Transcription, Adaptation and Maintenance in Live Electronic Performance with Acoustic Instruments

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ABSTRACT

This paper examines processes of musical adaptation in a live electronic context, taking as a case study the authors' collaborative work transcribing Richard Dudas' *Prelude No.1 for flute and computer* (2005), to a new version for clarinet and live electronics, performed in the Spring of 2014 by clarinettist Pete Furniss. As such, the idea of transcription and its implications are central to this study. We will additionally address some of the salient information that the user interface in a piece of interactive electro-instrumental music should present to the performer, as well as some possible ways of restructuring not only the interface itself, but also the *déroulement* of the piece to aid the solo performer to the maximum degree possible. A secondary focus of the paper is to underline the need for the creation of a body of musical works that are technically straightforward enough to serve as an introduction to live electronic performance for musicians who might otherwise be daunted by the demands of the existing repertoire.

1. INTRODUCTION AND MOTIVATION

The process of adapting an electro-instrumental[1] work has afforded the opportunity to consider three modes of transcription and their implications. Firstly, the musical material itself has been transcribed and transposed for a different instrument, as have some of the events in the electronic processing – those which stem necessarily from the new instrumental circumstances. These include adapting the pitch transposition and revoicing the harmonic material generated from within the software. Secondly, the user interface has been modified from a desktop-oriented design to one fit for onstage performer control. Thirdly, with a view to future performance of the work, a software-neutral, graphical transcription of the technological processes has been created as a form of "study score". The score-following technology employed to trigger events during the piece was also "transcribed" to use a more recent, and potentially more robust, system, but this has subsequently been revised and reworked, due to issues of maintenance, control and the licensing of third party software. The processes described here represent an ongoing work in progress, towards the publication and a future commercial recording of the piece.

Widening access to a composer's output has historically provided an incentive to produce adapted musical material for performance, particularly before the advent of commercially available recordings. Such adaptation also contributed to the expansion of available repertoire for instruments which may be have been under-represented in the catalogue as a whole. The tradition of musical transcription goes back at least as far as the 18th century, when it was important to both composer and publisher for the generation of maximum sales, and a broader dissemination among the music making populus. Many composers have produced pieces in versions for alternative instrumentation or reused their own ideas, and indeed whole works, in different contexts[2]. The piece that this paper uses as a case study, Richard Dudas' *Prelude No.1 for flute and computer* (2005), seems ideally suited to this purpose, due to the concise nature of its instrumental and technical requirements, its short duration and its pedagogical potential as entry-level live electronic repertoire.

Just as the initial impetus or compositional sketches for a musical work may be quite different from the final notation supplied to the performer(s), so the visual user interface of a live electronic piece may require significant adaptation from that designed during the work's creation. Moving from a "sketch" or prototype interface intended to drive the compositional process, towards one which is designed for use in performance, is an important and sometimes overlooked consideration; a streamlined interface is essential in providing the optimum "user experience" for any performer. What players often find presented in the software interface provided may offer only limited help to them in terms of both operating the software and learning how to interact in a comfortable and confident manner to the computer's musical output. In order to be more closely engaged with their electronically augmented instrumental environment as true soloists, some musicians are beginning to move

[1] The genre is sometimes referred to as "mixed" electronic music, primarily in the francophone community, or simply "live electronic" music, which generally implies the presence of one or more acoustic instruments. There is to date no universally recognised term and we will use both the rather technical "electro-instrumental" and perhaps more elegant "live electronic" interchangeably here.

[2] For example, Beethoven's *Septet* Op. 20 was transcribed as *Clarinet Trio* Op. 32, and Mozart's *String Quintet No.2*, K.406, from the *Serenade in C minor* K.388.

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towards taking as much onstage control as possible in electronically mediated performance [1][2][3][4]. As a practical result of taking these performer-oriented factors into consideration while adapting *Prelude No.1,* it now contains a more performer friendly interface with several options that allow performers to choose how much control over the electronics they would prefer to exercise. As a potential entry-level piece in the genre, this flexibility also extends to providing for both stereo and quadraphonic output.

2. THE ORIGINAL COMPOSITION

Prelude No.1 is a short piece for flute and real-time computer processing from 2005, originally entitled *Prelude* but since renamed, as it is now the first of an ongoing series of works for solo performer with live computer processing. All of these pieces so far share an initial *tabula rasa* state in their electronic component, in which no pre-recorded samples or synthesized sounds are used. Every sound produced by the computer is a direct result of the live input from the musician, either processed directly, delayed (and optionally processed), or recorded to memory an earlier point in the performance and played back (with or without processing).

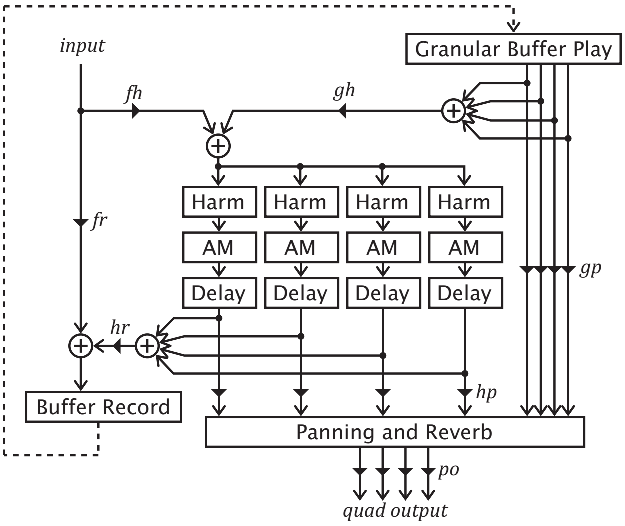

Figure 1. A block diagram of the DSP structure for *Prelude No.1*. The dashed line represents a symbolic link between the recording and playback functions which both access the same sample memory.

The digital signal processing (DSP) for the piece was designed in Max/MSP, and made use of a rudimentary pitch-tracking and score-following system to trigger a series of predetermined events that control live processing of the instrumental sound [5]. The structure of the audio processing part of the DSP engine is shown in figure 1. It includes a compact and carefully chosen selection of sonically simple, musically intentioned sound processing algorithms:

- real-time transposition
- amplitude modulation
- delay
- buffer recording with granular playback (used primarily for a “sustain pedal” effect)
- panning
- reverberation

The sound is ideally diffused on a 4-channel speaker system, set up either in the usual quadraphonic arrangement at the corners of the hall, or alternatively in an arc, radiating outward from the live instrumentalist’s central stage position. It may also be performed using a simpler stereo output, the inclusion of which was not a later concession, but rather one of the original design plans. It serves to widen the programmability of this brief and rather straightforward instrumental piece beyond the context of highly technical concert productions. Furthermore, since the majority of instrumental performers do not themselves own specialized technical equipment, a stereo option also enhances rehearsability, allowing for practice using the built-in internal microphone and simple headphone output of a standard laptop.

As was the case with another piece originally for flute and electronics – Thea Musgrave’s *Narcissus* (1988) – a clarinet transcription seemed to be an apt choice when, in 2008, we required a short piece to complete a programme of pieces for clarinet, piano and electronics in Seoul[3]. The initial transcription for that concert was rather hastily made, but in retrospect provided an important step within the context of this developing series of succinct, “blank slate” live electronic pieces for solo performers [6], which now includes works for clarinet (2006), alto flute (2010) and percussion (2014), as well as forthcoming works in the series for violin, piano and bass clarinet.

3. A COMPOSITIONAL PERSPECTIVE

The transcription from flute to clarinet was not as straightforward as it would have been for a piece without electronics, or for a piece with piano accompaniment. As with all adaptations, it involved making choices regarding modification or preservation of musical, notational and technical elements of the piece. The first problems to tackle were those resulting from changes in instrumental range, including those stemming from changes in timbre, and instrumental fingering considerations. Although several different transpositions were tested to fit the piece into the clarinet’s range in both 2008 and 2014, the fact that all of them were downward transpositions to a significantly lower pitch meant that that the real-time transpositions of the processed sound in the electronics needed revoicing and adjustment throughout. In many places this went beyond simply adjusting entire chordal transpositions by an octave. Similar transpositions of longer pieces have made use of various transpositions for different sections, with slightly recomposed bridging material (as with *Narcissus*), but the brevity of *Prelude No.1* seemed here to obviate the need for such measures.

Eventually a downward transposition of a tritone was settled upon together by composer and performer, since it

[3] Hanyang University Paiknam Concert Hall, 2008.11.15: Sarah Nicolls (piano), Pete Furniss (clarinet), Richard Dudas, Jongwoo Yim (electronics).

retains some of the brilliance of the flute version[4] and falls comfortably into clarinet fingerings, especially where trills are concerned. Differences in instrumental timbre between the flute and clarinet, alongside this significant transposition, necessitated a revoicing of the vertical (chordal) structures in the piece in order to clarify their texture. Adjustments to the volume levels within the signal processing component were also made at certain points in the piece in light of these distinctive timbral considerations.

Although making a transcription may involve compromising some of the original musical choices, in this case the transfer in fact enabled the reinstatement of a number of pre-compositional ideas that had been abandoned out of practical considerations in the original flute version. This included restoring a low trill in place of a flutter-tongue, and keeping the melodic profile of the opening motif when it returns at a lower pitch class towards the end of the piece. In both versions all decisions made with regard to the electronic processing originate from musical motivations.

4. A PERFORMER'S PERSPECTIVE

Although some performers are committed to working within the context of a team of skilled technical collaborators, a growing number of specialist players within this field express a preference (where practical or desirable) to cultivate independent control of the electronics [1][2][3][4]. Whilst this requires both a deeper understanding of software platforms, and a considerable commitment to learning how to operate them in combination with various forms of hardware, it serves to create an augmented practice that affords a much fuller understanding of the structure and pacing of all components of a piece, both electronic and acoustic. A musician working in this way, who has spent years developing a distinct, personal "sound", optimises control over it in the electro-instrumental environment, before passing it into the hands of the sound engineer in the venue.

A technically prepared musician should be capable of managing a complete sound strategy, expanding their instrumental perspective to include control of the wealth of electronic components that present such a vital contribution to the overall "performance ecosystem", comprising musician, instrument, technology and space [7]. From a performer's point of view, a two-player version of an interactive live-electronic piece (alongside a technical operator at the computer) may not feel very interactive. Rather it is weighted towards the *reactive*, which is quite unlike performing a duo with another human musician [8][9]. A solo version of the same piece, with the computer controlled on-stage by the performer, creates a more plastic relationship, leading to a more integral musical performance.

The objective of this approach is not simply the acquisition of wider control in performance, but rather the promotion of a more holistic, practice-led learning of the piece in rehearsal – an embedded process of learning by doing. It has been all too common for performers to be confronted with the electronics for the first time at the dress rehearsal stage of an event. By contrast, a more embedded learning practice, in which a musician has been able to adjust, rehearse with, and interact with the computer at home, is an entirely different experience. This process of learning "from the inside outwards" can lead to a performance of fine-grained integrity and understanding, in so much as it enables the performer to feel at once individually responsible and also at the helm of the whole virtual ensemble.

In approaching *Prelude No.1* in this way, several aspects of presentation needed to be addressed in the software materials provided. Often the computer part in such a work is not intended to be operated or monitored by the performer, but rather by a specialist technician – in many cases the composer-programmer. In such cases, significantly lower priority may be given to creating a user-friendly interface – especially in the all too familiar scenario of a composer working up to the hour of a premiere performance to debug their software. Even when the piece has been performed multiple times, and the GUI has been revised and streamlined, what is presented on-screen may still be tailored for a technically proficient sound engineer or computer musician, working either offstage or alongside the performer on the concert platform.

Just as the music itself was transcribed from flute to clarinet, the graphical interface in the Max/MSP patch needed to be "transcribed": from a composer-oriented interface to a performer-oriented one. An element of user adaptability within music software interfaces has long been encouraged [10][11], and with a growing number of musicians capable of effecting onstage control of electronic elements, there is an emerging need for a more nuanced, flexible approach, towards "expressive, higher-order music notations" [12], which reflect an emphasis on "user experience". A genuinely performer-friendly Max patch needs to be designed to be "plug-and-play", with clear, logically ordered instructions and optional performance settings which are grouped together in one region of the interface. Some examples of such performer-oriented interfaces are shown in figures 2 and 3.

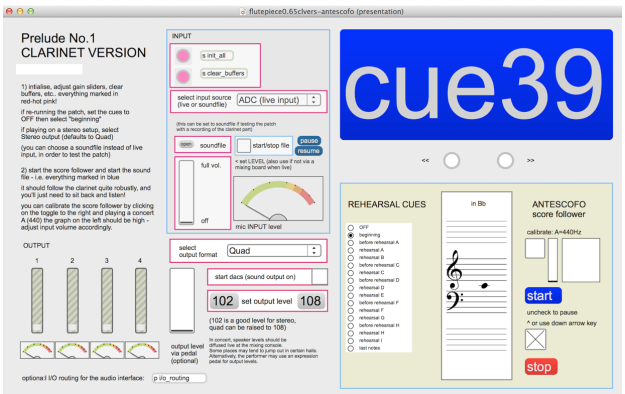

Figure 2. The performer-oriented interface (work in progress) for *Prelude No.1*.

Whether fully or partially notated, graphic or descriptive in nature, scores notated on paper are often personal-

[4] Lowering the transposition by a further semitone also fit the instrument well but yielded a darker overall sound.

ised by musicians to ease the process of learning and manage attention in performance. User-adapted *Presentation Mode* in Max/MSP provides a relatively uncomplicated means for musicians to adapt and personalise their visual material in an analogous way. Several prototype interfaces were made in this way for the *Prelude*, leading to the current work in progress shown in figure 2. Patch cords are no longer visible and many items have been enlarged, coloured distinctively and ordered into sequentially and logically organised task groups. These include text instructions for both set-up and running of the piece, settings such as audio input, output and volume levels, cues and other items relating to the score-follower. Naturally, these options should be configurable to the performer's preferred concert defaults.

The Max *Note Slider* has been adapted to present written – i.e., transposed – pitch, as would be notated in a traditional B♭ instrument part, so that the performer now sees the note which is played without the need for mental transposition. This interface clarifies the process of setting up audio and software, and provides clear and relevant visual feedback. A MIDI expression pedal connection was also added to control the global output volume of the patch, in order to nuance both dynamics and shape in some entries. For example, as a result of timbral differences between the clarinet and flute, certain cues were found to require a softer than expected attack and more exaggerated quiet dynamics, in order to create the desired effect in the (now clarinet-voiced) musical material in the electronics.

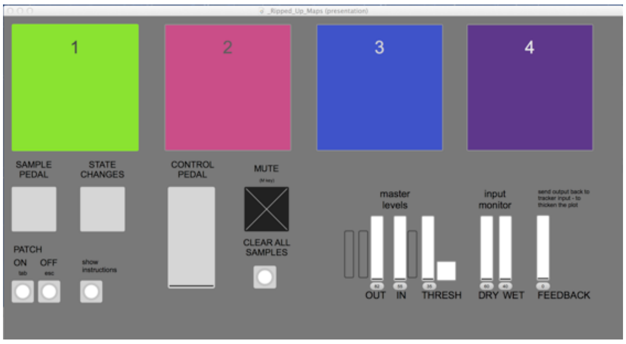

Figure 3. An example of a user-adapted *Presentation Mode* interface with large, distinctly coloured items that are easily seen in distant and peripheral vision. Andrew May, *Ripped-Up Maps* (2011 version).

Those items pertinent to rehearsal, as mentioned, have been grouped together and rendered large enough for ease of use at a distance and via peripheral vision (figure 3), since most performers prefer to have the screen to the side in performance, particularly when reading from a notated score on a more centrally placed music stand. Most important to any performing musician will be the interface items used in the actual concert itself. These should be made considerably larger than the initialisation and rehearsal items, have a prominent location in the interface, and be colour-coded in a functionally connective way. Such adjustments are not for aesthetic reasons, but rather for ease of visibility. They also provide a kind of visual reassurance or sense of *trust*, which can be invaluable in performance.

The issue of trust is analogous to an orchestral conductor's cue, in that it has more to do with communication and collaboration than the specific functionality of synchronicity. The initial cue, for example, is silent (with no output in the electronics) and is only employed to provide reassurance to the musician that the system is "listening". Although it was originally in bar 3, it was moved to its current position at the very beginning of the piece, in order to avoid having a period of 10-12 seconds before any such feedback is given. This type of "blank" cue provides a similar function in a later passage that does not feature electronic output. Fostering even a momentary degree of trust in the system is an important consideration in an environment which can be unpredictable and prone to error, allowing performers to worry less and manage their attention in a way which supports a confident and fluid performance.

A degree of error intolerance was encountered with each of the aforementioned score-following systems (detailed below), both in terms of feedback from the loudspeakers and accuracy of tracking within the score itself. The use of a parallel input from a piezo pickup mounted within an alternative upper section (barrel) of the clarinet provided adequate isolation against audio feedback. The pickup was fed only to the score-follower in the patch and not to the audio processing itself, which continued to receive its input from superior quality external microphones. This process was later adapted using an inexpensive contact microphone of the type used to feed tuning devices, simply clipped onto on the bell of the instrument. The score-following system that was finally settled upon was found to respond extremely robustly to input from this latter microphone, providing an efficient, lightweight and non-invasive solution – and more importantly in the context of this repertoire, one which is widely and cheaply available to any non-specialist performer.

5. TECHNICAL CONSIDERATIONS

The making of minor musical changes to the Max/MSP patch for the purposes of a transcription, and the abovementioned need to improve the user interface for ease of use by solo performers, highlighted the fact that there have been several upgrades to both computer hardware and operating systems in the decade since the original flute version was made, not to mention several major incremental software releases of Max/MSP itself. There has already been considerable discussion around the issue of updating electroacoustic compositions and maintaining performability in the face of technological obsolescence and "data archaeology" [3][13][14], and there are various schools of thought concerning the slavish imitation of the original, or the making of improvements in the update [15]. This is an intrinsic concern for all those involved in electroacoustic practice, and although it remains important to continue the community's ongoing engagement in a thorough discussion, a more detailed examination lies beyond the scope of this paper.

The score-following system used in the *Prelude* is implemented in Max/MSP [5] and uses a third party pitch-tracker at its core: Miller Puckette's *pt~* object. The choice of this particular pitch-tracker over other, more recent solutions has been discussed in more detail elsewhere [16]. For this transcription, the object initially needed to be recompiled for use with the 64-bit signals used by Max 6.1, but after updating and re-compiling the code, the object appeared to behave slightly differently (and much less reliably) than it had in the previous 32-bit environment[5]. It was therefore decided to evaluate an alternative score-following system based on IRCAM's *antescofo~* object [17].

For the purposes of transcription, a considerable attraction of this system is that the *antescofo~* object's textual "score" also contains the musical event parameter information which will be used to control the DSP. This means that a single common Max/MSP patch may be used with individual "scores" for the different instruments. Another supporting factor was the active development and maintenance of the object within a relatively stable, institutional environment. The main disadvantage of *antescofo~* is that, as a third party object, it does not come with standard Max/MSP distribution; performers would be required to purchase it separately at their own expense. Another consideration is that, whilst in theory the object exists for both Mac and PC platforms and has been compiled for both Max/MSP and Pd (thereby accommodating performers using the most widely established platforms and software), in practice the PC and Pd versions are often out of date and updates to them appear only occasionally. After evaluating the transfer to a system based on *antescofo~*, we decided to return to the older (Puckette-Lippe) system, since it proved to be more tolerant of noisy input and lenient in regard to performer error. After necessary fixes were made to some objects, the original system proved in fact to be significantly more robust.

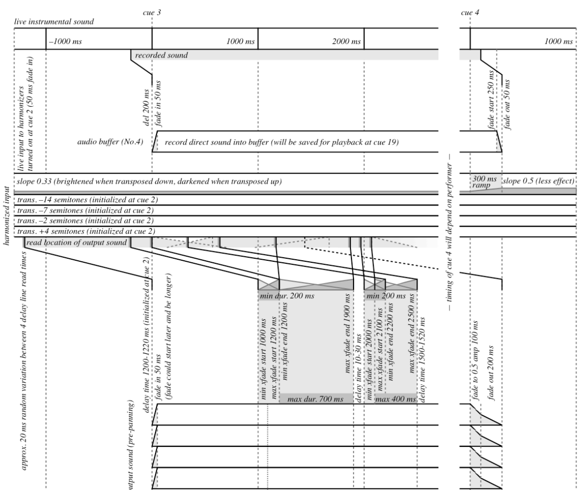

Figure 4. Cues 3 and 4 from *Prelude No.1* in a software-neutral graphical representation.

The act of transcription within an electroacoustic environment additionally highlighted the need for "future-proofing" in the form of a descriptive notation of the electronic part, in addition to the software itself, via a software-neutral graphical "score". Therefore, it is intended that on publication[6], the piece will be supplied with a full description of the electronics that contains all the necessary information for the realisation of the piece using any musical software package, alongside the traditionally notated instrumental part, technical rider and current software materials. Figure 4 shows an example page from this score.

This idea of a text-based or graphical "study score" for electronic music may be traced back to the early pioneers of the genre, but it is commonly overlooked in current practice. It is very easy for composers to assume that the software itself constitutes the "electronic score" for their piece. However, having a published representation of the electronic part of the piece in a software-neutral form that can be used as a point of departure to re-implement the piece in the future will help to secure the piece's performability, at least in the short to medium term. As an alternative example to that described here, figure 5 shows part of the printed score for John Croft's *Intermedio III* for bass clarinet and live electronics (2012), which includes a software-neutral description of the electronics in the form of a "simplified process diagram" that additionally serves as a guide to any potential performer, regardless of their software literacy.

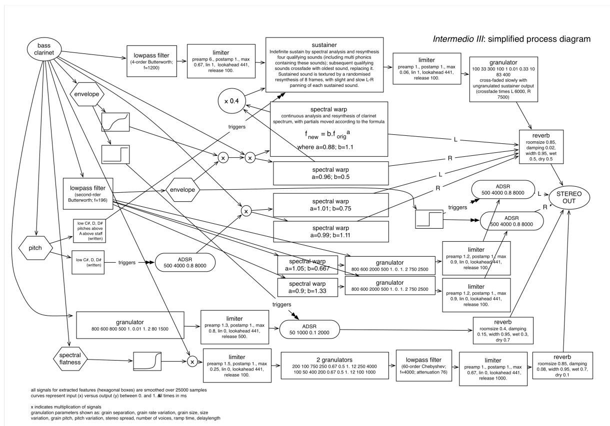

Figure 5. John Croft, *Intermedio III*: software-neutral DSP description

6. CONCLUSIONS

One result of the composer-performer interaction during the transcription process was a realisation that this piece could provide a valuable resource as entry-level live electronic repertoire. From the performer's perspective, choosing this short piece over a more complex one ended up being an ideal starting point for a deeper understanding of the nature of live electronic performance, Max/MSP programming and other aspects of working with technology. Many intermediate to advanced level musicians express an interest in working with electronics,

[5] Actually, the problem turned out to be not with the updated *pt~* object, but rather caused by a bug in the Max 6.1 version of the *detonate* object. This has been fixed for future versions.

[6] *Prelude No.1* is due to be published this year by *Swirly Music* http://www.swirlymusic.com.

but may be daunted by both the technological expertise necessary and by an unfamiliarity with the style and aesthetics of sonic art practice. This piece is accessible both musically and technologically, and there is no reason why *Prelude No.1* couldn't eventually exist for a multitude of instruments; it is, in fact, ideally suited for this, with its relatively short duration and simplicity of technical demands. Upon publication, the patch itself should additionally exist in a simpler version that disposes of the score-following and uses manual (or pedal) cueing, to allow the piece to be performed by less experienced performers, with relatively little concern for the triggering of the electronics and with a primary focus on musical aspects.

It is often the case that close composer-performer interaction is fruitful for a musical project [18] and this method of working often generates ideas for future development. We propose that it would be helpful to be able to have multiple *Presentation Modes* available in Max/MSP patches: certainly at least alternatives for rehearsal and concert use. This would enhance a more intuitive, graphic design-based approach to what is essentially an extension of musicians' score personalisation. Whilst it may already be possible within the current software to further elaborate the interface design, this currently requires detailed knowledge of the software beyond the scope of most performers, certainly at entry level to the genre.

Although score-following techniques have been in use since 1984, when both Dannenberg and Vercoe first published their independent work in this area [19][20], there are still a number of problems and shortcomings with computer-based score-following, including a certain amount of difficulty in force-navigation through the score (particularly in reverse/rewind mode). The ongoing issue of relative intolerance to error in these systems places considerable, perhaps unreasonable or even unethical, demands on performers. Nevertheless, and despite the difficulties listed here, the genre continues to develop and define established principles of good practice, and to afford a richly rewarding environment for composer and performing musician alike.

7. REFERENCES

[1] M. Kimura, "Creative Process and Performance Practice of Interactive Computer Music: A Performer's Tale," *Organised Sound*, vol. 8, no. 3, 2003, pp. 289-296.

[2] S. L. Nicolls, *Interacting with the Piano*, PhD thesis, School of Arts, Brunel University, London, UK, 2010.

[3] S. Berweck, *It Worked Yesterday: On (Re-) Performing Electroacoustic Music*, Doctoral thesis, University of Huddersfield, UK, 2012.

[4] M. van Gorkom, http://sonicspaces.eu, accessed 2014.07.14.

[5] M. Puckette and C. Lippe, "Score Following in Practice," *Proceedings of the International Computer Music Conference*, San Francisco, California, USA, 1992, pp. 182-185.

[6] R. Dudas, "Prelude for Clarinet and Computer: a Confluence of Technological and Musical Choices," *Proceedings of the Asia Computer Music Project 2011*, Tokyo, Japan, 2011, pp. 69-72.

[7] S. Waters, "Performance Ecosystems: Ecological Approaches to Musical Interaction," *Proceedings of the Electroacoustic Music Studies Network*, Leicester, UK, 2007.

[8] E. McNutt, "Performing electroacoustic music: a wider view of interactivity," *Organised Sound*, Vol. 8 No. 3, 2003, pp. 297-304.

[9] C. Lippe, "Real-Time Interactive Digital Signal Processing: A View of Computer Music," *Computer Music Journal*, vol. 20 no. 4, MIT Press, 1996, pp. 21-24.

[10] M. Vaughan, "The Human-Machine Interface in Electroacoustic Music Composition," *Contemporary Music Review*, vol. 10, no. 2, 1994, pp. 111-127.

[11] M. Stroppa, "Paradigms for the High-Level Musical Control of Digital Signal Processing," *Proceedings of the COST G-6 Conference on Digital Audio Effects*, Verona, Italy, 2000.

[12] D. Stowell and A. McLean, "Live Music-Making: A Rich Open Task Requires a Rich Open Interface," *Music and Human-Computer Interaction*, (ed. Holland, Wilkie, Mulholland and Seago), Springer, 2013.

[13] D. B. Wetzel, *Analysis, Reconstruction, and Performance of Interactive Electroacoustic Works for Clarinet and Obsolete Technology: Selected Works by Musgrave, Pennycook, Kramer, and Lippe*, Doctoral dissertation, University of Arizona, USA, 2004.

[14] J. Bullock and L. Coccioli, "Modernising Live Electronics Technology in the Works of Jonathan Harvey," *Proceedings of the International Computer Music Conference*, Barcelona, Spain, 2005, pp. 551-554.

[15] R. Dudas, "Expanding the Performance Possibilities of Real-Time Computer Music Repertoire through Re-Working Dated Technology," *Japanese Society for Sonic Arts 20th Meeting Journal*, vol. 6, no.1, Tokyo, Japan, 2014.

[16] R. Dudas, "Developing Real-Time Systems for Concert Performance," *Proceedings of the 2012 Australasian Computer Music Conference*, Brisbane, Australia, 2012, pp. 121-124.

[17] A. Cont, "Antescofo: Anticipatory Synchronization and Control of Interactive Parameters in Computer Music," *Proceedings of the International Computer Music Conference*, Belfast, Northern Ireland, 2008.

[18] H. Roche, *Dialogue and Collaboration in the Creation of New Works for Clarinet*, Doctoral thesis, University of Huddersfield, UK, 2011.

[19] R. Dannenberg, “An On-Line Algorithm for Real-Time Accompaniment,” *Proceedings of the International Computer Music Conference*, Paris, France, 1984, pp. 193-198.

[20] B. Vercoe, “The Synthetic Performer in the Context of Live Performance,” *Proceedings of the International Computer Music Conference*, Paris, France, 1984, pp. 199-200.