REFLECTIONS ON *DUEL*; PERFORMERS, PERFORMANCES, TECHNOLOGY, AND THE AUDIENCE

Rob Godman
The Music Centre
Faculty for the Creative and
Cultural Industries
University of Hertfordshire
United Kingdom

Philip Mead
The Music Centre
Faculty for the Creative and
Cultural Industries
University of Hertfordshire
United Kingdom

Xenia Pestova
Centre for Interdisciplinary
Research in Music, Media and
Technology
McGill University
Montreal, Canada

r.godman@herts.ac.uk   p.mead@herts.ac.uk   xenia.pestov@mail.mcgill.ca

ABSTRACT

Duel – for piano and sound projection is a large-scale composition by Rob Godman commissioned by Philip Mead in 2006 with funds provided by the Arts Council of England. It has received performances by both Philip and Xenia Pestova (SARC, Belfast, ICMC 2008). The work addresses a number of issues, most notably the relationship and interaction between pianist and sound projectionist and between performers and audience.

With the hindsight and experience of composing/performing a new concert hall composition, this paper will reflect on the initial aims of the work and how it has evolved through rehearsal, performance and observation. It will investigate the effectiveness of the available technology and compare existing tools and instruments used in the work with new tools created specifically for the job (code, hardware). It will offer alternative ideas on technical developments involving mixed media. It will conclude by making a proposal for future developments including the formation of a Centre of Excellence, focusing on the study and art of live performance with technology.

1. INTRODUCTION

For many decades composers and performers have apparently expressed concern about the relationship between audience and performer in concert hall works where electroacoustic technology has an important role. However, this is not reflected in audience numbers, as can be identified by the small quantity of promotions (outside of academia) and number of people attending live concerts on a regular basis.

This appears to be genre/type/space specific. Lack of interest, awareness and apathy doesn't appear to be an issue for certain types of 'commercial music' (i.e. dance, drum and bass, breakbeat…) as can be identified by the large number of people attending *live* gigs on a regular basis. Whilst success is clearly not synonymous with 'bums on seats', the obvious correlation probably shouldn't be ignored; no matter how long this argument has been in existence and no matter how uncomfortable the outcomes might be.

In the past, we have been told that audiences are to be educated to develop the skills and sympathy required for contemporary music. Might it be more appropriate for concert promoters, performers and composers, technologists and programmers to benefit from this education also?

2. WHAT IS *DUEL*?

2.1. Initial concept

The original proposal to the Arts Council of England read as follows:

Concept:

Electroacoustic music frequently denies the importance of visual representations and the sheer theatre of music in live performance. At worst, the sound-projectionist is seen as a passive provider of accompanying sound for the instrumental performer on stage. This commission aims to provide a large-scale composition that allows both Philip Mead (pianist) and the composer/sound-projectionist the opportunity of working as a true duet, exploring the important communication issues that arise when working with different medias. Fundamentally, it will provide greater transparency of the relationship between acoustic instrument and electronics.

The commission is to produce a 25-30 minute composition exploring responsive audio and video projection and create new performance tools enhancing the theatre of live performance. Rob Godman and Philip Mead will perform as a duet between pianist and sound-projectionist with both parties having control over aspects of the live electronics.

2.2. Real Communication? – a case study for *Duel*

In 2006, Rob Godman delivered a paper for a Research Symposium at the Institute of Creative Technologies, de Montfort University, UK. Discussing the wider implications for network audio, it addressed issues of haptic controllers in comparison to acoustic instruments and the role of 'performer' within a network. *Duel* implements a simple network of two computers during live performance although the arising points have great relevance to wider network audio. The imaginary invention of the neuroch in Adam Lively's book '*Sing the Body Electric*' [1], was investigated as a means of finding the *utopian* haptic controller! Is there anything to be learnt from such a fantastical controller?

2.3. Technical

Duel – for piano and sound projection is a large-scale composition including fixed, live and responsive electroacoustic sounds in combination with live piano.

The following were key technical issues:

- Developing new haptic controllers for projectionist and pianist
- Identifiable (by the audience) communication between pianist and projectionist
- A sense of 'liveness' and interaction between all parties (pianist, projectionist and audience) - although *Duel* is fundamentally non-improvisatory
- Create the potential for pianist and projectionist to have equal 'stage-presence' (even if the projectionist is off-stage)
- Create tools (code) and instruments, allowing suitable flexibility for 'performance' by the sound projectionist and to allow for real time manipulation of material in the time and frequency domain.

Two networked laptops are used maintaining clock contact between the two parties. Both performers (pianist and sound projectionist) have some control over the electroacoustic sounds via various haptic controllers – namely gaming joysticks and MIDI drum pads. The role of the sound projectionist in *Duel* is significantly more demanding than in the composers other works. Independently cuing short pre-rendered sound files, live mixing, spatialization and filtering, cuing timed pulses for piano/sound synchronization, adjusting sensitivity of responsive elements, allowing for changes in tempo by the pianist (and visa versa), and other actions by the pianist… are all activities acted upon by the projectionist, to name but a few.

The work allows for genuine human response as a 2-way flow of information. Each player can respond to the other in real-time. Whilst the pianist's ability to 'perform' has never been in doubt, *Duel* allows plenty of performance options for the Sound Projectionist. The composer was keen for the projectionist to be placed in a visually *obtrusive* place (including being on stage to one side of the pianist or close to the front with audience behind). The aim of this is for the audience to be clearly aware of cause and effect and to address the theatrical nature of live performance.

Fundamentally, *Duel* was about creating a meaningful duet between both parties.
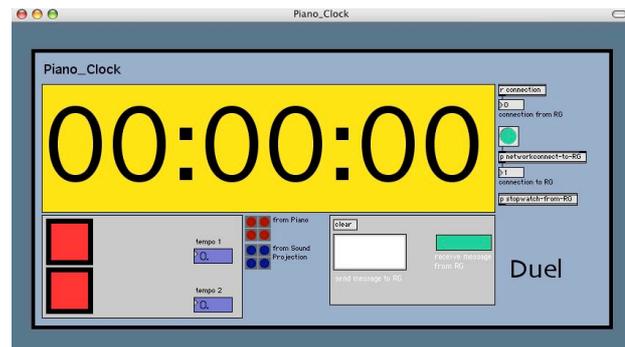
2.4. Tools and Code

In addition to the keyboard of the piano (no other extended techniques for creating sound on the piano are used in this work), the pianist has a computer relaying information from the sound projectionist and an AKAI MPD16 for controlling different aspects of the electroacoustic sound.

Through experimentation and rehearsal, the quantity of information relayed to the pianist from the sound projectionist was gradually reduced over time as they became more reliant on non-visual understanding and traditional chamber music skills.
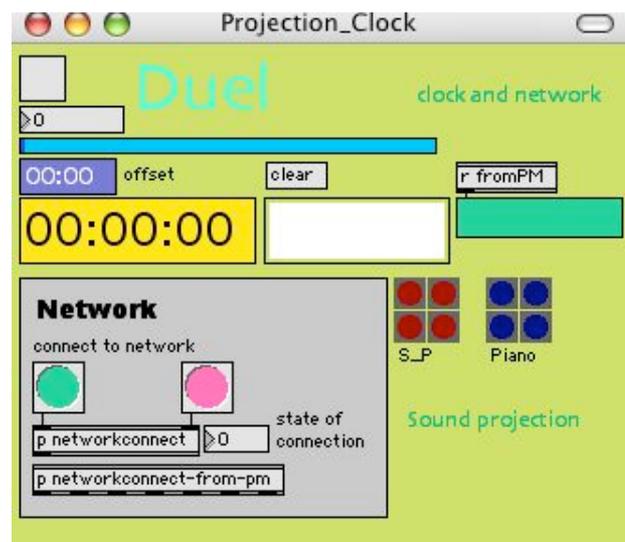
Xenia Pestova states:

… In order to become comfortable with technology, a performer requires regular access to technological resources over a sustained period of time. The unfortunate reality is that musicians often lack the opportunities to have regular access to microphones, loudspeakers and interfaces, and it is common to be introduced to new equipment just days before a concert! [2]

The development of *Duel* included several months of rehearsals, concerts and revisions to the score and code (a benefit of the two original collaborators being in the same institution and having access to appropriate facilities).
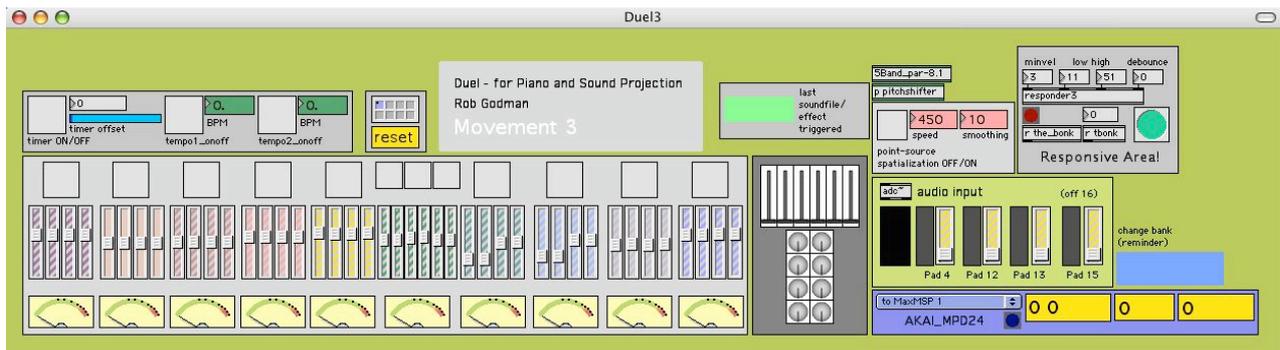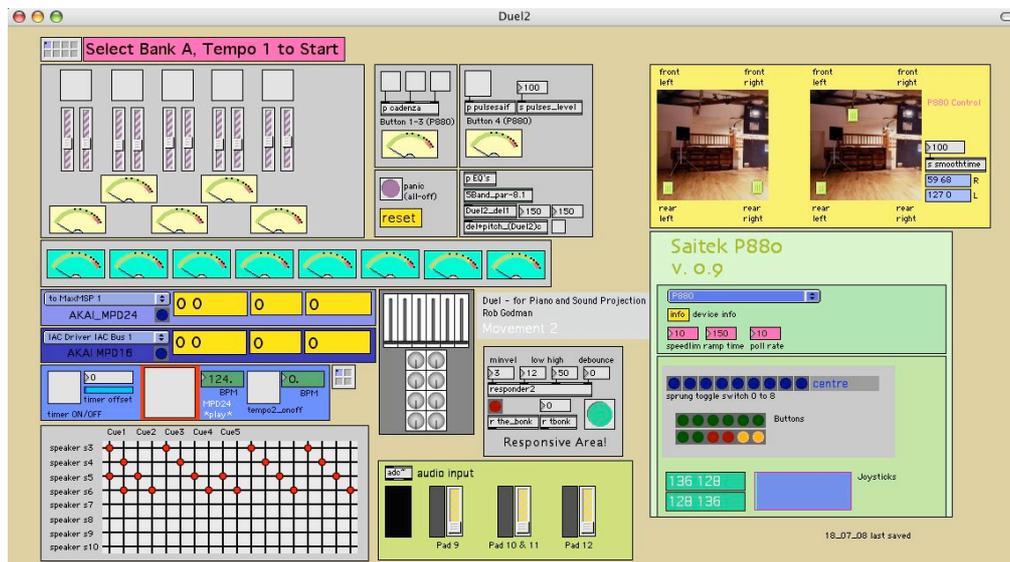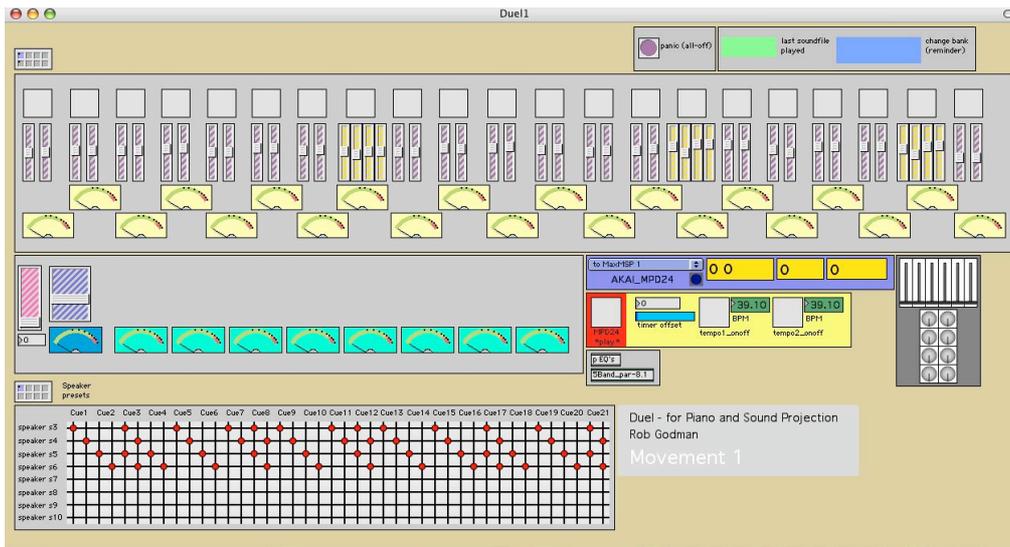

Figure 1. - interface for the pianist computer. In addition to the clock, information can be given for specific pulses (squares, far left of interface) and generic data indicating the sound projectionist is manipulating some aspect of the audio.

The two computers are connected via a LAN. This communication system proved particularly useful for rehearsal purposes. Information provided through this network was intended to compliment the traditional human musical communicative skills both parties would possess.

Figure 2. - interface for the sound projectionists computer. All data to be sent to the pianist's computer goes through this patch. The LED's (S_P and Piano) provide visual confirmation of activity from each party.

Figure 3. – the sound projectionist has a separate patch for the three movements of *Duel*. *Duel1* is primarily about firing short pre-rendered sound files via an AKAI MPD24. *Duel2* contains more live and responsive material as well as live spatialization controlled via a SAITEK 880 games pad (top right of *Duel2* interface). The microphone is used for sending live sound for treatment (in the time and frequency domain) and also as a sensor, detecting percussive transient changes from the piano with the result of triggering a granular synthesizer within the patch (Eric Lyon objects). *Duel3* combines the technical aspects of *Duels 1* and *2*.

2.5. Performing with Tools? Making Instruments?

Max, Pd, SuperCollider etc, invite the user into a paradox of opportunity for constantly inventing new tools for use as instruments. Whilst this creative potential appears enviable, it may be introducing problems into the composition/performance chain that wouldn't have been in existence without this flexibility.

Bill Drummond contradicts this creative potential:
The artist doesn't invent the tool – they respond to the tool. Jimmy Hendrix wouldn't have been Jimmy Hendrix without a guitar. He didn't invent it – although it may have evolved as a result of his playing [3, 4].

The instrument used by Philip and Xenia for *Duel*, the piano, has gradually evolved over the centuries. The fundamental premise of the instrument has remained intact. The same cannot be said for the sound projectionists instrument(s), which are likely to be reinvented (often by the composer) for each new piece. As a result, it is likely the pianists technical skill, dexterity and potentially aesthetic understanding of the art of playing their instrument will be greater than that of the sound projectionist. The pianist has a physical interface designed for the performance of music. This isn't just the keyboard – the whole instrument offers potential for exploration. The sound projectionist appears tied to a laptop. A laptop has never been a good haptic controller for live performance, although we use all types of attachable controllers to get information into it. A laptop also provides a visual barrier between what the projectionist sees and what the audience sees – frustrating for those interested in 'seeing' the theatre of musical concert. However, laptop performers can address this issue by projecting the screen for the audience to see. If live coding is part of the compositional process, it can be seen by the audience. The 'barrier' maybe an integral part of the theatre, demonstrating a lack of embodied gesture.

3. THE PERFORMERS RESPONSE TO *DUEL*

3.1 Performance issues

The two pianists currently performing *Duel* (and co-authors of this paper) were asked a number of questions by the composer. Their answers are enlightening.

RG: In Duel, some of the EA is described as 'responsive' (which differs from the conventional notion of 'live'). Did you feel the EA did 'respond' to what you were doing? Do you think the audience would have known (and is this important)?
XP: It was not always clear to me when the response came from the computer…, but I think ultimately this really does not matter.
PM: I thought this aspect worked brilliantly. I was very aware of the responsive nature of the electronics and found it exiting to be part of it. I don't think it matters if the audience knows how it is done.

RG: How useful was the visual display from the computer placed on the piano?
XP: In *Duel*, I found having the display at the piano somewhat distracting for me, and I imagine it might be distracting for the audience… I think it would take several weeks to integrate the laptop fully and inconspicuously into the performance.
PM: For me the most disappointing aspect of *Duel* was that the computer was 90% of the time simply a stopwatch. This was the aspect that I had hoped would be much more developed but as so often the original intention seemed to be diluted by practical necessity.

RG: How would you feel about having the score displayed on the computer, replacing the traditional written notated score? [5]
XP: … this would depend on how the score is displayed and how it moves. This could be an interesting direction to explore. I am not sure how this would impact the audience. The performer would still be facing and interacting with the computer where some events unknown to the audience might be taking place. This brings us to the whole debate of the idea of "performance" with laptops in situation when the audience is somewhat excluded due to the nature of the instrument/medium itself. Also, I personally like to have access to the physical score and to be able to cut and paste, put colours, circles and various squiggles, which all help my learning process.
PM: Fairly pointless.

RG: Did the drumpad provide you with an additional useful interface or was it superficial? Would you like to have more control over the EA?
XP: I enjoyed the fact that we could communicate very clearly by exchanging ideas this way (semi-improvised alterations between the pianist and the sound projectionist). I would have enjoyed having more of this kind of interaction integrated into the work. The drumpad was very simple to use, but I am not sure if it was the best interface – my impression was that it was a bit "too" simple, with little control over the resulting sound. I often feel this with gestural controllers. If the device itself is lacking in terms of control and flexibility, I end up having to "act" to try to make the performance "expressive," and this is very difficult for the performer. You can end up feeling "phony," like you are "faking it." While playing on the drumpad was intuitive to a certain extent, there was practically no haptic feedback, and for me the placement of the controller was a problem in terms of physical ergonomics and psychological tension for the audience.
PM: This was the aspect that I hoped would be developed much more. However I was always unsure what exactly I was doing to the sound and how helpful it was to the overall texture.
RG: Does it matter if the audience has an understanding of what is happening technically?
XP: No, I don't think so. We should always aim to make a musical statement/impact first.
PM: No

3.2 Intuitive communication skills

RG: For you as an individual, what are the differences between performing as a duet with acoustic musicians (for instance, two players on two pianos) and performing as a duet with electroacoustics? How do you feel during this relationship? Can you develop an understanding with the technology or the technology and sound-projectionist? Can you communicate with technology?

XP: From my experience, it is essentially the same, and we use the same sets of skills as in chamber music, except that obviously some of these have to be expanded [7]. I think that this also very much depends on how robust the technology is. It is possible to have a very satisfying musical relationship with technology when you know that you can depend on your "chamber music partner" and at the same time interact with and respond to any "reactions" to what you play that you might have in performance.

PM: There is no difference.

RG: I would like to develop the same levels of understanding and communication between pianist and sound-projectionist that can occasionally be seen (and perceived by an audience) between experienced acoustic ensembles (i.e. the intuitive communication skills that might be found in a wide variety of ensembles). This might be described as an almost telepathic understanding between players. Is this possible when digital technology is involved? Is this analogy (of acoustic players) useful or undesirable in this context?

XP: Yes, definitely, this is possible, and very desirable to have. It's a wonderful experience to play with a great sound projectionist. As a pianist, I feel so much more secure, and can focus on the music. I think that this is the same as when performing with other musicians in acoustic settings, except that you do not always have direct eye contact, but as you say, there are other ways to communicate.

PM: I agree with Xenia. However, the Montague/Mead Duo addressed this issue. Playing with the same sound projectionist – learning new works together, rehearsing them and performing them many times. Just like 'real' music…

RG: Both of you have very strong stage-presence although you are both very different (and I can't describe this in any other way - it felt different to me performing the work with each of you). Do you think it is possible for the duo of pianist and sound projectionist to have stage-presence and is this perceivable by the audience?

XP: Interesting question. What is stage presence in this context, if the sound projectionist is not on stage? I think it is possible if the sound projectionist has a more theatrical performance role, physically on stage or in sight of the audience. I think that the physicality of performance is extremely important for the audience in a live concert setting. As a performer, I feel it is very important to be able to establish a certain psychological tension on the stage. I think this is possible for a duo with sound projection, but the question remains: how? I

don't think that the duo will ever be perceived by the audience as having equal roles as long as the sound projectionist remains hidden from view.

PM: This is a complex question which needs a complex answer and probably is a question that needs the kind of research that a new department could involve itself in.

4. MAINTAINING THE THEATRE OF LIVE PERFORMANCE

4.1. How live is *live*?

According to Simon Emmerson, *live* means:
The presence of a live performer who takes decisions and/or actions during a performance which change the real sounding nature of the music [8].

Although arguable, we may still be at a stage where an audience regards or perceives electronic sound as pre-recorded (something that was created previously) and simply 'played-back' unless there is a visual confirmation otherwise.

Anecdotal evidence from audience members listening to *Duel* tends to regard the electroacoustic sound as being 'tight' and/or well synchronized. This doesn't really differ from a 'tight' and well-synchronized tape and live performer work – apart from the fact that achieving this degree of synchronization is undoubtedly harder with the performer/fixed work!

Bill Drummond has recently made a number of controversial points relating to the Music Industry and its obsession with recorded sound.

(Pre)recorded music is a two-dimensional medium of the 20th century. It exploits our weakness for nostalgia. Music is breaking away from the shackles of recorded music. Immediacy is lost in recorded music [3].

For those who share his view, music in the 21st century will return to time, place and occasion thus giving a significantly greater meaning. It would appear that liveness has more to do with audience perception of the event than the technical process [3,4].

According to Simon Morgan (University of Hertfordshire), *live* means:
I was there, ... unique and unrepeatable, live means more than one person, ... human-to-human contact.

4.2. Does the acousmatic deny live performance?

4.2.1 The acousmatic and the audience

The importance of the acousmatic is often misunderstood (possibly because it can be and often is 'taught' in an overgeneralised fashion in academia). At worst, we are encouraged to turn the lights down so we can hear better…

Acousmatic: ...indicating a noise which is heard without seeing the causes from which it originates. ... The acousmatic situation renews the way we hear. By isolating the sound from the "audiovisual complex" to which it initially belonged, it creates favourable conditions for a reduced listening which concentrates on sound for sounds sake... [8, 9, 10]

You do *not* simply become more aware of sound

when a light source is removed as a matter of course. A darkened space can be the most overwhelming visual stimulus you are likely to encounter.

The Dark is an audio installation produced by Braunarts with music and sound design by Rob Godman. The work gives the viewer an opportunity to explore a specially created three-dimensional audio environment in which the echoes of virtual ghosts inhabit a haunted soundscape. [11]. Whilst *The Dark* is unusual in that it encourages the viewer to move around and interact in the darkened (pitch black) space, it was clear that that an individuals energy was normally focused on understanding where they are in the world (although repeated listening opportunities changed this to some extent). Does such a listening environment provide a viewer with a greater perception of sound?

Listening acousmatically requires practice, learning, skill and, not least, interest in the sound worlds that are being presented to you. *The necessary skills were developed in a thorough training combining research and practice,* Schaeffer, [12].

4.2.2. Seeing sound and theatre

Whilst the trend for performance of acousmatic works continues to consist of minimal visual stimuli, there are others who do not find the 'visual' a hindrance (the author included).

Many listeners feel – with Stockhausen – that it is necessary to close the eyes when listening to acousmatic music. To avoid the distraction of the physical world… However, I [Simon Emmerson] have decided to make a personal statement to contribute to this discussion. I am a heretic, in that I maintain my eyes wide open during performances of such (acousmatic) music… The state of readiness to perceive sound and music requires my era/brain to be in ultra-attentive mode which is (for me) only possible when all senses are on full alert and active. [8].

In a work for instrument and electronics (involving the loudspeaker), clearly some sounds will be acousmatic and some will not. *Duel* explored the concept of imaginary spaces and resonances, sounds that were clearly heightened through the acousmatic situation [9, 10] of their playback. The dialogue between live instrument and electronics included the crossover point of 'is it acoustic' or 'is it electronic'? This has been a constant area of exploration for the composer. Without the visual, this dialogue would not be present.

There is one undeniable fact. The majority of audiences experience and *enjoy* the total theatre of a live concert. This includes the use of *all* of our senses…

5. AUDIO-VISUAL

5.1 In *Duel*

The original commission was for a work including responsive video and various sketches exist detailing the proposed material. However, concerns were expressed by both the composer and Philip Mead relating to issues of stage-presence and projected images. Would such projected material interfere with this theatre? Might it be perceived as being used to compensate for a lack of stage-presence? Currently *Duel* exists as a sound work for concert hall although the aim of live video as an integral part remains.

Xenia Pestova states:
*[about having live/responsive video as an option for Duel?] … This could be very effective. Video would work very well with the piece. In a way, it would solve some of the problems of audience perception. The focus of the audience would shift to the video, and the interaction between the image and sound and between the image and the performer(s) as opposed to between the pianist and the electronics/sound projection. I think that the relationship between the pianist and the sound projectionist is not so clear for the audience, unless they can **see** the sound projectionist.*

Philip Mead states:
I have never yet seen a video with live performance that was worth the trouble but there's always a first time!

5.2 In other works

5.2.1 BCMG and Braunarts

Responsive video projection may prove worthwhile in *Duel*. Early proof can be seen from the early experiments with other ensembles and audience reaction to these performances. In the examples cited below, the ensembles were performing music written by other composers or by the ensemble themselves.

In 2008, Rob Godman was commissioned by Braunarts to write the software for *4DMusic*, a series of responsive video performances with Birmingham Contemporary Music Group. The concerts took place in the CBSO Centre, a conventional concert hall. The aim of this project was to attract a young audience into contemporary music in the concert hall. The mixed-media approach proved very successful.

Figure 4. - Birmingham Contemporary Music Group performing *Trois pièces pour quatuor á cordes* by *Stravinsky* with responsive video (pre-rendered material by *Terry Braun*).

5.2.2 Diverted

Diverted are a breakbeat outfit based in the UK. They perform live on a regular basis in clubs around the UK,

including *Cargo* in Shorditch, *Fabric* in Farringdon and *Matter* at the O² arena, London. They perform with a variety of electronic and acoustic instruments. Technology is large part of what you 'see' on stage.

Rob has been performing as a VJ with *Diverted*. It is clear that all members of *Diverted* communicate with the audience – through their music, but also verbally and visually. The projected images respond to the audio as it is created demonstrating a correlation of 'liveness' for the audience. As a stage member, it is possible to 'feel' this liveness. As a stage member, it is possible to respond to the audience through the technology, in the same way as performers have been responding to audiences for centuries.

Lee Richardson (founding member of Diverted) states:
The thing is when I'm performing I tend to be enveloped in that and my interaction is involved between myself and the sampler. I think the audience is the main benefit of the video output. On a personal note I find it very exciting though, to know that what is happening up there is a visual and symbolic representation of our logo [plus other photography and video] and images of the band members is great promotion for us. When there is a live video feed of the band its really cool as well.
... [There's] definitely more interaction going on between ourselves as well as now having a video aspect. The audience certainly feels more involved if you can capture them on video, and also I've seen at other performances before where people have managed to get the audience involved in the musical output of a performance... I've seen some performances before with live VJs on stage but they have always been a reaction to what the musician is doing. It would be great during a show to demonstrate a video reaction that is truly interactive – a genuine two-way flow...

Figure 5. – Livid Union VJ software [13] controlled by the audio analysis system (written by the author) on a networked computer. The system is used to control video (as apposed to controlling audio in *Duel*) in a responsive fashion.

Figure 6. – Live performance by *Diverted* with real time video projection the background.

6.   QUESTIONS (AND ANSWERS?)

Are composers' overemphasizing the importance of creating new instruments rather than creating music? Technical ability is often transparent to an audience, whilst aesthetic understanding of 'music' often isn't. Composers' whose imagination truly combines instrumental and electronic sound appears to be rare.

Philip Mead states:
Vaggione's writing for the piano is that of a composer whose aural imagination is embodied in electronically produced sounds... To perform these wonderful works is for me a unique experience. One feels in the presence of a major musical mind at the height of its creative powers, completely in control of its own musical universe. If the piano is good, the sound system is good and the composer is at the mixing desk, a performance of these works is a life-enhancing experience [14].

Aesthetically, how practical or desirable is it for a composer to be producing all of the material in a mixed-media project? Are composers' the most appropriate and best sound projectionists of their own work or should they be working with external companies assisting with this role (Sound InterMedia for example)? There is a history of electroacoustic composers being resistant to musical collaborative process [15].

High quality commercial clubs have purpose built sound and lighting systems operated by engineers who have an in depth understanding of the PA they are using and the room that it is operating in. Is a concert hall the best venue for a work such as *Duel* where a portable system is most often used? For instance, is a concert hall with an RT60 time of over two seconds (which may be suited to live piano) suitable for material projected through loudspeakers and do composers *really* work with space?

There is a considerable difference between listening acousmatically at home and listening in a concert hall. Is the intimacy/anxiety encountered by many in this listening situation better suited to home consumption? How can we create the sense of 'liveness' in a home?

With artists such as Glenn Gould and The Beatles creating work only for recorded format in the 1960's, upholding our 20th Century obsession with recorded media [3, 4], how live can 'live' be in relation to concert hall performances? How else can this work be presented? Can we learn from the commercial sector?

It is encouraging that both performers of *Duel* consider the communication skills required when working with technology to be largely the same as with chamber music. It is unlikely that non-visual understanding (listening, intuition; skills that have served players in ensembles for years…) will be replaced by technology. However, there is a clear purpose in debating the whole performance question with regards to instrument and technology.

Does it matter if the audience has an understanding of what is happening technically? Education of audiences has always been an issue for any concert promoter but what are the differences when digital technology is involved?

Performance with technology is still a very small component of conservatoire training across the world. How can this be developed? The potential outcomes and implications are highly relevant to performers/ performance practice, as well as composers working with live performers, as well as to the end user (and most important part of the chain) – the audience.

Xenia Pestova states:
If we examine the literature by other performers [on matters relating to EA performance], we quickly realize that many of the issues people encounter are very similar (synchronization, sound balance and so on) - so, once the information is widely available, we can learn from each other, and simplify our own learning process. When you have more experienced performers working closely with composers, the end result is often more ergonomic and natural for the instrument, and we all benefit. I think it is inevitable that in the next few years we will see an emergence of a performance practice tradition with technology. In an ideal world, I would like to see more performance practice seminars being offered to University-level students, perhaps mixing the class with performers, composers and music technologists, as is already being done in several institutions around the world…

7. CONCLUSIONS: PROPOSALS FOR FUTURE DEVELOPMENTS

Communication skills for performers, where technology has an important role, are similar to a traditional acoustic ensemble. Composers' must explore the use and purpose of technology at their disposal to create meaningful results. A projected image (responsive or otherwise) is not to be seen as a replacement for an acousmatic listening environment per se but it should stated that there are alternative methods of presenting acousmatic sound to an audience. Communication and audience perception of 'liveness' needs to be investigated further. This paper demonstrates the need for research and new knowledge into the area of performance with technology. In order to provide answers to the many issues raised the authors make the following proposals and recommendations:

- Formation of a 'Performance with Technology' Centre of Excellence and Programme at the University of Hertfordshire
- Create a dedicated performance space
- Create collaborative potential and offer the idea of forming an apprenticeship for composers, performers and engineers working together
- Develop research and knowledge of the aesthetic of EA performance thus providing a unique contribution to the whole performance question
- Produce a hybrid software control system and devise methodologies for composing with the system
- Create a definitive document (a standard) for describing the technical issues of a composition
- Create a technical solution for bouncing to stereo (or other commercial, regularly available formats) from a hybrid multi-speaker work for documentary purposes [16]
- Explore the social context of where/how and to whom this music is performed [17]
- Develop a syllabus and appropriate Definitive Module Documents (DMDs) for 'Performance with Technology' and investigate the merits of teaching at Undergraduate or Postgraduate level

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