**Usability and sustainability in live electroacoustic music:
a union of scientific research and artistic practice**

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1.0 introduction

Live electroacoustic music, also known as 'music with live electronics', could be defined as the real-time interaction between musicians and technology in live performance. While in music for fixed media the often complex technological tools used in the creation of a piece are not a requirement for the piece's performance, in live electroacoustic music the technology - a set of hardware and software tools and the instructions to operate them - is always there: it is a constituent part of the score, taken in its widest meaning, like any other instrument. Without it the piece cannot be performed. When the technology is modified or becomes obsolete, the piece ceases to exist in its intended form.

The analogy between live electronics and other musical instruments leads to these considerations:
- live electronics technology lacks a user interface equivalent to the musical score.
- it lacks widely adopted standards.
- it is not easily sustainable, even less so retroactively.
- it is very often bound to proprietary systems.

We believe that the most pressing challenge facing live electroacoustic music researchers is to act on these four points. We cannot stress enough the need for a paradigm shift in our research field to provide an answer to the above issues and overcome the artificial separation between scientific investigation and artistic practice in favour of a true interdisciplinary approach. Much research carried out today is quite detached from artistic practice. There is still a widespread experimental ethos, a do-it-yourself approach to technology that prevents the research community from tackling large-scale topics such as standardisation and the long-term preservation of the live electronics repertoire. There is also a terminology barrier that makes it harder to

bridge the gap between researchers and practitioners.

To remedy this situation we have identified usability and sustainability in live electroacoustic music as the two main strands of our research effort. This novel approach will allow us to implement a scientifically rigorous yet practice-based research programme. We intend to focus on composition and performance with live electronics, seen through the prism of usability and sustainability. Interface design, human-computer interaction principles, and the adoption of standard, open source technologies
will form the core of our research activities over the next five years.

2.0 background

Since the year 2000, when I arrived in Birmingham to take up the newly created Head of Music Technology position, the Conservatoire's management has generously supported capital investment in Music Technology, allocating more than £1,000,000 to provide new facilities and state-of-the-art equipment. This commitment has allowed the department to grow, and created the infrastructure for a number of ambitious initiatives and high-profile international projects.

My intention from the beginning has been to develop a centre of excellence for composition and performance with live electronics. This was the natural development of my personal career path, building on my experience of working for five years with the late Luciano Berio and at Centro Tempo Reale in Florence. I also wanted to embrace the specific characteristics and ethos of Birmingham Conservatoire, by integrating technology seamlessly in the curriculum and in performance activities.

There was already a lively scene for electroacoustic music in the UK, and a thriving underground electronic music culture, but it lacked almost completely a focus on live electroacoustic music, especially within higher education institutions. Birmingham seemed the ideal place to start, considering the presence of the electroacoustic music studios and BEAST at the University of Birmingham. I wanted to create a new, complementary resource focusing on live technologies, thus providing students coming to Birmingham with a wider choice of electronic music studies.

Over the past five years we have built the infrastructure needed for a thriving research environment. The effort has gone in three areas:

- artistic practice: in my role as Director of the Thallein Ensemble during the period 2002-2005, I have organised many concert performances - often UK premieres - of repertoire and new works with live electronics.
- research: in 2003 we created the "Centre for Composition and Performance using Technology", with the purpose of drawing together composers, performers, researchers and technicians in the exploration of the potential for the real-time interaction of musical performance and computer-based systems.
- technology: by providing the expertise needed to renovate and equip our concert venues, studios and computer labs.

3.0   research environment

UCE Birmingham Conservatoire is particularly well placed to lead the suggested paradigm shift towards a practice-based research methodology in live electroacoustic music. The most important factor, from our point of view, and one that sets us quite apart from other British universities, is how live electroacoustic music is integrated with the rest of the Conservatoire's programmes and activities. We can take advantage of an artistic and academic framework that allows us to promote projects and concerts involving technology and embed technology-related activities in undergraduate and postgraduate courses. We have access to a large pool of highly skilled performers, both staff and students, and two resident ensembles devoted to new music, the Thallein Ensemble and the Composers' Ensemble.
We also benefit from the following resources:

- two main public concert venues:
    - the Recital Hall, dedicated to live electronics performance.
    - the Adrian Boult Hall, a mid-sized concert venue recently refurbished to the highest technological standards.
- a state-of-the-art cluster of music technology facilities:
    - six recording and editing digital music studios.
    - two computer labs.
- Composition with Technology pathway built in the BMus and MMus degrees.
- MA Digital Arts in Performance jointly with BIAD, the UCE Birmingham Institute of Arts & Design, currently being validated, for a start in September 2007.
- BSc in Music Technology with TIC, the UCE's Technology Innovation Centre.

Currently, the Centre for Composition and Performance using Technology is composed by a team of two active researchers, Jamie Bullock, also a PhD student, and myself; we also have one regular external collaborator, Jonathan Green, a research assistant at BIAD. Compared to the size of our group the amount of research activity that we are generating is significant. We are involved in two main research projects:

- Modernising live electronics technology in the works of Jonathan Harvey [http://www.conservatoire.uce.ac.uk/harvey]
- Integra - A European Composition and Performance Environment for Sharing Live Music Technologies [http://www.integralive.org]

The Harvey project follows up from our previous modernisation work on *From Silence* and *Soleil Noir/Chitra* for two performances of the Thallein Ensemble. Our work with Harvey illustrates the key process of 'migration' by which the obsolete technologies required by specific compositions are reconfigured in a software environment for long-term preservation. In collaboration with the composer and his publisher, Faber Music, we have migrated so far two of Harvey's major works - *Madonna of Winter and Spring* and *Wheel of Emptiness.* Research outputs for this project include two papers, one presented at the ICMC 2005 conference in Barcelona, and the other published on *Organised Sound* in 2006.

Integra, started in September 2005, is a 3-year, €1,035,048 project led by UCE Birmingham Conservatoire and supported by the Culture 2000 programme of the European Commission. It is a European-wide collaboration of research centres and professional new music ensembles to develop together a new environment for the composition and performance of existing repertoire and new works using live electronics technology. Integra's activities develop along the three axes of research, creation and dissemination. The research element is represented by two strands: repertoire migration and development. Our specific role, together with the overall management of the project and its scientific outputs, is to modernise four major existing works (by Harvey, Grisey and Hurel) and to contribute to the development through the design and realisation of an online database and its connection with the graphic user interface. We also provide expertise, support and training to two commissioned composers and to the performers of their work.

Integra's scientific partners include NOTAM (Oslo), La Kitchen (Paris), LMTA (Vilnius), SARC at Queen's University (Belfast), Krakow Academy of Music and CIRMMT at McGill University (Montreal). The University of Oslo, IEM in Graz and CIRM in Nice have also asked to become external partners after the beginning of the project.

Planned activities for 2007 include a one-day Integra conference at Oslo's Ultima Festival in Oslo and a session at the AEC (Association of European Conservatoires) meeting in Strasbourg. In June 2008 an Integra Festival and final conference are planned in Birmingham. Next year we will apply for three more years of Integra funding (2008-2011). This will allow us to disseminate the project further so that it can become, as we intended, the de facto standard for composing and performing music with live electronics.

Among Integra's many research outputs are papers on DMT and Nordic Sounds, participation to the "Music as Memory" conference in Oslo, and an invitation from IRCAM to collaborate on the CASPAR project - another large EU-funded project on digital data storage and preservation - with a view to finding a common model for the documentation and representation of works with live electronics.

The Centre also maintains an ongoing artistic collaboration with BCMG, the Birmingham Contemporary Music Group. I have worked on the realisation of the electronics and the performance of Julian Anderson's *Book of Hours*, winner of the Royal Philharmonic Society Award for Large-Scale Composition, and the Centre is currently collaborating with BCMG on a new work by Austrian composer Johannes-Maria Staud.

Another important facet of our work is our own composition as research, involving the collaboration with performers on specific aspects of interaction with electronics. My recent work includes *Alúna*, a concerto for viola, ensemble and live electronics, written for renowned virtuoso soloist Rivka Golani, and *Flectar*, for trombone and live electronics, written for David Purser, a member of the London Sinfonietta, and Head of Brass at Birmingham Conservatoire. Jamie Bullock's recent projects include a viola duet with electronics developed with the viola students, a bass trombone and electronics piece written for Simon Hall, and a piece for cello with electronics and video in collaboration with BIAD.

4.0   research plan

The proposed plan shows the coherent development of our research vision over the next five years. The main point of this plan is to establish a fertile, lively connection between artistic practice and scientific investigation by focusing on usability and sustainability in live music technologies.

4.1   usability

Our research methodology aims to be user-centred rather than technology-centred. In the Integra project we have achieved this by adopting an approach where small development cycles are accompanied by regular usability testing by end users. In the case of live electronics technology these users are composers, performers, pedagogues and researchers. We believe that it is possible to meet the needs of these groups by adopting simplicity and modularity as core facets of design.

In the field of live electroacoustic music, the usability of the technology may be approached by considering its instrumentality. The aforementioned target users of this technology are familiar with working with traditional acoustic instruments as media, score as text, and the traditional lexicon of Western-European art music as the mode of discourse. It is therefore important that we begin to establish analogous modes of discourse, media and text for the live electronics elements of live electroacoustic music. Thus, in a sense, the technology should be considered just like another musical instrument – a polymorphous one, that we can learn and play. To achieve this, we should simplify the technological tools, and establish a standard vocabulary to describe them.

Standardisation and simplification in design do not imply a de facto reduction in expressive potential. Most acoustic instruments are extremely simple in design, they have a simple and standardised user interface, but their behaviour is very complex. Our research aims to create a shift in emphasis that steers digital music technologies towards this paradigm.

In terms of software interface design we have started the process of developing a software environment as part of the EU funded Integra project. The Integra graphical user interface

(GUI) is unique in that it acknowledges the usability requirements at different stages in the production of a musical work: composition, rehearsal and performance. The GUI does this by acting like a portal, providing a 'view' of the software's state that is appropriate to its required usage. Should we be successful in the second round of funding, we would seek to refactor the Integra software based on usability testing, and develop further modules that provide a range of tools for musicians. These would include continuous relative timbre recognition tools based on work in J Bullock's PhD; a bioacoustic plugin; and the implementation of a high level semantic layer providing human-readable descriptors for real-time control parameters.

In terms of hardware interface design we intend to develop a multi-touch interface for musicians based on work by Davidson and Han. The focus of the development will again be on usability, and we will aim to address the concerns raised in the recent Davidson/Han paper (Davidson and Han, 2006). It is anticipated that the multi-touch interface will become an aid for composers and performers to experiment with the Integra system and an instrumental interface for use in live performance.

All of the research and development work will culminate in testing and ultimately live performance with practitioners of international standing. One of the unique benefits that UCE Birmingham Conservatoire will bring to this research is that all of our team are experienced in both software development and musical practice. Our research methodology will therefore entail a reciprocal process of development and practice-based testing. Ultimately this will result in the production of a new opera (by Lamberto Coccioli) as an integrated environment in collaboration with the Visual Research Unit at BIAD.

4.2   sustainability

Long-term preservation of live electroacoustic music has only recently been recognised only very recently as a serious issue. A number of works have already been lost forever, while the future performance of many others cannot be guaranteed. Composers have been using mostly experimental or commercial hardware and software tools, both prone to rapid obsolescence, albeit for very different reasons. Maintenance of the electronics, normally the

responsibility of music publishers, has also been neglected on a vast scale. The high cost involved in migrating the electronics through frequent hardware and software changes have so far prevented publishers from looking after their live electroacoustic repertoire in a proper way. Because of the ephemeral nature of technology and the lack of common standards, composers seldom document properly the electronics in their scores. Research centres and electronic music studios across Europe also have their share of responsibility: the majority have kept musicians out of the lab, perpetuating an esoteric image of the 'musical assistant' as an indispensable intermediary between the composer and the machines, and thus creating an artificial layer of specialist knowledge, often with the result of locking composers into specific non-standard technologies.

One of the achievements of the Integra project has been to identify the need to describe electronic events in a score independently from the technology being used, be it hardware or software. To ensure sustainability of the repertoire, instead of trying to reproduce or translate existing electronic instruments or software patches, we have proposed the adoption of a namespace compatible with the Open Sound Control protocol and an XML file format to describe univocally the audio network, the control network and their behaviour over time. These would constitute all the performance data of a given work, and together with the work's meta-data they will be stored on a standard database server.

We are convinced that ensuring sustainability is, after usability, the second big challenge facing today live electroacoustic music practice and research. The lack of a human-readable, standardised model to represent electronic events is compromising the survival of works using obsolete technology and hindering a more widespread adoption of technology among contemporary composers. We plan to continue working closely with other research centres, composers and international music publishers to refine this new, higher level vocabulary to describe live electronics events. The purpose of our research is to arrive at an "electronic" score equivalent to the musical score; a fixed artefact, an embodiment of knowledge, a conceptual object that can be analysed and compared.

5.0   implementation plan

The research objectives we have set for ourselves are ambitious. We intend to realise them by expanding our research team, currently composed by two people, with the appointment of three post-doctoral Research Assistants and with the provision of three PhD scholarships linked to specific research projects. The profile of the prospective candidates reflects the interdisciplinary nature of the research plan.

The first Research Assistant (RA1) will be assigned to the Usability strand. The candidate will have a proven track record of developing release-quality software for relevant projects and will have a flair for interface design and usability. Good music technology skills are also required.

The second Research Assistant (RA2) will be assigned to the Sustainability strand.. The candidate will have a proven track record of developing release-quality software for relevant projects along with experience in information management and preservation technologies, and good music technology skills.

The third Research Assistant (RA3) will be working mainly as a Musical Assistant on both Usability and Sustainability strands. The candidate will have a strong musical background as a composer or a performer, and outstanding music technology and programming skills. His/her specific role will be to collaborate with composers on the realisation of the electronics of their new works, and to migrate existing works using obsolete technology.

All these appointments should last five years, and will be directly linked to the scientific activities of the Integra project, in its current and future form. To complement these full-time positions we have identified three specific research projects to be linked to PhD studentships.

Research student A: electronic score model, a standard vocabulary for representing live electronics events (sustainability).
Research student B: software interface design - development of new interactive tools for musicians: the bioacoustic plugin (usability).
Research student C: hardware interface design - realisation of a multi-touch interface for musicians (usability).

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