PORTFOLIO OF ORIGINAL COMPOSITIONS

A thesis submitted to the University of Manchester for the degree of
Doctor of Philosophy
in the Faculty of Humanities

2009

DIANA J. SALAZAR

SCHOOL OF ARTS, HISTORIES AND CULTURES

Contents

Written Commentary

Portfolio of Musical Works

Audio CD 1

1.	*Anima Machina* (2006)	12'58
2.	*Cipher* (2007)	11'42
3.	*Topographia* (2008)	9'31
4.	*Papyrus* (2008)	8'23
5.	*Pavakoothu* [recording] (2007)	10'57

Audio CD 2

1.	*Spindlesong* (2008)	15'57
2.	*Bosonica* [stereo mix] (2009)	24'41
3.	*The Spindlesongs Installation* (2008)	25'52

Data DVD 1: Stereo works

(All audio files in aiff format, 24bit 44.1kHz)

1.	*Anima Machina* (2006)	12'58	
2.	*Cipher* (2007)	11'42	
3.	*Papyrus* (2008)	8'23	
4.	*Topographia* (2008)	9'31	
5.	*Pavakoothu* [recording] (2007)	10'57	(Clarinet: Anna Hashimoto)
6.	*Pavakoothu* [tape part] (2007)	10'57	

Data DVD 2: Multi-channel Works

1.	*Spindlesong* [8-channel] (2008)	15'57	8 mono aif files, 24bit, 96kHz
2.	*Spindlesong* [stereo mix] (2008)	15'57	stereo aiff file, 24bit 96kHz
3.	*Bosonica* [5.1] (2009)	24'41	6 mono aif files, 24bit 44.1kHz
4.	*Bosonica* [stereo mix] (2009)	24'41	stereo aiff file, 24bit 44.1kHz

Data DVD 3: Installation

1.	*The Spindlesongs Installation* [8-channel]	25'52	8 mono aif files, 24bit 48kHz
2.	*The Spindlesongs Installation* [stereo mix]	25'52	stereo aiff file 24bit, 48kHz

Data CD: Max/MSP patch for *Pavakoothu*

Score: *Pavakoothu* for clarinet, fixed media and electronics

[Final Word Count: 15,911]

List of Diagrams, Tables and Figures

Abstract

This PhD confronts and analyses the relationship between internal (compositional) spatial thinking and aspects of external (performance) space, with the intention of revealing new musical possibilities.

Eight original electroacoustic compositions are presented in the portfolio. These are *Anima Machina*, *Bosonica*, *Cipher*, *Papyrus*, *Pavakoothu*, *Spindlesong*, *Topographia* and *The Spindlesongs Installation*. The works exhibit a variety of spatial characteristics, not only through the spatial implications of the sound material used, but also in their presentation formats. The portfolio comprises four stereo works, one 5.1 work, two 8-channel works and a work for solo instrument (clarinet) and electronics. All but one of the compositions are acousmatic, and the mixed work is greatly informed by the acousmatic tradition.

The main concern spanning the portfolio is the creation of spatial aspects on a number of levels, from source material through processing, layering and spatialisation to dissemination in performance. The commentary presents supplementary information on each work, with a view to providing the reader with an insight into the evolution of my compositional vocabulary. Those aspects considered spatially most significant are highlighted, with reference to the current musicological terminology of space-form (Smalley 2007) and other contextual writings in the field. The research findings are assembled according to the nature of spatial presentation: stereo, multichannel, installation, and instrumental performance.

Technical Information (Surround Works)

The works are supplied in their original, high-resolution formats, on 3 data DVDs. To aid the listening of materials, two audio CDs are also supplied, with all works presented in stereo aiff format at 16bit 44.1kHz resolution.   There is one score included, for *Pavakoothu,* which also includes technical notes on the performance of this work. The Max/MSP patch for this work is also provided on a Data CD.

On DATA DVD 2 there are six discrete files for the original, 5.1 version of *Bosonica*. These are labelled as follows:

Bosonica_L.aif

Bosonica_C.aif

Bosonica_R.aif

Bosonica_LS.aif

Bosonica_RS.aif

Bosonica_LFE.aif

and correspond to the following loudspeaker arrangement, a common 5.1 formation:
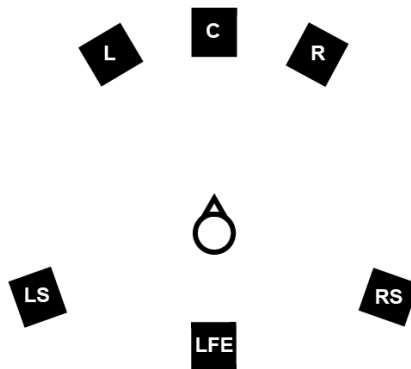
Diagram 1: Loudspeaker plan for playback of *Bosonica*

The above diagram shows the relative loudspeaker positions for the files which are labelled as Left, Right, Centre, Left Surround, Right Surround and LFE. The relative positioning shown for the LFE loudspeaker is not obligatory.

(A stereo mix is included on DVD 2 and Audio CD 2, for reference purposes.)

The *Spindlesong* folder on DVD 2 contains eight mono aif files, labelled as follows:

Spindlesong1.aif

Spindlesong2.aif

Spindlesong3.aif

Spindlesong4.aif

Spindlesong5.aif

Spindlesong6.aif

Spindlesong7.aif

Spindlesong8.aif

During playback, these correspond to the following loudspeaker arrangement:
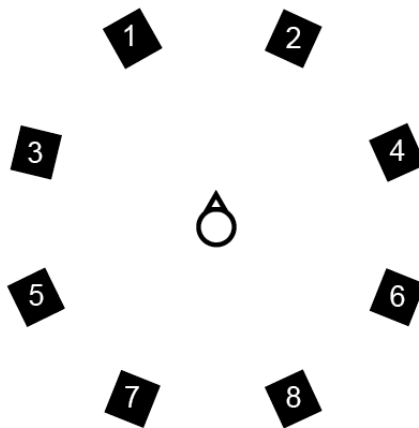
Diagram 2: Loudspeaker plan for playback of eight-channel works

The files for *The Spindlesongs Installation* (installation1.aif, installation2.aif etc.), located on DVD 3, are arranged with the relative positioning as shown in Diagram 2, but with no prescribed orientation for the audience.

Declaration

I hereby declare that no portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or any other institute of learning.

COPYRIGHT STATEMENT

i. The author of this thesis (including any appendices and/or schedules to this thesis) owns any copyright in it (the "Copyright") and she has given The University of Manchester the right to use such Copyright for any administrative, promotional, educational and/or teaching purposes.

ii. Copies of this thesis, either in full or in extracts, may be made **only** in accordance with the regulations of the John Rylands University Library of Manchester. Details of these regulations may be obtained from the Librarian. This page must form part of any such copies made.

iii. The ownership of any patents, designs, trade marks and any and all other intellectual property rights except for the Copyright (the "Intellectual Property Rights") and any reproductions of copyright works, for example graphs and tables ("Reproductions"), which may be described in this thesis, may not be owned by the author and may be owned by third parties. Such Intellectual Property Rights and Reproductions cannot and must not be made available for use without the prior written permission of the owner(s) of the relevant Intellectual Property Rights and/or Reproductions.

iv. Further information on the conditions under which disclosure, publication and exploitation of this thesis, the Copyright and any Intellectual Property Rights and/or Reproductions described in it may take place is available from the Head of School of Arts, Histories and Cultures (or the Vice-President).

Acknowledgements

An Introduction to Space in Electroacoustic Music

> 'The immaterial nature of audio reproduction enables auditory spatial art to exploit the spatial schemata of everyday life'[1]

Sound carries the potential to communicate a wide range of spatial information, from implied shapes, motions and trajectories, to complex environments.[2] This presents a rich resource for the composer who works with recorded sound as their medium, and consequently space has been widely acknowledged as a key parameter in electroacoustic music. As testimony of this, in 2007 Denis Smalley[3] proposed a musical analysis methodology called 'space-form'[4], based exclusively on considerations of space. Smalley proposed that space is *the* crucial parameter in acousmatic music:

> '...space should now move to centre stage to become the focal point of analysis of, or commentary on, acousmatic music'[5]

Strategies for the description of space and its functionality in electroacoustic music had already been proposed by Natasha Barrett[6], Frank Ekeberg Henriksen[7] and Jonty Harrison[8] to name but a few. However, Smalley's article builds on such writings by considering and categorising all manner of spatial angles, and crucially includes those which are shaped through perception. The comprehensive spatial taxonomy presented in the article is a valuable resource for any electroacoustic composer or listener, and several terms from the space-form framework have been applied within this thesis. Smalley's taxonomy in itself, however, does not present specific strategies for the implementation of space-form on a practical level, more specifically, through composition. It is hoped that the application of space-form terminology within this commentary will offer examples of the construction of space-form in practice.

---

[1] Kendall & Ardila (2007), pp.131.
[2] Visual and physical analogies often aid the interpretation of spatial elements, frequently through our multi-modal understanding of the real world. Such synaesthesia can be essential in interpreting the dimensions and motions of spectromorphologies. (Smalley, in Austin (2000) pp.19, Barrett (2002), pp.316, Clarke (2005), pp.62.) and current scientific research reinforces this proposition ('Synaesthetic crossmodal correspondences ...appear to play a crucial (if unacknowledged) role in the multisensory integration of auditory and visual information', Parise and Spence (2009), pp.1.)
[3] Smalley, Denis, (2007) 'Space-form and the acousmatic image', *Organised Sound*, **12**(1) Cambridge: Cambridge University Press, pp.35-58.
[4] 'Space-form in acousmatic music is an aesthetically created 'environment' which structures transmodal perceptual contingencies through source-bondings and spectromorphological relations. Further, it integrates attributes particular to musical culture and tradition (like pitch and rhythm, for example).' Smalley (2007), pp.40. Previously Smalley had used the term 'spatio-morphology', for a similar concept, Smalley (1986), pp.91.
[5] Smalley (2007), pp.54.
[6] See 'Approaches to 'Space' in Music' in Barrett (2002), pp.313-320.
[7] See Fig. 6.1 'Overview of space in electroacoustic music' in Henriksen (2002) pp.124.
[8] See 'Fundamentals of Space' in Harrison (1999).

The unique potential of electroacoustic music to explore space[9] at an intrinsic level has in turn raised many issues concerning the appropriate performance practices for this music. Throughout the course of its evolution, the art-form has invited research into new modes of performance, where space has inevitably been a critical consideration. Research into aesthetic implications and technical developments of the spatialisation of electroacoustic music in performance includes Jonty Harrison's work with BEAST[10], Adrian Moore, David Moore and James Mooney's development of the M2 diffusion system[11], and countless other strategies and technologies. Much of my own interest in this field stems from extensive practical experience with the University of Manchester's own sound diffusion system, MANTIS.[12] While there has been a substantial level of documentation of such diffusion systems, there remains little contemporary research of how dissemination strategies might interact with and inform decisions at the initial, compositional level[13].

---

[9] Smalley, in Austin (2000), pp.20.
[10] BEAST, Birmingham ElectroAcoustic Sound Theatre, described in Harrison (1998), pp.121-127.
[11] Moore, Moore & Mooney (2004).
[12] The MANTIS (Manchester Theatre in Sound) diffusion system consists of a custom-built ethernet console and Max/MSP software for playback on up to 48 loudspeakers, designed by Dr. David Berezan and based at the University of Manchester, UK.
[13] This view is supported by Landy (2007), pp.220.

I Compositional Strategies in the Creation of Spatial Music

1.1 A Brief Introduction to Stereo Sound Diffusion

'this final act becomes the most crucial of all'[14]

Sound diffusion is one approach to the presentation of electroacoustic music in public listening situations. The practice, which involves live manipulation of the amplitudes of multiple instances of a stereo image over a number of loudspeakers, has been adopted by many as a preferred mode of performance for stereo acousmatic music. Examples of established sound diffusion systems include Birmingham ElectroAcoustic Sound Theatre, the Acousmonium of the GRM[15], and the *Cybernéphone* (formerly the Gmebaphone) at IMEB[16].

Through sound diffusion the audience may be immersed inside sounds. There is the potential to exaggerate and articulate implied spaces within the music, and true physical implications of position, depth and motion can be created. Crucially, the music, the 'fixed medium', acts as a template for reinterpretation in the performance environment and hence 'diffusion is an extension of the compositional approach'.[17] The 'diffuser' relies on the composed space within the piece to effectively shape the sound in the performance space.

> 'it is our listening experience of the physical, sounding world which is key to our understanding of both the illusory objects and virtual space of electroacoustic music, and if the musical appears 'unphysical' it is often the fault of poor performance'[18]

As such, the act of diffusion plays a crucial role in producing a *physical* experience of the work. However, the intrinsic qualities of a work, from the level of the individual sound-object to complex arrangements of these sounds, will inevitably contribute towards this 'physical' experience, and it is at this compositional level that space-form initially emerges.

---

[14] Smalley (1986), pp.92.
[15] *Groupe de Recherche Musicales*
[16] *Institut International de Musique Electroacoustique de Bourges.* See Clozier (2001).
[17] Harrison (1998), pp.125.
[18] MacDonald (1998), pp.21.

1.2 Proximal and Distal Transitions in *Anima Machina* (Composed 2006, Duration: 12'58)

Introduction

Anima Machina was the first work composed for the portfolio. Following from my compositions at Diploma and Masters levels[19], I was keen to explore new methods of structuring and timbral development in my works.

I am fascinated by the convincing communication of power and weight in Gilles Gobeil's compositions, and they have consequently been very inspirational for my own practice. *Le vertige inconnu* and *Point de passage* in particular informed aspects of timbral development and structuring processes within *Anima Machina*. In these works Gobeil utilises sound with rich physical implications, exploiting their mechanical origins and frequently drawing on interruption as a structuring device. I wanted to explore similar techniques in order to create a greater sense of *physicality* and *depth* in my compositions. In addition, having discovered an enthusiasm for sound diffusion as a performance tool, I wanted to create a work directly influenced and informed by this practice, in effect producing a work specifically designed for diffused performance.

Material

The title refers to the concept of 'living machines' – complex machines with decision-making and self-replicating abilities. This extra-musical idea created potential for allusion to a variety of scales and perspectives of mechanical structures. While the source material included recordings of clocks, metal tools, a bicycle chain and a 'slinky' spring, these materials were subject to varying degrees of processing which, for the most part, create an abstract framework in which recognisably 'mechanical' sounds exist. The persistent references to mechanical objects in the work, combined with a high degree of abstraction in the sonic landscape, presents a mechanised space with no audible signifiers of human intervention (i.e. agential space[20]). The work particularly focuses on the unpredictability inherent in nano-technology[21] – machines on a microscopic scale. As a result the music is underpinned by a sense of organic mutation punctuated by unexpected and sometimes seemingly unprovoked and dramatic changes.

---

[19] In particular *Broken Nerve* (2005) and *Kalimba* (2006), both stereo acousmatic works.
[20] Agential space: 'A space articulated by human (inter)action with objects, surfaces, substances, and built structures, etc.' Smalley (2007), pp.57.
[21] The ability to self-replicate also presents the potential for mutation, and expansion beyond human control, a scenario described in Drexler (1986), pp. 171 – 190.

Although at the initial stage of composition the use of mechanical material was key to the piece, the focus shifted from the extrinsic (or extra-musical) links of this material to the internal behaviour and spectral characteristics of particular sound-events, and their function within the overall spatial structure. This shift was directly influenced by an intention to create a dynamic and spatially rich sound environment with a sense of physical impact and possibly (as a result of this physicality) an element of drama. The gestures which punctuate changes in perspectival space[22] (i.e. 1'32, 1'42, 1'58) are intentionally 'punchy' due to their spectral content, as well as their real-world associations. Comparatively weaker gestures could not convincingly function to cause such significant structural changes in the music.

Software-based transformation techniques were employed as a means of artificially expanding or exaggerating the implied presence and behaviour of the original sound material. In many instances, I applied low shelf equalisation techniques in order to strengthen the low spectrum, giving the material a 'grounded' quality and implied 'weight'. A further example of processing was the use of reverberation to create implications of distance within the sonic landscape[23]. This acts to emphasise dramatic recession of the landscape, for example at 10'13, preceded by similar material, but in a far more proximate[24] zone. What acts as a catalyst for the change between these contrasting spaces, is a single, but ultimately significant, clock-tick. The change-point, however, is also prepared in background *landscape* material, which expands[25] and approaches the listener, creating an underlying sense of direction, and preparing, reinforcing and justifying the sudden shift in prospective distribution. The described techniques were utilised extensively within the work, to a degree where the structure is underpinned by how and when such points of spatial transitions occur, and by the contrasting spaces through which the listener journeys.

It is acknowledged that the distance classification of sound-events (e.g. 'distant' or in 'close proximity') by the listener is along a continuum defined by a multitude of perceptual cues, including spectral variations, sound amplitude, and reflections, including the ratio of direct to reverberant sound[26]. Such cues in the sound material were

---

[22] 'the relations of position, movement and scale among spectromorphologies, viewed from the listener's vantage point', Smalley (2007), pp.48.

[23] However Denis Smalley, Natasha Barrett and Jonty Harrison all avoid such uses of reverberation in order to reduce the risk of conflicting reverberation information when the work is juxtaposed in performance with the acoustics of the venue. (Smalley in Austin (2000), pp.16 and Barrett (2002), pp. 321 – 322.) In later works I adopt reverberation to smear spectral characteristics of background material, creating a more subtle sense of distance without imposing a specific 'acoustic space'.

[24] Proximate space: 'the area of perspectival space closest to the listener's vantage point in a particular listening context', Smalley (2007), pp.58. In this chapter I apply the terms distal and proximate with regard to the composed space, although distal and proximate zones can also be found in listening (performance) spaces.

[25] In amplitude and spectral occupancy.

[26] Moore (2003), pp.265-267.

electronically manipulated in order to create material with a certain 'distance' characteristic. In addition, layering such materials resulted in the presentation of increasingly complex environments and perspectival variety to the listener.

Sound-Events

There are certain sound-events which perform unmistakable roles in the spatial transitions within the work. These sound-events (in some rare cases a conglomeration of many short sounds, but inaudibly so) are either:

Catalytic sound objects which trigger the onset of new material, generally with the perceived effect of propelling the music forward with a sense of increased motion

or

Termination sound objects which halt the flow and intensity of previous material, if only temporarily. On occasion these also carry a dual function, introducing new material that exhibits characteristics of slower pacing, sparseness of texture and reduced intensity[27].

---

[27] Wishart discusses a similar concept of 'spatial anacrusis and resolution' in Wishart (1996), pp.223.

Spatial Transitions: Examples

The following sonograms illustrate how the aforementioned techniques are employed:
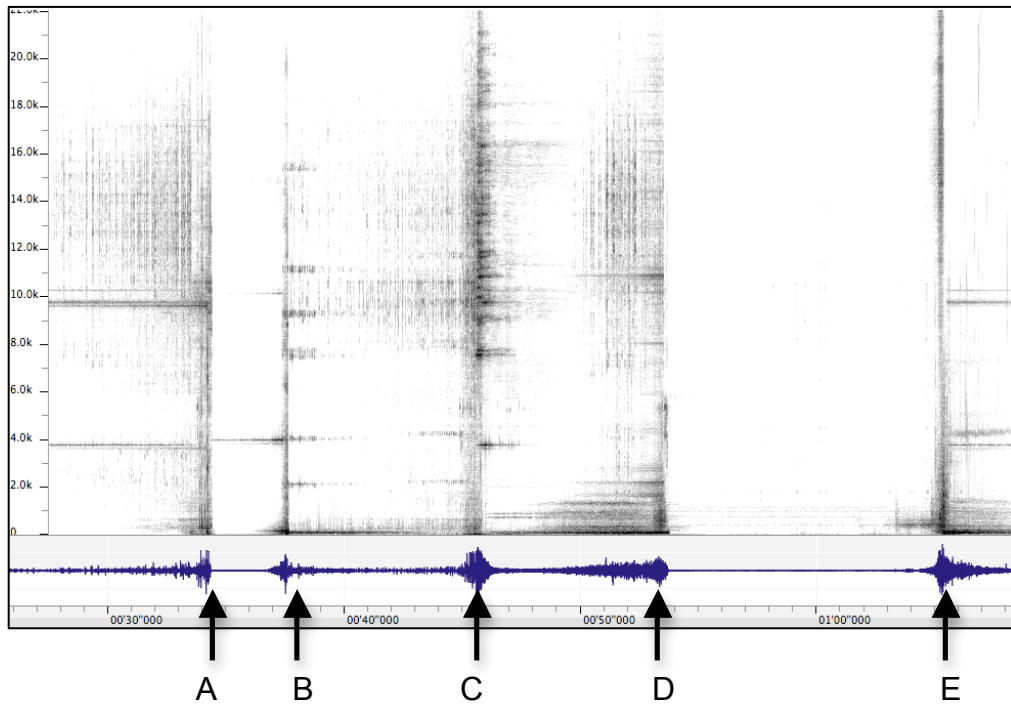
Figure 1: Sonogram, *Anima Machina* 0'27–1'08, Spectrally rich sound events (A, B, C, D, E) act as strong articulations of the onset or termination of new material and altered pacing, contributing towards a sense of *attack* and *punch*. A spatial transition is created through the subsequent presentation of new spectral and perspectival spaces.

Interruptions often direct the music from one spatial environment into another, contrasting spatial scene, frequently through the exposition of new material or the termination of previous material. One dramatic example of this occurs at 0'45 where increased depth of perspective in the soundfield is presented for the first time (C). Another attack follows at 0'53 (D), and reveals an even more distant and reverberant plane. At 1'05 a third attack (E) introduces for the first time a combination of perspectives and implied motion between them. The close and brittle mechanical winding action is contrasted with an approaching broad spectrum sound, which implies larger dimensions. This idea of using tiered approaches and recessions is crucial in the work.

Exponential growth in amplitude also typifies many of the onsets found in *Anima Machina*. In each case these act as anacruses to weighty attacks via a dramatic sweeping action, apprehending the forthcoming change in space, for example at 8'35. Prior to this point there is an increase in tension brought about through accelerating

motions. This leads to materials collectively approaching through the exponential crescendo which peaks at an attack with an extended decay. In this instance, the extended decay is in no way static. The downwards shift in pitch combined with spectral fill creates an arced trajectory, functioning additionally as an exponential onset for the subsequent, stronger attack/change point, at 8'48.
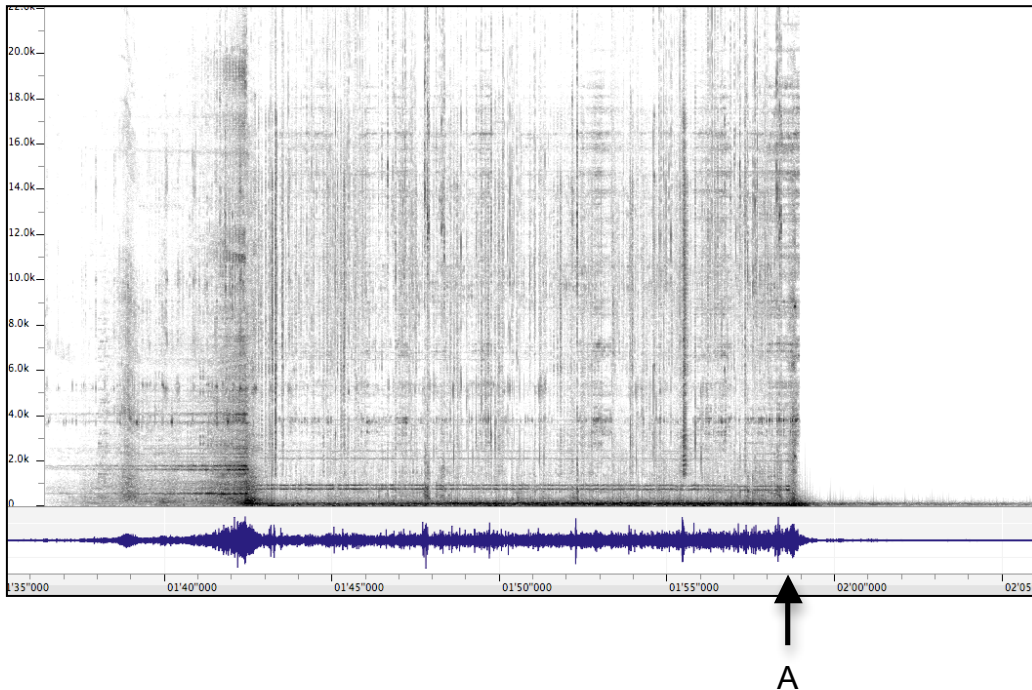
Figure 2: Sonogram, *Anima Machina* 1'36–2'06, Dense spectral layering and implied scattering of spatial trajectories, further emphasised through erratic stereo panning. Note the rupture of this dynamic environment at 1'59 (A), when material of minimal spectral distribution is exposed, presenting a dramatic distal vista.

Although there are no direct implications of agential space in *Anima Machina*, there are suggestions of behavioural space, created through the organic activity of certain sound materials. A major development of animated textural material commences at 5'06 (although it is previously introduced at 2'06 and 4'16). While its activity is at the forefront of our perception, it is placed within a wider sonic arena. At 5'44 a similar behaviour is set in motion, but on a more distal plane. This behaviour is introduced and increases its kinetic properties, while the boundaries of the spatial environment continue to be articulated through smeared continuants (Figure 3, A).
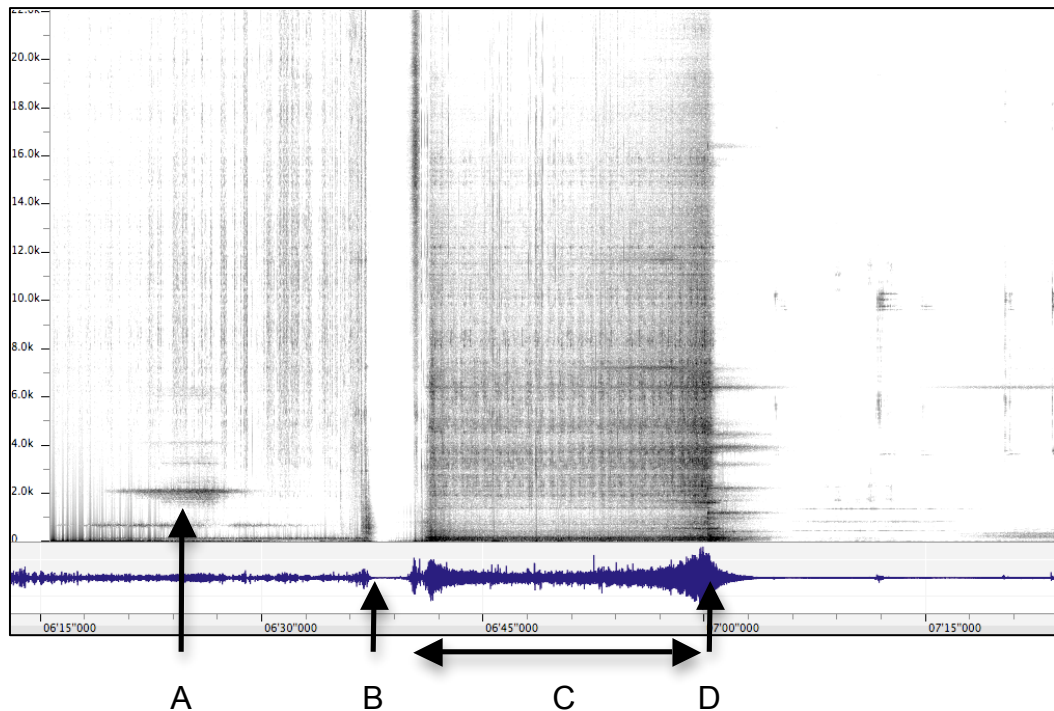
Figure 3: Sonogram, *Anima Machina* 6'12–7'24, Dramatic contrasts in spectral occupancy of material reinforce the spatial transition.

At 6'37 a termination sound-object (Figure 3, B) halts the flow of this established landscape, leaving only metallic traces. An altogether new landscape is introduced dramatically at 6'41 (C). Here the expansion of spectral content creates a far broader panorama. The escalation of intensity alludes to an intense approach which immerses the listener before dramatically bursting at 7'00 via another terminating sound-object (D). A cessation of proximate activity leads to recession into an almost vacant, expansive space (a process which Smalley refers to as 'ouverture'[28]).

---

[28] '…a process of ouverture, whether sudden or gradual, will be initiated by the total or partial erasure of elements within proximate space, permitting the view to expand into distal space…' Smalley (2007), pp.49.
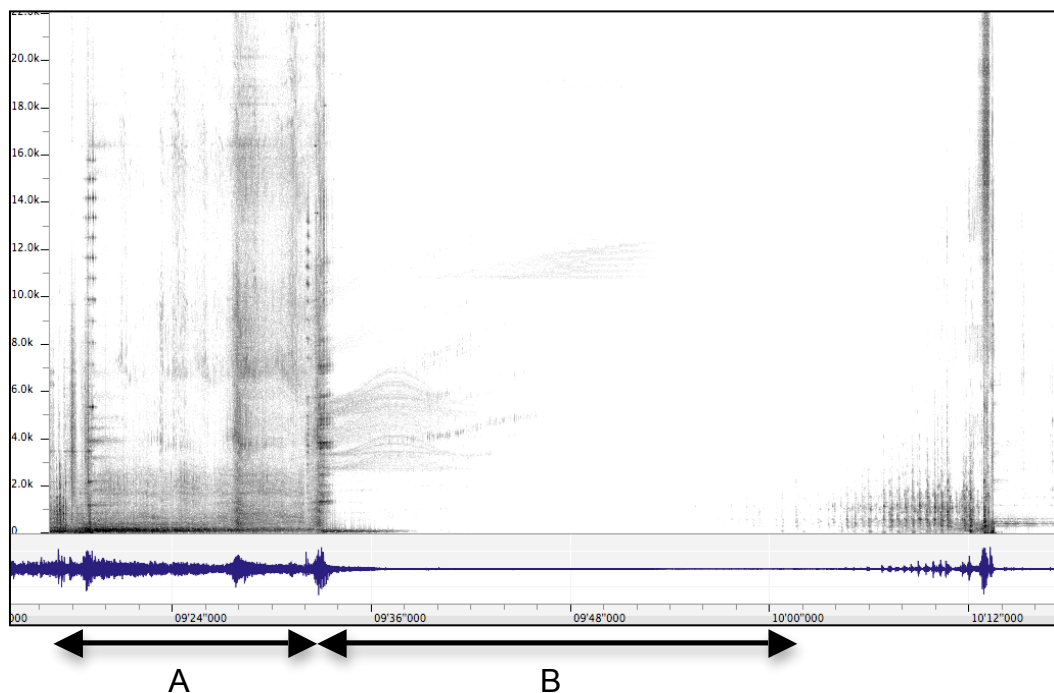
Figure 4: Sonogram, *Anima Machina* 9'18–10'16, Overlapping motions and trajectories (A) are followed by associations of ascent and increased distal space (B). In diffusion, section B naturally implies elevation and retreat over the loudspeaker array.

Conclusion

The examples given in Figures 1 to 4 demonstrate the application of dramatic gestures to aid spatial juxtaposition in *Anima Machina*. This work particularly draws on techniques of recession and approach, as well as the related techniques of enclosure and ouverture. These aspects of space-form interact to create a range of landscapes intended to exploit the capabilities of a diffusion system by maximising the possibilities of physical placement (i.e. perspectival space) in diffused performance[29]. The work lends itself to dramatic expansion and contraction of the stereo image via the articulation points, which may act as gestural cues for the diffuser.

---

[29] Dramatic changes in composed space are very likely to prompt a change in the physical distribution of sound in a performance space.

1.3 Interruption and Implications of Agency in *Cipher* (Composed 2007, Duration: 11'42)

Source Material and Motivation

Cipher explores themes surrounding the electronic transmission of codes, and the possible interference with such transmissions. Ideas concerning misinformation, ambiguity of meaning, continuums of intelligibility, words, patterns and ordering all informed the work. In order to emphasise such themes, there are frequently direct references to the original source-material, which included a manual typewriter, Morse code and more abstract 'fragmented' sound taken from recordings of broken glass, a female voice and metallic objects. Many of these sounds were processed to the point of creating glitch-like material, which specifically implies interference in the transmission of codes[30]. Aside from ideas concerning semantics, a major aim was to create a rapidly moving work in terms of structural variation, and one which might consequently be more engaging in performance. During composition, fragments of material were juxtaposed, exported as a single unit, and then time-compressed in preparation for the same process of juxtaposition with other time-compressed material. As a result a major characteristic of the work is its rapid gestural interplay, coloured by artificially fast vocal utterances. Gestures are frequently crisp and clean, created through use of high, narrow-band material.

Agential and Utterance Space

The use of voice within the work at first implies agential space[31]; however the voice is used as much for its abstract sonic characteristics as well as for its *human* connotations. While there is a sense of presence, at no point is this presence completely revealed to the listener. The voice ultimately remains restrained from true communicative capability. It does, however, contribute aspects of utterance space[32] to the work, and due to inherently strong referential properties of the voice, the piece becomes coloured by its use, even though it is certainly not the most extensively used source material.

---

[30] Use of this source-bonded material carries with it implications of 'mediatic' space, 'a particular genre of performance space within which the transmission of gestural/ensemble space is mediated by technology', Smalley (2007), pp.43.

[31] 'A space articulated by human (inter)action with objects, surfaces, substances, and built structures etc.' Smalley (2007), pp.57. In the context of *Cipher* such interaction can be found on an abstract level i.e. between sound-objects in the composed space, rather than as an actual performer on stage.

[32] 'A space produced by vocal sound. This may be an intimate, personal, or social space, and in communicational contexts can also be regarded as a behavioural space.' Smalley (2007), pp.58.

Vocal material is presented in many different guises. A voice first occurs in a very fragmentary form, barely perceptible within the dense sonic landscape: at 0'47 a breath acts as an anacrusis, but in concert with other sounds. A second, shorter, anacrusis occurs in a similar manner at 0'53. At 1'55 the vocal fragments are more audible, and are presented within a cluster of gestures. Here the gestures do not merge organically to form a chain, and consequently a phrase, but instead individually they behave in the manner of interrupting their predecessor. This sets up stuttering phrases that often display a rhythmic quality (a clear illustration of this being between 8'02–8'13), and is an example of interruption on the micro-scale. The integration of vocal utterance amongst fragmented found-sound gestures and the resulting ambiguity of sound source act to heighten tension at these points[33]. In addition, there are occasionally unusual images and dramatic results created as a result of source-bonding[34]. Such moments include an unexpected cough at 1'56 and the voice seemingly spitting out fragments of glass at 2'49.[35]

The voice does not function solely as gestural material. It consistently reinforces ideas of communication and language through its use in a textural capacity, as heard in the collections of utterances at 2'59, 3'01 and 3'11. A more striking example occurs between 9'12 and 9'30 where multiple voices are introduced over a variety of spatial planes. This extended presentation of almost exclusively vocal material at the climax of the work is a stark contrast to the individual intimate vocal utterances that previously dominated.

Tension may be heightened more directly through vocal material than through other material due to its emotive connotations, an example of this being the repeated gasping of breath at 2'14. In addition, the voice in some respects leads the ear through the structure of the work. At 9'12 multiple voices move to the forefront, and at 11'01 the voice is presented as almost intelligible text, for the first time in the work. The listener comes close to hearing the message, but it remains indecipherable. The idea of nearing the successful transmission of the code is further emphasised by the extended presentation of ordered rhythmic structures (8'41) and pulse towards the conclusion of the work. While such material has occurred previously (e.g. 1'36–1'48 and 2'23–2'30), it appears in its most extended and ordered state at this point.

At a more subtle level, vocal source recordings have been processed to create sustained material displaying veiled pitch and breath properties (2'32) which function to

---

[33] Through what John Young refers to as 'remote surrogacy', where 'physical cause is uncertain and will tend to be deduced by a psychological interpretation', Young (1994), pp. 23-24. A sense of abstraction is particularly dominant here due to the rapid juxtaposition of 'polarised orders of surrogacy', the voice as first order, and the found-sound material as remote.
[34] 'the natural tendency to relate sounds to supposed sources and causes, and to relate sounds to each other because they appear to have shared or associated origins.' Smalley (1997), pp.110.
[35] Although I acknowledge that not all listeners may perceive this image.

expand perspectival space by articulating a more distal plane against the crisp foreground material.

Macro Interruption

Cipher aims to explore the interruption of information and consequently *sonic* tension and *sonic* interruption (which can function to build tension, or release it completely) are crucial structuring devices. The work uses a number of techniques developed during the composition of *Anima Machina*, particularly in terms of spatial transitions. In Figure 5 a distal space presented from 3'47 approaches through increasing clarity in the high spectrum (A). It fractures at 4'08 (B) when material articulating its most distal aspects terminates, and through a process of enclosure the listener is exposed to a very proximate space (C). Proximity is reinforced through the source-bonded spaces created by unmistakeable whispered vocal consonants and the closely-recorded typewriter.
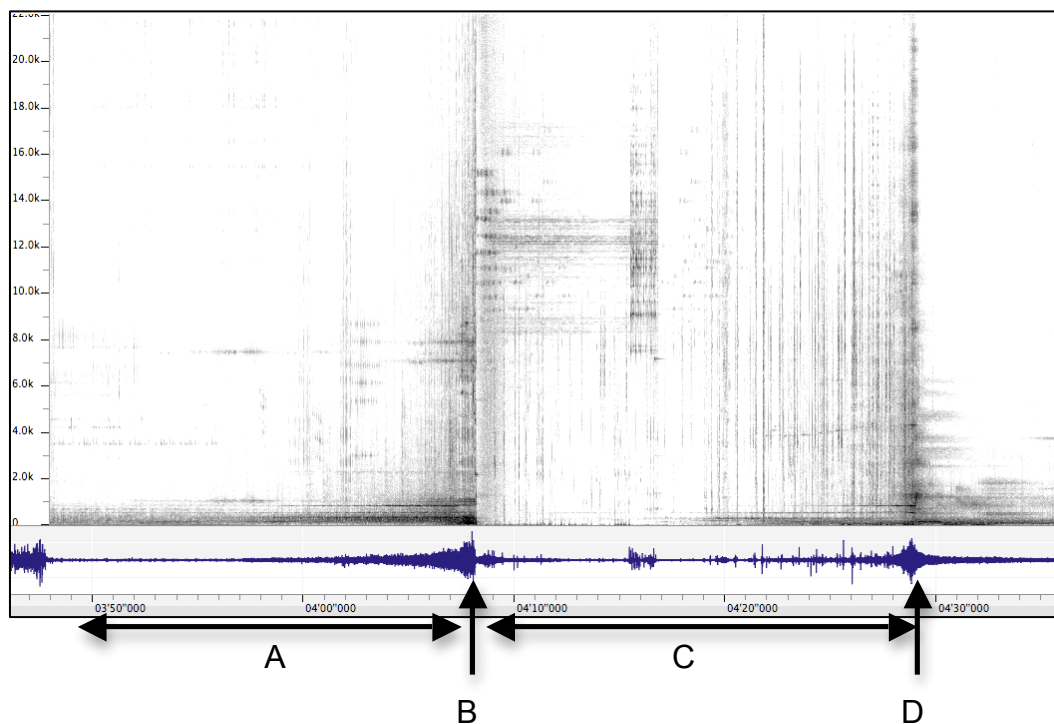
Figure 5: Sonogram of *Cipher*, 3'48–4'36.

Elements of the previous distal space re-emerge and the image extends to a broad panorama[36] at 4'29 (D), where the decays of breathy syllables transform into a vast peripheral landscape. As in *Anima Machina*, each spatial displacement is clearly punctuated, however approaches and recessions are generally more graduated.

---

[36] An example of 'ouverture', Smalley (2007), pp.47.

Micro Interruption

While change-points on the macro-level of structure do occur (as detailed above), they are arguably not as striking and clear-cut as those found on a micro-level, within phrase structure.
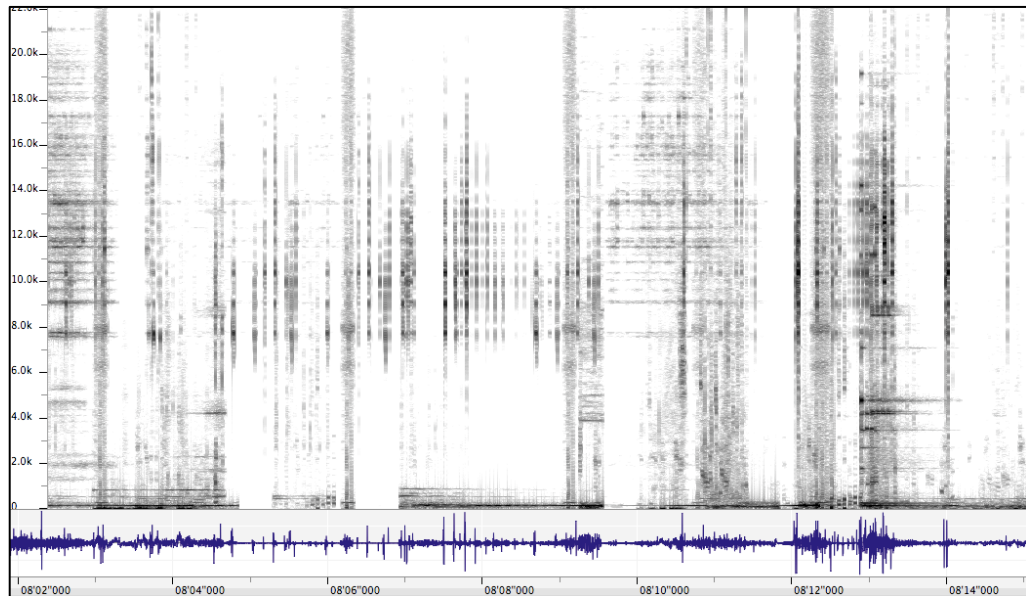
Figure 6: Sonogram of *Cipher*, 8'02–8'15

Figure 6 shows material commencing at 8'02 woven into complex, rhythmic phrases, creating stuttering interruptions. Similar phrasing occurs throughout the work, and was produced by layering and looping a variety of edited sounds of very short durations[37], exporting them as one unit and applying time compression. The result is often the creation of stuttering micro rhythms, and the rapidly changing sound material within these acts to increase pacing. Often the component sounds of these phrases differ substantially in terms of their spectral characteristics and implied proximal space. However, temporal organisation and synchronicity imply source-cause relationships between the proximate and distal material. In Figure 6 the jagged phrases gravitate towards more consistent repetition and eventually pulse at 8'13, elements which by their nature imply a more stable plane.

This approach to materials typifies that taken overall in the composition of *Cipher*. Equalisation to focus the high spectrum of materials, precision editing of sounds into short durations (often using individual voiced consonants), and time-compression were all applied extensively. Frequently these processes were taken to the extreme, where

---

[37] This technique was derived from those I was concurrently using in laptop improvisation using Max/MSP.

the sound's links to its original source weakened and the material began to adopt glitch-like properties, at times on the brink of distortion. This material helped to convey further the programmatic link to electronic codes and interference.

Vertical Shaping vs. Horizontal Organisation

The precise and dense arrangement of sound on the horizontal (temporal) axis generally dominates over vertical concerns of spectral distribution in this work. However, there is exploration of evolving spectral space and wider landscapes between 7'21 and 8'01, a section intended as a respite to frequent density on the horizontal axis. Outside this passage, spectral shaping generally occurs in the high frequency spectrum. This material is useful in creating a sense of clarity and intimacy, and the proximate space it implies is further developed through the intimacy of the voice and the close quality of recorded sound material. This approach to spectral content, however, has proved to be vulnerable in especially reverberant venues, where clarity, and consequently impact of the material, may be compromised. In reverberant acoustics rapidly articulated material suffers by sounding 'smudged' and high-frequency detailing is obscured. As a result, the work is best heard in a dry performance space where the clarity of gesture and interruption is more likely to be retained for the audience.

Conclusion

Proximate perspectival space dominates in *Cipher*. Although distal planes are present, they are often overshadowed by 'close' material, which frequently draws on source-bonded and agential space. Stuttering rhythms and patterns characterise the work, and these add to a sense of forward momentum and tension. Despite the integration of vocal material, the work does not draw heavily on behavioural space. Individual gestures, whether vocal or otherwise, are frequently short and fleeting moments which do not necessarily allow for the establishment of behaviour, trajectories and hence true spatial collaboration as an ensemble. Instead, mechanical organisation in the temporal domain[38] is favoured over organic evolution, and this precise temporal organisation of materials recalls the extra-musical stimulation for this work.

---

[38] Perhaps displaying elements of what Harrison refers to as an 'architectonic' structuring, which 'is built on the quantifiable distances *between* musical events (in all parameters) whereas organic structure explores the qualitative evolution, the spectro-morphology of the events themselves.' Harrison (2008), pp.127.

1.4 Spectral spaces and manipulating proximity in *Topographia* (Composed 2008, Duration: 9'31)

Background

Topographia aims to explore a number of sonic landscapes and topologies through variations in implied proximities, densities and kinetic behaviour of sound materials. The composition of *Topographia* arose from a project in which seven composers created a work using the same source material, this being a collection of twelve short samples from Denis Smalley's *Wind Chimes,* released for use by the composer himself. Bearing in mind Smalley's interest in the spatial attributes of electroacoustic music, it seemed appropriate to explore this particular area through the sonic material. In many respects *Topographia* is particularly influenced by Smalley's *Valley Flow*, a work which greatly influenced my early compositions, most notably *Soliloquy* (2003) and *Stratus* (2004). I have long admired Smalley's spectral shaping in *Valley Flow* in the creation of exquisite evolving landscapes.

Pitch-Centred Materials and Spectral Manipulation

In undertaking a work with very specific limitations on sound material (I was limited exclusively to the twelve samples, some of which were simply multiple transformations of the same material), I was required to reconsider and adapt my musical language. The majority of the original samples were heavily resonant and most displayed specific pitch-centres. Inevitably the resulting work has been coloured by this and the structure is underpinned by shifts in tonal pitch space[39]. While tonality is sometimes dismissed by the acousmatic composer, perhaps due to its ties to classical musical structures, pitch relationships can undoubtedly contribute towards the construction of space-form, as Hermann Helmholtz describes:

---

[39] 'The subdivision of spectral space into incremental steps that are deployed in intervallic combinations' Smalley (2007), pp.58.

'Such a close analogy consequently exists in all essential relations between the musical scale and space, that even alteration of pitch has a readily recognised and unmistakeable resemblance to motion in space, and is often metaphorically termed the ascending or descending *motion* or *progression* of a part. Hence, again, it becomes possible for motion in music to imitate the peculiar characteristics of motive forces which lie at the root of motion.'[40]

In addition, Smalley suggests another possible application of pitch-centred material, in the form of resonance:

'We can stretch out new, imagined resonances creating structure whose textural coherence retains the internal logic of resonance instigation, but may expand into fantasy'[41]

Resonances in *Topographia* are indeed artificially lengthened to lead the ear to new material, frequently through a bending of pitch. (However, this technique is developed to a greater extent in *Bosonica.*[42])

The obligation to work with predominantly pitch-centred material created an opportunity for me to explore these parameters further. I was encouraged to move away from my favoured noise-based gestures and metallic textures and, following the composition of *Topographia*, tonal pitch-space has featured more prominently in my practice.

Pitch-space can be regarded as a sub-category of spectral space, which in itself became a major concern in this work. Due to the dominance of pitch-centred sound materials it was necessary for me to investigate new and alternative techniques of transformation to create a sufficiently varied palette of sound. I frequently utilised graphic equalisers to isolate narrow bands of a sound's spectrum, which I then layered with a number of other narrow bands to create material with complex spectral occupancy. Generally such material is used to articulate planes in distal space. I also utilised graphic equalisation to highlight pitch-centres and reveal hidden harmonies. By performing this technique multiple times with subtle variations and pitch shifting, I was able to create from very little starting material a catalogue of spectrally similar sounds, each displaying a slightly different 'colour'. Dynamic control of equalisation allowed me to transform the spectral content of sounds over time, in order to imply gradual shifts in its mass and behaviour. The more drastic technique of varispeed led to the creation of glissandi, imprinting a more defined form of direction on sounds.

---

[40] Helmholtz (1954) in Windsor (1995), pp.370.
[41] Smalley (1986), pp.90.
[42] *Bosonica* sets out to exploit the source-bonds with instrumental music, hence the specific application of resonance to which Smalley refers was a particularly appropriate tool.

Structural Reinforcement Through Pitch-Space

Harmonic progression is employed as a structural tool, often to reinforce aspects such as 'progression' and 'arrival'. While the climax of the work, occurring at 5'32, is perpetuated by a broadening of spectral occupancy, harmonic preparation and escalation of pitch reaffirm its position as a climax. In a similar manner, pitch-centred glissandi frequently function to create trajectories leading the ear between implied spaces, reinforcing smaller scale impressions of ascent/descent, approach and retreat. This is particularly prominent at 8'30 where the diagonal forces created through glissandi dissipate to stabilise at 9'00. Such gravitational pulls are crucial in creating the organic ebb and flow of the work. While gestural interplay and shifting harmonies create instability, they frequently gravitate towards stable forms, for example the plateau heard at 5'05 and 5'48 (Figure 7, A and B), only for them to destabilise once again.
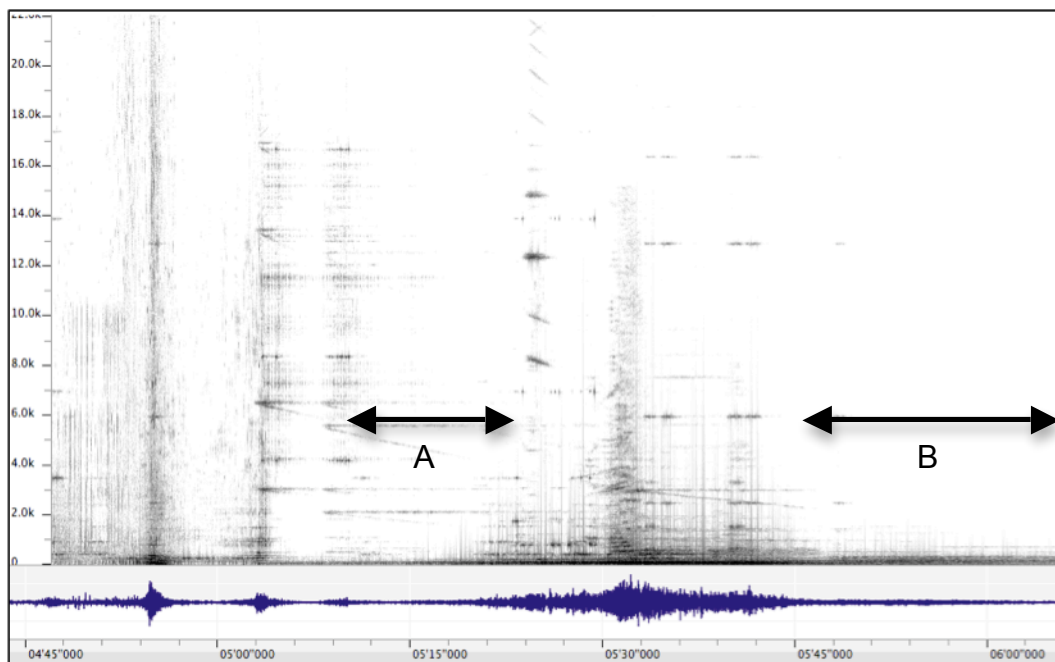
Figure 7: Sonogram of *Topographia*, 4'58–6'06 displaying stable planes at A (5'05) and B (5'48). Such extended passages of semi-stasis are not regularly found in *Anima Machina* or *Cipher*.

Gesture and Ensemble Space

While sustained textures emerged naturally from the source material, I found that I encountered more difficultly creating gestural material. Where I would usually have recorded additional source material which displayed inherent gestural characteristics, I was unable to do so in this case. Instead I continued to process the sounds further and further, eventually adopting extensive granulation techniques to manipulate the

resonant, sustained material into more dynamic entities. The resulting gestures generally exhibit a fluid water-like quality in the work, and form a layer which consistently represents the most proximate behaviour in the work. These bubbling gestures were often pitch-shifted to imprint upon them similar, albeit accelerated, dynamic trajectories to those found in the extended glissandi.

Once multiple gestures are layered they form *chains* of gestures which exhibit organic behaviours and implications of physical motion[43], for example at 7'22. Here the motion of the sound-objects implies that they are dynamically *bouncing off* one another, and there is a very clear sense of causality and interaction between them, key components of ensemble space[44]. Barrett calls attention to the ability of such gestures to define the arena, or larger environmental space, which they occupy:

> 'the size of space perceived from the combination of a rapidly moving gesture and a stationary point will be the product of the spatial extremes defined by each sound'[45]

In *Topographia* the juxtaposition of dynamic gestural activity on a proximal plane against distal elements reinforces relative dimensions of landscape, and when motion behaviour occurs in distal as well as proximal space an increased impression of spatial flux is produced.

The relationships between gestures may also help to define the state of their ensemble space by leaning towards either self-motion, or conversely an active environment. Clarke describes how, due to relativity, sound moving in the same manner will imply 'self-motion', whereas sounds with distinct motion attributes will imply the movements of external objects in relation to each other[46]. The latter technique dominates in the gestural content of this work. Compound gestures create micro-trajectories, which at times interact with and influence the behaviours of sustained material (macro-trajectories). Such interaction between spatial planes can be effective in creating an active, yet coherent, environment.

---

[43] Specific motion typologies are detailed in Smalley (1986), pp.74.
[44] Here I refer to ensemble space in its 'virtual' form, inside the composed space. A further type of ensemble space would be that experienced in the listening space, for example an ensemble of instrumentalists.
[45] Barrett (2002), pp. 320.
[46] Clarke (2005), pp.76.

The Construction of an Organic Environment

A variety of different motions are explored in this environment in terms of implied masses, velocities and trajectories. 5'04–6'07 represents a short section which is arguably most similar to the approach taken by Smalley in *Valley Flow.* A vast landscape is presented, with events taking place within the sonic framework at different proximities to the listener. Each of the sound-objects within this landscape exhibits individual motion behaviour and the combined result is a dynamic, yet organic, shifting landscape. This develops into a harmonic climax which, through spectral broadening, immerses the listener. There follows recession to the most distant landscape in the work, at 6'00. However, the landscape here continues to convey a degree of instability through subtle spectral fluctuations, which prepare the listener for an approach of material at 6'06 to reach the most proximate space in the work at 6'15. Even at this point, a more distal space continues to be defined, articulated through a receding and descending glissando on a more distal plane[47].

Such a section is in marked contrast to the style of writing explored in *Anima Machina* and *Cipher*. In *Topographia* I have made a conscious effort to elongate phrases and transitions, and to temper my propensity towards faster pacing (a notable example of this being in *Cipher).* There is slower and more subtle evolution of elements, exploiting static or semi-static planes[48] to their full potential, frequently as spectral grounds or canopies. This sustained material reinforces an overall slower pacing, even when proximal gestural interplay is at the forefront.

Conclusion

A major aim in the composition of *Topographia* was to focus on the creation of more varied perspectival frameworks within composed space, particularly the construction of landscape and impressions of distal space. However, spectral manipulation becomes crucial in achieving this. Attention to spectral aspects may assist in creating impressions of near and far, and fluctuations in spectral content may imply navigation *between* these established spaces.

Topographia is dependent on the *interaction* of elements of space-form, more so than *Anima Machina* and *Cipher*. At any given point in the work, the identity of space is defined through interactions between gestural space, perspectival space, spectral

---

[47] Even the most subtle of changes will contribute towards motion, and consequently an active space. The ability of 'change' to imply motion is discussed by Clarke (2005), pp.75.
[48] A static plane may not necessarily be a sustained sound, but could be a continuant characterised by internal pulse. While pulse is traditionally associated with motion in music, such intrinsic consistency may create an impression of grounding.

space, and pitch-space. It is often challenging to define the contribution of each of these elements due to overlapping characteristics and a tendency towards constant evolution.

1.5 Tactile spaces and gestural association in *Papyrus* (Composed 2008, Duration: 8'23)

Introduction

Papyrus is a short work developed from material used in the composition of a soundtrack for a site-specific theatre production[49] of *The Yellow Wallpaper*, based on the novel by Charlotte Perkins Gilman. During the production there were a number of set pieces where the actors performed movement choreographed to mimic the action of ripping paper. For these sections I found it particularly intriguing to compose music. I became very aware of the physical implications which could be conveyed through the sound of paper, a seemingly simple and mundane material. By utilising very close microphone techniques it was possible to detect in the recordings the speed, direction, mass, weight of paper, and ultimately the intention behind the interaction. (The quality of the original material is crucial, as the microphone space[50] inherent in the recordings emphasises intimacy and magnifies the intricate timbral details usually lost in conventional acoustic situations.) After seeing what powerful physical images the recordings could convey in the theatre production, I was eager to experiment with their potential in an acousmatic work.

While *Papyrus* uses the same source material (recordings of all kinds of paper manipulation, including the ripping of large sheets of wallpaper) as in the theatre soundtrack, it stands independently. There are no quotations of the theatre soundtrack, and no direct references to the narrative of *The Yellow Wallpaper.* Instead the idea of ripping wallpaper to reveal new layers was employed metaphorically as a general structuring tool. There are four sections (see Diagram 4), preceded by a short introduction.

Tactile Source-bonds

Through numerous tactile references to unprocessed, closely-recorded paper, *Papyrus* invites a transmodal[51] interpretation of sound. Isolated quotations of paper ripping (e.g. 0'38–0'47) refer to a human agent behind the act, but also more specifically to implications of the movement of the physical act and the intention of the act. This

---

[49] Performed at The Herbarium, Manchester Museum, 27th-29th May 2008. Adapted by Sarah Stewart, directed by Rob Drummer.
[50] 'A performed gestural or utterance space where intimacy of the image is magnified.' Smalley (2007), pp.57.
[51] 'The interaction and interdependence of various sense modalities' Smalley (2007), pp.58.

reliance on extrinsic source-bonding underpins the work, unlike in *Anima Machina* and *Topographia* where more abstract qualities dominate. Although there are source-bonded associations implied through a multitude of gestures and textures in the work, key moments when this material is heard in isolation occur at 0'34, 2'15 and 3'39, as introductory material to three of the four sections in the work. At these points there is direct allusion to the peeling of wallpaper to reveal a new surface; the final 'rip' from each of the 'real' (unprocessed) sections acts as an anacrusis into a new, imaginary sound-world.

Agential Relationships as Structural Devices

The initial twenty seconds can be interpreted as an accelerated journey through the intrinsic perspectival dimensions of the work. An intimate flicker of paper is interrupted to reveal a mounting tension which bursts to reveal an expansive landscape at 0'17. At 0'36 the listener is transported from this fictional landscape back to a *real* space, created through the isolated presentation of an original raw recording, clearly source-bonded with the turning of pages in a book. The human agency implied through this sets up gestural space with powerful potential. Frequently the action of ripping paper, rooted in this gestural space, develops and accumulates to take the listener to a new, fictional space, for example at 0'47 and 2'35. As a result a dichotomy is set up between the presentation of the raw paper material and, in stark contrast, the development of complex layered landscapes. The gestural impetus of the paper acts as a link from one world to the other, propelling the music to new spaces constructed from processed material and appearing heavily abstract. At 3'39 the trajectory set-up by the slow and tense paper ripping is continued by the new sonic materials it metaphorically *reveals*. In turn, new types of motion emerge and a complex set of interacting gestural behaviours are introduced.

Section Three, between 3'53 and 6'51, explores a similar mode of working with material to that found in *Cipher*. Individual gestures are organised to present rhythmic fragments, and occasionally there is a sense of pulse and meter (most prominently from 4'53). However, while such organisation of sound (rhythm and pulse) presents a powerful hold for the ear to follow, it can also possibly distract from richer spatial concerns and may tend towards a one-dimensional plane, even when very rich gestures are included. Yet, this section does act as a strong contrast to the organic abstract landscapes explored until 2'23. Section Two (2'36 – 3'37) acts as a transition from this environment into the more rhythmical material through the exploration of more dynamic gestural behaviours and intimations of rhythmic constructions. The final section, commencing 6'51, explores the most distal elements of the work, but with far more subtle gestural contributions.

Here spectral space dominates and constructs the dimensions of a broad panorama. Within this, the gestural space of a number of sound-objects articulate a variety of perspectival planes, one after another. The work concludes with a final quotation of proximal, intimate paper.

Introduction (0'00–0'34): Rapid presentation of the spatial dimensions of work.

↓

Paper Interlude (0'34–0'47)

↓

Section 1 (0'47–2'15): Landscape is presented and a number of planes are articulated within this environment. This disperses into the interlude.

↓

Paper Interlude (2'15–2'36)

↓

Section 2 (2'36–3'37): Development of more dynamic gestural material leading to Section 3

↓

Paper Interlude (3'37–3'53) (displaying more abstraction than previously)

↓

Section 3 (3'53–6'51): Rhythmic organisation of proximate material. Pulse and meter dominate. Energy disperses as a transition into Section 4.

↓

Section 4 (6'51–8'40): Exploration of distal material, interspersed with gestures echoing the previously active environment

Figure 8: Outline of Structure in *Papyrus*

It is in the tangible surface detail of the recorded material, which is manipulated and almost 'performed' through human agency, that gesture and corresponding trajectories are embedded. At 2'51 this is demonstrated through a particularly strong set of short trajectories, which when placed together direct the listener through a clear 'chain' of motion/direction information, or 'journey'. Although the context here distracts from a sense of direct human agency, the materials retain an organic quality of ensemble space through their collaborative identity.

Conclusion

Papyrus is a work drawing on a number of methods of constructing space. The work explores the relationships between unprocessed recorded sound and its source-bonded associations, and highly constructed abstract landscapes. A device which is common to both of these sound-worlds is the use of paper rips to communicate clear motion trajectories which in turn provide forward momentum. The idea of grouped gestural behaviour (i.e. ensemble space) which was first introduced in *Topographia*, is developed further, by constructing strings of overlapping gestures which display complex motions.

The source material naturally evokes tactile qualities and through a process of source-bonding, draws attention to an elusive human agency. This dominates in passages where unprocessed paper is presented in isolation. The structure is underpinned by dichotomies between the mundane and the imagined; the unprocessed and the heavily transformed; the natural and the constructed.

II Multichannel Composition: 5.1 and 8-channel concert works

2.1 Approaches to the Composition of *Spindlesong*, for 8-channel audio
(Composed 2008, Duration: 15'57)

Background to *Spindlesong*

Quarry Bank Mill is an 18th Century cotton mill in Styal, to the south of Manchester. The cotton industry was crucial to the growth of the economy in the North West of England, and many families found themselves in some way dependent on the industry during the 19th and early 20th Centuries. Quarry Bank Mill is now a museum of the cotton industry, owned by the National Trust. Inside remain many working examples of the machinery used in the manufacture of cotton, including looms (both manual and automatic) carders, spinners, and steam engines, all of which were originally powered by an iron water wheel, one of the largest examples of its kind in the UK. These sounds combine to create a rich sonic environment and exciting possibilities for the acousmatic composer. Two works emerged from the sound material I gathered at the Mill, *Spindlesong*, an 8-channel concert work, and an 8-channel installation, which will be discussed in further detail in Chapter 3.

Associated Repertoire

The Mill itself is no stranger to artistic collaborations. Its history, architecture, sights, smells and sounds have informed a number of cultural projects, including theatre, dance and video works by Manchester-based artists. In 2004 David Berezan utilised recordings made at the Mill to create his stereo acousmatic work, *Styal.* To my knowledge, this is the only other sound work inspired specifically by Quarry Bank Mill, although Annie Mahtani's *Past Links*, Peter Stollery's *Vox Magna* and Nye Parry's *Boomtown*[52] and *Living Steam*[53] are all examples of the Industrial Revolution as a composer's principal inspiration.

---

[52] An installation work commissioned (1998/99) for Oldham borough's 150th anniversary celebrations. The work references the sonic elements of the industrial revolution, including the cotton industry which underpins much of the social history of the region. This work uses material from the North West Sound Archive, as does *The Spindlesongs Installation*. Parry (2003).
[53] A site-specific installation work (1998/99) for eight-channel tape and steam engines, described in Parry (2003).

The constituent elements of *Spindlesong* and David Berezan's *Styal* are essentially very similar[54], but the two works exhibit very different approaches to the use of sound materials. When composing *Spindlesong* I refrained from listening to *Styal* until completion, to avoid being subconsciously led in a particular compositional direction.

Materials in Berezan's work are more ambiguous in terms of identifiable source. The work appears to be structured around dramatic contrasts in perceived mass and density. It is extremely effective at conveying the immense power and scale of machinery alongside detailed mechanisms through a wide range of spectral layering. The majority of the sound material references industrial machinery and its power in a general sense. It has been processed to reveal intrinsic properties which aid the creation of rich, dynamic textures and amplified physicality and motion. However there are a number of distinctive sound quotations taken from Quarry Bank Mill. These include looms (5'29, 8'45 and 12'48), the carder (2'37), a steam engine (6'39) and resonating cogs at 11'32. Although a few of these sounds (most notably the looms) are unmistakably recognisable for their link to the cotton industry, whether these quotations serve to identify the original environmental location is questionable. While I immediately recognise and link these sounds through source-bonding to the cotton industry and Quarry Bank Mill, I am unsure whether someone with reduced knowledge of this specific sonic context would. My personal listening experience of *Styal* exemplifies the power of source-bonding in the interpretation of a work. Having formed a close relationship to the Mill sounds, my interpretation of *Styal* is now radically different to that which I first experienced a number of years ago[55].

Initial Compositional Approaches in 8-channel Composition

The concert work *Spindlesong* represents my first experience of composing in an 8-channel format, utilising what Smalley terms the fixed mode[56] of circumspace[57]. Prior to this, my one experience with surround formats was in the composition of a work for dance, which utilised quadraphonic sound[58].

---

[54] Both works utilise recordings of almost exactly the same machinery found in the Mill. Like me, Berezan choose to utilise additional, studio-recorded material. While I made recordings of metallic objects, he draws on the sounds of textiles. Berezan's work is composed in stereo.

[55] 'the listener's knowledge of context, together with associations and connotations, play a vital role in the reception of the work', Truax (2001), pp.124.

[56] 'Where the delivery of perspectival space is integrated into the format of the composition and is not further diffused via the enacted mode of delivery', Smalley (2007), pp.57. However, the potential for enacted delivery of a fixed mode work is discussed in Appendix D.

[57] 'In perspectival space – the extension of prospective and panoramic space so that sound can move around the listener and through or across egocentric space [The personal space surrounding the listener]', Smalley (2007), pp.57.

[58] *66˚33'07"S…and all was white* (2006). A collaboration with Sari Lievonen, choreographer.

Barrett suggests that the inability to 'spatialise sound streams simultaneously'[59] can be a significant limitation in sound diffusion. Surround sound composition releases the potential to explore this tool. She highlights that the capacity to 'reproduce a spatial-gestural counterpoint featuring multiple independent motion trajectories'[60] in surround sound is a desirable tool, as does Trevor Wishart[61]. However, one risk of utilising this technique in its most extreme state, mono placement, is that it may draw attention to a fixed point, reiterating the loudspeaker's state as an inanimate and visual source. In addition, such use of mono placement can stifle any impressions of 'transcended' space, a space implied as existing beyond the ring of loudspeakers.

Perhaps for this reason, I initially decided to fully embrace the 8-channel format by creating solely 8-channel material. Having made all of the source recordings in stereo, I utilised a number of tools, including BEAST tools (in beta version)[62], panners in Max/MSP[63], Peter Batchelor's Orbit and Clatter[64] and MPSP[65] by Flo Menezes to generate 8-channel sound-files. However, I found that 8-channel sound proved unwieldy to control in a sequencing session, particularly when my previous experience had been almost exclusively in the manipulation of stereo material. The use of many different software applications to process, spatialise and then mix resulted in substantially less control over compositional decision-making than I was accustomed to in stereo composition.

As a result, the final version of the work reaches a compromise and uses a combination of mono, stereo and 8-channel sound files, mixed in Nuendo 4[66]. My experience questions the impact that software tools may have on compositional outcome. During the composition of *Spindlesong* I was very aware of software limitations which might hinder the realisation of creative goals. Certain tools seem to favour certain techniques, and this is particularly evident when composing in the non-commercial format of 8-channel sound. While Nuendo 4 was the software which best met my needs at the time,

---

[59] Barrett in Otondo (2007), pp.12.
[60] Barrett (2002), pp.318.
[61] Wishart (1996), pp.231.
[62] A set of Max/MSP based spatialisation tools, built by a number of BEAST (Birmingham ElectroAcoustic Sound Theatre) composers, with most modules intended for 8-channel processing and sound management. http://www.beast.bham.ac.uk/research/tools.shtml
[63] Timothy A. Place's '8 Channel MSP Spatializer'. Available at http://www.cycling74.com/twiki/bin/view/Share/TimPlace.
[64] Available for download at http://www.peterbatchelor.com/maxOrbit.html. Orbit allows for the translation of mono or stereo sounds into multi-channel formats, with flexibility over the distribution of sound across the array. The functionality of allowing sound to rotate around a fixed point is particularly useful. Clatter2to8 allows the user to 'draw' sonic gestures, created using a sample engine. This 8-channel version facilitates the creation of very effective spatial counterpoint.
[65] MusicPanSPace allows for the positioning of multiple sounds across a loudspeaker array. Other features include automation of sound trajectories, EQ and various presets. Available for download at http://www.flomenezes.mus.br/flomenezes/index_flomenezes.html.
[66] An audio production environment built by Steinberg Software. For me, this application offered substantial benefits over sequencing in other audio environments, including the ability to layer mono, stereo and 8-channel sounds, as well as automate the spatialisation of mono and stereo sounds over the 8-channel array using in-built panners.

there were some major frustrations; the in-built panners are in fixed orientation which prescribes a central loudspeaker, and there is minimal flexibility in the placement of stereo images across specific pairs of speakers in the array.

Sound Placement in Circumspace

Mono files are at times used to dramatic effect, often being panned across a number of loudspeakers. This is most frequently the case with the sounds of extended releases of steam (i.e. 2'44), which present spectromophologies that 'accept' the spatialisation attributes of panning across an area of the 8-ring. However, this manner of spatialisation may sound forced or imposed on certain other sounds. Smalley reinforces that 'the motion must be implicit in the sound itself, or the texture itself, or the context itself' and I have endeavoured to adhere to this principle.[67]

On occasion, mono and summed stereo files are allocated to individual loudspeakers for their duration, usually only when there are clusters of gestures spread across the array (i.e. 4'47 – 4'54). In these instances, the stark positioning in one loudspeaker is a fleeting moment, and not immediately noticeable in the context of a composed ensemble space.

---

[67] Smalley, in Austin (2001), pp.17. Although Smalley here refers to sound diffusion (the enacted mode of circumspace), it is logical to suggest a similar relationship between sound and the composition of fixed circumspace.

For this particular work I frequently considered the concentric circle of eight loudspeakers as four pairs from front to rear[68], in the style of a compact diffusion system (see Diagram 3). This idea of approaching 8-channel composition from a stereo perspective has also been also proposed by Barry Truax[69].
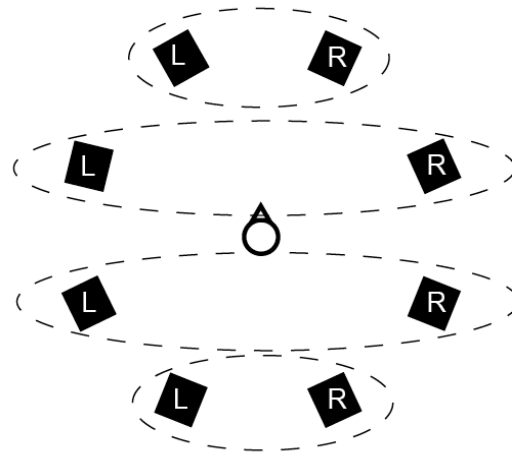
Diagram 3: Multiple stereo groupings in *Spindlesong*

This approach was directly influenced by my experience in stereo sound diffusion, and I frequently applied quasi-diffusion techniques to the arrangement of sound. For example, to create a sudden immersion in sound for the audience, I could place a stereo image on the 'front' pair of loudspeakers then rapidly add duplications of this stereo image over the 'wide', 'side' and finally 'rear' pairs of loudspeakers. As is often the case with diffusion, the work is generally frontal dominant, with loudspeakers one and two (at times in conjunction with three and four) more often used to present a stereo image in isolation than any other pair. It is true that localisation blur increases as a sound moves to the side of the listener, and furthermore to the rear[70]. However, despite such deterioration, a benefit of the layered stereo approach is the retention of symmetry, and to a certain degree, the stereo image. The method proved particularly useful for creating very substantial changes in circumspatial distribution by implementing techniques modelled on diffusion practice.

---

[68] Although the 'double diamond' formation in 8-channel composition is equally popular and other arrangements just as valid.

[69] 'I would like to suggest that the multiple-channel system can be understood as an extension of stereo practice. Eight-channel tape, for instance, can be thought of as four contrapuntal stereo layers...' Truax (1999), pp.145. However Truax follows this with reinforcement of point-source placement as a crucial tool in multi-channel composition.

[70] Blauert (2001), pp.40.

However, in order to expand my spatial palette beyond the permutations available with four sets of stereo sources, I also utilised other sub-groupings[71] of the 8-channel array (Diagram 4 and 5). Stereo sounds could be distributed laterally and also scattered across the array using panning tools within Nuendo 4. While the sounds then lost their 'stereo' characteristics (often due to the overly wide and asymmetric angle of 'left' and 'right' channels in relation to the listener, Diagram 5), this technique of sound placement resulted in variety across the 8-channel array. Much of the time, the sounds used in this manner were not high in the musical hierarchy. They were almost certainly not the focus of attention, and consequently clarity of stereo image reproduction was not vital.
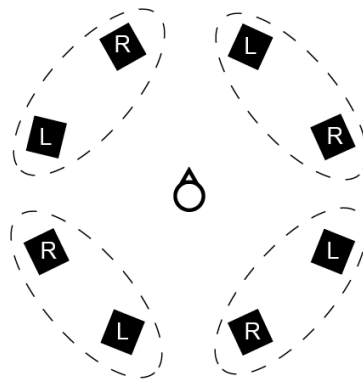
Diagram 4: Example one of sub-groupings for
presentation on an 8-channel array[72]

---

[71] James Mooney applies the term 'coherent loudspeaker sets' (CLS) to such groupings of loudspeakers. Mooney (2004), pp.163.
[72] Diagram 4 shows four possible stereo groups. However, this exact simultaneous formation with four individual stereo sounds would result in very audible subdivision of the circle. Instead, multiple sub-groupings are generally overlapped. However, there is no reason why the formation given could not be utilised for a particular aural result.
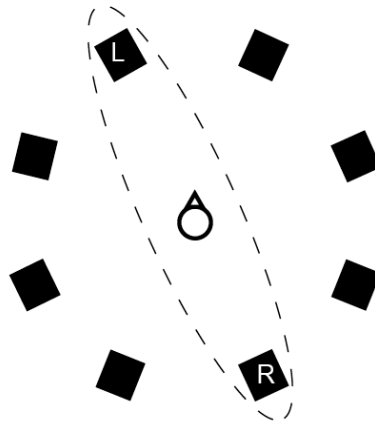
Diagram 5: Example two of sub-grouping for
presentation on an 8-channel array[73]

8-channel sounds were employed to create more subtle distribution of sound over the eight loudspeakers (as opposed to simply duplicating the stereo image four times) and at times they demonstrate audibly automated techniques of spatialisation. This is not heavily utilised in this work, but does occur in the form of cyclical motion, and random panning of sounds (i.e. 10'39).

Material

I had no particular aspiration to create a soundscape work. While the raw recordings were rich with sonic information, I was keen to place my own compositional stamp on the material, to remould it as my own. In terms of the composed space of this work, the integration of environmental-based material and *clean,* processed sound was a major difficulty. The source materials were a mixture of recordings from Quarry Bank Mill, and also found sounds, (a variety of metallic objects which were recorded in the studio). The recordings from the Mill presented rich soundscapes with environmental depth[74], which conjured vivid images in the imagination. However, they proved to be challenging as musical material. Due to the combination of multiple sound objects (including unwanted 'background' sound) within each recorded image and a very characteristic spatial fingerprint of the Mill acoustics, processing created mixed results and in general, there

---

[73] This wide stereo formation is generally used dynamically around the array for particularly animated textures. For the chosen sound material, perceiving an accurate stereo image was not vital.
[74] 'Environmental sounds are not only source material that is rich in acoustic complexity, but also rich in a variety of levels of meaning, both personal and cultural, and possibly even cross-cultural.' Truax (1996), pp.52.

was stark spatial disparity[75] when they were juxtaposed with 'clean' sounds from the studio.

However, quotation is employed as a device to echo directly the acoustics and sonic qualities of the Mill which cannot be synthesised. Ironically, I used the studio-recorded materials to reinforce motion aspects that could not be fully conveyed through the acoustic recordings. There is a deliberate exploration of materials associated with the construction of the mill. Clearly identifiable materials including water (also in the form of steam), metal and wood are major elements and while some of the materials were not recorded in the mill at all, they are still firmly rooted in the identity of the milling industry. Figure 9 presents the layers of material abstraction within the work:

Unprocessed Machinery is used as a direct reference to the Mill, presenting a rich environment which could not be synthesised i.e. 10'58.

Water is used in a textural capacity. Its recognisability and strong referential capabilities emphasise a real location i.e. 1'27–1'32.

Steam is used to colour passages. As a malleable sound material it is used to create trajectories and forward motion, but is also used for extreme panning across the 8-ring i.e. 2'43–3'06.

Wood and Metal. Small fragments of studio recorded sounds are combined to create gestural counterpoint. The abstract temporal arrangement and spatialisation of materials contributes to an imaginary soundworld which is timbrally linked to the Mill i.e. 3'36, 3'39, 3'49.

Processed Machinery most commonly through equalisation and looping alludes to the relentless pulse of the Mill. Overlapping pulses create tension and complex textures i.e. 12'57–13'37.

Resonant drones are found in the Mill itself, however in the work they behave as abstract material, drawing together passages which would otherwise sound fragmented (i.e. disjunct bursts of gestures from 3'40). Low frequency resonances open up perspectival space and allude to the large-scale structures in the Mill.

Increasing abstraction

Figure 9: The reality-abstraction continuum of materials in *Spindlesong*

---

[75] Barrett discusses spatial consonance and conflict in Barrett (2002), pp.319-320.

Traces of the Mill are common; quotations of the original recordings are masked and unveiled amidst even the most abstract of sound-worlds. The relentless pulse of the machinery is found throughout in one form or another, whether real, or alluded to through pitched iterations and internal sound movement.

Structuring

The structure of the work is based heavily on traversing the reality-abstraction continuum detailed in Figure 9 (and its associated spaces), in conjunction with variations in pacing.

The **introduction** (0'00–3'21) commences with water sounds, a reference to the origins of the Mill's power. An imaginary landscape is presented, with references to small-scale machinery through intimate pulses and loops. There are occasional references to greater power, through the sweeps of sound at 0'38, and 2'58. Machinery increasingly takes centre stage and this introductory section concludes with a tense 'winding up' towards a dramatic release at 3'21.

Gestural Development (3'24–6'11)**:** Stillness is initially presented (3'30), but is interrupted by clusters of gestural material. Harmonic stability is provided through extended pitched material, (which is later replaced by pitched pulses from 4'30). At 4'30 increased pacing is established through presentation of a diversity of materials, A contrasting, more expansive perspectival space is revealed twice, at 4'54, and 5'38, which acts as a release from 'close' gestural material. Gestural interplay and counterpoint accumulates and the soundworld becomes increasingly dissociated from the Mill's origins.

A **transition** (6'11–7'55) initially explores distal environments through veiled pitches. The presentation of a ticking mechanism from 7'11 signifies the renewed energy of mechanical materials. Tension is created through overlapping (and seemingly endless) ascending glissandi in the background.

Gestural Development II (7'55–11'23): Gestural counterpoint is recalled at 7'55, again in conjunction with tonal pitch space in the backdrop. Faster pacing is established through greater layering and diversity in sound materials, and more perceptible implications of 'weight' and 'attack'. Rhythmic pulses are more apparent and now overlap. 9'25–10'40 represents the climax of the work, with the phrasing characterised by dense, frantic textures, presented through interruptions and juxtapositions of material and space (a technique first explored in *Anima Machina*). This section is brought to a

close with exploration from 10'36 of almost exclusively 'real' material. However, there is a dramatic shift to abstraction at 11'08.

A further **transition (**11'23–12'56) presents smaller-scale abstract gestures, seemingly unrelated to the Mill's true sounds. Echoes of previous material occur within a mystical and meditative landscape.

Coda (12'55–15'50) Rhythms and pulses are introduced and layered from across the reality/abstraction continuum, although unified pulse is presented from 14'54. This final escalation of energy leads to a release at 15'16, and the machinery 'winds down' as it would in reality.

Circumspatial Consonance and Dissonance

The difficulties encountered when attempting to integrate the different materials in composed space were also echoed when considering the domain of circumspace. Barrett (2002) and Smalley (1991) have both discussed the topic of spatial consonance and dissonance. While spatial dissonance might be most readily perceived in a performance venue, when, for example, a reverberation implied in a sound conflicts with the acoustic of the space in which it is transmitted, the terms consonance and dissonance are arguably just as appropriate for use in the composed space and fixed circumspace.

The projection of the environmental images from Quarry Bank could itself be regarded as spatial dissonance. The original environmental landscape is condensed to a stereo image, then spatialised over eight channels. The convincing reproduction of the original spatial qualities of the sound after its compression to stereo is an extremely difficult task[76]. However, I was not aiming for precision reality-equivalence[77] but a new world of spatial imagery informed by my experience and interpretation of the original context.

Conclusion

Overall, the circumspatial vocabulary over the eight loudspeakers is extremely varied in *Spindlesong*. While one sound may appear in the foreground and its associated spatialisation is consequently highlighted, there may be multiple types of circumspace

---

[76] Malham (2001) pp.31-32.
[77] Had this been an intention, I would have utilised surround recording techniques at the outset, for example using Soundfield's DFS-2 microphone.

occurring simultaneously in the background. In practice the work reflects the great number of tools applied through the research of a novice multi-channel composer. The work was very much a learning process for me, and post-composition this is reflected in some loss of clarity in the resulting spatial image. One theory which might explain this is that by prioritising the composition of fixed circumspace from the outset, other compositional parameters were to a certain degree overlooked. Later I addressed this concern by composing the basic framework of *The Spindlesongs Installation* (also for 8-channels) in stereo before tackling circumspatial possibilities.

2.2 Approaches to the Composition of *Bosonica*, for 5.1 Audio (Composed 2008, Duration: 24'41)

Introduction

This work was informed by three starting points; a desire to explore instrumental sounds as material, an interest in exploring the 5.1 format and a general interest in physics. The decision to use 5.1 spatialisation arose for various reasons, the major one being that it is a commercial format (unlike 8-channel) and is currently the industry standard for 'surround sound'. In addition, the 5.1 medium provides a sufficiently different surround format to compare and contrast this work with the 8-channel and stereo works in the portfolio.

In theoretical physics, Bosonic refers to the original version of 'string theory', developed in the 1960s. Although the initial hypotheses behind Bosonic String Theory have since been expanded and modified, the underlying principle remains intact; that the various properties of matter and force can be thought of as a reflection of the ways in which a string vibrates. The oscillating properties of these hypothetical strings determine the properties of particles and all forms of energy. As such, the theory proposes that the entire world may be composed of these infinitely small vibrating 'strings'.

Material

Bosonica is a sonic exploration of the concepts behind this theory. Taking a somewhat literal interpretation of 'string theory', the sound material which underpins the piece is predominantly sourced from stringed instruments, in particular piano (conventional and prepared), guitar (acoustic and electric) and cello (conventional and extended techniques). Prior to this, I had not used instrumental material as a starting point for any fixed media works. (*Pavakoothu* and *Chemistries*, both involving live instrumentalists, are the exception.) As a result, *Bosonica* might be perceived as a work that stands out in the portfolio with its substantially different 'sound-world'. Much of the instrumental material features in a 'semi-raw' state, with minimal processing, and this is intended to create a sense of clarity, detailing and presence.

The Construction of Gestural 'Chains'

The material is not utilised deliberately for any agential reference, although to some listeners the instrumental material may present ideas of performance and the human involvement in sound creation. Instead I was interested in exploiting and extending the intrinsic physical implications found in the material. In order to do so, I adopted a slightly different style of working with gesture. Gestures do not merely function as articulation devices in the initiation or termination of material (a common purpose in previous works like *Anima Machina* and *Cipher*), but instead compound gestures contribute towards counterpoint and forwards momentum. This technique was directly influenced by being introduced to the music of Randall Smith, notably *Elastic Rebound*. While *Elastic Rebound*, too, utilises stringed instrumental material, I was particularly drawn to Smith's creation of dynamic sequences of gestures. To me, the work projected a vibrant range of physical motions which I had been striving towards in my music, but had not yet mastered. I was confident that a similar spatially active approach to materials would translate well into the 5.1 format, as I had already heard convincing spatial distribution of this kind of material in Thomas Bjelkeborn's *Unplucked* (for 5.1 audio).

As a result in *Bosonica* there is deliberate manipulation of internal sound trajectories (often through simple techniques like varispeed). These sounds are then woven together, overlapping to create dynamic counterpoint, which is later magnified through dynamic distribution over the 5.1 array. From 17'40 to 17'52, for example, an entire phrase is built from overlapping trajectories. The result is a dynamic structure which explores not just a single perspectival plane, but navigates through and around that plane. Within this phrase alone is a complex network of accelerations, ascents and descents, approaches and recessions that interact to present what is essentially the focal point, the two pitch centres at a distance of a semitone.

Instrumental Source-Bonding vs. Abstraction

At times the original properties of the vibrating strings used in the work are very present and recognisable. However the work explores increasing blurring and abstraction, presenting new constructions from the original material, and introducing to the listener dense and abstract dimensions (14'53) alongside the dynamic gestural behaviour. Despite this, the untreated instrumental material consistently returns (6'10 and 16'55) as a reminder that it serves as the building block from which all other sound-worlds are derived.

To balance the aforementioned crisp and close material, abstract *landscape* material is

also present which is intended to 'transcend' beyond the 5.1 array. This material is often characterised by its sustained and reverberant qualities as well as its pitch-centres. It performs a number of functions; it expands the perspectival space of the work through emphasis of distal elements and provides a contrasting spectral palette to that found in gestural materials. It also allows for development of underlying harmonic sequences that contribute towards the structuring of the work (a technique which was first explored in *Topographia*).

Structure

In this large-scale composition, I was keen to avoid composing discrete movements (as heard in *The Spindlesongs Installation*) in order to create a through-composed work more appropriate for concert performance as a complete unit. However, retaining the audience's engagement over the course of a through-composed work of lengthy duration becomes a concern. In order to tackle this, *Bosonica* displays measured variations in pacing and density. The climax of the work can be heard as the build-up towards 21'30, with the least dense section at 16'35, a simple sine tone, which in contrast to the majority of the work, presents a stark and empty void.

The two major aims behind this work were to extend my palette of intrinsic spatial gestures, and to develop further my compositional technique in multi-channel formats. In the musical language here I attempt to exploit fully the intrinsic physical properties and energy of gestures. The work presents several characteristic compositional approaches. These contrasts in harmony, rhythm and extra-musical references also contribute towards the creation of variations of pacing and density in the work (Figure 10).

At the micro-level, pitched fragments are presented, at times creating miniature melodic counterpoint. i.e. 8'12–8'26	**HARMONY**	On the macro-level, extended harmonic sequences underpin structural development. i.e. 14'21–15'40
At the micro-level, asymmetric presentations of gestures generate bursts of spontaneity. i.e. 7'08–7'23	**RHYTHM**	The use of ordered, measured pulse and rhythms contribute to structural coherence. i.e. 14'07–14'33
The presentation of man-made, instrumental sound carries implications of human-agency & *conventional* musical discourse. i.e. 3'21–3'26	**REFERENTIAL**	Transformations of instrumental sounds allude to organic materials: water, wood, and stone. i.e. 15'10–15'32

Figure 10: Harmonic, rhythmic and referential continuums in *Bosonica*

Circumspatial Decisions

The use of 5.1 spatialisation magnifies the perceived kinetic energy of material; small gestural fragments are scattered over the 5.1 array to form accumulative trajectories of sound, and the listener becomes immersed in dark and abstract landscapes generated by the sounds of strings.

The majority of the work was composed in stereo, with 5.1 spatialisation taking place once the structure was in place. Although this stereo-led approach perhaps limited the spatial techniques available (there are no computer-directed techniques employed in the creation of sound, for example dispersion of sound over five loudspeakers, cyclical motion etc.), it allowed me initially to concentrate fully on sound materials and structuring, which might otherwise have been obscured if directing my attention immediately to spatialisation. From a technical standpoint this working method did create some phasing issues when spatialising to 5.1, and additional textural fill was required. However, I felt that the development of material and structure was ultimately more secure than it would otherwise have been.

Kendall and Ardila propose that:

> 'in electroacoustic music the interrelationship of spatial attributes and spatial schemata is often engaged in a play of perceptual grouping that blurs and confounds distinctions like source and ensemble'[78].

This idea relates to auditory scene analysis – the relations of sonic properties on the basis of Gestalt principles of perceptual grouping[79]. It seems logical to apply similar grouping criteria in the spatialisation of sound, with the result being what Kendall and Ardila term a 'nested organisation of spatial relationships'.[80] Following the composition of *Spindlesong* I was more aware of how confusing contradictions in spatial information[81] could be. For this reason I adopted a clearer strategy to circumspace in *Bosonica*. By analysing the function of materials within the work, 5.1 spatial attributes were assigned to the stereo material (Figure 11). By layering materials a spatial hierarchy was created. At any given point certain sound motion/s dominate over others, although this hierarchy is in constant flux as materials emerge and develop, blend and recede.

---

[78] Kendall and Ardila (2007), pp.125.
[79] Bregman (1994), pp. 196-203 in Henriksen (2002) pp.26. The grouping of sounds according to the pereception of similar attributes.
[80] Kendal and Ardilla (2007), pp. 130.
[81] Leider (2007), pp.130.

SOUND OBJECT	CIRCUMSPATIAL FUNCTION
Gesture clusters (formed from conglomerations of micro-gestures)	Extreme mono point panning of individual components to create phantom sound trajectories i.e. 18'03 – 18'10
Medium duration sounds with intrinsic motion trajectories	Mono panning across 2/3 loudspeakers. This is used sparingly due to its stark effect i.e. 2'46 – 2'51
Landscape materials displaying slow evolution	Static stereo placement over 2 or 4 speakers/slow evolution across pairs of speakers i.e. 16'38 – 16'55
High energy textures, exhibiting internal kinetic activity	Scattered stereo panning over all five speakers. Flipping of stereo image. Generally multiple layers of such material are used simultaneously i.e. 8'40 – 8'54

Figure 11: Circumspatial groupings in *Bosonica*

Whilst the spatialisation techniques presented above are all relatively straightforward, certain 'soloistic' materials stand out amongst the textures, and the listener's attention is directed towards these. As a result it seems logical to limit the spatialisation of slowly evolving materials not in the forefront of the sonic image. This will direct further attention to those sounds at the top of the hierarchy, and avoid muddiness in the overall perceived spatial image.

The audience may be deceived into hearing complex shapes and movement not solely as a result of dramatic mono panning, but also through the simple layering of multiple versions of sounds across loudspeakers and, as is the case in sound diffusion, through the careful balancing and shifting of amplitude. What seems to be spatially more convincing is the presentation of rich intrinsic spatial information rather than the artificial imprinting of motion upon 'one-dimensional' sounds through circumspatial variations.

5.1 Specific Issues

In a sense, I have predominantly used the 5.1 array as a quadraphonic setup (front and rear stereo pairs) with the central channel and the LFE used for accentuation. There is more extensive placement of stereo images across the front and rear pairs of loudspeakers than lateral (side) placement, and priority is given to the frontal stereo pair, which is a legacy from my experience in stereo composition and concert diffusion.

I am apprehensive that in the concert hall context the unity of the work over the 5.1 array may be lost as the distance between loudspeakers increases. This is particularly a risk when dramatic point source placement is utilised, as in this work. However, it is common for side reinforcement to be utilised as a solution to this.[82] Harrison and Barrett[83] have also expressed some reservations about the concert hall performance of 5.1 works, but have suggested that in concert dissemination the work could be blended with diffusion techniques, including the duplication of the 5.1 image, and rebalancing of outputs.

---

[82] Stavropoulos (2006), pp.3 and Otondo (2008), pp.79.
[83] '...the use of five loudspeakers in a public space does not offer a large variety of spatial pictures' Barrett (2002), pp.322.

III Non-concert Spaces: The Composition of a Site-specific Installation Work

3.1 The Application of Acousmatic Techniques in the Installation Context: *The Spindlesongs Installation*

(Composed 2008, Duration: 25'52)

Introduction

> 'A genre often (but not always) has a primary focus, or a primary location for its definition. But this is flexible and often permeates into subsidiary locations that might gain in importance and focus, eventually gaining precedence'[84]

Quarry Bank Mill has already been introduced as a source of material and stimulation for the concert work *Spindlesong*. This material was also used in the creation of a large-scale 8-channel installation, presented to the public in the Mill during September 2008. The two works are not 'versions' of each other, but instead stand independently as two works stemming from the same source material.

This site-specific sound installation was an experiment in the dissemination of acousmatic music to a broader audience, in particular non-composers and those who might not have previously experienced electroacoustic music. Quarry Bank Mill is a non-conventional performance space, in fact one which is not in any way intended to be an artistic venue. For this reason the composition of the installation presented very different challenges to the composition of a concert work. I was keen to trace how a performance space radically different to the concert hall might inform and interact with the composed space. In addition, I wanted to examine how territoriality[85] could mediate engagement and reception.

Material

The fixed media 8-channel work was composed using recordings of the machinery in the Mill (that were also utilised in the *Spindlesong* concert work). However, in addition I used recorded interviews with the staff and also recordings of mill workers' recollections,

---

[84] Emmerson (2007), pp.4.
[85] Henriksen (2002) pp.114.

which were sourced from the North West Sound Archive[86] in Clitheroe. The intention was to immerse the listener in a meditative and reflective environment which traced an abstract sonic journey through the sounds of the Mill. For the installation a concentric circle of eight Genelec 1020 loudspeakers was installed (on stands) in a room mid-way through the visitor route through the Mill. Visitors were able to navigate in and around the eight loudspeakers, and had the opportunity to sit within the circle. The audio was played from a laptop running a Max/MSP patch, connected to a MOTU Ultralite mk3 audio interface. As much of the wiring and playback system was hidden as was logistically possible, with cables run against pillars and across the ceiling.

Figure 12: Photograph of *The Spindlesongs Installation* at Quarry Bank Mill
(courtesy of Dr. David Berezan).

The Voice as Persona

The employment of vocal material is a crucial difference between this particular work and the concert work based on sounds of Quarry Bank Mill. The installation is also one of two works in the portfolio utilising vocal material. However, in the *Spindlesongs*

---

[86] The North West Sound Archive: An archive of over 150,000 sound recordings relevant to life in the North West of England. Located at Clitheroe Castle in Clitheroe, Lancashire.
http://www.gmcro.co.uk/other/NWSA/nwsa.htm

Installation the listener experiences a very different presentation of the voice to that which is found in *Cipher*. The voices in this installation are presented as people, conveying information intelligibly to the listener (although in some instances the voice is also used as more abstract musical material, for example the muttering texture which builds between 9'36 and 9'58). The voices contribute utterance space and agential space to the work and serve to create enacted space within a work that is, technically speaking, 'fixed'. In this way, ironically, the disembodied voice functions as embodying the space and encourages a more emotional response to this sound-world[87]. In the style of a radiophonic work[88] I hoped that this would draw in the listener and create a degree of dramaturgy.

However, some degree of ambiguity is retained due to the fact that the voices are presented independently, and often in short phrases. They do not appear to speak to one another, nor do they directly acknowledge or address the listener, and while there are *implications* of narrative[89] (as indeed one could find in a work with no spoken word), narrative does not exist in the conventional sense. In this way the voices act as a guide for audiences who might have otherwise felt alienated by extensive abstract sound. Indeed, Smalley suggests that the application of predominantly remote surrogate spaces carries the danger of alienating the listener through a 'loss of tangibility'[90]. Arguably this is a greater risk when presenting such relationships to a listener untrained in acousmatic listening. For this reason, *The Spindlesongs Installation* presents overall a palette of sound material which is less abstract[91] than that found in its counterpart concert work[92].

Spatial Signatures: Dissonance and Conflict

Several issues arose through the inclusion of the vocal material, particularly in the use of archive recordings. The grain of the archive recordings contributed an unusual perspective, by providing a clue as to the age of the recording, and further emphasising the dominance of social history within the work. However, when such recordings are

---

[87] What Smalley terms a 'reflexive relationship' with sound, Smalley (1992), pp.521.
[88] In many respects this work displays a similar approach as that found in Pippa Murphy's *Pathfinder* (2008), a radiophonic composition which explores the musical communities in rural and isolated areas of Aberdeenshire.
[89] Results from the Intention/Reception research project conducted at De Montfort University suggest that narrative can act as important element in the inexperienced listener's appreciation of a work. Weale (2006), pp.195.
[90] Smalley (2007), pp.83.
[91] John Young's definition of abstraction is that it is 'measure of the psychological distance between a sound which displays source-cause ambiguity and a surmised source-cause model', Young (1994), pp.26.
[92] In addition, abstraction of material is reduced significantly by the performance locality being the source of the sound material.

mediated by 'older' (analogue) recording technology[93], they carry a specific 'spatial signature'[94]. This resulted in some difficulty when trying to integrate this material with other sounds with very different spatial signatures, whether 'clean' processed studio sounds or the environmental recordings of the mill. I was very aware that a result of overlaying these spatial signatures inappropriately can be confusing spatial dissonance. However, these spatial signatures can provide valuable clues in establishing location information, and in an installation context I was willing to sacrifice a limited degree of sound quality in order to exploit this information. Arguably this approach reinforces the radiophonic aspect of the work, with a level of sound quality 'secondary to conceptual originality'.[95]

The Voice as Spatial Signifier

The vocal material is not of the usual 'polished' sound quality which I would strive for in an acousmatic concert work. Small mistakes, including hesitancy and stutters, were retained in the recordings to communicate the 'raw' and 'real' nature of the people behind the memories. The dialects heard in the recordings contribute towards establishing a sense of geographical place and sociological context, aspects that can be difficult to recreate through solely abstract sound.

On occasion, subtle processing techniques are applied to imply a different nature of space through the voice. Processing is used to create imaginary or psychological distance from the voices and simultaneously assists in their integration into more abstract sonic contexts. Techniques involving reverberation, filtering, freezing and overlaying to create delays are all used. Such techniques are particularly prominent in two movements; during the introduction, the voices seemingly emerge from the water and their temporal displacement from the present is emphasised (0'53 – 1'48). In addition, at 8'32–842 and 10'18–10'33 voices are artificially 'distanced', this time to reinforce the semantic theme of deafness caused by the intense noise levels of the mill machinery.

It is interesting to observe that the use of intelligible text is more commonly found in electroacoustic works intended for presentation outside the concert hall. Commonly the voice will be utilised for its sonic properties as opposed to its ability to personify[96].

---

[93] Recordings from the North West Sound Archive were obtained from vinyl record, cassette tape, ¼ inch tape and Betamax formats.
[94] Dow (2003), pp.3.
[95] From the definition of radiophonics on *EARS: Electroacoustic Resource Site*.
[96] One might argue that any use of the voice will create an element of human personification, although abstract applications of spoken word will do so less than utilising complete and intelligible texts.

Arguably text is often considered problematic in concert works due to its literal qualities in a context where ambiguous sound-shapes and imagery tend to dominate. However, in the context of this installation, literal qualities were welcomed.

Spatialisation

In some respects, spatialisation was also used as an accessibility tool[97]. The installation used a concentric circle of 8 loudspeakers, the same as used in the *Spindlesong* concert work. This allowed for the creation of an immersive environment within the space, created using spatial techniques which included, like *Spindlesong*, a combination of point sources, movement of stereo axes, and general 'washes' of sound. The composition of fixed circumspace significantly differed from approaches taken in *Spindlesong*. Like *Bosonica*, I composed the majority of the work in stereo, with spatialisation taking place in the later stages of the compositional process. Due to the nature of the presentation of the work (with no fixed vantage point for the audience), I did not draw so heavily on spatialisation techniques informed by stereo sound diffusion (Diagram 3).

Applied spatialisation techniques include circular motion (18'49), rapid random panning (creating a scuttling effect i.e. 14'41), very clean sweeps of sound (12'40) and very obvious mono point placement (particularly for voice placement). At certain points, I attempt to amplify the motions of the machinery found in the mill into exaggerated spatial gestures, for example the loom side-to-side action was translated into dramatic panning across the circle of loudspeakers (6'22) and amidst spoken references to the water wheel, circular motions are heard (7'31).

From a technical standpoint, the variable vantage point of the audience led me to avoid prioritising any particular set of loudspeakers in the circumspace. Such a simple difference in performance can have a radical impact on compositional decisions[98]. There is far more 'equality' in stereo image placement in this work than in the frontal-biased multi-channel concert works.

Structure

Many sound installations present open forms, where the articulation of time becomes secondary to an experience of place, as Claudia Tittel discusses:

[97] In the intention/reception project based at De Montfort University, UK, it has been found that there is a 'positive response to spatial modulation' (Landy 2007, 40)
[98] As is discussed in Emmerson (2007), pp.155.

'Sound installations are, unlike concerts, temporally unlimited. They are open sound works, open to acoustical ephemeral reception...the musical material does not follow a process or development but exists in time and space. The 'open artwork' is durable and ephemeral at the same time. The composer does not determine the beginning and end of the piece; it is the listener who defines it.' [99]

This is true of the 8-channel sound installations *Memory Like Water* by Matt Rogalsky, *Fly With Me* (2002) by Suk-Jun Kim and Christina Kubisch's *Memory Room* (2008). On the contrary, *The Spindlesongs Installation* retains strong links to the composition tradition by utilising structures audibly 'constructed' and articulated by time. However, the work is intended to be a flexible form allowing for free exploration of any duration by the audience.

The work is structured as a series of short (one to five minute) movements. It is possible that this form presents increased variation to engage listeners who might feel uncomfortable encountering a large-scale through-composed work. Should an audience member wish to stay for a short duration, they may return at a later time, at which point they are likely to experience a different one of the ten movements, which are as follows:

Time Code	Movement
0'00	Voices from the Water
4'04	Living Memory
5'50	Pulsations
7'06	The Waterwheel; A Meditation on Deafness
11'28	The Carder Starts Up
15'25	Dangerous Mechanisms
18'18	The Musical Pulse of Weaving
19'44	Looms and Words
20'18	Steam Power
23'31	Woven Words

Table 1: Movements of *The Spindlesongs Installation*

While in some respects *Voices from the Water* does act as an opening by introducing the site of the Mill, the origins of its power (water), and by gradually unveiling voices, it is not essential that the listener identify this as the beginning. There is intentionally no

---

[99] Tittel (2009), pp.60.

beginning or end to the macro structure, although within the discrete movements there is a sense of progression from start to finish. Each movement explores either a semantic 'theme' (frequently established through the text) or a type of mechanical movement and power found in the Mill. In certain movements spoken word dominates (particularly *Woven Words*); in others sonic imagery is more present, for example *The Musical Pulse of Weaving*.

Transcontextuality

Due to the integration of spoken word, environmental material, and its positioning in an evocative site, this work draws more extensively on transcontextuality[100] than any other in the portfolio. This is developed further through source-bonding, which adds to the transmodal nature of the work by linking the sonic to the visual and haptic. Hence the work is not only sonic, but embraces via sound connections to the mill the geographical, social, cultural and historical implications of that space. Truax has discussed this process in relation to soundscape composition[101] and, accordingly, there is indeed a similarity between this work and the soundscape composition genre:

> 'environmental sound recordings form both the source material and also inform the work at all its structural levels in the sense that the original context and associations of the material play a significant role in its creation and perception.'[102]

However, a major characteristic which differentiates *The Spindlesongs Installation* from the soundscape genre is that listener recognisability of the source material is *not* maintained. The work does, at times, explore very abstract sound-worlds (9'39–9'58 and 16'25–16'55), which in performance are only 'context embedded'[103] through the physical placement of the work in the mill. Therefore, while the work draws on spatial imagery in a similar way as soundscape compositions, it does not fulfil the criteria to be classified as one.

---

[100] Where 'meaning is closely allied to recognising the sources, identifying with them, knowing which context they have been drawn from and reinterpreting their meaning in their new musical context'. Smalley (1997), pp.110.
[101] 'Environmental sound acquires its meaning both in terms of its own properties and in terms of its relation to context.' Truax (1996), pp.52.
[102] Truax (2000), pp.124.
[103] ibid.

Conclusion: Spatial Implications and Layering

The *Spindlesongs Installation* stands out in the portfolio not simply because it is presented in an alternative performance environment, but because it interacts with this environment using a wide range of spatially rich elements in its composed space, as shown in Figure 11.

Spoken Word

- Geographical location is implied through dialect.
- Location in time, whether past or present day is confirmed by verbal content, and the spatial signature of the recording.
- Moderate processing shifts the voice to a different acoustic (perspectival) space and/or implies psychological distance.
- Verbal content provides information to establish a socio-historical context and offers a human angle in an otherwise mechanised sound-world.

Quotation (or perceived quotation) of environmental sound

- Source-bonding with the immediate surroundings facilitates perceived transcendence far beyond the bounds of the speaker ring.
- Source-bonding may recall visual, physical and olfactory sense experiences from the Mill surroundings.

Abstract Sound and Abstract Sound Arrangement

- Arrangement of sound in fixed circumspace may reflect physical motions in the mill, even if the sound material is abstracted.
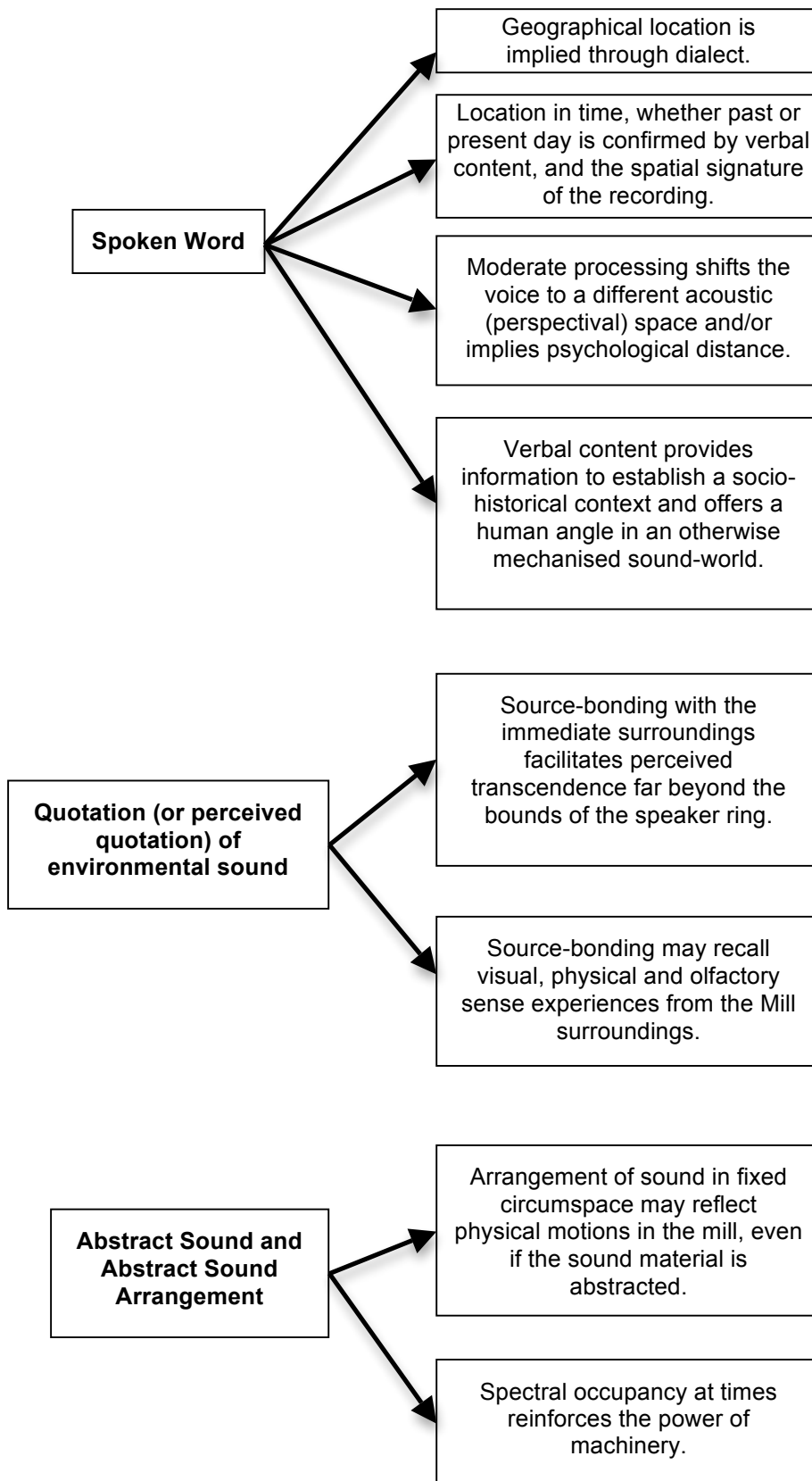- Spectral occupancy at times reinforces the power of machinery.

Figure 13: Spatial implications of materials in *The Spindlesongs Installation*

3.2 Observations on the reception and flexibility of *The Spindlesongs Installation*

It became clear during the installation that in using such a non-conventional space there needs to be some anticipation of practicalities which may be introduced by such a space and its associated audience. Questions include; why will people be in the space? What preconceptions may they bring? How long are people likely to stay? The experience of creating a work for such an environment has highlighted how complex the negotiations can be between the craft and grammar of acousmatic 'concert' composition, personal aesthetic decisions, and new spaces/audiences. This particular type of composition could be considered a kind of architectural task for the composer – combining considerations of physical space, people and function, and in a sense moving away from the dominance of sound-orientated decisions and shifting towards increased consideration of extra-musical factors, and hence extrinsic spaces. Many issues arose which were unique to this work as an installation:

- Frequently there was noise leakage from surrounding exhibits. While this could be interpreted as an intrusion, conversely it could be welcomed as a sonic reference which aided in transcendence of the installation not only beyond the loudspeaker array, but beyond the room boundaries.

- While the sounds of the mill are arguably more vibrant when experienced in reality, due to increased visual and physical information, the source bonds in the installation create a valuable link between the sound and the visitor's experience of the sound producers. As a result, the experience of the installation may become transmodal.

- Variations in volume levels could dramatically alter the experience of the work. The technical set-up allowed for overall volume levels to be set appropriately in relation to the background sound level. As a result the installation could sound ambient, or very 'present' depending on the amplitude. The result was a work either blending with the surrounding soundscape in the Mill, or demanding attention from the visitor.

- Without a subwoofer, much of the richness of the spectrum was lost, as a substantial portion of the source material displays rich low frequency content. A subwoofer might have emphasised further the tactile and physical experience of sound akin to that experienced with the machinery in reality.

- The increasing demands of a multi-media (and visually-dominated) society were reflected through such questions from visitors as 'what else does it do?'

- Unusual sounds carried the risk of sounding 'wrong' to the untrained listener. For example, white noise, glitch, or extreme abstraction may drive listeners away.

- The visual 'spectacle'[104] of the loudspeakers was undesirable as it drew attention to the technological mediation behind the work.

---

[104] As discussed in Emmerson (2007), pp.147. Unfortunately it was impossible to conceal the loudspeakers in the Mill.

IV Performed Space in Electroacoustic Music

4.1 Approaches to Performed Space: *Pavakoothu* for Clarinet, Fixed Media and Electronics.

(Composed 2007, Duration: 10'57)

Introduction

Pavakoothu is a work for amplified B flat clarinet and electronics. By its very nature the work explores the relationship between enacted space (created through the presence of the clarinettist on stage), the composed space of the tape part and the bridge between the two created by live processing in Max/MSP.

The work draws on a programmatic idea of puppetry. The word *pavakoothu* (puppet dance) is used in relation to many types of Indian puppetry. In *Nool Pavakoothu* the string puppets are often large, up to two feet tall, made of wood and often intricately carved[105], while *Thol Pavakoothu* refers to a variation utilising shadow puppetry[106]. Although the construction of the puppets may differ from region to region, the performances are almost always based on tales and legends. In addition, I found the word *pavakoothu* particularly appropriate for the title of a work for clarinet due to its onomatopoetic references to articulation ('kʊ' and 'tʊ').

In the work, the clarinet acts as the puppeteer, initially presented alone in a mystical landscape. Gradually the sound-world evolves to become darker and more dynamic. At this point, the clarinet directs the evolution of the 'puppets', created virtually through a combination of gestural interplay in the tape part and live processing of the clarinet. Following a section of energetic 'dances', the puppets disperse and the work concludes with echoes of their presence in the landscape alongside the solo puppet master.

Material

All material in this work is derived exclusively from the B flat clarinet. I had initially anticipated that additional non-instrumental found-sounds would be required to create the ethereal backdrop for events, and imply the dance movements of the wooden puppets, however the clarinet proved to be a rich source of material. By manipulating

---

[105] Ghosh and Banerjee (2006), pp. 97-98.
[106] Ghosh and Banerjee (2006), pp. 71.

the recordings of extended clarinet techniques, this source-material was transformed to create percussive materials and airy and otherworldly qualities of sound. The tape part is very much influenced by my compositional approaches to acousmatic music.

The clarinet part was written recognising the fact that extended techniques formed the basis of much of the tape part. As a result, extended techniques[107] are utilised heavily in the clarinet writing. Nevertheless pitch and tonality are equally important, and give the clarinet a distinctive voice in the sonic landscape. Often pitch is *coloured* by specified breathy tone colour, variations in speed and depth of vibrato, flutter tonguing and accelerating or decelerating trills. In addition, there are some elements of improvisation created by the undetermined pitching of certain gestures, for example at 2'03.

The part calls for extremes in register and dynamic range, alongside very animated playing to create the 'character' of the puppeteer and seemingly invoke the puppet dances. Wide *crescendi* and *diminuendi* are utilised extensively to create the impression of emergence and disappearance of the clarinet into the sonic landscape. Short bursts of gestural material (such as those at 2'02 and 2'20) intersperse these and allude to more lively activity which follows.

Frequently the instrumental writing is intended to display two characters simultaneously, almost schizophrenically, through the presentation of two sets of material concurrently. This can be heard at 3'35, where a murmuring *sotto voce* texture is contrasted with full-tone utterances. A similar approach is found between 4'30 and 5'12. Here, stark high register gestures which stand out against the middle-register melody are sampled and layered to create a phantom clarinet voice. This quasi-polyphonic approach occurs a third time, albeit in a less extreme form, between 6'45 and 7'25. A more subtle idea of duality is created through harmonisation and pitch shifting in the electronics (i.e. 2'05, where a descending glissando emerges below the performer's actual sustained pitch.)

While the clarinet is essentially a monophonic instrument[108], such writing serves to contribute multiple layers to an acousmatic environment already exhibiting numerous motion behaviours. The overall intention is to create sonic allusion to awkward scattered movements of the puppet dance.

The first moment of true stillness occurs at 9'33. Prior to this, there is constantly an underlying tension, even in sustained notes. Through these, internal movement has consistently been generated through the techniques of flutter tonguing, variations in vibrato and note-bending.

---

[107] Exaggerated articulation, note-bending, key-clicks
[108] Although the clarinet's limited polyphonic capabilities are exploited towards the conclusion of the work through the use of multiphonics.

Structure

The overall arc of the work, peaking with the dance of the puppets, has already been described. However, more specifically the work can be regarded as a number of sections:

The **opening 'scene'** (0'00–3'33) introduces an abstract and mysterious sound-world. While the clarinet initially blends with these surroundings, by 2'20 it has established itself as a soloist in this arena.

⬇

Transition (3'33–4'33): New material in the clarinet displays greater motion behaviour and heightened tension.

⬇

Dance 1 (4'33–5'12): Increasingly percussive material is heard in the tape part. Animated writing in the clarinet reaches a dramatic climax at 5'07.

⬇

Dance 2 (5'13–7'18): In this second dance, the origins of the puppets from the clarinet puppet-master are explored. A percussive and twisted sound-world emerges through live buffering and layering of the clarinet.

⬇

Dance 1B (7'10–8'06): Material from Dance 1 is recalled. However there is a gradual reduction in pacing and energy.

⬇

Transition (8'06–9'52): The clarinet adopts a textural rather than soloistic role as the landscape materials from the opening re-emerge in the tape part.

⬇

Coda (9'52–10'50): A closing theme in the clarinet (again based on material from Dance 1) is followed by recession of material in the tape part to a conclusion.
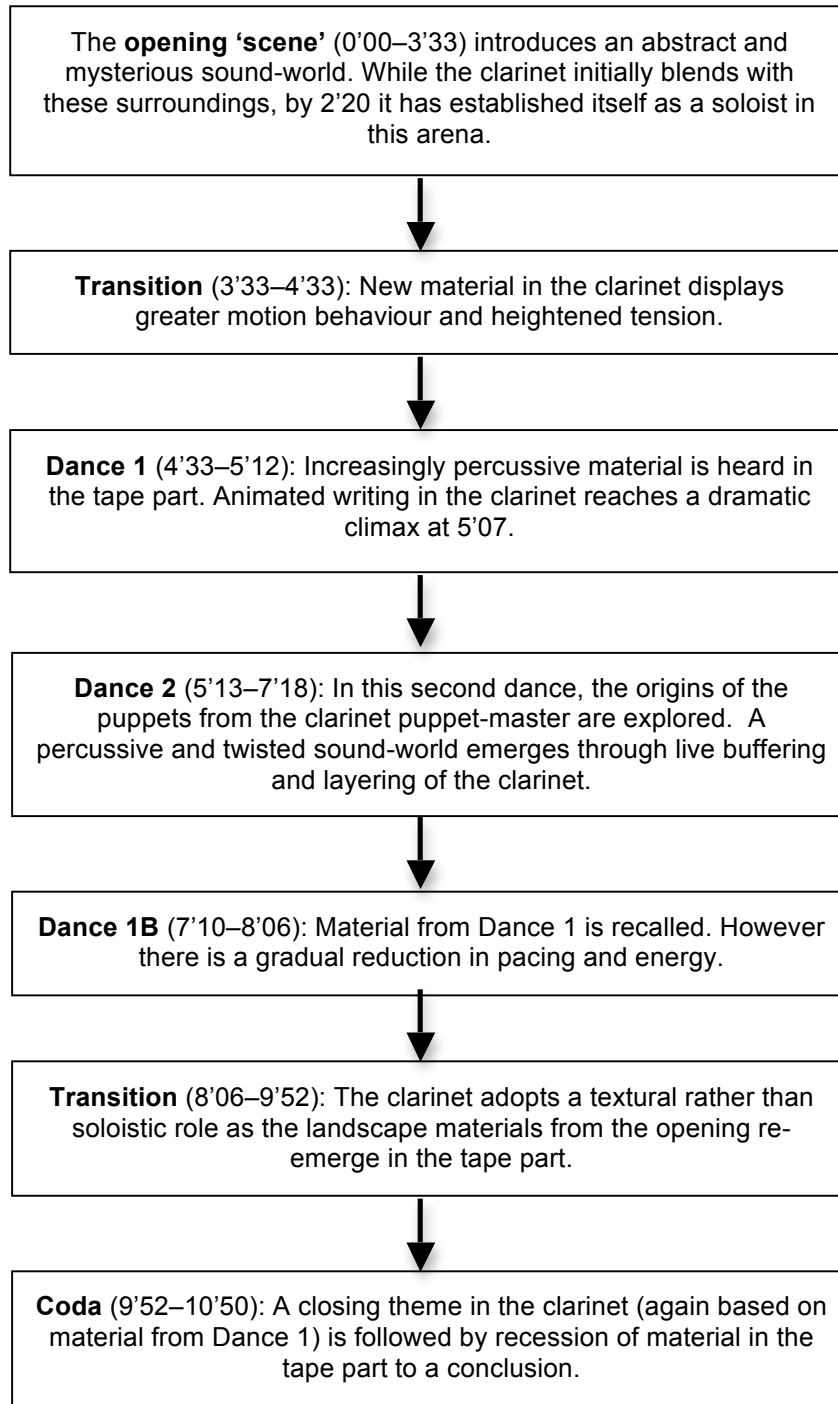
Figure 14: Structural analysis of *Pavakoothu*

The Score

The score uses proportional notation, which allows for notation of events to correspond with the tape part in a way not possible within a conventional metrical framework. It was felt that this would create greater unity between the clarinet and the inherently organic materials found in the tape part. The clarinet stave is notated above a graphic interpretation of the tape part, which serves to guide the performer through its progression, and aids synchronisation between the two at certain points. In performance, the performer may be given a time-code display to confirm their position in the score.

Although in theory the performer could perform the work with only this time-code (and no graphic representation), I felt it was important for the performer to be aware of the acousmatic part and be able to follow its progression, development and relationship to their role. A familiarity and understanding of the sound organisation is far more beneficial than a stopwatch at points like 6'32–6'40, where synchronicity can only truly be achieved through acquaintance with the organic timing of events.

Lines of Intersection between Clarinet and Fixed Media

The tape part is a through-composed stereo track. Ultimately, due to its fixed nature, this track dictates the temporal progression of the work, and the clarinet 'follows' its timeline. However, synchronisation points between the clarinet and the tape part are intended to create a sense of spontaneity by articulating causal relationships.

A number of techniques were utilised to blend the acousmatic tape part and the clarinet including:

Pitch Correspondences: Tonal pitch space dominates in the 'landscape' sections of this work. A pitch relationship is established at the outset, when the clarinet's initial note is mirrored in a pitch-centre found in the tape part. Further correspondences occur throughout the work, including 0'40, 1'59, and 4'41. In addition, the acousmatic part often provides pedal points (e.g. 7'10–7'50) and subtle harmonic progression (e.g. 1'49–2'03) created by resonant pitch-centred material. These provide further opportunities for the clarinet and tape part to blend through tonal pitch-space.

Synchronisation of the Live and Fixed: Similar materials in the clarinet and tape part are aligned to create the illusion of *connectivity*. This technique is most prominent between 6'29 and 6'40, where the rhythms of both parts are intended to match directly,

and again between 5'04 and 5'12 where both the behaviours and a dramatic termination align.

Causal[109] Relationships: Frequently wide crescendi are scored for the clarinet, followed by a dynamic burst of sound in the tape part. It is intended that these bursts seem generated by the preceding progression of the clarinet. Examples of such causality are found at 2'35–2'42 and 2'57–3'06.

In some cases such perceived (but essentially 'constructed') 'interactivity' between the clarinet and the virtual sound-world could not be pre-prepared, as because of some flexibility in the live part (i.e. improvisatory elements or flexible timing) it would be either impossible to anticipate a suitable 'interaction' in advance for integration in the tape part, or to coordinate timing with the required precision. In addition, the sound produced by each clarinettist may be specific to their instrument and playing technique. For a causal relationship to function effectively it may be useful to use exactly the *same* clarinet sound. Again, such subtleties cannot always be pre-composed into the tape part. In these instances, live electronics are used for their ability to create what cannot be created in advance.

---

[109] Causality 'is more concerned with one sound's acting upon another, either causing the second event to occur or instigating change in an ongoing sound'. Smalley (1996), pp.88.

The Electronics

The work uses a modular processing patch built in Max/MSP, which applies certain types of processing throughout the work. (The patch is included on a Data CD.)

Figure 15: Screenshot of Max/MSP processing patch for *Pavakoothu*

The processing performs a number of functions:

- **To mask** the dry and present quality of the live instrumentalist, as a means of blending the clarinet and the tape part.

- **To create immediate causal relationships**, reinforcing 'interactivity' between the sound-worlds.

- **To 'extend' the clarinet.** For example, a texture initiated by the clarinet may be developed through processing into a denser and more dynamic texture impossible to produce acoustically.

There are also some practical aspects integrated into the patch:

- Up to four microphone inputs. (In performance, three have generally been used; two condenser microphones on either side of the clarinet, and a third compact 'clip-on' microphone attached to the performer, to capture the sounds of key-clicks.)

- The ability to alter the mix of dry clarinet[110], processed clarinet and tape part.

- The ability to 'jump' to certain cues or points in the tape.

The presets are stored using the pattr object, and recalled at the cue points in the score by pressing the space bar. A number of processing techniques are utilised. (Most of these are concealed in the inner workings of the patch and are therefore not visible on the user interface, as shown in Figure 15.)

- **Buffering:** This is used in the middle 'dance' section to extend textures established by the clarinet into more dynamic and irregular textures. Used multiple times, this builds up a dense sound-world which clearly originates from the clarinettist on stage (5'13–6'40).

- **Delay Lines:** Depending on the delay times, these either exaggerate short gestures through rapid and irregular repetition (6'46–7'03) or, conversely, longer delay lines assist in the build-up of textures. Filter taps behave in a similar way, but spectral filtering creates less obvious delay (0'05–0'45) and a resonant quality of sound.

- **Freezing:** Used in 'landscape' sections, this facilitates harmonic layering based on the clarinet's note being artificially 'held' once it has moved to another. Between 4'38 and 5'00 it is used to 'capture', loop and layer short gestures, creating a stuttering echo of the clarinet.

- **Granulation:** This is frequently used to add fluctuating textures to sustained notes (1'19–1'55). Parameters are controlled via amplitude tracking (i.e. a louder sound will have a smaller grain size and greater grain variation). Pitch shifting is occasionally added.

---

[110] Amplification is crucial in performance, as it 'reveals' sounds which might not otherwise project, for example multiphonics and key-clicks.

The real-time processing does not adopt such a large role in this work as is found in the repertoire of other composers, particularly those who specialise in live electronics (e.g. Andrew May, Russell Pinkston, or Michael Edwards). This reflects my reservations regarding sound quality when working with real-time processing. Having composed acousmatic music for a number of years, I am now accustomed to the control and precision of sound which is offered when working with fixed media. I was aware that extensive utilisation of live processing would result in some aural disparity between this and the sculpted acousmatic identity of the tape-part.

Mixed-Music Approaches

Convincing integration of all elements in this work is complicated by spatial disparities between the artificial (and stylistically acousmatic) nature of the tape part and the acoustically coloured[111] instrument with its amplified partner[112]. It is inescapable that the 'ambiguous stationary'[113] nature of the clarinet will result in some spatial dissonance when superimposed with the vast fluctuating perspectival spaces in the tape part. Simon Emmerson suggests that:

> 'The degree to which spatial dislocation is used can become part of the composer's range of options but care must be taken to understand the consequences to the perceiver of any time delay between visual and aural cues' (Emmerson 2007, 124).

So while spatial dislocation could in theory be used creatively it seems that synchronicity, or illusions of synchronicity can be a crucial element in 'tying' spaces together. Attention can be diverted away from spatial dissonance and towards causality[114] (a powerful tool for the acousmatic composer, but perhaps even more so for the mixed composer). In *Pavakoothu* such synchronisation points do exist (as detailed above), but due to the reliance on time-code or the player's knowledge of the tape part, there is the potential for such synchronisation points to be obscured and lose their impact.

In a work composed later in the same year (2007), I opted to explore the idea of constructed causality further. *Chemistries* for flute, violin, cello, accordion and electronics draws on causal relationships perceived as interactive, but which are in reality generated through careful synchronisation of the tape part, which is subdivided

---

[111] Through the acoustics of the performance space
[112] Emmerson (2007), pp.105.
[113] Emmerson (2000), pp.207.
[114] Smalley (1992), pp.526.

into a number of short sections. By using triggered causal relationships and gestural interplay[115] as an alternative to live processing, the acousmatic material became far more strongly linked to the live instruments, even through both display independently very different aspects of space-form. Due to my ongoing reservations with sound quality when using real-time processing, I was more comfortable with this approach.

---

[115] These devices are employed extensively by João Pedro Oliveira in his instrumental compositions, including *Labirinto* and *Time Spell*.

Conclusions

'Space is social, for each society produces its own space, space simultaneously mental and physical. Space is always produced, in the sense that it is always a set of relationships, never a given, never inert or transparent, never in a state of nature untouched by culture. There is no such thing as an empty space'[116]

Space remains an elusive parameter in music, because of its links to perception and a reliance on modes of listening. Indeed Smalley's article on space-form has highlighted how wide-ranging space is as well as its ability to be created at all levels of composition and performance. While terminology may assist in discussions on the construction and interactions of space in acousmatic work, due to the vast array of implied and real spaces from the micro level of a sound-object to the macro level of complex landscapes, coupled with perceptual hierarchies and contextual source-bonding, words are often inadequate in 'defining' the spatial experience for the listener.

However by adopting an analytical approach to my compositions, I have formed a greater understanding of spatial layering in my works. I have endeavoured to create increased complexity, evolution and interaction between layers in composed space in order to produce works which almost 'spatialise themselves'. I have begun to establish a scheme of translation of these composed elements into circumspace. Here this 'final act becomes the most crucial of all'[117] given that all internal space relies on aspects of the performance site, which is anything but neutral, for clarity of transmission.

Clarke comments that:

'the recognition that a listener's sense of meaning in music is powerfully bound up with his or her experience of being subjectively engaged (or alienated) by the music, and with the varieties of subjective states that music can afford. An important component of that subjective engagement with music is its corporeal, proprioceptive and motional quality, which may on occasion provide listeners with experience of "impossible worlds" that have some of the same attractions as do other forms of virtual reality'.[118]

A major reason that I compose acousmatic music is the exciting opportunity to engage the listener through the communication of virtual spaces. A key aim of this research has

---

[116] Wiles (2003), pp.10.
[117] Smalley (1986), pp.92.
[118] Clarke (2005), pp.90. In footnotes, Clarke refers specifically to electroacoustic music as an example of this in practice.

been to establish a compositional vocabulary which allows me to create and explore the composed space and circumspace. Some of these techniques have included:

- **Spectral Space**: I have developed the technique of spectral layering to create 'planes' which articulate proximity and distance. Masking and revealing planes can reinforce approach and recession, while gradual transformation of a spectral layer may create gravitational 'forces' towards a plane. I have increasingly looked to using pitch-centred sound, a subcategory of spectral space, to create harmonic progression, and used glissandi to reinforce gravitational pulls.

- **Rhythm**: I have increasingly employed looping and patterning as a means of creating stability, while utilising their potential as structuring devices.

- **Gesture/Ensemble Space**: A major development in my recent work has been the linking and overlapping of gestures with clear motion trajectories in order to create dynamic 'strings' which may traverse spatial planes.

- **Source-bonded space**: I have discovered the potential offered by exploiting the spatial inferences of source recognition and drawing on transcontextual associations.

- **Agential Space**: Certain works in the portfolio have drawn on agential affordances, either directly, through the integration of 'human' produced elements, or more abstractly, through gestures exhibiting inherently organic behaviours.

- **Fixed circumspace**: I have devised spatial hierarchies in my multichannel compositions which serve to lead the listener through composed spaces with a greater degree of clarity.

However, as a composer my primary aim was to produce original new music, which concurrently challenged my personal understanding of space, not only at an internal musical level, but also taking into account the performance environment. In doing so, my music has been taken in new directions. I have established a vocabulary of techniques in stereo and multi-channel composition which acts as a platform for me to continue research in this area.

Bibliography

Austin, Larry (2000), 'Sound Diffusion in Composition and Performance Practice: An Interview with Denis Smalley, *Computer Music Journal* **24**(2), Massachusetts: MIT Press, pp.10-21.

Austin, Larry (2001), 'Sound Diffusion in Composition and Performance Practice II: An Interview with Ambrose Field', *Computer Music Journal* **25**(4), Massachusetts: MIT Press, pp.21-30.

Bahn, Curtis; Hahn, Tomie and Trueman, Dan (2001), Physicality and Feedback: A Focus on the Body in the Performance of Electronic Music in *Proceedings of the 2001 International Computer Music Conference – Havana, Cuba*, San Francisco: ICMA, pp.44-51.

Bandt, Ros (2006), 'Sound Installation: Blurring the Boundaries of the Eye, the Ear, Space and Time', *Contemporary Music Review*, 25(4), London: Routledge, pp.353-365.

Barbour, Jim (2002) 'Applying Aural Research: the aesthetics of 5.1 surround', *Form Space Time: Music Architecture and Design: Proceedings of the Australasian Computer Music Conference*, Melbourne: ACMA, pp.17-24.

Barrett, Natasha (2002), 'Spatio-musical Composition Strategies', *Organised Sound* **7**(3), Cambridge: Cambridge University Press, pp.313-323.

Bass, Sarah (2009), *Introduction to a PhD research project on Sound Diffusion* (Unpublished research), Belfast: Queens University.

Bayle, François (2007), 'Space, and more', *Organised Sound* **12**(3), Cambridge: Cambridge University Press, pp.241-249.

Blauert, Jens (2001), *Spatial hearing: the psychophysics of human sound localization*, Massachusetts: MIT Press.

Clarke, Eric F. (2005), *Ways of Listening: An Ecological Approach to the Perception of Musical Meaning*, Oxford: Oxford University Press.

Clozier, Christian (2001), 'The Gmebaphone Concept and the Cybernéphone Instrument' in *Computer Music Journal*, **25**(4) (trans. Justice Olsson), Massachusetts: MIT Press pp. 81-90.

Dack, John (2003), 'Sound, Installations and Music', in *MAXIS II Conference Proceedings*, Leeds: University of Leeds, pp. 35-39.

Dow, Robert (2003), 'Sound Diffusion and the Sonic Image', *Diffusion*, London: Sonic Arts Network, pp.2-6.

Dow, Robert (2004), 'Multi-channel sound in spatially rich acousmatic composition', *Proceedings of the 4th Conference on Understanding and Creating Music*, Caserta, Italy: Seconda University de Napoli, pp. 23-26.

Drexler, K. Eric (1986), *Engines of Creation: The Coming Era of Nanotechnology*, New York: Anchor Books.

EARS Electroacoustic Resource Site, http://www.ears.dmu.ac.uk (accessed 9 September 2009).

Emmerson, Simon (1998), 'Aural Landscape, Musical Space', *Organised Sound*, **3**(2), Cambridge: Cambridge University Press, pp.135-140.

Emmerson, Simon (2007), *Living Electronic Music*, Aldershot: Ashgate.

Emmerson, Simon (2007), 'Where next? New music, new musicology', *Proceedings of the Electroacoustic Music Studies Network Conference*, Leicester: EMS, pp.1-6.

Ghosh, Sampa and Banerjee, Utpal K. (2006), *Indian Puppets*, New Delhi: Abhinav Publications.

Harrison, Jonty (1998), 'Sound, space, sculpture: some thoughts on the 'what', 'how', and 'why' of sound diffusion', *Organised Sound*, **3**(2), Cambridge: Cambridge University Press, pp. 117-127.

Harrison, Jonty (1999), 'Imaginary Space – Spaces in the Imagination', *Imaginary Space: Proceedings of the Australasian Computer Music Conference*, Wellington: Victoria University of Wellington, pp.7-15.

Henriksen, Frank Ekeberg (2002), *Space in Electroacoustic Music: Composition, Performance and Perception of Musical Space*, PhD Thesis, London: City University.

Justel, Elsa (2002), *Space As Structural Function In Electroacoustic Music*, Form, Space, Time: music architecture and design (Proceedings of the Australasian Computer Music Conference), Melbourne: ACMC, pp.153-164.

Kendall, Gary S. and Ardila, Mauricio (2007) ' The Artistic Play of Spatial Organization: Spatial Attributes, Scene Analysis and Auditory Spatial Schemata in *Proceedings of the 2007 International Computer Music Conference*, Copenhagen, Denmark: ICMC, pp.63-68.

Iosafat, Dani (2009), 'On Sonification of Place: Psychosonography and Urban Portrait', Organised Sound, **14**(1), Cambridge: Cambridge University Press, pp.47-55.

LaBelle, Brandon (2006), *Background Noise: Perspectives on Sound Art*, London: Continuum.

Landy, Leigh (2007), *Understanding the Art of Sound Organization*, Massachusetts: MIT Press.

Leider, Colby (2007), 'Multichannel Audio in Electroacoustic Music: an Aesthetic and Technical Research Agenda, *2007 IEEE International Conference on Multimedia and Expo*, Beijing: ICME, pp.1890-1893.

MacDonald, Alistair (1998), 'Performance Practice in the Presentation of ElectroAcoustic Music', *Sonic Arts Network Journal of Electroacoustic Music* 11, London: Sonic Arts Network, pp.21-24.

Malham, David G. (2001), 'Toward Reality Equivalence in Spatial Sound Diffusion', *Computer Music Journal*, **25**(4), Massachusetts: MIT Press, pp. 31-38.

Mooney, James (2005), *Sound Diffusion Systems for the Live Performance of Electroacoustic Music*, PhD Thesis: University of Sheffield.

Moore, Adrian, Moore, Dave and Mooney, James (2004) 'M2 Diffusion – The live diffusion of sound in space' in *Proceedings of the 2004 International Computer Music Conference,* San Francisco, CA: ICMA, pp.316-320.

Moore, Adrian (2007), 'Making choices in electroacoustic music: bringing a sense of play back into fixed media works',
http://www.shef.ac.uk/content/1/c6/04/14/88/ajmICMCfinalfracture.pdf (accessed 9 September 2009).

Moore, Brian C. J. (2003), *An Introduction to the Psychology of Hearing*, San Diego: Academic Press.

Myatt, Tony (1998), 'Sound in Space', *Organised Sound*, **3**(2), Cambridge: Cambridge University Press, pp.91-92.

Otondo, Felipe (2005), 'Some Considerations for Spatial Design and Concert Projection with Surround 5.1', *Organised Sound*, **13**(1), Cambridge: Cambridge University Press, pp.77-81.

Otondo, Felipe (2007), 'Creating Sonic Spaces: an interview with Natasha Barrett' *Computer Music Journal*, **31**(2), Massachussets: MIT Press, pp.10-19.

Otondo, Felipe (2007), 'Recent spatialisation trends in electroacoustic music', *Proceedings of the Electroacoustic Music Studies Conference*, Leicester: EMS.

Parise, Cesare and Spence, Charles (2009) 'When birds of a feather flock together: synesthetic correspondences modulate audiovisual integration in non-synesthetes', *PLoS ONE* , **4**(5), e5664.

Parry, Nye (2003), 'The Relocation of Concrete Music in the Environment Boomtown and Living Steam: Two Site Specific Music Installations', *Global Village-Global Brain-Global Music (Proceedings of the KlangArt-Kongress 2003),* Universität Osnabrück, pp.370-381.

Prior, David (2007), 'A Space for Sound: the Rise, Fall and Fallout of the Concert as a Primary Space for Listening' in *In the Place of Sound: Architecture, Music, Acoustics* (ed. Colin Ripley), Cambridge: Cambridge Scholars Publishing, pp.125-133.

Rebelo, Pedro (2003), 'Performing Space', *Organised Sound*, **8**(2), Cambridge: Cambridge University Press, pp.181-186.

Sazdov, Robert; Paine, Garth and Stevens, Kate (2007), 'Perceptual Investigation into Envelopment, Spatial Clarity and Engulfment in Reproduced Multi-Channel Audio', *Proceedings of the Audio Engineering Society 31st International Conference*, London: AES, (CD-ROM).

Smalley, Denis (1986), 'Spectro-morphology and Structuring Processes' in *The Language of Electroacoustic Music* (ed. Simon Emmerson), London: Macmillan, pp.61-96.

Smalley, Denis (1991), 'Spatial Experience in Electro-Acoustic Music', *L'Espace du son II* (Special edition of *Lien, revue d'esthetique musicale*) (ed. Francis Dhomont), Brussels: Musiques et Recherches, pp.121-124.

Smalley, Denis (1996), 'The Listening Imagination: Listening in the electracoustic era', *Contemporary Music Review*, **13**(2), London: Routledge, pp.77-107.

Smalley, Denis (1997), 'Spectromorphology: explaining sound-shapes', *Organised Sound*, **2**(2), Cambridge: Cambridge University Press, pp.107-126.

Smalley, Denis (2007), 'Space-form and the acousmatic image' *Organised Sound* **12**(1), Cambridge: Cambridge University Press, pp. 19-20.

Stavropoulos, Nikos (2006), 'Multi-Channel Formats in Electroacoustic Composition: Acoustic Space as A Carrier of Musical Structure', *Proceedings of the Digital Music Research Network Conference 2006*, London: Goldsmiths College, University of London.

Tittel, Claudia (2009), 'Sound Art as Sonification, and the Artistic Treatment of Features in our Surroundings', *Organised Sound*, **14**(1), Cambridge: Cambridge University Press, pp.57-64.

Toole, Floyd E. (2008), *Sound Reproduction: Loudspeakers and Rooms*, Oxford: Focal Press.

Truax, Barry (1996), 'Soundscape, Acoustic Communication and Environmental Sound Composition', *Contemporary Music Review*, **15**(1), London: Routledge, pp.49-65.

Truax, Barry (1999), 'Composition and diffusion: space in sound in space', Organised Sound, **3**(2), Cambridge: Cambridge University Press, pp.141-146.

Truax, Barry (2001), 'The aesthetics of computer music: a questionable concept reconsidered', *Organised Sound*, Cambridge: Cambridge University Press, pp.119-126.

Tutschku, Hans (2002), 'On the Interpretation of Multi-Channel Electroacosutic Works on Loudspeaker Orchestra: Some Thoughts on the GRM-Acousmonium and BEAST', *Journal of Electroacoustic Music*, Vol.14, London: Sonic Arts Network, pp.14-16.

Wiles, David (2003), *A Short History of Western Performance Space*, Cambridge: Cambridge University Press.

Windsor, William Luke (2000), 'Through and around the acousmatic: the interpretation of electroacoustic sounds' in *Music, Electronic Media and Culture* (ed. Simon Emmerson), Aldershot: Ashgate, pp.7-35.

Windsor, William Luke (1995), 'A Perceptual Approach to the Description and Analysis of Acousmatic Music', PhD Thesis, City University, London.

Wishart, Trevor (1996), *On Sonic Art* (ed. Simon Emmerson), Amsterdam: Harwood.

Young, John (1994), 'The Extended Environment', Proceedings of the International Computer Music Conference 1994, San Francisco: ICMA, pp.23-26.

Young, John (2004), 'Sound Morphology and the Articulation of Structure in Electroacoustic Music', *Organised Sound*, 9(1), Cambridge: Cambridge University Press, pp. 7-14.

Young, John (2007), 'Reflections on Sound Image Design in Electroacoustic Music', Organised Sound 12(1), Cambridge: Cambridge University Press, pp.25-33.

Zvonar, Richard (2004), 'A History of Spatial Music', eContact! **7**(4) http://cec.concordia.ca/econtact/Multichannel/index.html (accessed 9 September 2009).

Discography

Batchelor, Peter (2005), 'Kalaidescope Arcade' (stereo mix) on *Reflections*, C3R, C3R 014. (8-channel version provided by composer).

Berezan, David (2004), 'Styal' on *La face cachée*, empreintes DIGITALes, IMED 0896.

Bjelkeborn, Thomas (2008), 'Unplucked' (5.1, unpublished, provided by the composer).

Gobeil, Gilles (1993-94), 'La Vertige Inconnu', on *La mécanique des ruptures*, Empreintes DIGITALes, IMED 9421.

Gobeil, Gilles (1995), 'Nuit Cendre'*,* on *...dans le silence de la nuit…*, Empreintes DIGITALes, IMED 0155.

Gobeil, Gilles (1997), 'Point de passage', on *…dans le silence de la nuit…*, Empreintes DIGITALes, IMED 0155.

Harrison, Jonty (1999 - 2006), 'ReCycle' (5.1 version) on *Environs*, empreintes DIGITALes, IMED 0788.

Mahtani, Annie (2008), 'Past Links' (8-channel, unpublished, provided by the composer).

Murphy, Pippa (2008), 'Pathfinder' (unpublished, provided by the composer).

Oliveira, João Pedro (2001), 'Labirinto' for string quartet and tape, on *Cultures électroniques 16: Prix Magisterium et Prix Trivium, 29e Concours international de musique et d'art sonore électroacoustiques, Bourges 2002*, LDC 278 076/77.

Oliveira, João Pedro (2004), 'Time Spell' for clarinet and tape, on *Música Maximalista Vol. 12: VI CIMESP 2005*, PANaroma, SPAN 199020737.

Smith, Randall (1995), 'Elastic Rebound' on *Sondes*, Empreintes DIGITALes, IMED 9948.

Smalley, Denis (1987), 'Wind Chimes', on *Impacts intérieurs*, empreintes DIGITALes, IMED 0409.

Smalley, Denis (1991 - 92), 'Valley Flow', on *Impacts intérieurs*, empreintes DIGITALes, IMED 0409.

Stavropoulos, Nikos (2004), 'Atropos' (5.1, unpublished, provided by the composer).

Stavropoulos, Nikos (2007), 'Polychoron' (5.1, unpublished, provided by the composer).

Peter Stollery (2003), 'Vox Magna' on *Un son peut en cacher un autre*, empreintes DIGITALes, IMED 0678.

Tutschku, Hans (2008), 'Zwei Räume' (24-channel, unpublished, provided by the composer).

Appendix A: List of Portfolio Works & Supplementary Compositional Work

Portfolio Works

Anima Machina (2006), stereo fixed media	12'58
Cipher (2007), stereo fixed media	11'42
Pavakoothu (2007) for clarinet and electronics	10'57
Topographia (2008), stereo fixed media	9'31
Papyrus (2008), stereo fixed media	8'23
Spindlesong (2008), 8-channel fixed media	15'57
The Spindlesongs Installation (2008)	25'52
Bosonica (2009)	24'41

Supplementary Compositional Work

For the purposes of this commentary I have focussed on the composition and performance tradition of acousmatic music. However, throughout the course of the three year research period I have also undertaken a variety of cross-disciplinary and collaborative projects, the details of which can be found in Table 2. These other works, which span video, dance, theatre, laptop performance, soundscape and installation art forms, have greatly informed my compositional outlook. They have provided platforms for the implementation of new ideas and allowed me to present my work in alternative forms to new audiences. To give one example, I have frequently utilised the Max/MSP tools which I designed for laptop performance to improvise and create material for fixed-media works. In addition, the fixed media work *Papyrus* stemmed directly from the composition of a substantial soundtrack for a site-specific theatre production. Arguably most importantly of all, the process of working with practitioners from a range of artistic backgrounds has broadened my understanding of how acousmatic music is situated in the larger framework of the arts.

Title	Nature of project	Collaborators (if appropriate)	Date
Laptop improvisations	Live laptop performances in venues across the U.K.	Manuella Blackburn, Sam Salem, Mauricio Pauly.	2006 – 2009
Performances with *Kairos* ensemble	Involvement in improvisational ensemble, performing flute & laptop	*Kairos* ensemble	2006 – 2008
Flourish	Film soundtrack	Commissioned by Universities Scotland	2006
dans la mémoire de mon corps	Live video processing (Jitter) for Music Theatre	*Kairos* ensemble	2007
A Walk in the Park	Soundscape work for children	Commissioned by Bookstart Scotland	2007
Chemistries	Large-scale (30') work for flute, violin, accordion, cello and electronics	Commissioned by Symposia Ensemble	2007
David	Soundtrack for art video	Commissioned by Dani Marti, visual artist	2008
The Yellow Wallpaper	Original electroacoustic score for a play	TwoTwenty Theatre (directed by Rob Drummer)	2008
3 Meditations (Glass, Water and Steel)	3 one minute miniatures for the *Canções Submersas* installation	Installation conceived by Vivian Caccuri	2008
Australia	Soundtrack for art video	Commissioned by Dani Marti	2008
One Flew Over the Cuckoo's Nest	Music for Theatre	University of Manchester Drama Society, directed by Timmy Jones.	2008
A Theory of Everything	Installation work (part of devised theatre work).	TwoTwenty Theatre (directed by Rob Drummer)	2009
Three Dance Studies	Music for Dance	Sari Lievonen, work developed during a Dance House Scotland residency	2009

Table 2: Additional Compositional Output 2006 – 09

Appendix B:

Additional Information on the Portfolio Works

Anima Machina **(2006)**

Awarded the Prix SCRIME (*Studio de Création et de Recherches en Informatique et Musique Electroacoustique*), Bordeaux, France, 2007

Programme Notes

In a technological age, our lives are becoming more dependent on machines, and those machines are becoming increasingly smaller and more intelligent. This work is heavily influenced by the concept of tiny machines at the atomic level, and their ability to become capable of decision-making and self-replication.

The work is underpinned by a changing flux between control, restraint and disorder. There are references to metal and machinery, although the original source material is likely to be very far removed from this perceived scale of material. Most source recordings were closely amplified small materials, (various gardening tools, parts of a bicycle mechanism, clocks, and a 'slinky' spring), now given a magnified energy and greater mechanical status through processing. There is a mirroring of the potential qualities of machines at the atomic level, with key ideas being the implications of friction, surface tension and a dark instability and unpredictability.

Performances

- MANTIS weekend, Martin Harris Centre for Music and Drama, Manchester, 26th November 2006.
- BULO, Bristol University Loudspeaker Orchestra, RMA Students' Conference, Bristol, 4th January 2007.
- Sonorities Festival of Contemporary Music, Sonic Arts Research Centre, Belfast, 23rd April 2007.
- University of Costa Rica, 6th Annual Conference on Musical Composition, 25th April 2007.
- SCRIME Finalists' Concert, University of Bordeaux, 22nd May 2007.
- RMA 'Surrounded' Study Day, Keele University, 24th May 2007.
- SCRIME, *Halle des Chartrons de Bordeaux*, 31st May 2007.
- EMS Conference, De Montfort University, Leicester, 14th June 2007.

- ZKM, Center for Art and Media, Karlsruhe, 7th July 2007.
- DMRN Conference, Leeds Metropolitan University, 8th July 2007.
- Urban Ampitheatre, Atlantic Center for the Arts, Florida, 3rd August 2007.
- Futura Festival 2007, Paris, 17th August 2007.
- BBC Radio 3 'Hear and Now', 25th August 2007.
- *Ecole Nationale Supérieure d'Electronique, Informatique et Radiocommunications de Bordeaux*, Talence, 12th September 2007.
- *Technische Universität Berlin*, Concert curated by Kaho Cheung, 18th October 2007.
- 'Sonic Voyages', Bristol University Victoria Rooms, 24th October 2007.
- 'MiniBEAST', University of Birmingham, 31st October 2007.
- Radio France, *'Electrain de nuit'*, 17th December 2007.
- The Great Hall, City University, London, 29th April 2008.
- 5th Season of the Los Angeles Sonic Odyssey, USA, April 23rd, 2009
- *Festival di interpretazione della musica acusmatica*, Cagliari, Italy, 12th July 2009
- Tweak Festival, Limerick, Ireland, 24th September 2009.

Bosonica (2009)

Programme Notes

In theoretical physics, Bosonic refers to the original version of 'string theory', developed in the 1960s. Although the initial hypotheses behind Bosonic String Theory have since been expanded and modified, the underlying principle remains intact; that the various properties of matter and force can be thought of as a reflection of the ways in which a string vibrates. The oscillating properties of these hypothetical strings determine the properties of particles and all forms of energy. As such, the theory proposes that the entire world may be comprised of these infinitely small vibrating 'strings'.

Bosonica is a sonic exploration of the concepts behind this theory. Taking a somewhat literal interpretation of 'string theory', the sound material which underpins the piece is predominantly sourced from stringed instruments, in particular piano (conventional and prepared), guitar (acoustic and electric) and cello (conventional and extended techniques). At times the original properties of these vibrating strings are very present and recognisable, however the work explores increasing blurring and abstraction, presenting new constructions from the original material, and introducing to the listener dense and abstract dimensions. Despite this, the untreated instrumental material consistently returns as a reminder that it serves as the building block from which all other sound-worlds are derived. The use of 5.1 spatialisation magnifies the perceived kinetic energy of material; small gestural fragments are scattered over the 5.1 array to form accumulative trajectories of sound, and the listener becomes immersed in dark abstract landscapes generated by the sounds of strings.

Performances

- MANTIS weekend, Martin Harris Centre for Music and Drama, Manchester, 31st October 2009.

Cipher (2007)

Honourable Mention in CIMESP 2007 (International Electroacoustic Music Contest of São Paulo), Brazil, 2007

Programme Note

'…I have come to believe that the whole world is an enigma, a harmless enigma that is made terrible by our own mad attempt to interpret it as though it had an underlying truth.' Umberto Eco[119]

Cipher explores a range of sound material associated with cryptography. Through the use of Morse code rhythms, mechanisms and electrical sparks, there are references to early mechanical devices built for code making and breaking purposes, in particular the Enigma encryption machine used during World War II. These elements are continually being revealed, obscured, repeated or interrupted, as is possible in the transmission of any code. Over the course of the piece, broken elements gradually merge to reveal voices, often very fragmented, and rarely intelligible.

The original sound material was gathered from a variety of sources and includes Morse code, a typewriter, small mechanical parts and glass fragments. In addition, much of what might initially seem mechanical or 'glitch' to the listener may be derived from recordings of extended vocal techniques, performed by Sarah Alexander.

Performances to date

- MANTIS weekend, Martin Harris Centre for Music and Drama, Manchester, 11th February 2007.
- 'Sound Junction', University of Sheffield, 10th May 2007.
- CIMESP 2007 Finalists' Concert, Theater of SESC-Ipiranga in São Paulo, Brazil, 28th August 2007.
- 'Soundings', University of Edinburgh, Reid Hall, 3rd November 2007.
- 'Soundings', Reid Hall, Edinburgh, 1st February 2008.
- Petit Théâtre Mercelis, Brussels, 8th February 2008.
- Australasian Computer Music Conference, Sydney, 10th July 2008.
- BIMESP, SESC Vila Mariana, São Paulo, Brazil, 16th August 2008.
- Fylkingen, Stockholm, Sweden, 13th September 2008.
- National University of Ireland, Maynooth, 24th October 2008.

---

[119] From Eco, Umberto (1988), *Faucault's Pendulum*, New York: Ballantine Books, pp.95.

Papyrus (2008)

Programme Note

Almost all source material in *Papyrus* is derived from recordings of a variety of paper, from notepaper to large sheets of wallpaper. Much of this material was recorded for the creation of a soundtrack for a theatre production of *The Yellow Wallpaper*, based on the novel by Charlotte Perkins Gilman. A site-specific production of the theatre adaptation was directed by Rob Drummer and performed at the Manchester Museum in May 2008. While composing the soundtrack I was fascinated by the intricate sonic details present in the closely recorded paper and was keen to explore their potential further in a standalone acousmatic concert work.

As a result, *Papyrus* explores the wide variety of spatial motions, trajectories and perspectives which can be created through the manipulation of this seemingly simple and lifeless material. Through the course of the work the sounds of paper gather energy and they form increasingly animated behaviours within a changing abstract landscape. There are four sections, each one seemingly revealed through a metaphorical 'tearing' of the wallpaper.

This work exists independently of the theatre soundtrack. However, the transformations in this piece reflect the behaviour of the woman behind the wallpaper in the novel: a development from hypnotic creeping in the shadows to 'mechanical and ugly movements' in a 'twisting and twisted dance.'

Performances

- MANTIS Festival, University of Manchester, 31st October 2008.
- International Women's Electroacoustic Listening Room Project, Cal State Fullerton, USA, 21st March 2009.
- Pixel Palace's 'Step Sequence' Installation, Tyneside Cinema, Newcastle, 2nd – 27th March 2009.
- SSSP Conference at De Montfort University in Leicester, 7th May 2009.
- International Computer Music Conference, Montreal, 19th August 2009.
- Tweak Festival, Limerick, Ireland, 24th September 2009.

Pavakoothu (2007)

For B flat Clarinet, Fixed Media and Electronics

Programme Note

The word pavakoothu (puppet dance) is often used in references to Indian puppetry, particularly the practice of shadow puppetry. Consequently this piece is an exploration the act of puppetry through sound. The clarinet acts as a metaphorical 'puppeteer' within a sonic landscape which alludes to enchanted and ethereal elements. The dance of the puppets themselves is characterised by percussive sounds, and increased gestural energy towards the middle of the work At this point much of the sonic activity stems from the clarinet itself through live processing. Ultimately, all of the sound material stems from the clarinet, although this is not always apparent. The piece is characterised by the changing status of the puppeteer, the puppets, and the sonic landscape in which they exist. Traces of narrative or 'story' remain deliberately ambiguous throughout. With thanks to the clarinettists William Stafford and Thom Harrison for their assistance during the composition of this work, and to Esther Lamneck for premiering it.

Performances

- Premiered by Esther Lamneck (NYU) at Manchester University Novars Launch Festival, 4th Nov 2007.
- Performed by Michiko Chiba at New York University, USA, 24th February 2008 & 4th April 2008.

Spindlesong (Concert Work, 2008)

Programme Note

This 8-channel work is inspired by the Industrial Revolution, and more specifically the textiles industry, which saw massive expansion in the Manchester area in the 19th Century. The energy and kinetic movements inherent in this industry are explored through various techniques of spatialisation.

Thanks are due to the National Trust for allowing me to record at Quarry Bank Mill in Styal, close to Manchester. Most of the sound material used for the work is sourced from this site – from the river which powers the water wheel, to the working spinning machines, the demonstrations of hand-spinning, to the steam engines. The sounds are presented as both unprocessed and abstracted forms which take the listener on a journey into the innermost workings of the machinery itself.

This work was composed during a residency at the Institute of Electroacoustic Music in Sweden (EMS), Stockholm, funded by the Scottish International Education Trust and the Holst Foundation.

Performances

- LICA-MANTIS Festival, Lancaster University, 1st March 2008.
- Digital Media 1.0 Festival, Valencia, Spain, 19th April 2008.

The Spindlesongs Installation (2008)

Programme Note

Spindlesongs is a sound installation which uses almost exclusively recordings gathered at Quarry Bank Mill alongside archive recordings from the North West Sound Archive. These sounds have been edited, manipulated and layered using a computer to create sonic journeys through the sounds and stories of the cotton industry in the North West of England. In this particular installation, surround sound, here 8-channel sound, is used to simulate spatial movement, referencing the motions of the machines found in the Mill.

The voices heard in the work are taken from interviews with Quarry Bank Mill staff and a number of recordings of the recollections of Mill workers, archived at the North West Sound Archive, which describe first-hand experiences of the cotton industry in the North West of England.

The work comprises a number of short movements, each focusing on a certain sonic aspect of the Mill, the most recognizable being water, steam and specific machinery, like the looms and the carder.

With thanks to The National Trust and the North West Sound Archive.

Performances

- Installed at Quarry Bank Mill, Styal between 19th and 25th September 2008.

Topographia (2008)

Programme Note

This work aims to explore various sonic landscapes and topologies through variations in implied proximities, densities and the kinetic behaviour of the sound materials. *Topographia* emerged from a project in which seven composers created a work using the same source material, this being a collection of 12 short samples from Denis Smalley's *Wind Chimes*, released for use by the composer himself. Bearing in mind Smalley's interest in spatial attributes in electroacoustic music, it seemed appropriate to explore this particular area through the sonic material. In many respects *Topographia* is particularly influenced by Smalley's *Valley Flow*, a work which greatly influenced my early compositions.

- Premiered at the MANTIS Spring Festival, Manchester, 7th March 2009.
- ICMSN (Sixth Biennial International Conference on Music Since 1900), Keele University, 4th July 2009.

Appendix C

Post-Analysis 1: Context, issues and considerations for the composer/performer

All four of the stereo works presented in this portfolio have been composed with the performance practice of sound diffusion in mind. I have endeavoured to explore a range of spatial techniques which, when applied in acousmatic works, will be particularly suitable for this practice. It is hoped that by exploring a rich palette of spatial activity in composed space, the potential for a wider variation in sound image manipulation is available when in the listening space. This is not to say that a work that is spatially more 'active' or 'varied' is more 'suitable' for diffusion or more 'challenging' to diffuse, but only that such a work may be more likely to exploit a greater range of spatial permutations in performance.

In hindsight, I have found that more interesting spaces and more successful phrase-structuring may be constructed not merely by articulating extremes of space, but by navigating 'between' spectral layers and planes and by exploiting dynamic spatial change within individual sound objects, as well as that constructed on a larger temporal scale. This more fluid use of superimposing sounds exhibiting individual motion behaviours can be heard in the later works of *Papyrus* and *Topographia*, where spaces tend towards evolution and flux, and are characterised by particular motion identities. Contrastingly, *Anima Machina* presents a high degree of spatial variation overall, but less dynamic shaping and evolution within each environment.

The majority of sound diffusion systems, even those comprising only eight channels, will present the capacity for shifting an image from near to far, expanding and contracting, enveloping the audience and directing the sound to a focal point. (More extensive diffusion systems will allow for more complex, subtle configurations within this.) Such techniques seem to work particularly well in tandem with their counterparts in the composed space. However there are some aspects of space-form where the great majority of perceptual information is uniquely defined in the composed space. In these instances while spatial positioning in diffusion may alter our understanding of the sound, its core identity is predominantly defined by composed space. Particular examples of this include utterance space and source-bonded space, where the physicality of sound experienced in the listening space will be heavily reliant on intrinsic sonic properties.

Naturally the translation of the composed space into the listening context is not prescribed[120] for any of the works discussed. However, considerations when

---

[120] Nor could it be, given the great diversity of diffusion systems and performance venue acoustics.

manipulating the physical placement of sound around the audience (i.e. circumspace[121])
were discussed in Chapter 2, where I asserted that decisions regarding the 'fixing' of
circumspace at a compositional stage are, for me, based on similar decision-making
processes as I might apply during diffusion preparation and performance (enacted
circumspace).

---

[121] Smalley (2007), pp.53

Appendix D

Post-Analysis 2: The Fixed Mode of Circumspace: Issues and observations

One aspect which I have yet to research is the potential to introduce elevated sound into the multi-channel work. Similarly, discrete sound streams could be introduced on varied levels of proximity and distance at the compositional stage (as opposed to through the means of diffusion). Hans Tutschku explores this technique in his 24-channel work *Zwei Räume*, in which 'the encapsulating space expands over the boundaries of the physical concert hall; the inner space develops a strong presence for individual sound objects'[122] The loudspeakers are arranged in three rings of eight around the audience, in increasing distance, the inner rings at a higher elevation to simulate a dome-like structure. Such an array carries great potential to create envelopment, or engulfment[123], but also a great variety of motion trajectories.

In exploring such options, the composer must ask at what point does the work's meaning become dominated by a quasi-architectural construction of circumspace? Peter Batchelor's *Kalaidescope Arcade* for twelve channels, prescribes a very specific seating arrangement[124] for the ideal performance of the work, however like most composers who explore such an unusual configuation, he offers a reduced, more conventional alternative. The composer is faced with a dilemma – whether to compose for more challenging formats, or to utilise more conventional formats with increased opportunities for dissemination.

Composing in multi-channel has reaffirmed that for me the most critical spatial construction happens in the composed space. I have found that my most successful outcome in multi-channel composition has been by initially dealing with stereo sound for the majority of the compositional process[125], a working method which stems from my personal familiarity with stereo composition and diffusion. In this way I am able to articulate spatial clarity within the music and form a purpose-built template for the chosen surround-format.

---

[122] From Tutchku's programme note for *Zwei Räume, available at http://www.tutschku.com/content/works-zwei-raeume.en.php*

[123] Sazdov, Paine and Stevens (2007), pp.3, where the authors suggest that engulfment is specific to 3D compositional practice.

[124] http://www.peterbatchelor.com/kainfo.html

[125] This is not to say that I would ignore the final spatial goal, as I would consider circumspatial possibilities from a theoretical standpoint from the outset, e.g. by sketching out a spatialisation plan. In this way, the work would not be composed 'as' a stereo work, but 'in' stereo 'for' a multi-channel format.

It is understandable that some composers may strongly advocate the consideration of fixed circumspace concurrently with considerations of individual sound-objects and sound layering. This approach seems more appropriate for the creation of a homogenous, unified surround sound work. However, from a personal standpoint I have found that internal spatial thinking may become compromised by conceptual ideas of fixed circumspace, particularly when dealing with larger numbers of loudspeakers.

Appendix E

Max/MSP Patch for *Pavakoothu*
(See Data CD)