MODERNISING LIVE ELECTRONICS TECHNOLOGY IN THE WORKS OF JONATHAN HARVEY

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ABSTRACT

Many twentieth century works composed for instruments and live electronics are seldom performed due to their use of near obsolete technology. Some performing bodies avoid such works because the necessary technology is either unavailable or too expensive to hire. This paper describes the current status of a project to modernise the technical aspects of Jonathan Harvey's works in order to increase the likelihood of performance and improve longevity. The technical and ideological implications of the project are discussed in the context of a broader need for the preservation of contemporary works involving technology. The use of open source software and standard protocols is proposed as a way of reducing technological obsolescence. New solutions for two of Harvey's works are proposed, and discussed in relation to the problems encountered with the project so far. Conclusions are then drawn about the current status of the project and its implications for further work.

1. INTRODUCTION

As they have been invented, new forms of electronic technology have been incorporated into new musical works as an addition to and expansion of traditional musical resources. Cage's *Imaginary Landscape* (1939) for variable speed turntables and Messiaen's *Fête des Belles Eaux* (1937) for six Ondes Martenot are some of the earliest examples of this. Through the second half of the twentieth century, composers continued to utilise new electronic technology as it became available, to the extent that a significant historical canon has now emerged. However, whilst the musical scores for many of these works are relatively easy to obtain and use, the technological elements are sometimes impossible to realise because the technology is nearing obsolescence. Many works of the 'eighties, for example, used hardware FM synthesisers and samplers, and although software equivalents for these are now available, the media for many works have not been revised.

Another problem facing performers is the lack of clear and complete documentation regarding the technical implementation for a work. In a recent performance of a canonical piece for percussion and live electronics at Birmingham Conservatoire, several hours of rehearsal time were wasted working out how real-time control data was to be mapped onto sample playback parameters. This could have been avoided if clear instructions had been provided with the score.

In other cases equipment is too expensive to hire, too esoteric to be quickly set up, or unreliable due to its age. Some of the larger scale works from the 'eighties require the original and unique equipment for which they were composed, and a technical team to operate the equipment.

The problems associated with obsolescence in works involving electronics are often exacerbated by the ambivalence of composers to the longevity of their work. In a survey about the “Record Keeping Practices of Composers” [1], Longton concludes that out of 161 composers questioned, “almost half (47 percent) ... lost files they considered valuable due to hardware or software obsolescence.” He continues to conclude that the lack of concern for preservation (of their work) indicated by responses to his questionnaire reflects the fact that “composers have not historically had to concern themselves with preservation.” He also notes that 76 percent of composers questioned used commercial software and that this will be “important to remember when considering how preservation strategies will affect this community.”

There have been few attempts so far to address these issues. Even when using software-based systems composers are often poor at record keeping. Whilst accurate score production is a requirement of instrumental performance, the composer often performs their own live electronics part. In these cases, the composer's own knowledge reciprocates the documentation, making the need for clear instructions less immediate.

In his paper on “New Public-Domain Realizations of Standard Pieces for Instruments and Live Electronics” [2], Puckette outlines a method and rationale for performing canonical works “without resorting to special hardware or proprietary software”. He describes how the live electronics elements for four historically important works were revised and modernised using PD (Pure Data) software running on a Linux PC. Puckette discusses the practical need for more cost effective and widely available performance technologies, and suggests that realisations based on open source solutions might be “longer lasting than previous realizations have been”. In addition to this the notion of a PD realisation as a musicological and pedagogical model is discussed, along with the need for freely available standards-compliant documentation.

Some of the broader issues concerning the modernisation of canonical works and the portability of technology are being addressed by Integra[1], a new and unique project funded by the European Commission and currently being hosted by Birmingham Conservatoire. Integra - 'A European Composition and Performance Environment for Sharing Live Music Technologies', seeks to form links between academic organisations and performing bodies in order to solve performance problems regarding works involving live electronic media. In this paper we will describe a specific project for modernising the live electronics elements in the works of Jonathan Harvey.

2. PROJECT MOTIVATION

The project began with a discussion with the composer concerning his requirements, and after various meetings a list of priorities was established. The list included 14 pieces requiring a broad range of technical modernisations. These included the replication of a VCS3 synthesiser in software and the re-writing of mixing desk configuration data for modern consoles. However, the majority of problems fell into two broad categories: sample playback and FM synthesis. Of the 14 works originally discussed with the composer, 12 are of particular relevance. The work for the project therefore consists of modernising the primary technical elements of the following works (in order of descending priority, as agreed with the composer):

1. *Madonna of Winter and Spring* (1986) – Yamaha TX816 and DX1, E-mu II, ring modulation and reverberation;
2. *Wheel of Emptiness* (1997) – E-mu E-64 samples on ZIP;
3. *White as Jasmine* (1999) – two Yamaha SY77 patches (already ported to Native Instruments FM7);
4. *Soleil Noir/Chitra* (1995) – SY77 and Eventide harmoniser;
5. *Ashes Dance Back* (1997) – CD player, two E-mu E-64 digital samplers, five-octave keyboard controller, ZIP drive, effects processor (Yamaha SPX 990), four-channel spacialisation;
6. *From Silence* (1988) – Yamaha DX7 patch (already ported to FM7);
7. *Valley of Aosta* (1988) – DX7 and Steinberg Pro24 on Atari ST;
8. *Inner Light 2* (1977) – VCS3 synthesiser;
9. *Inner Light 3* (1975) – four-track tape;
10. *Gong-Ring* (1984) – ring modulator;
11. *Inquest of Love* (1992) – SY77 and two DX7s, ring modulation, artificial reverberation, and hardware-based sampling,
12. *Calling Across Time* – SY77, hardware-based sampling.

It is pertinent that two of the 12 works on the composer's list have already been updated using proprietary solutions and need further updating.

3. IDEOLOGY

Having considered Harvey's requirements, thought was given to how the technical and aesthetic needs of the works might be met with new technological means. The two options that seemed most suitable were Max/MSP and PD. There are clear and successful precedents for the use of these applications in works with live electronics, and it was decided that either package could meet the technical needs of the project. However, after careful consideration, the decision was made to use PD due to the fact that is free, has better cross-platform portability, and is unlikely to suffer from commercial restrictions such as company bankruptcy.

The use of PD avoids adding software purchase to performance costs. PD runs on most modern platforms including MacOS, Linux, Unix and Windows. Even if the performing body had to purchase a new PC specifically for performing a work by Harvey, a feasible performance-ready system could be set up for under £400[2], whereas the license for Max/MSP alone costs $495(£260).[3] An open source solution has therefore been chosen because it meets all of the requirements for modernising the technological elements, in the most cost effective manner .

PD (like Max/MSP) uses ASCII text files to store patch data, and therefore files can easily be distributed. Any external files used for the project, such as audio files, or documentation files, will be converted to formats for which the specifications are known and available. WAV format will be used for all audio, because it is supported by a wide range of software and platforms, and because it has 'built in' facilities for setting up loops. It is also the sample data file format used by modern Akai samplers. All documentation will be produced in plain text or html.

The intention of the project is to modernise the technology and media used for performance whilst keeping the performance experience perceptually consistent for both audience and performer. Consideration has been given to the notion of using sampling techniques rather than resynthesis in order to replicate the sounds required for Harvey's works. This method has several advantages; it is quicker and easier in the short-term, it guarantees faithful reproduction of the timbral qualities of the original sounds, and it simplifies the process of performing further updates (soundfile format conversion for example). However, whilst it seems reasonable to adopt this approach on a short term basis or for occasions where there is insufficient time to emulate the original technology, it may not be so useful in the long term. The first reason for this is that although creating a successful emulator with software (a DX7 emulator in PD for example) has a greater initial 'time cost', once the initial work has been done the process of importing data (existing patches) is relatively fast. Adopting a sample-based strategy would always require the same process of obtaining the relevant hardware and sampling each sound for every piece. The second reason why this is only considered to be useful in the short term, is that it fixes the evolution of the sounds over time and restricts interaction between the electronics and performers. This is particularly relevant to changes in tempo, where timbral changes in a sampled sound might

[1] http://www.conservatoire.uce.ac.uk/integra

[2] Price from DABS.co.uk as of 01/03/2005

[3] Price from Cycling74.com as of 01/03/2005

not be reproduced with the correct proportions should a performer choose to change the tempo of a piece.

4. WHEEL OF EMPTINESS

Wheel of Emptiness[1] is a work of approximately sixteen minutes duration, for sixteen players. It utilises an E-mu E-64 sampler and a keyboard controller for triggering samples at various points in the work. This was the first work to be attempted, partly due to requirements for two performances, one in Berlin, and one by the BBC Scottish Symphony Orchestra in Glasgow.

The first stage in modernising the E-64 samples was to make copies in E-IV format using an E-mu ESynth rack-mount unit. This meant that the samples could be read without conversion by a wide range of samplers. The E-IV versions of the patches were 'performed' against a good recording of the piece, to ensure that the sound was perceptually identical to the E-64 versions. Several copies were made onto fresh ZIP disks and checked for consistency before being sent to the publishers for archival purposes.

Various attempts were then made to read the E-IV formatted disks using software, such as CDXtract[2] on both Mac and PC platforms. This was unsuccessful, and due to an incompatibility between the SCSI I interface used by the Esynth, and the SCSI III interface on the computer's PCI card, the data could not be transferred directly to the computer's hard drive. The solution was to use an Akai S5000 sampler as a translator to convert the samples into Akai S5000 format. The S5000 uses WAV files to store sample data, and a proprietary file format to store Patch and Bank data. This meant that transferring the sample data into PD was trivial. However, in comparing the original E-IV Patches to the converted Akai versions, various significant discrepancies were noticed. In particular, none of the filter settings had endured the transfer. It was therefore decided that given the time constraints, the Berlin and Glasgow performances of the work should use the E-IV versions of the files. In future further conversion software such as Chicken System's Translator[3] will be investigated in order to simplify and optimise the Sample file conversion process.

The next problem posed by the project was how to transfer the E-mu patch performance data into PD so that information such as velocity curves, panning and keygroups could be preserved. Copying the information 'by hand' seemed neither appealing nor beneficial for future work, and since the information (other than filter settings) had endured the transfer onto the Akai S5000, it seemed sensible to start with the Akai copies. The specification for the AKP (Patch) file format has been 'reverse engineered' by several developers, and can be found on the Internet. It was therefore decided that a PD AKP reader would be set up in order to facilitate the transfer of the patch settings into PD. This was considered to be a useful resource, not only for the Harvey project, but for anyone else needing to transfer Akai performance data to PD. Work on writing the PD AKP patch is currently in progress, and should be complete by September 2005.

The more difficult element of the transfer of the E-mu IV samples into the PD environment is the modelling of E-mu's patented z-plane filters[4]. These filters allow the user to set the centre frequency, bandwidth and gain for 7 filter 'sections' and then smoothly 'morph' between different sets of coefficients. The morphing and settings can be controlled in real time by user defined function curves or external control data. Harvey used the filters quite extensively to 'shape' his material, so any copy of the filters made in PD needs to be perceptually identical within the context of the musical work.

Initial experiments have now begun into emulating the E-mu z-plane filters in PD. Unlike the conventional use of the term z-plane in filter design (as used to refer to the complex plane) E-mu's documentation uses the term to describe a complex filter with the facility to interpolate between various preset coefficient sets. This z-axis interpolation is controlled by a single 'morph'[5] parameter. Some initial attempts to emulate these filters were conducted using cascaded instances of PD's internal biquad~ object, but this approach was considered unsuitable due to the lack of audio rate control for modulating coefficients in real time. Instead experiments have begun using the wide range of filters from the IEMLIB[6] external library.

Consideration has also been given to using E-mu's own EmulatorX software, which can import E-64 samples natively. However, this would mean replacing a proprietary piece of hardware with proprietary software that even requires further proprietary hardware (from E-mu) in order to run. This option was therefore considered unsuitable.

5. MADONNA OF WINTER AND SPRING

This was the second work to be attempted. It is a work for orchestra, incorporating synthesiser, sampler and ring modulator, and lasts approximately 37 minutes. It uses a Yamaha TX816 for synthesis, a DX1 for controlling the TX816, and an E-mu II sampler for sample playback. As the E-mu II does not use the same operating system (EOS) or file format as the E-64 and E-IV, an alternative method is required for converting the sample and performance data. In order to proceed, an Emulator II needs to be obtained so that further investigations can be conducted.

The TX816 patches for *Madonna of Winter and Spring*[7] were provided on a Macintosh HFS formatted floppy disk along with a patch librarian called DxEd. Unfortunately the librarian's 68k binary file wouldn't run on a G3 running OS 9. There are however various open source librarians for the windows platform that can read

[1] Harvey, J., *Wheel of Emptiness*, London, UK, Faber Music, 1998

[2] http://www.cdxtract.com

[3] http://chickensys.com/home.php

[4] US Patent 51769

[5] As described in the EOS 4.0 manual (available at http://www.emu.com/)

[6] http://iem.kug.ac.at/pd/iemlib/

[7] Harvey, J., *Madonna of Winter and Spring*, London, UK, Faber Music, 1986

TX816 patch files, including Papareil Synth Labs SynLib software[1]. There is also an existing open source DX7 emulator called Hexter[2]. The rx7~ PD external, based on the code from which Hexter is derived, is broken and does not work. Work is therefore in progress to make a PD object based on the Hexter code. The PD object will emulate a DX7, so that multiple instances of the object could be used to emulate a TX816. A PD patch will then be created, which reads data from the patch bank files and directs it to the appropriate instance of the Hexter object. It is anticipated that this work will be completed by January 2006.

Because many of Harvey's other works use similar technology, once *Madonna of Winter and Spring* has been completed, the process of modernising additional works should accelerate. Furthermore, works by many other composers utilise Yamaha DX7-based technology. The aim of the project is therefore to make the process of importing patches and emulating synthesis in PD as transparent and straightforward as possible.

6. PROJECT DIARY

A project diary is being maintained as an online weblog[3]. This is a log of all work undertaken, problems encountered and a running list of priorities alongside any working documents and files. The aim is that the documentation should be sufficiently detailed for an outside party to take over the project at any time. The log is made available to all involved with the project via a passworded web link, and has the facility to be set up as an XML RSS feed if required. Because the project is in its early stages, and only preliminary research has been conducted, it is currently not feasible to give detailed timescales for project completion. However, it is believed that the decision to base development work on open source solutions should increase development time significantly. This is partly due to the availability of shared knowledge within the open source community, and partly due to the availability of existing solutions that can be adapted rather than re-invented. Likewise contributions and feedback are welcome from interested parties.

7. CONCLUSIONS

In terms of measurable outcomes, the project has so far concerned itself with service provision to external bodies such as the BBC Scottish Symphony Orchestra (via Harvey's publisher). This work has consisted of media format upgrades and media duplication. This is precisely the sort of work that the project seeks to avoid. All materials should eventually be available online from the publisher and run successfully on standards-compliant hardware without modification. The project is currently in its early stages, but once the facility is available to import DX and TX series patches into PD running an emulator object, and it is possible to import Akai S5000 samples, with their preset data, it should be far quicker to update not only Harvey's works, but works by other composers that employ the same technology.

[1] http://m.bareille.free.fr/synlibdxtx/synlibdxtx.htm

[2] http://dssi.sourceforge.net/hexter.html

[3] http://www.conservatoire.uce.ac.uk/harvey

8. REFERENCES

[1] Longton, M., "Record Keeping Practices of Composers", InterPares 2 website at <http://www.interpares.org>, accessed March 2005.

[2] Puckette, M., "New Public-Domain Realizations of Standard Pieces for Instruments and Live Electronics" *Proceedings of the International Computer Music Conference*, Miami, USA, 2004.