(Re)discovering Sounds of CCRMA - Towards Computer Music Preservation

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ABSTRACT

Sixty years after the initial experiments on digital sound synthesis, we are now facing several problems regarding the preservation of computer music artefacts. The usual practice has been to safeguard the end product - the actual sound output - at the expense of the sources that have been used in the production process; but by doing so, we risk losing the traces of important practices and works. In that respect, CCRMA provides an interesting case study: as one of the first and leading center for computer music research over four decades, countless musical productions (compositions, musical examples, teaching material) have been produced there. The archives and the different types of documents found will be described; the problems due to the polymorphic nature of these archives will be discussed. A methodology for the preservation of significant musical artefacts will be presented and the key questions raised will be identified and discussed. While this proposed methodology and practice will be initially used on documents of CCRMA, it is designed to be sufficiently flexible to be functional on other similar archives.

1. INTRODUCTION

It has been now more than sixty years since computers were first programmed specifically to produce digital sounds. During this time, numerous systems have been designed, constructed, developed, used and abused to generate sound examples, teaching materials or compositions [1]. While some common ground was found after the introduction of the *Music-N* software series [2], technical limitations, different requirements, research goals, aesthetical aims, led to different practices and to a diverse range of software and realisations.

A key center for the development of Computer Music is Stanford's Center for Computer Research in Music and Acoustics (CCRMA). While its history is well documented, notably regarding the institutional aspects [3], little work has been done to document its rich creative history, especially regarding the musical works and teaching materials that have been created there by hundreds of scholars over the forty years of its existence. This research project is concerned with the examination and preservation of *musical artefacts* that have been produced at CCRMA; to address this, a new methodology is proposed, based on the (re)discovery of original sources and its update.

While the computer music field progressed by introducing new techniques for digital sound processing and synthesis, and by importing new methods for symbolic treatment of musical information, very little work has been done to address the safekeeping of computer music works: in a sense, it was assumed that the important object was the archival of outputs, the *musical artefacts*, and not documents or information pertaining to the *production chain* [4]. This is partly the situation at CCRMA: despite that many groundbreaking techniques and works have been created there, little information and documentation are still available.

Investigating CCRMA archives makes us gain a better understanding of the evolution of computer music techniques and tools, which can then be evaluated *in retrospect*. We propose to do this using a global approach, focused first and foremost on musical aspects: hence the primary purpose is the description and understanding of the interactions between new technologies and music, with the goal of providing a comprehensive and accessible environment to explore and preserve the important works contained in archives. We will first detail the content of the 'extended' CCRMA archives, then propose a protocol (ICE-R) for an effective treatment of key musical elements found in the archives.

2. EXPLORING CCRMA ARCHIVES

The exploration of what constitutes CCRMA archives is a work in progress; the diversity of information (and the complexity of accessing it) certainly plays its part, as it will be explained below. However - as it is quite common with any work involving archives - the most complicated aspect in this case is actually tracking down the location of information: in the case of CCRMA that means getting access to personal archives, which might contain more information pertaining to this research than what is available in the institutional repositories.

2.1 Description

There are several distinct elements that contribute to what constitutes the "CCRMA archives". The definition of these archives, as mentioned, is quite complex in terms of sources and documents, but can be quite straightforwardly summarised as being constituted by "any significant artefact

[1] For a good overview of the early period of computer music and descriptions of some systems, refer to [1].

which has been produced at CCRMA" [2], which explain why elements of interest might be stored elsewhere [3].

2.2 Locations

Documents found in institutions' archives are, of course, vitally important. In the case of CCRMA, it has been possible to track down elements in several locations.

2.2.1 Stanford University Library

At Stanford University, the two sources for information are the University Library and Archives, and CCRMA itself. Regarding the the history of CCRMA, the University Archives have a collection of 25 boxes which contains documents of varying interest. This archive has been detailed in [3], with an emphasis on institutional and historical aspects. Most of the documents comes from papers kept by the former CCRMA administrator - hence the emphasis on administrative aspects - and they paint a vivid picture of the first 30 years of CCRMA history [4]. However the bulk of the documents are hardcopies - with some worthy exceptions [5].

2.2.2 Center for Computer Research in Music and Acoustics

At CCRMA itself, the situation is more complicated, since the cataloguing has not been done yet. Of particular interest are the digital files that are stored, in what form or another, at the Center: this includes sound files of musical examples and compositions but also, and perhaps more importantly, source codes for these musical artefacts. Another location may have interesting items in its archives: the Computer History Museum in Mountain View; some older machines that are part of CCRMA's origins (when it was hosted by the Stanford Artificial Intelligence Laboratory) are stored there.

2.2.3 Personal archives

Another part of the archives pertaining to CCRMA history are preserved in individual collections. Key CCRMA personnel have collected and (hopefully) stored documents related to their work at the center. Moreover, their knowledge of earlier systems (e.g. the infamous Samson Box) is invaluable to be able to work efficiently at the preservation of the works produced at CCRMA.

2.2.4 SAILDART

Finally, an online repository of digitized tapes of the SAIL system provides snapshots of several programmers' home folders, including CCRMA members.

[2] Of course, the importance of any document/artefact can be hard to judge; this question will be addressed in the next section.

[3] At the time of writing, the majority of research has been spent on examining the institutional archives (mainly at Stanford University).

[4] These archives end in 2001; see [5]

[5] The most striking being two 3.5" floppy disks containing the 1995 version of Jean-Claude Risset's Catalogue of Computer Synthesized Sounds [6]

2.3 Document types

The documents can be roughly classified in 5 categories: paraphernalia (e.g. photos, concert posters, flyers), administrative papers (e.g. grant applications, letters to and from governmental agencies, yearly budgets), research papers from, or of interest to, members of CCRMA, technical documents (e.g. operating system and software manuals, printouts of computer music software) and digital files.

2.3.1 Paraphernalia

are essential to obtain a list of the works that have been created or played during CCRMA events. It is therefore possible to derive (a) a timeline of the music works that have been played (not necessarilly produced) at Stanford and (b) a list of works that have been composed by composers working there.

2.3.2 Administrative documents

form (unsurprisingly) the basis of the archives at Stanford University's Library. While they provide the all-important background to understand the environment in which a musical artefact has been created, they are not directly relevant to its understanding or its use. They nonetheless provide valuable information to understand the backdrop for a particular project or composition.

2.3.3 Research documents

are found in all archives. They are, of course, essential to understand the research atmosphere and the interests of CCRMA dwellers at any given point. They also sometimes are linked to particular individuals [6]. While they are not of direct interest to inform the musical artefact, they nonetheless provide a necessary insight into techniques that were investigated at a particular time.

2.3.4 Technical documents

are invaluable resources to understand the mechanisms of software and hardware being used at the time. For example, several annotated copies of 1960-70s manuals that were being used for the DEC machines (PDP-10 and PDP-11) are available in the archives; they sometimes help understand the reality of working with a particular computer system. In this category, it is possible to find older source code - the entire source code of Leland Smith's SCORE software is available in hardcopy, with annotations from the author.

2.3.5 Digital files

are of two types: (a) binary files - audio and/or executable files - in formats that may or may not be usable by modern systems; and (b) text files - documents and/or source code - that are extremely important for the preservation process.

2.4 Limitations

On top of getting access to several archives and documents, which is the initial concern of many researchers concerned

[6] The most impressive and exhaustive folders are those pertaining to John R. Pierce, with documents from his long and diverse carreer, as well as copies of articles from colleagues whose work he was particularly interested in.

with historical works, there are two challenges that are directly linked to the nature of the documents examined in the case of computer music.

2.4.1 Cataloguing

The sheer amount of information scattered in various places and formats makes the inventory and cataloguing very complicated. While the Stanford Library's archives is well documented and almost completely catalogued, the situation at CCRMA is still unclear. Generally, several systems were used throughout the center's history, evolving from a centralised system - PDP-10 - to workstations - NeXT - then to current personal laptops - meaning, since the quantity of information has evolved exponentially, simultaneously more information (as everyone carries a data collection nowadays), but also loss of information through dilution (such as CCRMA storing only 'final' versions of works - e.g. for concerts). There are also local issues since very little work has been done throughout the years to keep the data created at/for CCRMA systematically organised.

2.4.2 Diversity

Another problem is related to the diversity of systems that have been in use at CCRMA - hardware: DEC systems, Samson Box, NeXT computers; software: MUS10, Music V, SCORE... - which mean acquiring expertise in many different environments to be able to conduct the preservation process. There is, of course, a circular dependency as documents contained in the archive inform on and about the environments.

3. TOWARDS A METHODOLOGY FOR THE PRESERVATION OF COMPUTER MUSIC HISTORY

The problem of preservation of computer music, and more generally of electroacoustic music, has been addressed several times [7] [8] [9] [10] [11], proposing different approaches. One common concern of these research is the will to overcome the obsolescence of media support that were used to store musical works and to find strategies to keep these musical artefacts alive. While the process itself is quite tied to particular works and not easily transposable, *reconstruction* is an interesting way forward.

3.1 A preservation methodology: the ICE-R protocol

With the goal of a proposed reconstruction as the final stage, we propose a 3+1-step protocol for the preservation of computer music artefact and works.

*3.1.1 **I**dentify*

It is tempting to focus on 'important' works of computer and/or electroacoustic music as targets for preservation. While this may seem like a valid standpoint, many musical artefacts are generated by users of a research center and some of them might hold real importance for non-esthetical reasons (for example, historical, pedagogical, technical...). The first step is therefore to identify the target work to be preserved: this includes being aware of the cultural, technical and possibly institutional surroundings of a particular work - hence the importance of 2.3.1, 2.3.2, and 2.3.4 documents in this phase.

This stage serves both to discover and to ascertain the significance of a musical work target. Note that the 'significance' of a given musical artefact might mean different things - from historical, to musicological, to technical elements.

*3.1.2 **C**ollect*

The second step is a more focused, more precise grouping of all available documentation on a given musical artefact. This means notably getting all 2.3.4 and 2.3.5 documents, without being concerned about their nature at this stage.

Regardless of the document types, the aim is to gain sufficient information about the circumstances and the technical details of the work to make the next stage possible, but without being concerned about the feasibility of the last step of the process. This implies, for a targeted composition, to get hold of as many source codes as possible (e.g. algorithmic elements, sound synthesis...), but also technical documentation, artefacts (e.g. old machines or computers), and, of course, research outputs related to the musical work.

*3.1.3 **E**nhance*

This stage is concerned with finding the right strategies to present the musical artefact in a 'modern' way. By careful examination of 2.3.4 and 2.3.3, it should be possible to propose a plan for the optimal 'update' and presentation of the artefact. It is also at this stage that it is determined if a musical work can or would benefit from a reconstruction process, which implies several important deontological decisions (and possibly having to guarantee the authenticity of documents used in the process).

3.2 ***R*econstruct**

This last step is another process in itself, similar in certain ways to what happens during the creation of a musical work. A reconstruction should strive to stay as close as possible to the original 'idea' - and here lies all the complexity of this step. Consequently, there are a number of strategies that could be used in order to ensure the reconstructed artefact is 'coherent' with the original - or the original's concept and goal.

3.2.1 Technical aspects

In terms of technical solutions, we identify two main families of strategies to complete a reconstruction.

Emulating the original system might be the best solution if there are several (parts of) works to reconstruct and if the goal is to provide a (ideally exact) 'clone' of the original artefact. Otherwise this process might be time-consuming

Translating source codes in modern languages will give excellent results if the goal is to give a musical artefact a new 'life'. This might also be the best solution to ensure the preservation of a given work: by multiplying the implementations (possibly resulting in many different 'avatars'), it introduces a flexibility into the musical work akin to the plasticity of a traditional score.

3.2.2 Esthetical implications

There might be a deviation between the 'original' output of a computer music work and its reconstruction, for numerous reasons. The sample or control rate might (would probably) be different thanks to the computing power of modern computers and this will impact the outcome of an otherwise identical sound synthesis patch. This kind of deviations may have an enormous impact on aspects of a given piece - it essentially implies that a computer music composition becomes similar to traditional Western score-based music, with a score (e.g. algorithmic graphs, sound synthesis patches) that can be interpreted using different instruments (programming languages).

3.3 Goals

Aside reconstructing important musical work that may have been lost/degraded, one of this research goal is to provide an integrated environment for the exploration of the history of CCRMA. Instead of focusing solely on a history of events, a recounting of experiments or a list of musical works, the end product will provide the user with several views on a same musical artefact. For a computer music composition, this means presenting the original source code file(s), along with a proposed reimplementation, in recent programming language(s); giving access to selected documents shedding a light on the circumstances for the creation of the work; and providing links to a grand historical narrative about the center and more generally about computer music.

4. CONCLUSION

Preservation of computer music works is getting more and more urgent. Several key works have already been nearly lost to the degradation of media support and some of the early masterpieces of electronic music are only available as n-th generation copies of an initial analog transfer. CCRMA archives, given its importance and score, provides an ideal case study for the ICE-R protocol: it has been at the forefront of technological innovations for music over the last forty years and has seen the creation of many musical works, which have been implemented on several systems (both hardware and software). Since the documentation on these systems is/may still be available, it means that it will be possible to achieve, in many cases, reconstructions of key musical works.

Of course, the ICE-R protocol is designed to be transposable to other archives, and each of its step will become more detailed as the research carries forward. Ultimately, and with sufficient data, the later stages (E-R) might result in a semi-automated software: this will allow for a quick deployment in the archives of other centers, or as an all-in-one solution for the preservation and portability of computer music works.

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