REIMAGINING BEECROFT:

The Spatialization of Archival Audio

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Introduction

Norma Beecroft (1934-2024) was a Canadian composer, broadcast host and pioneer of electronic music who composed many pieces that pushed common conceptions of concert hall performance. By spreading loudspeakers in various formations across the concert hall she accompanied acoustic instruments with spatial electronic elements. Her radio program (1977) and subsequent book (2018) “Conversations with Post World War II Pioneers of Electronic Music” cemented her as a key figure in not only the development of electronic music, but also its preservation. Carrying forward Norma’s legacy, this project aims to preserve, remaster and spatialize one of her pieces, “Amplified String Quartet with Tape (1992).

Objective

To effectively create a spatial mix of one of Norma Beecroft’s pieces using archival recordings and scores. As is often the case with archival material, the only materials available are a stereo recording of a performance as well as the electronic accompaniment track. A primary goal in this project is the separation of the recording and source material into many discrete elements. The more discrete elements there are, the more control there is in the placement of sound sources in the spatial field. After the audio is prepared, I will remaster the recording using modern audio processing tools. Finally, the last step will be spatializing the final output via binaural synthesis. Above all, this process needs to respect the vision and integrity of the original composition.

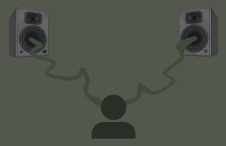
Methodology

- Gather any available archival material on “Amplified String Quartet”.
  - Provided by the University of Calgary Archives and Special Collections department, under the supervision of David Jones, Music Archivist at the University of Calgary.
- Investigate the effectiveness of 3 different techniques for the preparation of discrete audio tracks:
  - Spectral editing (RX 10)
  - A.I stem splitting (DEMUCS)
  - Frequency-based separation (PRO-Q 4)
- Remaster the archival material using modern audio processing
  - Dynamic equalization (Bloom)
  - Limiting (PRO-L2)
- Spatialize the individual elements within a synthetic 3D space
  - SPAT Stereo M4L device for Ableton 12

Mono

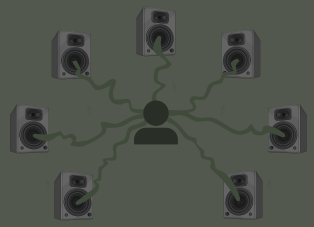
A single channel of audio

Stereo



Two channels of audio

Surround



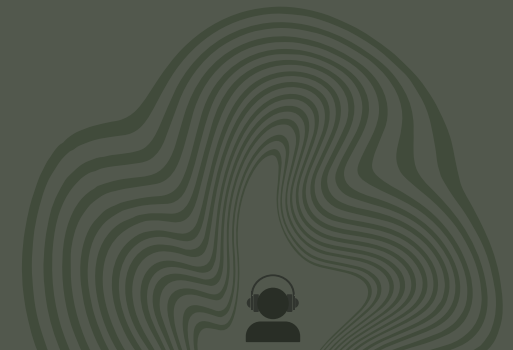
Three or more channels of audio

Some configurations utilize speakers placed above and below the listener

Spatial / Binaural

Algorithmic 3D localization of sound

Binaural audio mimics the acoustic effect of sound waves interacting with the outer ear and head to simulate how we localize sound (HRTF)



For comparison!
Original Audio

References

Headphones only!
Binaural Demo

Audio Preparation

- **Spectral editing** via iZotope’s RX10 proved unfruitful for this particular piece. The proximity in timbre between the electronics and the strings led to overlapping harmonics, making the separation of sources difficult and error-prone.
- **A.I. stem splitting** using Demucs, a music source separation model, also resulted in little to no actual separation of the sound sources. Models are trained on primarily popular music, and as such, none of the main elements in this experimental piece (strings, electronics) fall into the main categories (drums, bass, vocals, and “other”) of the model’s training.
- **Frequency-based separation** was the least destructive to the audio, but the most destructive to the composition. Separating audio by frequency using EQ bands preserves the audio and effectively splits the source material into many separate tracks. However, this process results in an unnatural division of the sound sources, especially when placing them independently in 3D space.
- Ultimately, **none of these techniques were effective** in separating source elements. The only effective strategy for discretizing the elements of this piece would be to re-record a string quartet playing the piece. Care would have to be taken to minimize bleed, but this outcome would be much more applicable to spatialization.

Remastering

- **Dynamic equalization** provided relief from some of the harsher sections of the piece, allowing for a more comfortable listening experience at higher volumes. Dynamic EQ carves out unwanted frequencies, but only when they appear in excess. This preserves the frequency spectrum of the recording, while taming build ups when they occur in targeted areas.
- **Limiting** the final output along allows for the perception of a more exciting listening experience. Most, if not all music we consume today is dynamically squashed (or limited) so that we perceive the audio as louder. Although reducing the dynamics of the performance recording sacrificed a small amount of realism, limiting was a very beneficial update to the sonic signature of the recording. Overall, the mastering process was trouble-free and effective.

Spatialization

Binauralization via SPAT’s binaural synthesis engine was extremely effective. SPAT recontextualized the stereo recording into an immersive 3D hall, equipped with fine tunable settings for perceptual attributes. Working with only the stereo performance recording ultimately gives a more natural and realistic experience. Pairing the performance with subtle additions of the electronic tape track, placed farther in the 3D field, helped immensely to buttress the lacking electronic presence in the original performance recording. This effectively treated the unnatural qualities the stereo mix had before. Ultimately, working without the desired discrete tracks led to a more natural presentation of the piece.

Acknowledgements

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