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The Electro-Acoustic Music Mine Project (EAMM). Collecting, Archiving, Sharing, and Exploring
by Tae Hong Park

Introduction

Electro-acoustic music (EAM) is a tech-nology-driven genre of art music that began to develop during the 1950s. With the advent of the computer, the field of EAM has since grown signific-antly. EAM has established itself, in avant-garde and academic commu-nities, as a significant field of artistic creativity, research, and intellectual inquiry that includes composers, per-formers, scholars, researchers, engi-neers, scientists, and music practi-tioners. Due to the very nature of this work – including its heavy reliance on new technologies, multi-format audio files, idiosyncratic scores, computer code, and schematics that describe complex performance setups – an ap-propriate and reliable method of pre-servation is needed. For EAM, there are currently no such preservation systems that can effectively preserve the musical works and the software systems, models, and knowledge that engendered those works. Although many of such works are presented, performed, and temporarily stored

during the submission, review, and production phases of conferences where such works are typically presented, once the event is over, artifacts are relegated to physical and digital attics of the organizers. The EAMM project aims to take advantage of existing conference music collection workflows that loosely resemble music curating and archiving practices in an effort to collect, archive, share and create portals for exploring EAM.

Motivation

EAM is typically presented in academic settings including conferences and music festivals. Upon conclusion of the conferences, however, both the music and attendant data are either lost, or if archived, very difficult to access and "slowly disappearing" (Cuervo 2009). In cases when fragments of archived data do exist, they remain typically offline, making access difficult for researchers, and virtually invisible to the average information seeker. Two of the most significant EAM conferences are the International Computer Music Conference (ICMC) and the Society for Electro-Acoustic Music in the United States (SEAMUS)

conference. Every year, ICMC and SEAMUS program approximately 200 (~12% acceptance rate) and 100 (~20% acceptance rate) works respectively. Each conference produces a single audio CD with about eight works each: 90% to 95% of works presented at the conferences are lost. Since the inception of these organizations, both conferences have utilized vigorous peer-review procedures (developed over the past 40+ years) to curate the "best" pieces for presentation. An estimated 7,000 ICMC and 2,500 SEAMUS works have been lost, or are at best, inaccessible, since the establishment of the conferences in the mid-1970s.

The mere fact that this music from a cadre of significant international composers (conveniently provided and stored digitally at conference databases at the curating phase) is being lost is an issue in itself. Concerns are further heightened as the music being lost
(1) has significant musical and cultural value and is of historical importance,
(2) plays a central role in contributing, informing, enriching, and expanding our experience of contemporary musical thought and
a diverse musical heritage, and

(3) has little chance of being available for general public programming as musical traces are erased after the completion of events. Internationally recognized composers typically create much of this music, but it does not readily fit into existing music industry models and preservation mechanisms. This situation resembles highly theoretical scientific research papers, which oftentimes yield no immediate and practical application and neither seek recognition from industry, nor aim to be financially successful. The difference is that for such research, reliable preservation models do exist.

Preservation in itself, however, is just part of the problem; the materials have to be both archived and accessible. Conferences that temporarily create databases with complicated access mechanisms are designed for review purposes; as such, they not only severely limit and discourage access, but also negate the fundamental purpose of such digital archives – to allow the general public to explore, learn, and utilize materials for research, education, or to simply facilitate the enjoyment of art. There are also more "inspirational" reasons for providing access to EAM. For ex-

ample, there is the case of popular music group Radiohead, who created one of their most successful songs *Idioteque* (2000) after fortuitously coming across Princeton University Professor Paul Lansky's EAM composition mild und leise (1975). According to Lansky:

"The piece [mild und leise] came out on a Columbia/Odyssey LP in 1975 or so as a result of a contest run by the International Society for Contemporary Music (ISCM). It was called Electronic Music Winners (I've occasionally seen it for sale on Ebay), and Jonny Greenwood [one of Radiohead's songwriters] came across it in a used record shop when the band was on tour in the United States recently. I think it sold about 7,000 copies, which is a lot for a classical recording." (www.music. princeton.edu/paul/radiohead.ml.html, last access Sept. 14, 2020)

Radiohead has sold well over 30 million records in total. There are, of course, other interesting examples where EAM has had considerable artistic influences on popular music cultures. For the band Matmos, EAM became influential upon their discovery of musique concrète techniques,

which they have adapted as a fundamental fabric of their music – utilizing everyday sounds via standard recording devices. It is no coincidence that both band members, Drew Daniel and Martin Schmidt, have their roots in academia and are also well versed in the history and literature of *musique concrète* (Daniel is currently a professor of English at Johns Hopkins University). For Frank Zappa, the shaping of his music was also highly influenced by EAM. His exploration of art music seemingly began when he found the album *The Complete Works of Edgard Varèse*, Volume One after a year-long LP searching quest (Zappa and Occhiogrosso 1989). Towards the latter part of his career, Zappa focused much of his signature work around the Synclavier, a digital sound synthesizer developed by Dartmouth College EAM composer Jon Appleton. In another celebrated example, the Beatles wrote their infamous "sound collage piece" *Revolution 9* after being exposed to the works of Edgard Varèse, Karlheinz Stockhausen, and Yoko Ono (MacDonald 1994; Sheff 2000). The distinctive artistic and musical paths of all these artists could have been very different (perhaps for the worse) if they had no access to an esoteric EAM resource, whether by chance or whether being in a privileged position of access. The affective impact of EAM that ignited innovation and creativity amongst these prominent musicians, and its contribution of musical culture, is immeasurable.

The affective role that EAM has had is not only found in artistic and musical spaces. Due to the multidisciplinary nature of EAM, innovative research and development, and creation of new technologies are also key aspects of its very existence. Technological innovations are often originally expressed in, and tightly coupled to, the compositions themselves and documented in concert program notes. A plethora of examples exist including pioneering research and development of sound recording techniques with early tape recorders, invention of musical synthesizers, and the first computer language created by Max Mathews who is widely regarded as the grandfather of computer music. An especially impactful example of this cross-disciplinary narrative can be found in EAM composer John Chowning's invention and patenting of frequency modulation (FM) sound

synthesis. In 1994 FM was the "second most lucrative licensing agreement in Stanford's history" (http://news.stanford.edu/pr/94/940607Arc4222.html, last access Sept. 14, 2020).

Existing Models for EAM Preservation

There are a number of existing EAM preservation models today, including professional archival services, commercial recordings, artists' personal websites, and other Internet-based sites. Artist websites are ubiquitous but have limitations as preservation models
(1) distribution: sites are randomly spread over the Internet;
(2) sustainability: hosting is often temporary and maintained by the artist; and
(3) accessibility: the user has to sift through an ocean of data as the great majority of music recommendation research in MIR is focused on popular music.
Few record labels publish EAM at all, and the ones that do operate within a framework of economic viability, which can be at odds with artistic merit. This typically involves a curating system that can also be at times sensitive to political factors and inher-

ent biases due to practicalities that may are not necessarily a function of artistic or cultural significance.

Existing "professional" EAM-related archives include the Digital Anthology of Recorded American Music (http://www.dramonline.org, last access Sept. 14, 2020), International Electro-Acoustic Music Archives (http://on1.zkm.de/ zkm/e/institute/media-thek/ideama, last access Sept. 14, 2020), and Ubu-Web (http://www.ubu.com, last access Sept. 14, 2020). DRAM is a non-profit resource (paid subscription) with 3,000-album archive of recorded American music, including some EAM. The anthology is compiled from recordings provided to DRAM by independent record labels. Although DRAM is a valuable resource for new music and EAM, it is worth noting that it is limited to American music recordings and works already available through record labels. The limited repertoire is the most significant issue – searching the DRAM anthology for EAM pioneers John Chowning, Max Mathews, and Barry Truax yields no results, for example.
A second archive, IDEAMA was created in 1988 in an effort to preserve the "most endangered early [EAM]

works" up to around 1970. In 1990 the project developed into a collaborative project between Stanford University and the Zentrum für Kunst und Medientechnologie Karlsruhe (http://on1.zkm.de/zkm/e/, last access Sept. 14, 2020); 570 works, selected by an "international advisory board," are now archived. These are valuable collections in MP3 format. The database, now maintained by ZKM, has grown since the 1990s to include newer EAM works under the <mediaartbase.de> framework. Limitations of the IDEAMA archive include the fact that the collection only catalogs works up to 1970. The extended ZKM archives include either self-submitted contributions or entries curated through ZKM. UbuWeb is a repository that went online in 1996 with much contemporary avant-garde music, including EAM. As a do-it-yourself initiative, it is unsupported by any institution or industry partner, and although it is easily accessible on the Internet now, it falls short as a preservationlevel archival resource owing to uncertainties about its sustainability, audio quality standards, and curation process. According to their website, "UbuWeb posts much of its content without permission; we rip out-of-print LPs into sound files; we scan as many old books as we can get our hands on; we post essays as fast as we can OCR them."(http://www.ubu. com/resources/index.html, last access Sept. 14, 2020) YouTube, in the present context, could be considered a gigantic, crowdsourced version of UbuWeb. As preservation repository, however, it fails to measure up with respect to audio quality (often substandard), stability of its content (here today, gone tomorrow) and intellectual property management.

The EAMM Preservation and Archival Model

Multiple concerns exist in current EAM preservation and archival models. These include:
(1) the lackof established practices that are sustainable, expandable, scalable, and diverse;
(2) the absence of internationally accepted peer-reviewing standards;
(3) the absence of an agreed-upon EAM metadata standard; and
(4) the limited accessibility to archives through modern technologies.
The Electro-Acoustic Music Mine (EAMM) model attempts to contribute in addressing the aforementioned concerns. EAMM attempts to enhance and contribute to, rather than replace,

existing technologies and models of digital archiving methodologies. In establishing protocols that are effective, efficient, sustainable, and scalable, EAMM attempts to address issues concerning peer-reviewing, metadata standards, technological currency, interface design, development of transferable technologies, scalability, the building of low-risk structures, and adaptability to changing digital archive environments.

Structurally, EAMM comprise of three modules at various development stages:
(a) the filtered crowdsourcing module (FCS),
(b) the archive/preservation (AP) module, and
(c) the content-based analysis (CBA) module.
The FCS module provides a streamlined crowdsourcing model for data collection that is subjected
to a "credentialed filtering" process via peer-reviewed jurying. "Filtering" the crowd-sourced submissions provides a mechanism for selecting the most significant works as determined by an internationally recognized peer-reviewing system. This mechanism helps to control the number of works we can reasonably archive, as it is im-

practical, infeasible, and undesirable to archive every submitted work. The AP module consists of the archival database that contains all media data, metadata, and any other data associated with a composition, including performance and performer history. Lastly, the CBA module provides a baseline platform for the development of next generation exploration interfaces of the EAMM archives by utilizing digital signal processing (DSP), visualization techniques, and music information retrieval (MIR) as further described below.

We are currently working with NYU Libraries and the International Computer Music Association (ICMA), and the New York Electro-Acoustic Music Society (NYCEMS). ICMA, in particular, has a preeminent international reputation in the field for its sponsorship of annual EAM conferences since 1974; and there is ample evidence through these 46+ years of experience that ICMA conferences will continue to strive and attract the best EAM works for the foreseeable future. At the same time, the cultural value of EAM extends far beyond the academic community alone and we hope that academics, music enthusiasts and the general public will benefit

from EAMM outputs which will ulti-
mately include:
(1) a permanent, sustainable, and ex-
pandable EAM preservation repository
housed at the NYU Library;
(2) interfaces for discovery and inter-
action with the material; and
(3) access to otherwise unavailable
EAM resources including audio files,
metadata, computer code, digital
conference booklets, details about a
composition, performance history,
and musical scores.

Retroactive Archival Efforts

To lay the foundation for EAMM, we
will build a historical archive that will
salvage what is left of the recordings
and related data for works presented
at the ICMC conferences – including
high quality recordings and concert
performances whenever available –
up through 2020. We have thus far se-
cured the 2011, 2012, and 2018 data-
sets and are working on collecting the
2020 dataset. The retroactive collec-
tion program will not only preserve
this important legacy, but it will also
contribute in developing and tuning
our EAM metadata set by researching
and analyzing metadata structures
used in the conferences. We anticipate

that this, in turn, will greatly contrib-
ute towards creating an inter- nation-
ally recognized EAM metadata
standard. For the retroactive initiative
we will use the camera-ready FCS
sub-module – interface used to col-
lect conference accepted data – to
streamline and crowdsource the col-
lection of archival quality media files,
additional metadata, and other data
types that we have identified as ne-
cessary for our EAM metadata
schema.

**Intellectual Property and Author
Permissions**

Since our EAMM collection is interna-
tional in scope, aim for its accessibility
is to be as open as possible. The level
of restriction for access to the material
can be, however, individually modu-
lated according to each contributing
artist's preferences depending on
enduser types: general public or
individuals who formally apply to us
as researchers, for example. Other
mechanisms that we are considering
is access limited to those physically
on the premises. All works is ac-
companied with authorial permission
and all rights of the archived works in
our EAMM database will remain with

the author. Each submitter to the ICMC conference is provided with a digital agreement form where authors can choose to participate in archiving their works. As EAMM's collection mechanism is primarily based authorial crowdsourcing paradigms, intellectual property, copyright, and licensing issues are greatly simplified, and the EAMM archive (by virtue of its metadata structure) will itself be the place where intellectual property (IP) agreements with authors are documented.

Conclusion

EAM explores and pushes artistic, aesthetic, and technical boundaries and is typically presented by specialists at academic conferences. Unlike the majority of popular music, it is not economically-driven, nor reliably preserved by market mechanisms or archival projects sponsored by industry, libraries, or museums. Furthermore, all of the EAM data that is carefully and painstakingly collected is typically lost after a conference concludes. When and if the music is archived, the burden to create a preservation system falls on conference organizers unprepared to build and maintain a dependable archive. The

physical inaccessibility of EAM for the expert and wider audience is an issue in itself as its current outlet mechanism limits its exposure to the academic community, which in turn inhibits growth in musical diversity and the wider aesthetic and pedagogical potential for the general public. The musical inaccessibility further diminishes accessibility of this work to a greater audience, a problem exacerbated by inadequate exploration platforms for "art music" in general. These factors contribute to the difficulty of fitting EAM to existing preservation models. The Electro-Acoustic Music Mine (EAMM) attempts to address the aforementioned issues by creating an EAM preservation and exploration portal based on:
(1) a semi-automated crowd-sourced music collection module curated through credentialed peer-reviewing systems,
(2) a comprehensive archival and preservation module, and
(3) an analysis module based on the timbre-centric Electro-Acoustic Music Analysis (EASY) Toolbox providing an online platform for interactive visualization, navigation, and discovery of EAM.

This third module exploits Music Information Retrieval (MIR) and content-based analysis baseline to extend and enhance traditional text-based indexical discovery and delivery systems. No similar credentialed, peer-reviewed preservation system exists for EAM, and no MIR-based EAM exploration interfaces exist for any kind of music archival system.

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