judge audio quality at each given point. This index score will be a value between 0-1 with 1 being high correlation to the source audio and 0 being low correlation. Firstly, industry standards in room acoustics e.g. Direct to reverberant ratio (DRR) and Clarity (C80) should be considered to approach this problem as …here is why those things were chosen. The use of these standards will hopefully mean that it is intuitive to understand for engineers who would already be familiar with such ideas, however, it would also be important that an untrained person can get a good idea of quality, so simplicity is key.

There is a lot to be gained from looking at other similar ideas like the speech intelligibility index (SII) points with references about SII.

## Spatial model

To perform these calculations obviously a 3D model of a room is needed,

Microsoft project triton, Interactive sound propagation for dynamic scenes using 2D wave simulation, complexity, prebaking

reason why for this project im going to just use a simple cuboid so trig could be used in the calculations so I don’t have to create a whole wave tracing system as that would be slightly outside the scope of the project.

## Ideas On visualisation of Index Score

High scores are more see-through to see bad bits more, side on/ top down, cross-sectional, interactive?

Also might it be playable along with a given song so frames get calculated then all get passed back to the user who can then play a song along with it.

Research on:

Visual models of audio, survey audio techs with questions about usefulness of frame by frame vs total, EQ visualisation, reoccurring patterns in music visualisation.

When creating a visual model the main aim is to make it as intuitive as possible, so the end user has to spend as little time to decipher the results as possible. A quick look at other visualisation methods across the music industry shows that, while there is a lot of divergence, there are a few specific patterns that often show up. One of these is the idea that the visualisation will dynamically move along with the music, like how a digital EQ might show a spectrogram of the output, quote about how this is better, another idea might be … . a few more examples of patterns in music visualisation (colour, 2D, 3D).

Explain with reference why dynamic visualisation is good for EQs. Then explain example 2,3…

The reason to include these patterns is to slot seamlessly into a world where people are very used to specific ideas so it will improve initial acclimatisation as well as the efficiency of displaying information.

A survey of 20 sound engineers on their views on what type of model they might work best shows …

To conclude…

# Plan of Work

## Creating an Algorithm

### Design Methods and Optimisations

How 3D space is dealt with. Separation of getTimes() from getIndex() and how total 3D model might not be completed. Other design complications. Showing independent extracurricular research is in the rubric.

Oop vs functional. GPU acceleration. How optimisation links with end user, perhaps they would be in the field and need a quick response, could that be possible - web deployment and scalability (nginx massive concurrency). Big O notation.

## Spatial model

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## Creating the UI/Visualisation

webGL, interactive/draggable, transparency, playback with audio that you uploaded

## Deployment

Web page, easy access for a sound tech on the job, can “order” process time before hand and once you have the file to play back you can play it back any time with the playback functionality on the website

### Prototype Code Examples

Can perhaps include references to a public git hub repository.

Early code prototypes used for design research.

# References

References here.

# Appendix

Appendix here.