A PORTFOLIO OF COMPOSITIONS: COMMENTARY

by

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Abstract

I present here a Portfolio of Compositions totalling five works composed between October 2007 and September 2011 at the University of Birmingham Electroacoustic Music Studios. The works are varied in medium including acousmatic, mixed, instrumental and laptop compositions. In addition to the DVD containing recordings and video of the works and performance scores for four of the compositions, I include this commentary as an outline to the techniques used in the composition of the works as well as the aims and objectives of the works. The commentary also includes some discusison of the compositions in relation to the current context of electronic music writing, and some background to the influences that have shaped my compositional direction, with a particular focus on the use of technology in current performance practices. Included in the appendix are a number of supporting documents and a further composition discussed in relation to one of the compositions for submission.

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Contents of the DVD

All tracks are submitted as stereo soundfiles at 16bits/44.1kHz sample rate.

Submission

Track 1. Chordophonia - studio recording ..... 4'35"
Piano: Jamie Man, Harp: Bethany Spicer, Guitar: Ed Nightingale, Violoncello: Ed Furse

Track 2. Vanishing Point - workshop recording ..... 4'22"
Performers: Birmingham Contemporary Music Group

Track 3. Kyorei - video ..... 9'47"
Flute: Carla Rees, Tam Tam: Eric Bumstead

Track 4. For Piano - acousmatic piece ..... 8'40"

Track 5. XYZ - performance recording ..... 10'31"
Performed by Benoit and the Mandelbrots (Holger Ballweg, Patrick Borgeat, Juan A. Romero and Matthias Schneiderbanger)

Folder: KYOREI_code

Folder: CHORDOPHONIA_code

Appendix

Track 6: XYZ - video ..... 11'04"
Performed by Benoit and the Mandelbrots

Track 7: XYZ - studio recording ..... 10'04"
Performed by BiLE (Julien Guillamat, Charles Celeste Hutchins, Shelly Knotts and Chris Tarren)

Folder: XYZ_BiLE_examplecode

Introduction

This portfolio for submission for a Masters Degree in Composition consists of five pieces totaling 38 minutes of music. The pieces and materials for submission are as follows:

Chordophonia (2008) - Score and Recording

Vanishing Point (2009) - Score and Recording

Kyorei (2010) - Score and Video

For Piano (2010) - Recording

XYZ (2011) - Score and Video + additional recording included in appendix.

I also include the following items in the appendix for reference purposes in relation to one or more of the submitted pieces:

Programme notes

Transcription of a spectral analysis of a tam-tam

Berck Plage - by Sylvia Plath

Manifesto on the Forming of a Laptop Ensemble

Statement from Benoit and the Mandelbrots on realising *XYZ*

In relation to the pieces I include this commentary discussing their development, realisation and context.

The prime concern of this portfolio has been to investigate the use of electronic forces in

composition, with a particular focus on how new technologies can be utilised in performance practice. During the course of my masters I found performance to be a vital aspect of my compositional direction, and it seemed that the use of technology offered some new avenues for ensemble interaction and modes of performer-to-audience communication. This is a diversion from my original intentions, which were to investigate approaches to writing music that combines instrumental and electronic forces, primarily with a view to expanding the timbral range of the acoustic instruments.

For the above reasons my portfolio is particularly varied and encompasses the following:

- two pieces which fulfill my original aims of expanding timbral possibilities with electronics;
- an instrumental piece in which I apply some compositional tools from my electronic writing;
- an acousmatic piece in which the aesthetic is related to the concept of performance;
- a piece for laptop ensemble investigating ensemble interactions.

Commentary

Chordophonia (2008)

Chordophonia was composed in response to a request for a contribution to the CD accompanying Leonardo Music Journal, Volume 18. It is a mixed piece scored for piano, harp, guitar and cello with electronics and is the first piece I wrote during my Masters degree.

The piece was heavily influenced by Karlheinz Stockhausen's piece *Freude* for two harps, which made me consider contemporary writing with extended techniques for harp, as well as the use of various serialist or pre-determined techniques for pitch selection.

I began *Chordophonia* with the intention of writing a piece for harp and electronics, with the idea that I could expand the timbral range of the instrument as well as circumnavigate some of its inherent impracticalities by using electronics. However, I found in writing the piece that the original serialist pitch structure was too restrictive for harp writing and that I wanted also to investigate further timbral possibilities by combining the harp with other string instruments.

The piece is essentially a timbral investigation of string playing technique with some extended possibilities and amplification provided by the electronics part. The electronics have an unobtrusive presence in the ensemble, acting as a mediator between instrumental timbres rather than adding any significantly different sound material.

Chordophonia plays on the instruments exchanging their idiomatic playing techniques with those of the other instruments of the ensemble in a sort of subverted string quartet where members of the ensemble imitate the timbres and methods of sound production of the other players.

The electronics part for this piece is deliberately subtle as I was attempting to explore the possible timbres available by using various extended techniques on different types of strings. The electronics part is used to add some extra texture, and to extend the timbral possibilities slightly, with the intention of creating a median timbral point between the sounding instruments and blending the instruments together in some way.

Vanishing Point (2009)

In relation to *Vanishing Point* I will discuss my reasoning for including an instrumental piece in this portfolio and its relation to my electronic works, as well as the composition's relation to the poem *Berck Plage* by Sylvia Plath.

I have included *Vanishing Point* in this portfolio is as a demonstration of the crossover between my instrumental and electronic compositional techniques. I have found it to be important to be flexible enough when composing to be able to work in a number of different media depending on the requirements of the expression of the idea for the piece. My music tends to focus on timbral and performative aspects rather than harmonic or rhythmic ideas, so moving between instrumental and electronic mediums is advantageous and does not reflect any great change in musical aesthetic. My compositional techniques remain reasonably constant whether working in acoustic or electronic media.

To clarify further, my focus on timbre in my instrumental writing is most frequently reflected by extensive use of highly specified extended techniques,. In larger ensemble works such as this, I also make frequent use of doubling at unison and octave intervals, and use orchestration to colour the sound - often by the use of percussion. I am using the instruments as ‘timbral entities’ i.e. capable of making specific characteristic sounds, in a similar manner to a software plug-in or a characteristic sample, rather than as the purveyors of melodic or harmonic motifs.

For example, in bars 11-18 of *Vanishing Point,* the flute, oboe, clarinet and violins I & II

combine to create a single line: F#, C, A, G#, G, F#, F - with timbral variations provided by the orchestration, the line passing smoothly from one instrument to another, in the same way that a single sample might be put through several sound processing techniques to modify its timbre. The only point in the piece in which any instrument may be said to have any line that could constitute a melody is in bars 52-56 where the piccolo plays a single line supported by other instruments in the ensemble. However, the accompaniment provided by the other instruments functions to diversify the timbre rather than to create a harmonic backdrop. It mostly doubles the pitches of the piccolo, the same way that sounds might be combined for timbral variation in a sequencer.

Another motif that exists in both of my practices is the use of pointillistic textures. This appears in *Vanishing Point* in brief sections such as bars 56-57. Here, a number of instruments combine to make a pointillistic a-metrical texture with timbral variations and no discernible melody. This gesture appears frequently throughout the piece. Similarly, in my electronic piece, *For Piano*, several samples with varying pointillistic timbres are combined, such as the section 3:00-3:30, as well as at other points in the piece .

Indeed, all of my pieces, with the exception of *XYZ*, are primarily concerned with instrumental timbres. The use of electronics or extended techniques is, for me, different means to the same end.

Vanishing Point is intended as the first movement of a seven movement work based on Sylvia Plath's seven-part poem *Berck Plage,* with each movement based on the corresponding part of the poem.

Berck Plage is Sylvia Plath's grotesque depiction of a trip to a beach in France where Plath was particularly affected by a convalescent home for injured soldiers. Almost exactly a year after the trip to the beach an elderly neighbour of hers died of cancer around the same time as Plath’s son was born. The poem combines these events into a single unfolding beach scene depicting themes of transfiguration, re-birth and mutilation.

Vanishing Point is divided into nine sections roughly corresponding to the nine couplets of the first part of the poem. I do not attempt to translate the imagery of the poem directly into music, although it is possible to draw some parallels between the two. Rather, the music takes some of the broad themes of *Berck Plage*, such as the grotesque imagery and allusions to transformation and mutilation, as an influence. Specifically these are translated in the continual morphing of the same musical figures and pitch sets and the use of extended techniques as well as the deliberately odd and often stark sound worlds and harmonies.

Kyorei (2010)

In relation to *Kyorei* I would like to discuss the use of electronic and computational methods in the compositional process, the use of electronics in the creation of a theatrical performance situation and the relation of the piece to Japanese shakuhachi music.

Kyorei, written for concert flute (doubling alto flute and piccolo), tam-tam and electronics, aims to combine two instruments with contrasting spectral identities, using electronics as a link, and to explore the theatrical situation of performance. The computational processes used as the basis of the composition of the flute and tam-tam parts of *Kyorei* focused on the extraction of spectral and timbral data from pre-recorded sound samples from the instruments. Similarly, the electronic processes used in the creation of the electronics part used processes such as FFT based spectral filtering and convolution focussing on altering the timbre of pre-recorded samples of the flute and tam-tam. These processes were used in order to merge the sounds of the two instruments by integrating aspects of one instrument into recordings of the other, to modify the timbre or spectral characteristics of the recordings and to provide connecting material. The electronics part used in performance was essentially a live-triggered tape part, with one section that includes live granulation of the flute material.

As the starting point of composing *Kyorei*, I analysed the spectrum of two sounds from the tam-tam: a loud and a soft hit with a standard tam-tam beater. As the timbre of the tam-tam is spectrally rich, this provided me with a large amount of varied spectral data, which I then transcribed as musical notation, quantising the pitch to the closest quarter tone, in order to use it as base material for the flute part. I have attached this transcription in the appendix to this

commentary.

The transcribed tam-tam material was then used to compose flute melodies and rhythms, which were then used freely and with various distortions and transformations, over the course of the piece. Although all the flute material originates in this spectral analysis of the tam-tam, and all pitch material can be found in the analysis, its use in the composition is not structurally related, but is merely a starting point for the free composition of related material.

Although the use of spectral analysis in composition originates in the French spectralist school of composers such as Grisey and Murail, my piece is related only in that the basic compositional material is generated from a spectral analysis. I do not attempt to reconstruct the sound of a tam-tam with a flute, as this would be a futile quest; spectral analysis in the case of *Kyorei* is used much more freely in order to create harmonic and melodic relationship between the two instruments. *Kyorei* is far more soloistic in its approach and in the final piece the tam-tam analysis morphs into idiomatic contemporary flute writing utilising extended techniques particular to the instrument.

In combining the instruments in the final piece, I attempted to match their timbres and spectral regions (of the two instruments), so that they are often ‘mimicking’ each other, to the extent that this is possible with this combination, for example, matching high metallic sounds on the tam-tam with the sharp sounds of the piccolo and thumb rolls with low alto flute with heavy vibrato.

In addition to this the electronics part aims to connect the timbral characteristics of the two

instruments. I have used various techniques, for example using FFT-based filtering to strip out noisy elements of the tam tam sounds, leaving the more pitched elements in order to create electronic sounds that attempt to sit halfway between the two performing instruments.

Although it was not my intention at the beginning of writing the piece, during the workshopping phase with the performers and in discussion with my supervisor, the piece has been compared to Japanese shakuhachi music and also to Noh Theatre.. This led to me investigating these areas of music and theatre, with which I was previously unfamiliar, and assimilating some of the features of shakuhachi music, which were already present in a more fragmented way, into the final version of the piece.

The title - *Kyorei* - originates in a piece of Japanese shakuhachi music of the same name, which was said to have been written by a monk attempting to imitate the sound of a bell (or gong) with a wooden flute. Since, in Japanese culture, the gong has a spiritual significance, the music was said to lead the soul to a state of openness where it is possible to become enlightened.

Although I do not aspire to the same aims of enlightenment through my music, I found it useful to draw some sonic comparisons with the genre of shakuhachi music, as well as acknowledging the fact that parallels exist between the origins of shakuhachi music in the flautist imitating a gong and the use of material originating from a spectral analysis of a tam-tam in *Kyorei*. In *Kyorei* the organisation of sound loosely follows the structure of a typical shakuhachi piece- i.e. starting in the low register of the instrument, moving to the upper register with more activity and then returning to the low register of the instrument at the end.

I was able to extend the pitch range - and the timbral range - by using alto flute, concert flute and piccolo in *Kyorei*.

I would like to mention briefly the theatrical elements of the piece relating to the use of electronics.

The technical requirements of *Kyorei* ask that the electronics part be played through a single speaker placed directly behind the tam-tam. This has several purposes. Firstly, any electronic sounds, made up primarily of processed tam-tam and flute sounds, emitted from the speaker will cause the tam-tam to resonate, thereby adding the resonant frequencies of the tam-tam to the output (sound). Also, from a visual perspective, placing the speaker behind the tam-tam hides it from the audience so that the live performers are the main focus and not the electronics. Finally, it adds an element of subversion, whereby at certain points in the piece it can be difficult to tell whether the sounds are electronic or performed live. This 'subversion' is aided by the fact that both flute and tam-tam are often playing with extended techniques, so the audience is less familiar with the sounds that are being produced anyway.

In *Kyorei*, electronics are integral to the aesthetics of the piece, as the theatrical situation is made possible only via the electronic medium. The electronics are used not so much to expand the timbral possibilities of the music but to create a relationship between the live instruments and to expand the dramatic potential of the medium.

In developing and writing the piece I referred to Robert Dick's *The Other Flute* and Carla Rees' writing on contemporary flute technique. These greatly influenced my flute writing and

the scoring of the piece.

***For Piano* (2010)**

For Piano is the only acousmatic piece submitted as part of this thesis. My original intention was to write a mixed piece for fixed electronics and live piano performer. I wanted to explore expanding the timbral possibilities of piano sounds without losing the social and communicative elements of live performance. However, whilst composing the piece, I felt that, as I was able to represent gestural elements accurately through the use of familiar sound sources, it was no longer necessary to include a live performance part. This will be discussed later.

I wanted to include a piece in my portfolio with extensive use of processed electronic sounds as a means of developing my compositional skills in this area and expanding the possibilities for the use of electronics in my music. The majority of my previous mixed pieces had involved a limited number of sound processing techniques and I felt that in order to fulfill my objectives to use electronics to expand the timbral possibilities of instrumental ensembles I should focus on increasing my skills in this particular area.

The sound sources for the piece come from recordings of two Bösendorfer pianos - the first, a concert grand and the other significantly uncared for, out of tune and with a number of defects. I recorded a wide variety of sounds from the concert grand, including a large number of extended techniques and sounds from the inside of the piano as well as auxiliary noises. From the defective piano I mostly played the pitches with normal piano technique but the decay of the piano created extra sounds and often the pitches were out of tune. I wanted to juxtapose the sounds from these two pianos as an abstract reference to the decay of the piano

as the great romantic instrument with the development of popular and electronic music, sound recording and electronic means of reproduction. The piece is about the piano as an object, its place in historical context and the process of digitising it.

To record the pianos I used DPA microphones inside the instrument very close the sound sources in order to pick up the sound of auxiliary action as well as to produce a very intimate acoustic with the purpose of then being able to represent the piano in a slightly alien and unfamiliar way in the finished piece. I also recorded some sounds with AKG 414 microphones placed in close proximity to the piano, but not inside, in order to pick up room resonances.

In composing the piece I juxtaposed unprocessed or relatively natural sounds with highly processed sounds and unnatural editing, such as instantaneous cuts to silence, without natural reverberation, and crescendos, which of course are not physically possible within the normal functioning of the piano. I wanted a certain amount of discontinuity, in the piece related through placing recognisable sounds next to slightly alien sounds and unrecognisable sounds that still have the timbre or some characteristics of a sound produced by a piano. The more unrecognisable sounds represent some abstract or imaginary piano, whilst the sound world used is deliberately grotesque and reminiscent of a piano being destroyed in some way.

Although in the final piece my original intention of using a live performer was rejected, the concept of performance is still integral to the aesthetic of the piece. It is important that the listener understands the basic functioning of a piano and the physicality of performance on the instrument to be able to perceive the ensuing subversion and to make a gestural

connection to the more abstract sounds as being in some way connected to piano playing.

The main structural concern of *For Piano* comes from the timbral aspects. However, this piece has evolved over time. At the beginning of the compositional process, I set out with a strict pitch structure based on serial techniques as well as a temporal structure derived from an arbitrary mathematical process. The main purpose of the pre-determined temporal structure was in order to give the timings of the several abrupt cuts to silence as unnatural a feel as possible. As I worked on the piece the overall pitch structure became somewhat distorted but the local pitch relations, dictated by the serial techniques, still remained. However, the timbral aspects grew in importance and became the main structural element of the piece.

***XYZ* (2011)**

XYZ is a piece for 3 or 4 laptop performers written for the laptop ensemble BiLE (Birmingham Laptop Ensemble) of which I am a member. The piece exists as a text score, which is essentially a set of instructions for realising the piece. The piece has so far been realised by two ensembles: BiLE and Benoit and the Mandelbrots.

In relation to this piece I would like to discuss some background issues regarding BiLE's working methods and its implications on composing for the ensemble.

In the appendix I have included a document entitled *Manifesto on the forming of a Laptop Ensemble.* I wrote this document as a way of solidifying and consolidating the key aims and objectives of BiLE as an ensemble, and also as there seems to be a large amount of documentation on Laptop Orchestras following similar models to SLOrk and PLOrk, but little on other ways of working. BiLE's model is more similar to The Hub than to recent trends in laptop orchestras. I found it helpful in order to consider the implications of the working methods of the laptop ensemble on composing for the ensemble, and also on performing as a member of the ensemble.

Although the other members of the ensemble did not have direct input into the document, I felt that having spent a large amount of time working and performing as part of the group, I was able accurately to represent the views of the ensemble in identifying our key aims, objectives and criteria in forming and developing the ensemble. In the manifesto I identify eight key concerns as follows:

Democratic Approach

Collaboration

Musicality

Inclusivity

Cross-Platform

Open Support Forum

Communication

Progressive Experimentalism

I feel that the most important of these objectives and criteria for the forming and functioning of BiLE, and those that are most influential in the composing of *XYZ,* are Democratic Approach, Musicality, Collaboration and Inclusivity. That is, that BiLE considers all members equally - i.e. we do not have an ensemble director and distinctions between composer/performer/programmer are somewhat blurred and always non-hierarchical. We are more interested in the musical contributions that members can make to the group than technical contributions, and musicality remains central to all ensemble activities.

I have found that one of the most valuable aspects of being a member of BiLE is that all of our pieces are developed in collaboration and include a significant amount of group discussion and feedback; in most cases significant revisions are made after rehearsing and workshopping pieces. BiLE also spends some of its rehearsal time experimenting in group coding sessions and working together to find technical and musical solutions to realise ideas of different members of the group. When developing new pieces, the role of the composer for

each particular piece is usually informally designated as the person who proposes the initial idea and takes the most responsibility in guiding the collaborative process of realising it.[1]

I hope to demonstrate in the following how the ensemble objectives of BiLE apply to *XYZ*.

XYZ was heavily influenced by one of the first pieces that BiLE realised: *Stuck Note* by Scot Gresham-Lancaster of The Hub.

> As an antidote to the increasing complexity of Hub projects, Scot Gresham-Lancaster designed a piece that re-focused the band on simple interactions, with specific sonic results. His piece "Stuck Note" was designed to be easy to implement for everyone, and became a favorite of the late Hub repertoire. The basic idea was that every player can only play one "note", meaning one continuous sound, at a time. There are only two allowable controls for changing that sound as it plays: a volume control, and an "x-factor", which is a controller that in some way changes the timbral character or continuity of the instrument. Every player's two controls are always available to be played remotely by any other player in the group... this created an ensemble situation in which all players are together shaping the whole sound of the group. An interesting social and sonic situation developed when more than one player would contest over the same controller, resulting in rapid fluctuations between the values of parameters sent by each.[2]

I was interested in the situation created by allowing all members of the group to control the sounds of all other members. Not allowing ensemble members full control over the sounds they are creating challenges the notion of the performer's ownership of the sound. It is not possible to control fully any element of the music produced as all other players are able to control the same parameters. So instead of fully controlling micro-elements of the sound, as would be usual in group improvisation, the player instead have to find a way to act in a meaningful way within the overall sound production as a group activity.

This seemed like an interesting attitude to collaborative music-making, leading to a strong

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[1] Booth and Gurevich, 'Collaborative composition and socially constituted instruments: Ensemble laptop performance through the lens of ethnography', p. 3.

[2] Brown, '5.0 Stuck Note', http://crossfade.walkerart.org/brownbischoff/index.html.

ensemble aesthetic, and one that is intrinsically linked to the technological aspects. This piece is only possible when performers are linked via a network, but the technology is not used in forming part of the sound aesthetic, but rather as part of the performance aesthetic. It also seemed that having very simple controls allowed the players more time to listen to the sounds produced in the context of the ensemble as a whole and therefore to play more musically.

The problem that I found with *Stuck Note* was that although the sonic results were interesting there was no way of communicating the process behind the sound production to the audience. In writing *XYZ,* I wanted to create a similar ensemble situation for music making to that of *Stuck Note,* but to create a dialogue between performer and audience by way of creating a visual connection to the sonic results, and in some way to demonstrate the process of the music making through performance.

In beginning to develop *XYZ,* I asked the members of BiLE to create a sound generating patch that could be controlled by a physical, motion capture device such as a wiimote or iPhone. Due to the nature of the devices and the naturalness of moving in three dimensions the single x-factor of *Stuck Note* was expanded to three controllable parameters named x, y and z, corresponding to the x, y and z axes of the control devices being used. The use of three controllable parameters allowed for greater complexities in the performance of the piece, which would later become integral to the piece's identity.

As the use of three controllable parameters, rather than one, as in *Stuck Note,* greatly increases the complexity of control in the piece, I considered it necessary to impose a formal structure on the performance of *XYZ.* I also wished the audience to be able to perceive, at

least in part, the process behind the sound production.

The structure decided on related to both the overall structure of the piece and the interactions between performers. In *Stuck Note,* performers are free to control whichever player's parameters they choose, as and when they wish. However for the sake of transparency of performance, I decided in *XYZ* to introduce 'fight' sections in which the players can try to take control of another player's x, y or z parameter controlling it with their own motion capture device. As with *Stuck Note,* the players then enter into a battle in which both players are sending values to the same parameter, creating glitches as the sound fluctuates between values. However, in *XYZ* this only occurs for a pre-determined limited time period, after which some autonomous decision making process awards one player or the other full control of the particular parameter in question. Of course, in certain sections of the piece, performers are permitted to engage in as many or as few 'fights' as they wish.

In BiLE's performance of the piece, which lasts ca. 10 minutes, the length of the fight is 10 seconds as this seemed to be optimal for creating a variety of texture within the performance - this was arrived at through rehearsal and workshopping. The decision making process in BiLE's performance is made via a simple probability, executed by the computer, that the challenging player would win 75% of the time. It was suggested that the decision making process should have a less arbitrary method for deciding a winner, but I felt that the more that the players were focused on reaching some goal in order to win fights, the less able they would be to focus on the sound that their fight is producing. Another issue may have arisen that it is impossible to tell what would be a musically appropriate goal outside of the context of the particular performance of the piece. Therefore it seemed that, as the function of the

fight sections is to create interesting interactions between the performers- so as to create sonic diversity and contrasts in the piece and to highlight the fact that a new player is about to start controlling a sound, as well as to create and interesting theatrical situation for ensemble interaction- the most musically appropriate deciding factor of who 'wins' a fight is irrelevant. Therefore, the deciding factor is completely independent to all other elements of the piece, i.e. decided upon arbitrarily by the computer rather than any element of the performance. Also there is a psychological aspect at play where audience members will most likely form their own opinions as to why one player or another may have won or lost a fight, so in any case a deciding factor becomes irrelevant.

A performance of *XYZ* falls into three main sections with an ending strategy.

Section 1 – Introduction of the sounds and demonstration of the 'fighting' process. As it is described more fully in the score, the players enter one at a time and engage in isolated fights to control individual variables. This section gradually builds in complexity as more sounds enter and the interaction of controllers with sounds becomes more complex. This demonstrates clearly to the audience, through starting with simple interactions and obvious 'fights', the process of sonic production and the methods of interaction within the ensemble. It should be clear, at least at the beginning of the section, which controllers are affecting which sounds.

Section 2 – ‘Cease-fire’. After all of the sounds have been introduced, the piece should include a section where the players are not allowed to engage in any more 'fights'. Typically in BiLE’s performance this section lasts between one and two minutes. In it, players must act

within defined musical limits and develop something musically interesting, controlling only the variables that they ended up controlling at the end of section 1. This could be compared to a development section in classical sonata form, in that the ‘themes’ - in this case, sounds, interactions and controllers - introduced in the previous section are now explored in more detail without the introduction of new material. In relation to communicating with the audience, an extended period where the performers are not engaging in fights allows the audience to understand more fully via movement-to-sound relationships: the interactions between players, controllers and sounds being produced; and the fact that one performer may be controlling elements of two or more sounds.

Section 3 – The final section is a free improvisation, which serves the musical purpose of providing a contrast to the previous section and a build up to the end. In this section it should be difficult for audience members to keep track of the interactions between players.

Ending – the piece ends with all performers fighting to regain the x, y and z parameters on their own sounds, after which the performers can either opt to fade out together, or one by one. There may be some blur between the ending and section 3.

It is indicated in the score that a performance of *XYZ* should ideally include some visual representation of the interactions and process of winning and losing fights. The purpose of the visuals is to demonstrate more clearly the process to audience members and to clarify the interactions between performers as well as to enhance the theatrical elements of the piece. BiLE plans to develop visuals with a video-game aesthetic to show the connections between sounds and controllers, and to announce winners of fight.

The decision to use a video-game aesthetic for the visuals was made via a process of group workshopping and in discussion with BiLE's live visual artist Antonio Roberts. We felt that since the piece already had an aspect of 'winning' and 'losing', and since 'fighting' is clearly represented in the auditory and performative aspects, then it would be appropriate to also represent these elements of the music in the visuals. Also, as we were using controllers developed by the gaming industry - such as the Xbox Kinect and the wiimote - to perform the piece, referencing these links to video games in the visuals seemed appropriate, and gave an opportunity to further emphasise the theatrical elements of the piece by making parallels to classic games such as Street Fighter.

It should be noted that this particular visual aesthetic is not vital to the representation of the piece. Another ensemble may choose to represent the same elements of the music in a way more fitting to their ensemble's visual aesthetic and this is acceptable within the directions for realising the piece.

There are several points of discussion in relation to *XYZ* and BiLE's development as an ensemble. These are discussed below.

XYZ was written when BiLE was developing the use of gestural devices in performance and wanted to create pieces that specifically demanded this type of control. BiLE began to use a range of devices including wiimotes, iPhones running TouchOSC and c74 apps, and an Xbox Kinect in order to give the audience visual feedback and to demonstrate a strong connection between sound produced and the actions of the performers.

The use of a variety of controllers, with different calibrations, in the piece allowed for a musical structure and development to be created via the behaviour of the controllers in each of the axes. For example, the Xbox Kinect calibrated specifically for that performer's sound may react very differently in the z -axis to the iPhone calibrated by a different performer, so a performer using this controller can create a different sort of musical expressivity with the same sounds.

XYZ creates a situation of extended group improvisation whereby the performers are making changes to variables which are affecting the same sounds as those being affecting by other performers, and as they may be controlling up to three variables, a change in one dimension can make changes to up to three sounds Therefore the performers must have a greater sense of musical awareness in order to act within a complicated system of consequence.

Although the use of gestural controllers in laptop ensembles is not a new phenomenon (many laptop ensembles use wiimotes or iPhones to control their sounds), interdependency of variables controlled by motion-capture devices is not a common area of exploration. In a large number of laptop performances, controllers will be mapped to one sound over which no other player has control. In effect, this implies a simplified instrumental approach whereby a simple mapping of parameters to the x, y and z axes of the controller allows for only three possible physically changeable controls over the sound production. It is of course possible, and not uncommon practice, to change the character of the instrument over the course of the piece with software, but it was, in this instance, integral to the aesthetic of the piece, for each player and instrument to have a consistent character for the duration of the piece.

The complicated system of consequence in *XYZ* begins to move the laptop ensemble towards a more traditional instrumental realm of complexity of performance and improvisation, whereby every action to change one element of the sound has an effect on several other aspects of the sound. In this sense, *XYZ* could be described as a complex and infinitely variable collective multiplayer instrument, thus fulfilling BiLE's desires to create music that is consensus based, collaborative and uses new technology for new forms of expression and musical creativity.

Two ensembles have so far realised the piece: the original version by BiLE and a second by Benoit and the Mandelbrots. I have included a statement from Benoit and the Mandelbrots on their realisation of the piece in the Appendix. The recording submitted with this portfolio is the performance by Benoit and the Mandelbrots at ton:art 2011. I am also including a video with low quality audio and a further studio recording by BiLE in the Appendix for reference purposes. I acknowledge that the sound file submitted for assessment is corrupted with digital clicks but I chose this as the main submission as it also had video available, which I felt to be important in the representation of the piece.

Having the piece realised by two ensembles enabled me to consider the scoring of the piece and its impact on the character of the performance.

The original realisation by BiLE involved a large amount of development and rehearsal time. As BiLE is a collaborative ensemble, the piece evolved in certain ways due to the input of the other players and due to the fact that a great deal of time was spent rehearsing, discussing and

revising the piece. In total, BiLE spent around a month developing the piece, then a further two weeks making revisions before a second performance.

The performance by Benoit and the Mandelbrots was proposed by the ensemble after they saw the piece performed by BiLE at Laptops Meet Musicians Festival, Venice. I then sent them the score, after which they spent around 3-4 weeks developing the performance, with some clarifications via email. I then attended rehearsals with the ensemble two days prior to the performance and was able to give further clarifications, feedback and guidance.

I noticed that Benoit and the Mandelbrots opted to make more decisions about the structure before the performance than BiLE- i.e. they decided the order in which the fights in the opening sections would happen and made more decisions about moving from one section to another . I also felt that the sounds that Benoit and the Mandelbrots were using were orchestrated in such a way as to use a larger frequency spectrum than BiLE did, and in some cases their sounds had a greater contrast between 'fighting' and normal control of variables.

However, in general, it seemed that the two performances had a large number of similarities - although, this may have been the because Benoit and the Mandelbrots saw BiLE perform the piece before realising it themselves - but I would also hope this demonstrates that the piece has a strong concept, clearly communicated in the score.

It should be noted that throughout the 20th and 21st century many composers have experimented with various methods of writing pieces which do not specify the content of a work, but rather structural elements and/or a process for realising a work. Therefore, the

precedents for *XYZ* lie in a large body of work, written by a great number of composers. Some of the most notable composers who have written pieces in this manner who I will mention briefly below are John Cage, Karlheinz Stockhausen and Steve Reich. However, I would also like to acknowledge that a large number of composers belonging to the American Experimental movement - such as Morton Feldman, La Monte Young, Earle Brown, David Tudor, Alvin Lucier and others - have also written works which would fall into this category, and have greatly influenced my compositional practice.

John Cage in particular experimented extensively with omitting various elements of the music from his scores and wrote a large amount of literature on composition without content. One early example is John Cage's *William's Mix* (1953) which is a score for creating a tape piece where 6 groups of sounds sources and a pattern for cutting and splicing is defined, but the specific sounds used are not. Most famously John Cage wrote *4'33"*(1952) - three movements in which the instrumentalist do not play their instruments, but instead the music is created by the environmental sounds in the performance space. Perhaps more relevant to the discussion of *XYZ* though is *4'33" No. 2* or *0'00"* where Cage instructs the performer to perform some action with contact microphones attached to their body. This composition is more related to *XYZ* as the composer specifies some that process - decided upon by the performer - should constitute the content of the piece.

Another early example of pieces without specified content is Karlheinz Stockhausen's, *Aus den sieben Tagen* (1968), which variously specify processes, and situations and ways of thinking for group music making. For example, the first piece in the collection, *Richtige Dauern* instructs performers to:

Play a sound
Play it for so long
until you feel
that you should stop[3]

The text goes on to tell the performers to repeat the process and to specify a type of group interaction. The text does not describe the musical content or the structure of the piece, but, like *XYZ*, a type of interaction and a process by which to make music.

One final example of process based composition is Steve Reich's *Pendulum Music* (1973). In the score for this piece, Reich describes a technical setup and the process to perform the piece. The piece consists of microphones freely swinging above loud speakers and the feedback created is the sound material for the piece. *Pendulum Music* ends when the microphones come to a natural stasis and a static tone is being produced. Similarly *XYZ* describes a technological situation within which to make the music as well as a strategy for performing the piece.

All of the above pieces are representative of my ongoing research and have influenced my current compositional practice and most specifically, in relation to this portfolio, my composition *XYZ*.

I would like to acknowledge that the realisation by BiLE was made possible by the development of BiLEtools by Charles Celeste Hutchins and Chris Tarren.

[3] Stockhausen, Aus den Sieben Tagen, 1

Further resources relating to the piece can be found as follows:

Short article: http://cncptn.com/

Video of BiLE's performance of XYZ at NIME2011: http://vimeo.com/26619928

Conclusion

In conclusion I would like to refer briefly to the following quote from *Gesture and Morphology in Laptop Music Performance*:

> The computer does not act as a signifier for any one approach to communication, let alone musical performance. Its amorphous nature lends itself to a remarkably wide range of realtime music making possibilities… Such an approach forces reflection on the fact that if the instrument has changed so fundamentally, then so too can the performance practice[4]

As described in the above thesis, over the course of my Masters degree my compositional practice has taken a diversion from my original intentions to explore timbre and the use of live electronics. The pieces presented track my diversification of compositional interest and exploration of technology in performance practice and technologically-defined musical form as well as considering democratic ensemble interactions in composition.

Perhaps this thesis does not, however, demonstrate a complete change of path. It became important during my Masters degree to investigate how new trends in technology can be used in my work in a way that is integral to sound production, musical aesthetic, performance practice and finally to promote democratic forms of interaction. While this has allowed me to diversify my practice, I do not wish to completely abandon composition that explores timbre and highly specified sound production, so I hope I can find a way to combine this initial aim of my work with new ideas. As Paine states, the computer offers the opportunity to explore many forms of musical expression, therefore, I hope that technological advances can continue to offer new ways of considering music making and can guide my compositional practice.

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[4] Paine, 3

APPENDIX

Programme Notes

Chordophonia (2008)

Chordophonia was written after a request to contribute to a CD accompanying the Leonardo Music Journal. The piece is an extension of the traditional notion of the 'string quartet' and attempts to explore the diversity of timbre that can be produced by string instruments. The instrumentation consists of instruments that traditionally make their sound by striking, plucking and bowing strings. Each instrument uses a combination of idiomatic and extended playing techniques to draw out as many timbres as possible. The electronic part seeks to extend the timbral possbilities and to emphasise the quieter sounds that would traditionally be 'undesirable' and which, without amplification, would be lost in the ensemble.

Kyorei (2010)

Legend dictates that the shakuhachi music of Japan began when a monk tried to imitate the sound of a bell or gong with a wooden flute. The original shakuhachi piece was called *Kyorei*. The Japanese word Rei, has a double meaning of both bell and spirit. *Kyorei* is thought to lead the spirit to a state of emptiness in which it is possible to reach enlightenment.

The flute material in my piece is derived from a spectral analysis of a tam-tam and attempts to explore the timbral possibilities of this instrumental combination. The form follows the typical form of shakuhachi music, beginning in the low/middle register, moving to the high register in the middle section and returning to the low register at the end.

Kyorei was composed and first performed in 2008 but has since been significantly revised, including the addition of the electronic part.

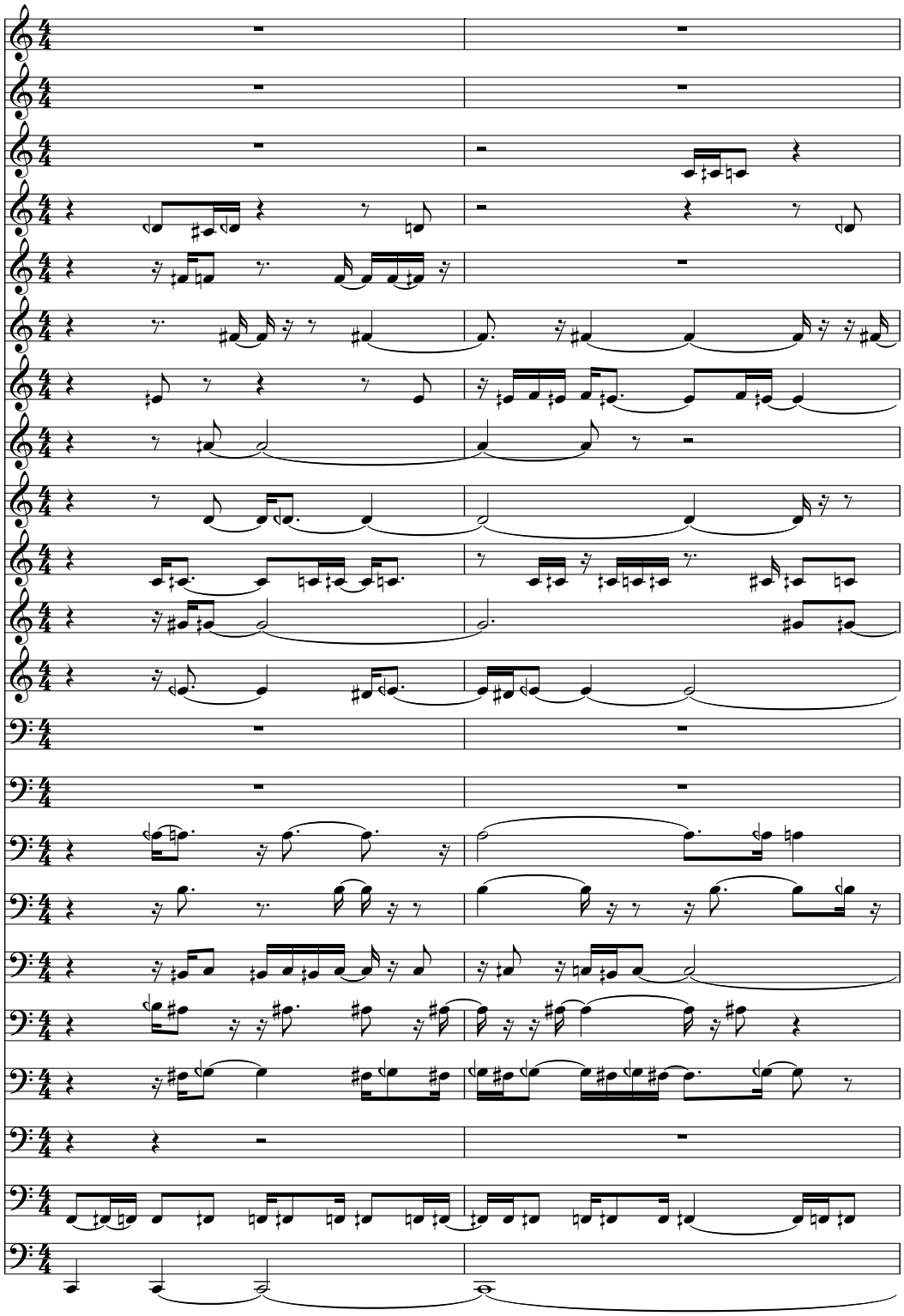
For Piano (2010)

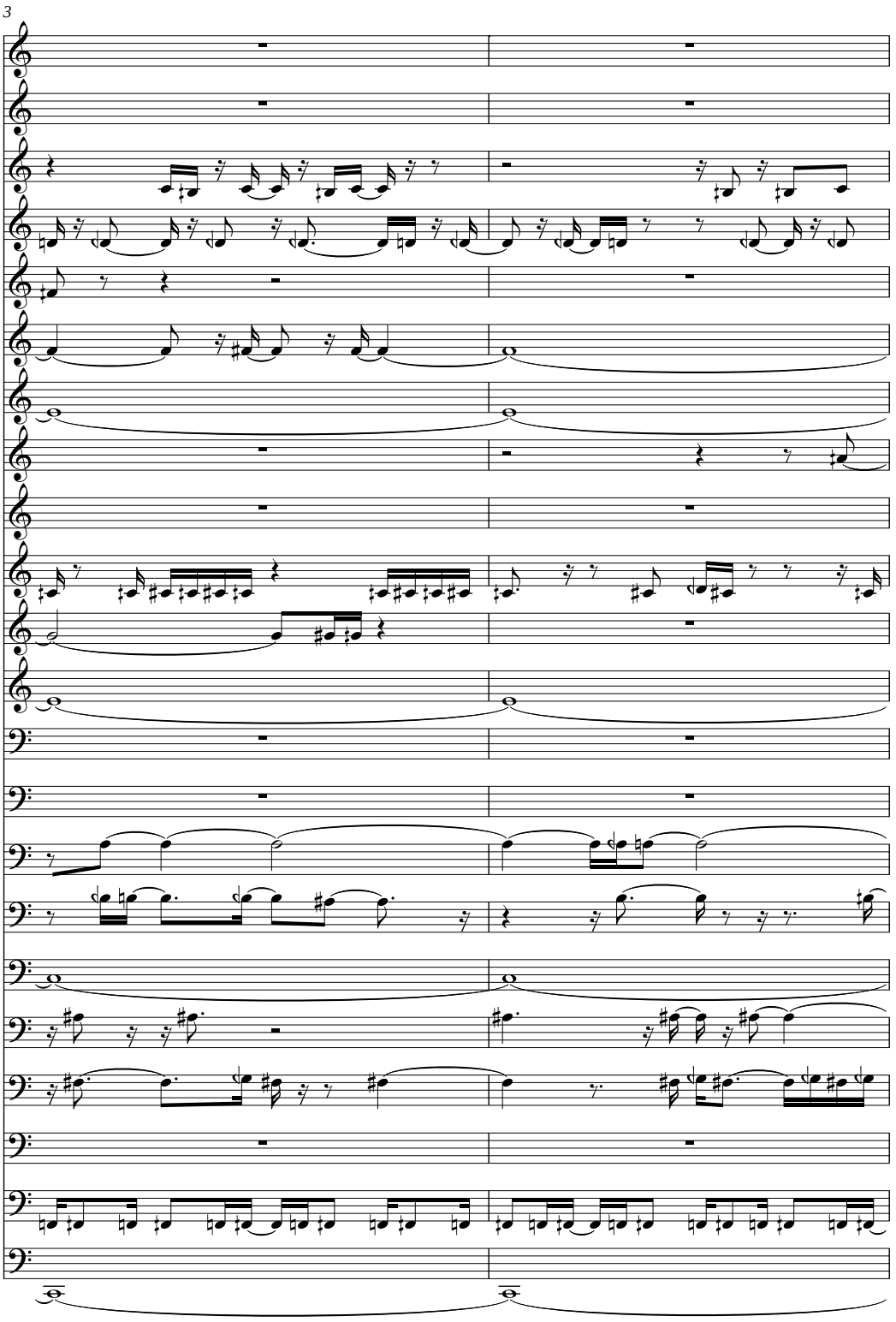
A grotesque collision of Bösendorfer pianos.

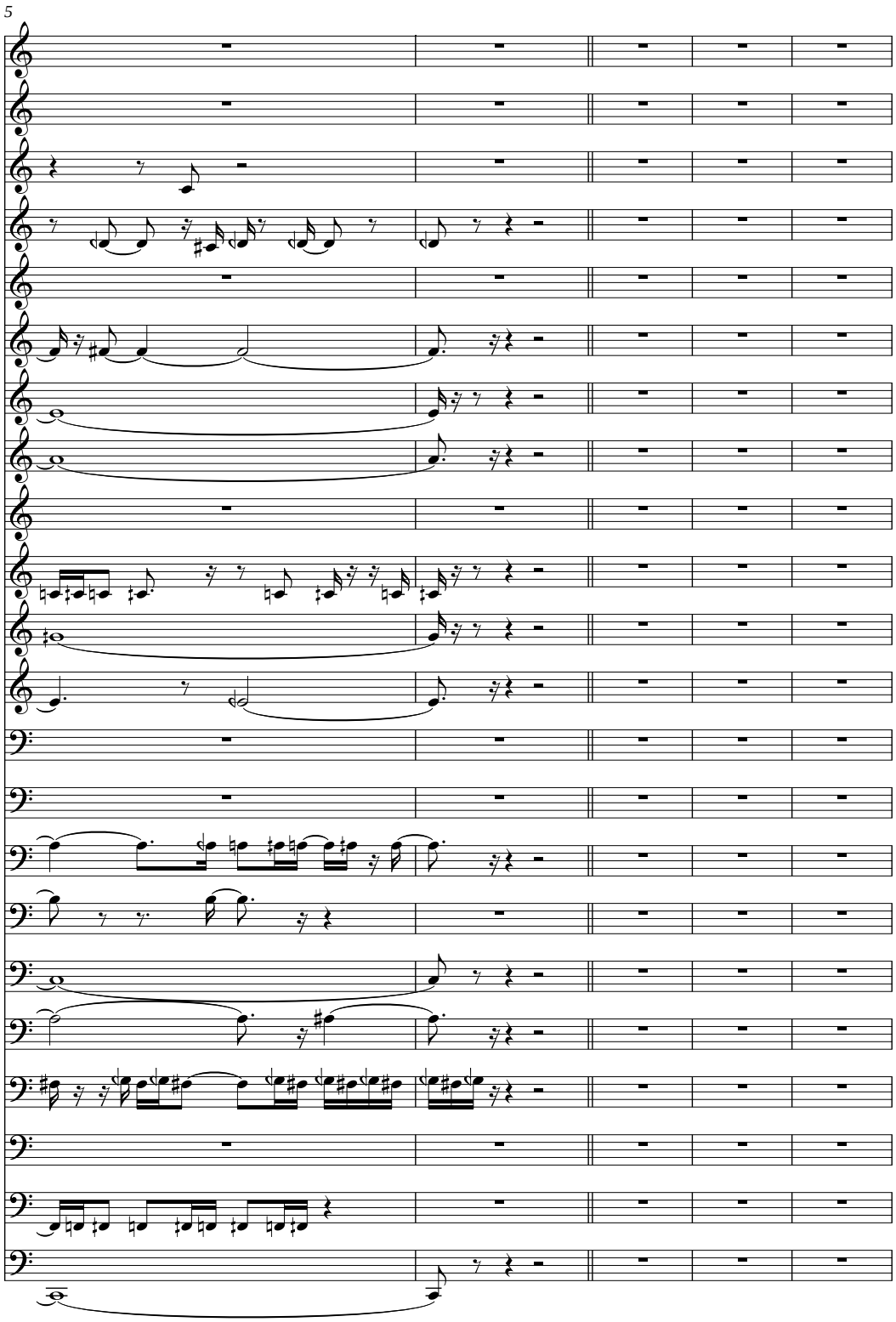
XYZ (2011)

XYZ (or sonic arm wrestle) explores the possibilities offered by using gestural controllers within a networked laptop ensemble. The piece requires each performer to create a sound with 3 controllable parameters, X, Y and Z, and to map these parameters to a motion capture device e.g. iPhone or wiimote. During the course of the piece the performers freely choose to control either their own sound or the sounds of other members of the ensemble. If a player decides to control an X, Y or Z parameter of another performer's sound they must 'win' the right do so, by way of a sonic 'fight' (a period of time where both performers are controlling the same sound, thereby creating glitches as the parameter value fluctuates between two sets of controller values). Each player maintains control of the amplitude of their own sound for the duration of the piece.

Transcription of a Spectral Analysis of a Tam Tam




3


5

Berck Plage – Sylvia Plath

(1)

This is the sea, then, this great abeyance.
How the sun's poultice draws on my inflammation.

Electrifyingly-colored sherbets, scooped from the freeze
By pale girls, travel the air in scorched hands.

Why is it so quiet, what are they hiding?
I have two legs, and I move smilingly..

A sandy damper kills the vibrations;
It stretches for miles, the shrunk voices

Waving and crutchless, half their old size.
The lines of the eye, scalded by these bald surfaces,

Boomerang like anchored elastics, hurting the owner.
Is it any wonder he puts on dark glasses?

Is it any wonder he affects a black cassock?
Here he comes now, among the mackerel gatherers

Who wall up their backs against him.
They are handling the black and green lozenges like the parts of a body.

The sea, that crystallized these,
Creeps away, many-snaked, with a long hiss of distress.

(2)

This black boot has no mercy for anybody.
Why should it, it is the hearse of a dad foot,

The high, dead, toeless foot of this priest
Who plumbs the well of his book,

The bent print bulging before him like scenery.
Obscene bikinis hid in the dunes,

Breasts and hips a confectioner's sugar
Of little crystals, titillating the light,

While a green pool opens its eye,
Sick with what it has swallowed----

Limbs, images, shrieks. Behind the concrete bunkers
Two lovers unstick themselves.

O white sea-crockery,
What cupped sighs, what salt in the throat....

And the onlooker, trembling,
Drawn like a long material

Through a still virulence,
And a weed, hairy as privates.

(3)

On the balconies of the hotel, things are glittering.
Things, things----

Tubular steel wheelchairs, aluminum crutches.
Such salt-sweetness. Why should I walk

Beyond the breakwater, spotty with barnacles?
I am not a nurse, white and attendant,

I am not a smile.
These children are after something, with hooks and cries,

And my heart too small to bandage their terrible faults.
This is the side of a man: his red ribs,

The nerves bursting like trees, and this is the surgeon:
One mirrory eye----

A facet of knowledge.
On a striped mattress in one room

An old man is vanishing.
There is no help in his weeping wife.

Where are the eye-stones, yellow and valuable,
And the tongue, sapphire of ash.

(4)

A wedding-cake face in a paper frill.
How superior he is now.

It is like possessing a saint.
The nurses in their wing-caps are no longer so beautiful;

They are browning, like touched gardenias.
The bed is rolled from the wall.

This is what it is to be complete. It is horrible.
Is he wearing pajamas or an evening suit

Under the glued sheet from which his powdery beak
Rises so whitely unbuffeted?

They propped his jaw with a book until it stiffened
And folded his hands, that were shaking: goodbye, goodbye.

Now the washed sheets fly in the sun,
The pillow cases are sweetening.

It is a blessing, it is a blessing:
The long coffin of soap-colored oak,

The curious bearers and the raw date
Engraving itself in silver with marvelous calm.

(5)

The gray sky lowers, the hills like a green sea
Run fold upon fold far off, concealing their hollows,

The hollows in which rock the thoughts of the wife----
Blunt, practical boats

Full of dresses and hats and china and married daughters.
In the parlor of the stone house

One curtain is flickering from the open window,
Flickering and pouring, a pitiful candle.

This is the tongue of the dead man: remember, remember.
How far he is now, his actions

Around him like living room furniture, like a décor.
As the pallors gather----

The pallors of hands and neighborly faces,
The elate pallors of flying iris.

They are flying off into nothing: remember us.
The empty benches of memory look over stones,

Marble facades with blue veins, and jelly-glassfuls of daffodils.
It is so beautiful up here: it is a stopping place.

(6)

The natural fatness of these lime leaves!----
Pollarded green balls, the trees march to church.

The voice of the priest, in thin air,
Meets the corpse at the gate,

Addressing it, while the hills roll the notes of the dead bell;
A glittler of wheat and crude earth.

What is the name of that color?----
Old blood of caked walls the sun heals,

Old blood of limb stumps, burnt hearts.
The widow with her black pocketbook and three daughters,

Necessary among the flowers,
Enfolds her lace like fine linen,

Not to be spread again.
While a sky, wormy with put-by smiles,

Passes cloud after cloud.
And the bride flowers expend a freshness,

And the soul is a bride
In a still place, and the groom is red and forgetful, he is featureless.

(7)

Behind the glass of this car
The world purrs, shut-off and gentle.

And I am dark-suited and still, a member of the party,
Gliding up in low gear behind the cart.

And the priest is a vessel,
A tarred fabric, sorry and dull,

Following the coffin on its flowery cart like a beautiful woman,
A crest of breasts, eyelids and lips

Storming the hilltop.
Then, from the barred yard, the children

Smell the melt of shoe-blacking,
Their faces turning, wordless and slow,

Their eyes opening
On a wonderful thing----

Six round black hats in the grass and a lozenge of wood,
And a naked mouth, red and awkward.

For a minute the sky pours into the hole like plasma.
There is no hope, it is given up.

Source: http://www.sylviaplath.de/plath/berckplage.html

Manifesto on the forming of a Laptop Ensemble:

Democratic approach: *BiLE* rejects the notion of an autocratic ensemble with a top-down approach in which the roles of composer/programmer, leader, performer are discrete and hierarchical. *BiLE* instead supports the approach of integration, collaboration and the blurring of the distinctions betweencomposer-performer-collaborator in a democratic, non-authoritarian ensemble.

Collaboration: *BiLE* supports the production of scores and collaborative compositions where the framework is such that each composer-performer is free to interpret the sound production elements of the piece, thereby allowing each member to contribute his or her ideas and imagination to every performance.

Musicality: *BiLE* asserts that musicality should be at the forefront of the priorities of any music-making ensemble. Therefore technological concerns are subservient to musical intentions and musicality is central to the criteria set out to define the ensemble.

Inclusivity: *BiLE* is an inclusive ensemble with criteria for membership based on similar musical aesthetics and a high quality, complementary musical output rather than specific technical skills. This makes *BiLE* a creatively rather than technically focussed ensemble. *BiLE* members should be experienced in composition and/or performance and dedicated to ensuring all creative output is of high quality.

Cross-Platform: *BiLE*'s commitment to inclusiveness necessitates the ensemble to be cross-platform. Any ensemble member is free to use the software they are most comfortable with and that they feel is most suited to the performance of a particular piece. *BiLE* have developed their own networking tools in order to facilitate this cross-platform approach.

Open Support Forum: *BiLE* members should support each other in the creation of quality musical performances and the production of new works through sharing technical and musical guidance with other members of the ensemble. The rehearsals should be an open forum for ideas and discussion on music, technology, performance, improvisation and other matters relating to the ensemble.

Communication: *BiLE* is committed to sharing its creative output with its audiences in as inclusive a way as possible. *BiLE* feels that visual aspects are an important communication tool in any performance. As such *BiLE* includes visuals and movement as appropriate to the aesthetics of the piece being performed. *BiLE* shall also engage the audience in talks and demos before or during performances to facilitate understanding of *BiLE*'s creative process and performance aesthetic.

Progressive Experimentalism: *BiLE* should be a progressive ensemble prioritising experimentalism over historicism. *BiLE* should consider and utilise the possibilities available by virtue of being a networked laptop ensemble rather than rely on old musical forms and structures to develop their creative output. Exploring the new forms and new possibilities for creativity that can be developed by the use of this technology is desirable, so long as an emphasis on musicality is maintained.

Author: Shelly Knotts

A Statement by Benoit and the Mandelbrots on Realising *XYZ*

The implementation by *Benoit and the Mandelbrots* of *XYZ* consists of a SuperCollider class to manage the fighting and routing, a GUI to display this status and a clickable matrix for easy routing of any of the three variables to all other variables available on the network.

The class works only on a win/lose system, which supports “resign” and “steal”, being defined as instant loss or instant win respectively. The fight times are 10 seconds and the probability of winning is 70%, but this might be changed easily.

The players are defined with name and IP address, so that one can use the GUI to route the players variables. Three control buses are provided for the synthesis processes and another address to send data and notifications for visualisation purposes.

Sounds

Each player developed their own sound using SuperCollider. The sounds could be described as follows:

- a bassy, muffled sound, using two slightly shifted sine oscillators with strong signal processing, like folding, nonlinear distortion and feedback.
- a granulated speech sample using the axis as rate, sample position and grain size
- a glitchy/grainy sound using low frequency noise combined with different resonating filters and a ring modulator.
- Three different sounds. Uses one of the variables to navigate through these, and the other variables for the parameters of each sound. Provided a single controller with 3 variables with a wide range of sound characteristics.

4 different controllers were used: An iPhone, an iPod Touch (both using TouchOSC software), a WiiMote and a custom built dataglove (Matthias Schneiderbanger’s Chirotron). An interesting observation was that the different controllers varied greatly in precision and response. Controlling a sound with another controller sometimes was enough to change its characteristics.

Visuals

The visuals were realized using the Lua programming language with the unreleased NeoJuice Framework. The SuperCollider system of each performer sent all values for the X, Y and Z axes as well as all notifications about fighting, losing and winning via OSC. The current patching of all values was derived from this information.

Each player is visually represented by a blue blob, wobbling according to the players control data. If a player sends its control data to another player`s sound the connection is represented by a blue line of circles. The circles illustrate the signal flow as well as the signal

by changing their size according to the values. A connection engaged in a fight is presented in red to highlight the fighting situation.

A player controlling his own sound wasn’t visualised in any way. The piece started with four blobs with no connections and ended the same way. In the middle of the piece there were many connections and simultaneous fights (easily recognised by the red colouring).

Bibliography

BLACKWELL, ALAN and COLLINS, NICK, 'The Programming Language as a Musical Instrument' *Proceedings of the 17th Workshop of the Psychology of Programming Interest Group. Sussex University*, (2005), 120-130.

BOOTH, GRAHAM and GUREVICH, MICHAEL, 'Collaborative composition and socially constituted instruments: Ensemble laptop performance through the lens of ethnography', (2012). [MANUSCRIPT] Held by G. Booth, Berlin, Germany.

BRITZOLAKIS, CHRISTINA, *Sylvia Plath and the Theatre of Mourning*, (Oxford: Oxford University Press, 1999).

BURNAND, DAVID and REES, CARLA, *Composing For Quarter Tone Alto Flute*, 2003, revised 2009 [Multimedia CD-ROM] London: Royal College of Music.

CASCONE, KIM, 'The aesthetics of failure: post-digital tendencies in contemporary computer music', *Computer Music Journal*, Vol. 24, No. 4 (2002), 12-18.

CHADABE, JOEL, 'The Performer is Us', *Contemporary Music Review*, vol. 18, part 3, (1999), 25-30.

DICK, ROBERT, *The Other Flute: a performance manual of contemporary techniques*, (London: Oxford University Press, 2005).

EMMERSON, SIMON, ''Losing Touch?' the Human Performer and Electronics', in Simon Emmerson (ed.) *Music, Electronic Media and Culture*, (Aldershot, Hampshire: Ashgate, 2000).

BROWN, CHRIS, "Indigenous to the Net ~ Early Network Music Band in the San Francisco Bay Area." *Crossfade*, http://crossfade.walkerart.org/brownbischoff/index.html, accessed 12 September 2011.

LEWIS, GEORGE E., 'Interacting with Latter-Day Musical Automata', *Contemporary Music Review*, vol. 18, part 3, (1999), 99-112.

LIPOVETSKY, GILLES, *Hypermodern Times*, (Cambridge: Polity Press, 2005).

MALM, WILLIAM P., *Music Cultures of the Pacific, the Near East and Asia*, (Englewood Cliffs, NJ: Prentice-Hall, 1996)

OSTERTAG, BOB, 'Why Computer Music Sucks', *Resonance 5*, No. 1 (1996), 6.

OLIVEROS, PAULINE, *Software for People*, (NY : Station Hill Press, 1984).

PAINE, GARTH, ‘Gesture and Morphology in Laptop Music Performance’ in R. T. Dean (Ed.), *The Oxford Handbook of Computer Music and Digital Sound Culture, (*NY: Oxford University Press, 2009).

PLATH, SYLVIA, *Berck Plage*, http://www.sylviaplath.de/plath/berckplage.html, accessed 24 September 2011.

SCHLOSS, W. ANDREW, ‘Using Contemporary Technology in Live Performance: The Dilemma of the Performer’, *Journal of New Music Research*, Vol. 31, No. 1, (2002).

SMALLEY, DENIS, ‘Spectomorphology: Explaining Sound Shaped’, *Organised Sound*, Vol. 2, Issue 2, (1997).

STOCKHAUSEN, KARLHEINZ, *Aus den Sieben Tagen*, (Wien: Universal, 1970).

WAISVISZ, MICHEL, ‘Riding the Sphinx – Lines about Live’, *Contemporary Music Review*, vol. 18, part 3, (1999), 25-30.

ZICARELLI, DAVID, Keynote Speech given at the 2001 International Computer Music Conference, Havana, Cuba, 15 September 2001.