An approach to stochastic spatialisation A case of "Hot Pocket"

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ABSTRACT

Many common and popular sound spatialisation techniques and methods rely on listeners being positioned in a "sweet-spot" for an optimal listening position in a circle of speakers. This paper discusses a stochastic spatialisation method and its first iteration as implemented for the exhibition *Hot Pocket* at The Museum of Contemporary Art in Oslo in 2017. This method is implemented in Max and offers a matrix-based amplitude panning methodology which can provide a flexible means for the spatialialisation of sounds.

Author Keywords

Sound spatialisation, sound art, sound for exhibitions, immersive audio, sound and music computing.

CCS Concepts

•Applied computing → Media arts; Sound and music computing;

1. INTRODUCTION

This paper covers the implementation of a stochastic spatialisation technique using random walks for the exhibition *Hot Pocket* at The Museum of Contemporary Art in 2017.[1] The backgrounds for the technique, implementation in the space and considerations in terms of working with spatial sound design for exhibition works will be discussed. *Hot Pocket* was an exhibition by the Norwegian artist Tori Wrånes[2] which incorporated video, sculpture, sound, performance and documentation of previous performances as a *gesamtkunstwerk*. The visitor was invited into a completely transformed space where all walls and floors were covered in carpets giving the impression of being in a cave or encapsulated inside the belly of a large animal. The sound implementation had as its objective to completely fill the space and to envelop the audience to heighten the feeling of navigating this indefinable interior.

2. BACKGROUND

[1]The Museum of Contemporary Art is part of The National Museum: http://www.nasjonalmuseet.no. The exhibition ran from April 21st-September 3rd 2017.
[2]http://www.toriwraanes.com

NIME'18, June 3-6, 2018, Blacksburg, Virginia, USA.

There are no lack of spatialisation technologies currently available, which highlights this as a very fertile and popular field of research. The availability of high-density loudspeaker arrays (HDLA) is still small but the advances being made, could help the growth of spatial composition instead of the more traditional timbral composition with stereo diffusion over a speaker array [4]. Several existing HDLA spaces are used for a range of performances, where the audience would generally be seated when experiencing the works. In many cases multi-channel setups for exhibition venues will generally be designed and setup on an ad-hoc basis, which does not render it as flexible as venues with an established infrastructure for multi-channel sound reproduction, yet on the other side it can facilitate a thinking "outside the circle."

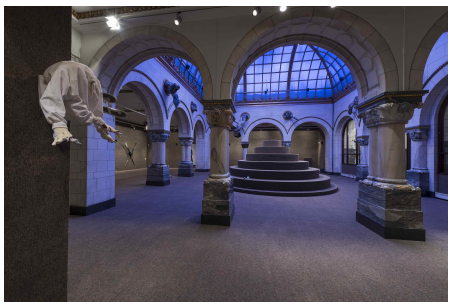

Figure 1: View of *Banksalen* at The Museum of Contemporary Art. Photo: Annar Bjørgli/Nasjonalmuseet.

For a good overview of technological developments of spatialisation methods see [6]. Several existing algorithms were considered for this project, among them Vector-Based Amplitude Panning (VBAP) [7], Distance-Based Amplitude Panning (DBAP) [2], flocking or swarming behavior [8], ambisonics [5] and Wave Field Synthesis (WFS) [1]. Although these are all spatialisation algorithms with strong merits for their uses, we found that our rather difficult wishes of perpetually traveling sounds would be difficult to achieve with these methods, specifically when considering the space it would be implemented in. The resulting method was heavily inspired by these existing algorithms.

3. IMPLEMENTATION

The project was implemented in Max[3]. A multichannel soundtrack could easily been assembled in a DAW like Reaper[4] but the same spatial distribution would be heard every day of the exhibition period and our aim was to create a dis-

[3]https://cycling74.com
[4]https://www.reaper.fm

tribution of sound which create an ever-changing sonic appearance of the exhibition, with varying densities of sound. Inspired by Iannis Xenakis' (1922-2001) approach to dynamic stochastic synthesis [10], the data for spatial distribution was generated using random walks. The random walk paradigm allows for higher or lesser degrees of control, determined by how "random" one wants the distribution to appear: "The fluctuation speed of a parameter is directly proportional to the step size of its random walks: the smaller the steps, the slower the rate of change in that parameter"[3] p. 79. The audience would generally not be seated, which would not be a well-suited situation for a fixed sweet-spot reproduction. With constant motion of the sound trajectories, the aim was that the audience experience the sound as immersive and continuously moving. First, the number of files to be played back was determined, then a mono sound stream is panned around the rooms based on the stochastic data. The data is generated for three parameters of amplitude, speaker number and transition time. The transition time is the cross-fade time between two speakers, where the amplitude value states to/from values of speaker transition. The transition time also defined the rate of reading the data which in effect means that the sound never "lingers" at any one speaker. At startup, the number of sound files are selected, the initial matrix data is generated and the internal clock controlling triggers is started. The stochastic data used to spatialise the sound is regenerated every time a new group of files are selected. Although of equal lengths, each file will end at different times due to the transition time parameter. When all files have stopped playing, a new selection of files and new data is generated.

The stochastic technique has several advantages among them being easily scalable data ranges, it does not rely on a sweet-spot position and it makes no assumptions about either speaker nor audience placement. By adjustment of step sizes for all three main parameters, a large variety of trajectories can be achieved - from the seemingly static to the random. The disadvantages are considerable lack of control over the spatial distribution of sound in a given space and adapting a work for different spaces is more time consuming than using Ambisonic encoded audio.

3.1 Equipment

The system was designed for an arbitrary amount of speakers and in total we ended up using 35 speakers and 4 subwoofers produced by Genelec, in a range of different models (6010, 8010, 8020, 8030, 8330, 7050), distributed as evenly as possible around the space. The difference in frequency response and power from the smaller to larger speakers was considerable but seen as an advantage. A Mac mini running Max along with two MOTU 24Ao soundcards[5], each providing 24 output channels over D-Sub to XLR. Where possible the speakers were hung at 3 meters above the floor, angled down 45 degrees.

4. NON-SPECIFIC SPATIALISATION

The stochastic methodology arose from a desire to take advantage of the inherent idiosyncrasies and limitations of the space. The Museum of Contemporary Art was housed in a former bank, which adds to the rather overwhelming appearance of the space and consists of rooms with dramatically varying sizes and ceiling heights. The artist's aim was to transform the space completely, which was achieved in large parts by the sound, the lighting and the carpets covering the walls and floors. The notion of non-specific spatialisation [9] emphasises that this methodology does not seek to 'simulate precise locations or directions of (usually point) sources' [9] p. 241. As such, in many situations one aims and wishes to recreate a specific real-world sound scene or to synthesise a 'new' space to create an imaginary but "real" space. The aim for *Hot Pocket* was not to attempt to create a believable real space but to emphasise the experience of being immersed in a cave or a large animal of some sort.Non-specific spatialisation is helpful when considering the lack of standarization among the various setups for multi-channel sound reproduction found in the world. But specifically when attempting to design a holistic and functioning spatialisation system for highly irregular spaces.

[5]http://motu.com/products/avb/24ai-24ao

5. CONCLUSION AND FUTURE WORK

Considering the site and the movement of people through the site, the decision to prototype a stochastic mode of spatialisation was deemed successful both by the artist and by the author. For setup, experimentation and changes, the method proved very flexible, where only simple step-size parameters needed to be changed to achieve a very different spatialisation in the space. The abstractions from this prototype implementation and the tools currently being developed are thought to exist at the very base of a compositional or sound art process allowing for a direct and immediate tool for exploring spatial organisation and placement. The advantage of this process is its flexibility as it is designed for used with an arbitrary amount of speakers and is not reliant on careful circular (or near-circular) speaker arrangements.

6. ACKNOWLEDGMENTS

I would like especially to thank Tori Wrånes and Rune Andreassen, along with his whole team.

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