An accessible method for transcription, preservation, and performance of electroacoustic musical works

Live electroacoustic music (music written for instrumental performers that incorporates live electronics) is critically underperformed due to difficulties in reproducing the electronics for repeat performances. For my doctoral research, I will develop an user-friendly transcription format, accompanying custom performance software, and an online repository to preserve the signal processing (electronic processes and effects) used in live electroacoustic compositions. My transcription method will document the audio effect settings throughout a given composition, organized into tables to facilitate comprehension and ease of input. The performance software will read transcription files like a script to execute the signal processing needed for a specific composition. Throughout my doctoral studies, I will compile transcriptions for over 100 compositions, many of which are not directly performable today, and host them in an online digital repository for open access. These methods are meant for the practitioners – performers and composers – who are often precluded from participating in archival efforts. By developing accessible preservation tools, this project investigates the vital role of the practicing artist and community-based, participatory digital repositories in media archaeology.

The inevitable obsolescence of technology poses a significant threat to the preservation and dissemination of electronic media (Battier 2004). The rapid pace of technological advancement, coupled with a lack of electronic documentation, means that pieces written just a few decades ago are often no longer performable. Without intervention, thousands of pieces will be lost to hardware and software obsolescence, making it crucial to safeguard this part of our cultural heritage. My project stems from a need for methods that allow artists to contribute to the preservation of electroacoustic works and the current absence of an accessible repository. Large-scale research projects such as GAMELAN (Barkati et al. 2012), Integra (Bullock et al. 2008), ASTREE (Barthélemy et al. 2010), Caspar (Bonardi et al. 2008), and MUSTICA (Bachimont et al. 2003) were undertaken to develop sustainable methods for preserving interactive media. The outputs of these projects, however, focused more on preservation methodology rather than producing accessible migrations of electroacoustic works. The solution for performance, especially for pieces involving obsolete analogue technology, lies in recreating the signal processing in specialized graphic programming software designed for music. There are a number of programs developed for this purpose, such as Max/MSP (Zicarelli 1998), Pure Data (Puckette 1996), Integra Live (Bullock et al. 2011), and OpenMusic (Bresson et al. 2011). To encourage the use of these transcriptions by practicing musicians and artists, I will develop my performance software "patcher" (Puckette 1988) for transcriptions in Max/MSP, as it is widely taught in university music programs and is often considered the *lingua franca* of computer music programming (e.g., Didkovsky and Hajdu 2008, 486; Place and Lossius 2006, 143).

However, any preservation that relies entirely on particular software carries the threat of future obsolescence. The need for software-agnostic preservation formats has been well-voiced (Bonardi and Barthélemy 2008, Bullock and Coccioli 2006, Bernardini and Vidolin 2005, Polfreman et al. 2005), as documenting in this manner creates files that are easy to store, are immune to obsolescence, and can be easily recreated in present or future software. While the Faust programming language is one of the most successful of these efforts (Barkati et al. 2011, Barthélemy et al. 2010, Orlarey et al. 2004), it does not directly produce a performance-ready version of the work, nor is it feasible for the modern performing musician to learn and use. Boutard (2019) emphasizes that many previous preservation efforts are grounded in perspectives of computer science and engineering, rather than creative perspectives, stating that "preservation strategies ... which disconnect curation from practice, are not sustainable." (170) An accessible, text-based preservation format that does not follow programming language syntax, yet is compatible with Max/MSP, would create a viable alternative for artists to comfortably transcribe live electroacoustic works at large.

In a similar vein, Boutard (2015) argues that participatory digital repositories are important for the preservation of live electronics, implying that several previous preservation efforts did not continue,

in part, because the electroacoustic community could not contribute direct input. Participatory repositories are particularly crucial for electroacoustic compositions due to the sheer number requiring preservation. The magnitude of the problem is significant enough that it must be tackled by a community of performers, composers and archivists rather than just a select few individuals.

In response to this problem, I propose to develop three distinct yet interconnected tools: a text-based transcription format, a program for using the transcriptions in performance, and an online repository for access to previous migrations with the ability to upload new ones. To ensure their feasibility, I will develop and test these tools by transcribing a large body of works. Initially, I will limit my selection to works that use three of the most historically significant signal processing types: delay, ring modulation, and pitch shifting (Wilmering et al. 2020). These represent some of the main effect categories used in electroacoustic music (time-based, modulation-based and frequency-based) and provide a feasible goal for implementing the performance software during my doctoral degree. By consulting and collaborating with archives that house works for live electronics, such as the Canadian Music Centre, IRCAM's Sidney (Lemouton et al. 2016), IDEAMA at ZKM Center for Art and Media (Goebel 2001), and Donemus Foundation's NEAR (Bosma 2005), I will compile a list of approximately 100 works for live electronics that rely on one or more of these effects. This will provide the sample size needed to test the patch and act as a dataset for large-scale analyses of patterns across works.

The transcription process involves taking detailed measurements of audio effect settings at each point of change throughout a composition. Unlike previous text-based preservation formats, which use programming language syntax, I will base my format on dataset syntax often used to emulate musical devices (Fasciani et al. 2024, Juvela et al. 2023, Bittner et al. 2019). Formatting in this manner will allow me to organize signal processing into a time-based series of events, with instructions for different parameter changes with each new event. The transcriptions will include metadata such as the number of microphones, speakers, and channels required for performance. I will host the digital repository, including the performance software and transcriptions made during my studies, on GitHub, a popular platform for open-source projects that encourages collaboration (Dabbish et al. 2012). A repository of this kind will encourage artists to perform more repertoire with live electronics, both because users are only required to learn a singular patcher layout to perform multiple pieces, and because they will discover other works with similar instrumentation or electronic elements.

Outcomes from this project will form the basis of my doctoral dissertation, several chapters of which I plan to publish in journals (e.g., Contemporary Music Review, Organised Sound) and conference proceedings (e.g., International Computer Music Conference, International Conference on Acoustic, Speech, and Signal Processing). Along with the GitHub repository, I will also create a series of tutorials and organize workshops demonstrating these tools at conferences and universities worldwide. Even without contributions by other artists, this collection will be the largest of its kind hosted by an individual for open access.

There are several promising future directions for this project. Works that include other effects, such as filters and reverb, could be transcribed and amalgamated in similar manners. Methods for integrating transcriptions into Faust will open up future opportunities for merging with other databases. Finally, the data generated from this project enable large-scale analyses of general patterns used in live processing in an empirical manner that has yet to be explored in this genre.