INTER-PIECE SAMPLING AND CONVOLUTION:

**PORTFOLIO OF 5.1 ACOUSMATIC AND ELECTRONICA
COMPOSITIONS, INTERACTIVE DIAGRAMS AND TEXT**

PHILIP MICHAEL REEDER

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Abstract

This practice-based PhD – 'Inter-piece Sampling and Convolution' – evolved against the background of composers such as Amon Tobin and Monty Adkins, who use techniques and workflows common to both acousmatic and electronica music. The pieces in this thesis are linked through a sustained commitment to working across these two musical contexts and through their relationships to source materials and pulses. Sound materials have been sampled from within the pieces themselves, and materials from older pieces have been convolved with newer sounds, furthering the connections between pieces. The continual feeding-forward of source material promoted the synchronous development of the conceptual tool: *Input, Sculpt, Output,* which brought about the evolution of intricate diagrams. All of the pieces are for fixed media, and nine of the ten are in 5.1-format surround sound.

The complex web of interrelationships created by the process of sampling and convolving material from previous pieces demanded an innovative means of representation. This representation took on a diagrammatic form in order to facilitate the analysis of a sound's continuous (re)appropriation, explicated within supporting text. The diagrams indicate the extensive use of sampling and convolution to connect pieces, and include embedded hyperlinks to audio at various stages. As a result, textual analysis of techniques and their implications takes place across multiple pieces, and results in a wider scope for individual commentaries. The hyperlinked nature of the diagrams provides a foundation for further research, and a number of conclusions are posited about the use of sampling and convolution across multiple pieces.

Contents

Portfolio of Musical Works

Data DVD

	Title	Year	Format	Time	Location
	Title	*Year*	*Format*	*Time*	*Location*
1.	*Sailsong*	2008	Stereo	5:23	Lancaster
2.	*Hemispheric*	2010	5.1	8:35	Lancaster
3.	*Little Tension*	2010	5.1	8:13	Lancaster
4.	*Little Tensile*	2010	5.1	5:44	Lancaster
5.	*Savious*	2011	5.1	14:52	Falmouth
6.	*Headwind*	2011	5.1	6:54	Falmouth
7.	*Palette*	2011	5.1	6:38	Falmouth
8.	*Upside Outward*	2011	5.1	6:33	New York
9.	*Drowning*	2012	5.1	12:20	Falmouth
10.	*Epilogue*	2012	5.1	11:44	Falmouth
				86:56	

Nine compositions are presented as 44.1 kHz, 24-bit, 5.1 files, and one as a stereo interleaved file. Each 5.1-format piece comprises six separate mono files and these are labelled to ensure correct channel configuration. They should be played back on an ITU 775 compatible system. The data DVD also includes 320 kbit/s .mp3 stereo mixes for reference purposes, a digital copy of the text, a series of hyperlinked diagrammatic figures that are referred to in the text, and an archive of the hyperlinked files. The source material for *Drowning*, the song *The Fishery,* by Thirty Pounds of Bone (Johny Lamb) is also included on the DVD.

Although the diagrams are included in printed form for reference, it is essential that they also be viewed electronically as they contain hyperlinked functionality that requires an internet connection and .mp3 playback capability. These diagrams form an integral part of the thesis.

List of Figures Grouped by Chapter

All figures are presented in .pdf (portable document format) and are bound into the physical thesis at the end of relevant chapters as an extension of the final page number in that chapter, or presented inline with the text, except for figure 5.1, which is presented as a .pdf and included as a separate physical document owing to its size. Figures 1.1 – 4.5 do not require a key, but subsequent diagrams do include a key to aid comprehension. Clicking on a graphic box in figures 5.1 – 8.2 whilst in a program such as Apple's Preview or Adobe's Acrobat Reader will often activate a hyperlink to a stereo .mp3 file, which on most computer systems will be opened automatically and played from the user's web browser.
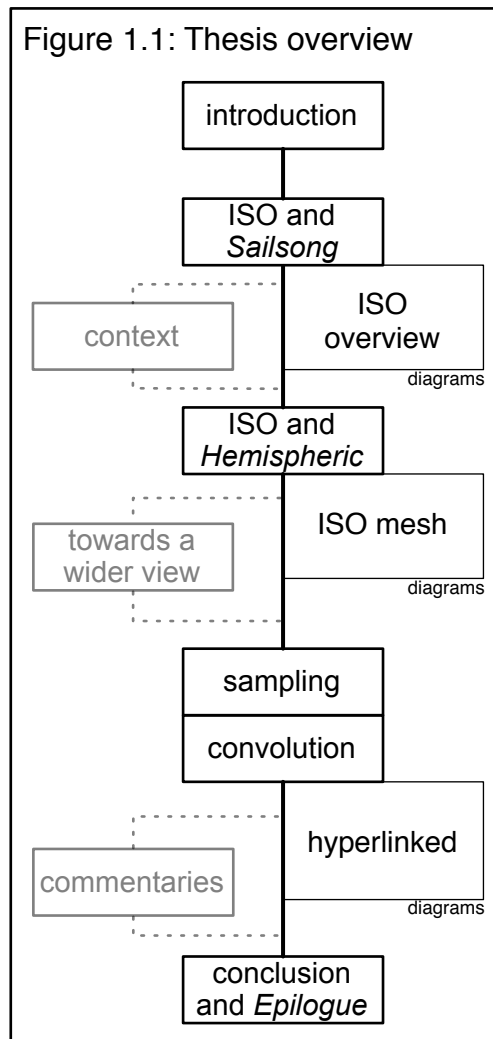
Acknowledgements

1. An Introduction to Research as a Bottom-up Process

Figure 1.1: Thesis overview

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              introduction
                  │
           ISO and
           Sailsong
                  │
    ┌ ─ ─ ┐       ISO
    context       overview
    └ ─ ─ ┘            diagrams
                  │
           ISO and
           Hemispheric
                  │
   ┌ ─ ─ ─┐       ISO mesh
   towards a
   wider view          diagrams
   └ ─ ─ ─┘
                  │
              sampling
                  │
              convolution
                  │
   ┌ ─ ─ ─ ┐      hyperlinked
   commentaries
   └ ─ ─ ─ ┘           diagrams
                  │
           conclusion
           and Epilogue
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This research project consists of ten compositions, a series of diagrams, and this text. The thesis has actively embraced a chronological evolution, demonstrating the synchronous development of a methodology for my compositional, diagrammatical, and textual inquiry. As figure 1.1 suggests, following this introduction there is an analysis of the only stereo work, *Sailsong.* This functions as an introduction to the diagrams that are a cornerstone of this thesis, and to the notion of "input, sculpt, output[1]" (Saario 2004), as a conceptual tool for compositional practice and analysis. The composition and analysis of *Sailsong* instigated a brief inquiry into aspects of electronica[2] and acousmatic[3]

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[1] Referred to henceforth as ISO. Refer to chapter 2 from which this extract is taken: "A composer working with sound for a fixed medium moves through three modes of activity (figure 2.1). For instance, the composer records sound at the *input* stage, organises and edits the sound at the *sculpting* stage, and plays the piece back through loudspeakers at the *output* stage."

[2] "An umbrella term for innovative forms of popular electroacoustic music created in the studio, on one's personal computer, or in live performance. Typically, although influenced by current forms of dance music, the music is often designed for a non-dance-orientated listening situation" (Landy 2007: 14).

[3] "Music in which electronic technology, now primarily computer-based, is used to access, generate, explore and configure sound materials, and in which loudspeakers are the prime medium of transmission. There are two main genres. Acousmatic music is intended for loudspeaker listening and exists only in recorded tape form (tape, compact disk, computer storage)" (Landy 2007: 13).

music that provides context for subsequent compositions, in addition to factors surrounding my use of the 5.1-format.

ISO (input, sculpt, output) was then employed during the composition and analysis of the 5.1-format piece *Hemispheric*. This includes a series of diagrams that evolved from the analysis of *Sailsong*, and references techniques that comment upon and extend issues raised in the contextual discussion. This inquiry of processes internal to a composition suggested the possibility of a mesh of diagrams and text that provides a method for interrogating concerns across multiple pieces, rather than a single piece. The diagrams and text therefore proceed to explore two techniques (sampling and convolution) that connect a number of pieces and are hyperlinked to online audio examples in order to provide an aural method of opening up analysis. These reveal aspects that are sometimes undetected when prioritising an individual piece. The knowledge gained through this grouped analysis facilitated a wider focus for the individual commentaries of the remaining pieces. The final composition, *Epilogue*, together with its commentary, function as the conclusion to the thesis.

Acousmatic composition typically progresses from recorded sounds, through transformations, to organisation over time. It is a deceptively simple compositional process. The activity involves 'sound objects', where the focus is on the perception of intrinsic sonic qualities, moving through the transformations and organisation, towards an output on a fixed medium over loudspeakers. This is a process carried out throughout this thesis and established with *Sailsong* and *Hemispheric* in chapter 2 and 4 respectively. Luke Windsor suggests that acousmatic music could be that for which "we are unable to see the sources of the constituent sounds" (2000: 8). This notion extends to an intent, where the composer not only attempts to ignore the physical causes of a sound, but also composes the music specifically for loudspeakers – often exploiting the improbability that the material could be present at the time of performance (Harrison 2006). As in *Sailsong,* where

sounding objects[4] are not present at the time of playback, the pieces in this thesis were frequently composed with this intent, that exploits the tensions of what R. Murray Schafer referred to as 'schizophonia'[5], while encouraging the process of reduced listening (for the internal qualities of a sound) as proposed by Pierre Schaffer (1966: 91). Acousmatic composers tend to be drawn towards material that has been precluded by orthodox musical approaches to sources and sounds, as exemplified by the choice of source material in this thesis. The music is often less concerned with the inclusion of familiar pitch and rhythm components (Windsor 2000: 16).

The reference to everyday sounds in acousmatic music has its origins in musique concrète. There, the movement of sound material is from the concrete – working on the sound itself – towards abstract musical structures that arise from interacting with the sound. This is posited as the reverse of instrumental writing, that moves from concept to concrete (Harrison 2006). The focus upon the intrinsic qualities of the sound has sometimes been purposefully eroded to explore new relationships, notably by Luc Ferrari's anecdotal music which relied upon both the recognition of source materials by the listener, and structuring traits of musique concrète (Emmerson 2007: 7).

Chapter 2 makes a number of references to soundscape composition as it pertains to *Sailsong*. Schafer suggested that "We can isolate an acoustic environment as a field of study just as we can study the characteristics of a given landscape" (1977: 7), though the precise representation of a landscape is easier to achieve than that of a soundscape. The immediacy that is possible with a single photograph to demonstrate features, is lacking with a soundscape which might require many recordings to acquire a similar level of comprehension, as in *Sailsong*. Schafer's notions of the soundscape grew

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[4] "physical source of the acoustic stimuli" (Adkins 1999: 56).

[5] "You know that *phono* pertains to sound. The Greek prefix *schizo* means split or separated. I was thinking of Barbara's wonder at how a voice or music could originate one place and be heard in a completely different place miles away" (Schafer 1977: 43).

into the application of composition techniques towards soundscape recordings, applying subtle manipulations or substantial transformations. A key aesthetic quality that maintains a difference between musique concrète and soundscape composition, is that "original sounds must stay recognisable and the listener's contextual and symbolic associations should be invoked for a piece to be a soundscape composition" (Truax 2008: 105).

A by-product of the shift away from familiar musical attributes towards recorded sounds in the above categories, is for the listener to respond both to abstract musical interactions engendered by the composer, and to the everyday sounds they recognise. This is an idea *Sailsong* exploits with its conceptual underpinning relating to urban noise, and that the ending of *Little Tensile* augments with its train sounds and dominant bass beat, exploring certain qualities of electronica.

Electronica music for the purposes of this thesis, focuses upon studio created music that though often affiliated with numerous popular genres arising from dance music, is not necessarily designed for dancing, and is oriented towards home listening on a fixed medium. The term covers a number of narrower musical genres[6], with Christoph Cox and Daniel Warner describing electronica as the "sonic and intellectual concerns of classic electronic music; the do-it-yourself and bruitist attitudes of punk and industrial music; and beat-driven dance floor sounds from disco through House and Techno" (2004: 365).

For this thesis select compositional traits particular to electronica were drawn upon, and these are elaborated on in chapter 3 and 7. They include: an increasing focus on sound to complement dominant uses of pitch and rhythm that conform to traditional ensemble-based models of instrumental performance, the preponderance for 4|4 time signature (e.g. *Headwind*),

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[6] The major sub-genres include Ambient, Ambient House, Ambient Techno, Big Beat/Funky Breaks, Disco, Electro, House, Jungle/Drum'N'Bass, Techno, Trip-Hop (Bogdanov, Bush, Erlewine, Woodstra 2001: 635).

repetition through looping material (e.g. *Palette*) and what Karlheinz Stockhausen referred to as "ice cream harmony" (2004: 383) pointing to harmonic methods that are used broadly in popular music (and adopted in *Savious*) and appear partially as a result of convolution (detailed in chapter 7). Unlike acousmatic composers, electronica composers often reach for a top-down approach, moving from abstract idea to concrete sound. Alternatively if working upwards, a sound is frequently used to fill a particular preconceived role in the piece, hypothecated for the drum track or atmospheric pad (as in the opening minutes of *Savious*), indicating significant workflow and relationship connections to those of acousmatic composers.

One connection between electronica and acousmatic music, as noted by Leigh Landy, stems from the common (though by no means rigid) means of its composition involving synthesisers and drum machines, sequencers and samplers. Significantly these tools can be used with or require user-selected audio samples (Landy 2007: 147). This relationship is continuously addressed through the compositions, diagrams and text in this thesis. As Emmerson notes, "the territory shared by these genres includes the *soundfile* - which is *one* trace of the work but not the sole one. It varies in meaning depending on its function and the relationship it engenders - which is not necessarily that intended by its maker" (2007: 31).

The research presented here has developed in an analogous fashion to the bottom-up process of acousmatic composers, and provides a basis for exploring ISO. In this document I will use the notion of ISO to investigate interactions with sound in the first acousmatic piece in the portfolio – both diagrammatically and in writing – and then move towards an investigation of the theoretical and compositional importance of the ensuing pieces in the portfolio. The outcome of every piece affects the composition of the next on both conceptual and material levels, informing the progress of diagrammatical and textual outputs. In many instances, my analysis begins with the diagrammatic representation of compositional workflow. This process of reflection facilitated the emergence of appropriate theoretical discussion from my practice. The direction of these compositions was not

entirely determined by the above theoretical concerns, but was also defined by the personal musical preoccupations that underpin the analysis.

In the compositions themselves, a number of concerns and approaches are posited that are not exclusively related to the dialogue between electronica and acousmatic music, but will be briefly delineated in this introduction. A consistent aspect of the compositional language in my works rests upon a contrast between underlying and surface level development. Structures incorporate a gradual exploration of underlying harmonic material, often with substantial introductions to set a harmonic space, or to instantiate a context through the use of sound objects. Both of these ideas are particularly evident in *Headwind*, where the opening alternates between noise and pitch focused continuants. Later, these same sound objects form the basis for surface level gestural interactions comprising the noise elements in the mid-section of the piece, and for pitch-based drone material on which these gestural interactions rest.

Textures with low internal animation are used as a bed to set other interactions against. This clearly differentiates foreground and background, as well as alleviating the minimal use of audible silence in the compositions. The low internal animation of many continuants can function to invoke silence when gestures are absent, addressing that state without deploying it directly, allowing structural deviations to occur against a consistent setting as in *Savious* and *Upside Outward*.

Foregrounded gestural material is both more detailed and animated, and deeper structural changes are promoted through the phrasing of these surface level interactions. Subsequent transitions depend largely upon the spectral weight, timbral aggression and spatial attributes (amongst other variables) of the interactions, needing only subtle variations in underlying parts to aid the spectromorphological imperative towards a transition. In contrast to electronica where the "streams established with any given work tend to remain intact - few have section divisions or dramatic changes of

focus" (Emmerson 2007: 86), many of the pieces establish a number of severe disjunctures, as in *Savious*, *Little Tensile,* and *Upside Outward*.

In this thesis the surface and underlying material frequently contrasts pitch material with noise-based elements, and this has been resolved through the use of convolution reverb, as detailed in chapter 7. It should be noted that the harmonic spaces set by the underlying material are predominantly the result of a particular bottom-up process consistent with an acousmatic process rather than an architectonic approach. Only in *Hemispheric* and *Savious* were certain pitches invoked that were consistent with a research focus of this thesis – in this case traits of electronica.

A common compositional expression is the focus upon growing and receding continuants. This is used to set up expectations, create transitions, assist less rigid loop structures, and as a means of integrating materials that otherwise might not fit easily into a grid (as in *Epilogue).* The growing and receding is established firstly in *Sailsong*, continues in *Hemispheric* through to *Upside Outward* where it is explicitly cited at the end of the piece, and is looped as a consistent foundation in *Epilogue.* Although this growing and receding theme has arisen partly from the sound objects and concepts surrounding *Sailsong,* as well as the technical preoccupations above, it also connects to the mimesis of events across the pieces, and the desire to maintain particular inter-piece compositional languages. This consistency has been balanced against continual exploration, for example the relationship to the source material, or 5.1-format spatialisation.

Spectral manipulation is important throughout the pieces as an aid to demarcate structural divisions and create impulsion towards transitions. Unstable scenes are deprived of bass components to suggest unrooted elements, which contrast with bass rich moments to portray a larger physical weight. The focus of this thesis on electronica and acousmatic music has resulted in an increasing use of particular sounds to indicate proximity, for example the mid-range noise components in *Savious*, and higher frequency noise sounds to indicate distance, as in the opening to *Little Tension*.

The research contribution made by this thesis stems from its use of practice-based works to bring to light concerns relating to the sampling and reuse of compositional material, and the dialogue of working methods between techniques engendered by acousmatic and electronica composition approaches. The thesis also contributes through a consistent exploration of 5.1-format composition techniques, and a sustained compositional approach across ten pieces. The interactive diagrams augment the textual analysis, and allow a singular method of probing the inter-piece compositional approach.

The thesis innovatively maps graphically, textually and audibly, a perceptible flow of inquiry concerning the relationship to source material in acousmatic music that can be enhanced through integrating certain traits of electronica composition. The compositions in 5.1-format are a substantial element of this research contribution, stemming from the interrogation of identity issues in the stereo work *Sailsong*, towards successive revisions to the deployment of techniques in subsequent 5.1-format compositions. The diagrammatic framework is often applied to multiple works simultaneously in order to determine the techniques, nature, and affect of connections between pieces and modes of interaction. This complements the evolving and equivocal nature of my practice and thought, and the cumulative findings in this thesis suggests a new territory for these works. The diagrams in particular, allow the practice to be embedded in the written research, re-evaluating the possibilities for inextricably bonding text to practice.

2. Input, Sculpt, Output and *Sailsong* (2008, Lancaster)

This chapter reveals the initial stages of my research. It introduces the notion of ISO and applies it to *Sailsong*, a stereo piece that is concerned with issues of identity and genre. This chapter also marks the initial use of diagrams as a tool for analysis. A composer working with sound for a fixed medium usually moves through three modes of activity (figure 2.1). For instance, the composer might record sound at the *input* stage, organise and edit the sound at the *sculpting* stage, and then play the piece back through loudspeakers at the *output* stage. The composer moves between these stages of ISO as required with minimal external mediation, excepting factors that may colour the sound, such as room acoustics and loudspeaker variations. This movement does not happen only once, but is a continuous flow between stages. The movement between inserting a sound into a piece, responding to it, and sculpting it, can happen so fast as to elude qualitative real-time documentation. Acknowledging these stages was the first step when composing *Sailsong*, and this acknowledgement informed both its composition and framework for analysis. Viewing *Sailsong* through ISO demonstrates how a simple planar conception of acousmatic composition belies complex strategies.

Figure 2.2 reduces a network of complex interrelated actions encompassing technical parameters and guiding abstract notions to a basic overview of *Sailsong*. It specifies in diagrammatic form the nature of the recording, what the editing entailed, and the playback medium. In order to reveal the network of decisions behind *Sailsong,* each stage of ISO is subjected to a limited amount of internally recursive interrogation to reveal finer granularity in figure 2.3. The recording *input,* represented at the top of the diagram, therefore has its own *input, sculpt, output.* Activities at the *input* stage are broken down into the sounding objects, the technique and microphone required, and the chosen recording format for the sound. The shotgun microphone, a Sennheiser MKH 418S records in middle-and-side format, and has high off-

axis signal rejection. This choice of microphone is a sculpting decision, as its specification transforms the sound. The sounding object is an input, and the storage format (in this case stereo, 96kHz and 24bit) is the output.

The above view of ISO suggests a hierarchical model of sound interaction that places importance on one mode of interaction over another. This can be compounded by a perception of both a linearity and separation to the process that in *Sailsong* at least, was actively eroded. The process was non-linear with feedback and feed-forward, and the influence of a decision was not restricted to the diagrammatically hierarchical level of corresponding activity as demonstrated in figure 2.4. For example, the middle-and-side shotgun microphone was chosen to obtain a particularly intimate and isolated sound. This facilitated panning of sound objects in the studio, owing to the strong mono-compatibility of the microphone. The microphone also allowed a valuable balance between the space of the wider environment and proximal detail that could be rebalanced in the compositional process because of its middle-and-side specification. A mono shotgun microphone would have provided the necessary off-axis rejection, but would have failed to adequately locate the sounding object in space. This would limit the ability to be led during the compositional process by audible clues about the space surrounding the object (Harrison 1999). In this case, the chosen microphone was contingent upon the eventual playback medium of the piece, and highly detailed source recordings were required to maintain fidelity in reverberant concert halls. In this example therefore, the decision-making flowed backwards, from output to input. The move to finer granularity focussed upon the microphone chosen to record with and subsequent technique, rather than just the source material itself. ISO has penetrated a deeper level of interaction for insight here, demonstrating that a significant amount of compositional activity in *Sailsong* took place through using the microphone "the way photographers often use the camera" (Westerkamp, cited in Emmerson 2007: 10). If the nature and recording of the source material were less important than digital audio workstation (DAW) facilitated transformations, then ISO would demonstrate this.

Figure 2.5 continues to unravel the web of decisions, and reveals that the composition of *Sailsong* was indeed not guided solely by practical parameters or a journey through sound transformation. Conceptual themes were also admitted to the model. The rural environment where many sounds originate from is windswept and rich in haphazard metallic sounds. The recordings are from Embsay reservoir in the Yorkshire Dales, where a local sailing club stores and sails a number of boats by the water's edge. Sail rigging is silent only on the calmest of days, and masks more delicate sounds. *Sailsong*'s use of the shotgun microphone facilitates the recording of these delicate sounds, most notably a tuneful dry-stone wall, and the gentle lapping of water by a metal grate. Located far from a main road, the reservoir does not suffer from noise pollution related to motorised traffic. Recordings of wind were sculpted into Doppler shifted sounds reminiscent of passing traffic, and the rigging sounds were similarly panned and treated. This conflation likens the pollution of the rigging in this remote area to the pollution experienced in more urban environments.

Though the composition includes the reference to motorised traffic and its ability to mask other sounds, the gestural interplay of the composition was regulated by spectromorphological attributes as perceived by the ear. *Sailsong* does comprise some processed sounds, but these maintain their original source bonding. Figure 2.6 therefore expands the notion of non-linear flows integrating more directional arrows that highlight the complex circulation of decisions. The initial gestural control (1:00) after the introduction moves toward the transformation of materials leading to the Doppler section (3:30). The piece misleadingly suggests a consistent single microphone location, but is in fact constructed from multiple locations around the reservoir. It assembles gestural and textural material in an effort to create and then subvert through transformation, a deceptively natural constitution (fade out and reverb at 3:27). It is not a strict Schaeffarian model of musique concrète owing to the conceptual nuances, although it includes aspects of a bottom-up process and non-instrumentally derived sound sources. As *Sailsong* was composed with acousmatic intent, the sounding objects are unlikely to be physically present at playback, and it relies on the

transformation of sound materials not present to create abstract relationships over time. This might perhaps indicate a modernist stance on form (McKinnon 2007: 1). The focus upon the sonic characteristics of the reservoir, and its relationship to urban noise masking is also suggestive of the traits of soundscape composition, allowing the recorded sounds to be recognised by the listener, with contextual undercurrents intact. Although *Sailsong*'s composition has been steered by particular audible intrinsic qualities of the sound recordings, this has to be measured against other attributes.

ISO has revealed a number of key technical and aesthetic characteristics belonging to *Sailsong.* It is apparent that this type of work has a fuzzy logic[7] (Zadeh 1994: 192), with no sharp boundary determining its location in either acousmatic, soundscape or musique concrète genres. This analysis moves toward the recognition that a single decision is often made while considering the ramifications across multiple modes of activity. *Output* at one level of granularity is often the *input* at another. Stages of composition are therefore not always suited to stratified and bounded boxes. Shifting categories of sound interaction possess a fuzzy identity that will determine the exploration of a more flexible diagrammatical and compositional approach when using ISO with the next work, *Hemispheric.* The context for *Hemispheric* and subsequent pieces is relayed in the next chapter. This outlines a number of prominent concerns brought about during *Sailsong*'s composition and analysis.

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[7] "The culprit as I saw it was the universally made assumption that classes have sharply defined boundaries…almost all classes are fuzzy in the sense that the transition from membership to nonmembership in such classes is gradual rather than abrupt" (Zadeh 1994: 192).

3. Context

Developments in electronica, the experience of composing *Sailsong*, and the fuzzy identity of its associated modes of composition instigated a change in my compositional practice and analysis. A series of entangled concerns are related in the following discussion, and it is their cumulative weight that brought about the abrupt change and on-going development in my compositional output. This chapter intends to lend some context to the development of the following pieces.

Around the time that *Sailsong* was written, I became interested in an apparent trend amongst electronica composers towards making recordings themselves, rather than appropriating sounds from existing records. This coincided with the wider availability of sound-focussed production tools[8]. The integration of many of these processes into digital audio workstation (DAW) environments, often with more user-friendly interfaces, dramatically broadened access at a time when electronica artists were already looking for ways forward from MIDI sampling. The incorporation of aspects of sound-based[9] music by electronica composers suggested the possibility of a shift in my own output. The trajectory of Amon Tobin's music over his last few albums at that time was particularly relevant. He referred to musique concrète as an inspiration for his *Foley Room* album, and was explicitly transitioning from making only "tracks from other tracks" (Tobin 2007), to tracks from self-recorded sound. Nonetheless, his compositions still rely largely on units of organisation that conform to popular ensemble notions of performance that comprise electronica's idiomatic aural discourse. Although Tobin has created sampler instruments from his recordings, he continues to work within his customary grid based system of organisation. By "Taking

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[8] For example, a current leading software plugin by Camel Audio, *Alchemy*, is capable of additive synthesis, spectral modelling, granular synthesis, and sample manipulation with 'morphable' presets.
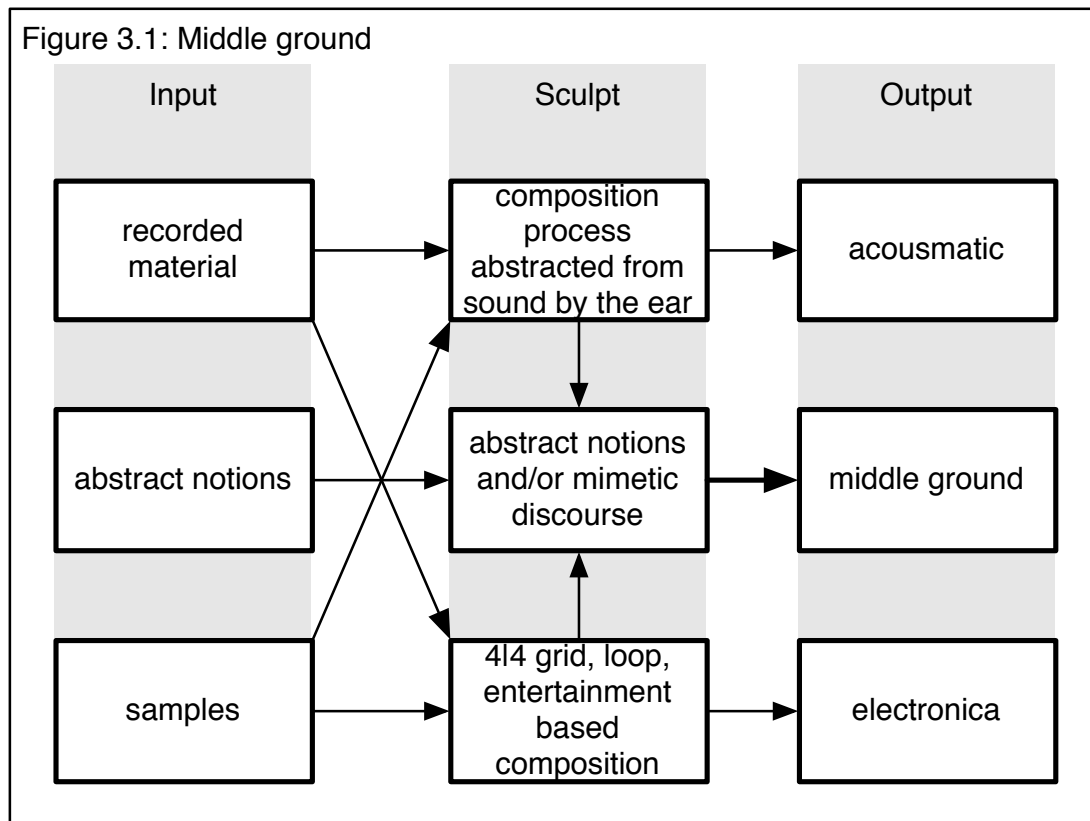
[9] "*sound-based music* typically designates the art form in which the sound, that is, not the musical note, is its basic unit" (Landy 2007: 17).

short field recordings of new environmental sounds, Tobin has subsequently synthesised them, enabling them to be remodelled and effectively played as real instruments" (Daultrey 2011: Clash Music). This contrasts sharply with the use of field recordings in *Sailsong*, where the quality and origin of the sounds largely dictated their use, instead of according to how they might adhere to an 'instrumentalised' paradigm. The notion of "tracks from other tracks" (Tobin 2007) however, has been extensively utilised in future compositions in this thesis, and forms the basis for continued diagrammatic analysis.

In contrast to *Sailsong*, Tobin's electronica tends to use sound at the service of rhythm, harmony, and melody. While researchers such as Ben Ramsey have contemplated analysing electronica through the theories of Denis Smalley and Simon Emmerson (2012), Tobin's use is perhaps more analogous to Michel Chion's theory of added value. Here, sound enhances the cinematic image without becoming redundant (Chion 1994: 5). Alternatively Walter Murch's foreword for the same book, *Audio Vision*, could be re-focussed away from the image to suggest that for Tobin, recorded sound is "Queen" (Murch in Chion 1994: VIII) to the Sovereignty of electronica's idiomatic systems, except that in this case, there is no picture.

Pragmatically, Ben Neill contends that on a material compositional level, the key area of engagement that signifies whether a work is "high art computer-music" (2002: 3) or electronica can simply be the "presence or absence of repetitive beats" (2002: 3). This is an ingredient that *Sailsong* omits, but that subsequent pieces explore. As part of his personal manifesto (2005) Matthew Herbert denies himself the use of a drum machine, and yet much of his output still contains recognisable repetitive beats, comprising a mixture of source material sounds to convey meaning and pulse. Alternatively in his piece *Symbiont,* Monty Adkins has worked with electronica drum rhythms, using the same processing that he has used in more acousmatic tracks (Adkins 2007: 4). To cite a converse example, Richard Devine, whose practice traverses both electronica music and sound design, incorporates extensive beat elements. However he enjoys working with music that doesn't

repeat, stating that his "intentions are not to really make people dance, but to engage the listener in a surround-sound experience of acrobatic sound textures" (cited by Adkins 2007: 3). Unlike typical acousmatic composers, some of whom could relate to this intent, electronica composers are often working within 4|4, as a "vehicle for a wide range of compositional ideas and innovations" (Neill 2002: 4).

Figure 3.1: Middle ground

Input	Sculpt	Output
recorded material	composition process abstracted from sound by the ear	acousmatic
abstract notions	abstract notions and/or mimetic discourse	middle ground
samples	4|4 grid, loop, entertainment based composition	electronica

The pieces in this portfolio, even those with strong beat elements, draw upon acousmatic principles. They build upon qualities already present in the material and "the arbiter of this process is the ear" (Harrison 1998: 127). The constraint of a grid may not appear to align with the notion of bottom-up composition associated with acousmatic ideals. However, the sonic content and rhythmic attributes of the beat itself are often determined by the ear, and can develop a more spectromorphological character while maintaining the pulse. This resembles a blend of abstract architectonic judgment and processes abstracted from the sound itself, as suggested by figure 3.1. Sound's various uses in electronica have proceeded to influence the compositions in this thesis, in particular researching how pulses and sound

material can be integrated without losing the focus upon the sound and its inherent qualities.

The relationship to the source material when composing was often explored in this thesis, particularly given its previous importance in *Sailsong* and the possibilities for electronica composers. Not unusually in electronica, early Tobin albums are claimed to be built predominantly from other music tracks (Tobin 2007), and explicitly reference his focus on sound transformation, which is essential to their underlying aesthetic. The albums are titled *Bricolage*, *Supermodified*, *Permutation*. Although sound transformation tends to play a large role in acousmatic music (as it does in *Sailsong* through granular synthesis and Doppler effects), the relationship to the source material is typically quite different for the electronica composer, restricting the equivalence.

The acousmatic composer might be aware that "the ability to move between and among sonic material via a variety of connections has opened up new fields of meaning beyond the normal scope of music as understood traditionally (i.e. quantitatively)" (Harrison 1999). Concurring, Dugal McKinnon observes that "acousmatic discourse may be built on the tensional binary of mimesis and abstraction" (2007: 4), while noting that this has received relatively little critical attention. This ability to make a number of different connections through sound has not escaped electronica composers, and is evident through their practice of sampling, which influences subsequent compositions in this thesis.

Electronica and acousmatic composers have historically had different approaches regarding the choice and acquisition of source material. While, no doubt, early electronica composers had various reasons for adopting particular tools and workflows, one incentive towards the appropriation of existing music might have been the lack of access to high quality recording equipment and spaces, and this could certainly be identified in early hip-hop. Acousmatic composers however, were generally predisposed not only to different tools and sound materials, but also to different notions of originality.

My approach to gathering source materials in this thesis has integrated both an acousmatic predilection for generating novel sound and electronica's tendency towards generating new meaning by appropriating existing sound material.

Toby Marks states that there are three main ways that makers of electronica usually deploy samples (in Taylor 2001: 150). Focussing on legality, these strategies encompass; clearing the rights with the original holder, rendering the sample unrecognisably obscure through manipulation, or using samples sufficiently overlooked that they are unlikely to be recognised. These strategies can result in outcomes with differing connotations. Leaving a sample intact or recognisable indicates some use of it as "homage" (Taylor, 2001: 152). In hip-hop genres it can be proffered as a respectful acknowledgement of antecedent (Taylor, 2001: 152). In contrast to these notions of sampling in electronica, in acousmatic music the acknowledgement of antecedent and the listener's relationship to that previous context, exists rather more opaquely and through imitation rather than sampling. An awareness of previous musical contexts is not unusual in acousmatic music, and has been referred to as an acoustic chain (Adkins 1999). Acoustic chains are therefore utilised to provide further links between the compositions in this thesis.

Tobin often obfuscates meaning through treatment on *Foley Room* (2007), and this use of "extremely aestheticised bits of sound" and "snippets of sound for sound's sake" (Taylor 2001: 150), seems akin to a narrow musique concrète perspective. Sounds are categorised and employed according to musical function, or inspire composition owing to some inherent sonic quality, rather than being deployed because they represent the kind of musical meaning invoked by the sampling of an existing record. Marks's statement that "sometimes a sample will suggest the whole tune" (in Taylor 2001: 154) is also peculiarly analogous to the acousmatic notion of the unfolding of a single sound conferring a structure for an entire piece. The composer of acousmatic music may focus on a different musical implication to the electronica composer, but the scope of use is clearly comparable. Adkins

sees his own convergence between sampled material and acousmatic sound through processing as an interpenetration, and cites Simon Emmerson's language grid whereby disparate elements are juxtaposed to synthesise a new relationship for further development (Adkins 2007: 4). This idea of 'meaning' at multiple levels through merging workflows is reinforced by Matthew Herbert, who when referring to the difference between art and entertainment states that "with a sampler there is the possibility of imbuing the music with...stories" as opposed to the entertainment of "A Britney Spears song" (Herbert, cited in BBC Collective 2010).

Tobin has moved towards using sounds he recorded himself, and meanings are created by presenting recognisable sounds in new contexts. With reference to his album ISAM (2011) he said "the sample actually needs to be recognisable in order to appreciate its new placement and use." (Tobin 2011: Wired). Within the context of this thesis, my compositional style errs more towards the abstraction of sonic characteristics, rather than exploiting the referential qualities of sound. Indeed, there are a number of pieces in this thesis where samples are swiftly rendered unrecognisable. However this does not negate the significance behind my choice of sound source, or method of concealing its lineage through processing.

The majority of the pieces in this thesis are composed in 5.1-format. This configuration was devised primarily for cinema but has been embraced to a certain degree by both the acousmatic and electronica communities. Examples of this include BT's *This Binary Universe* DVD (2006) that also toured American theatres and the on-going commitment by electroacoustic label 'empreintes DIGITALes' to 5.1-format DVD releases. The decision to adopt the 5.1-format as implemented by Apple's Logic software, arose from a desire to create more expansive sonic situations and take advantage of the spatial, spectral, pulse and morphological contrasts possible in the format. I had already composed a 5.1-format piece before starting the PhD, and in contrast to this earlier piece, *Lynchpin*, no 5.1-format sound recordings were

used in the pieces in this thesis[10]. My focus was not upon the accurate recreation or transformation of recorded surround spaces. Instead, I worked with stereo sources, and although 5.1-format synths such as Reaktor were investigated, I did not make extensive use of them.

In preference to integrating 5.1 sources derived from surround microphone techniques or surround capable synths, I gravitated toward stereo sources as this promoted a flexible and collage-like approach to space. The use of stereo sources facilitated the construction of opposing integrated spaces between, for example, front and back, or a combination of integrated spaces across the front and pointillist distributions on the rear channels. Although Logic's panner could be enhanced[11], working in stereo with it allows sources to be 'played' very easily, and aids the widening of a stereo image to all speakers, and the quick collapse to a single channel.

Logic's panner is based upon amplitude panning. While this may not offer the level of realistic sound-world reproduction offered by integrated surround technologies such as ambisonics, this was not a primary concern for the material or the manner in which I was working with it. This was particularly the case as many of the sounds enter pieces from individual channels before widening, or collapse and recede to a single channel; an approach that works with the strengths of the 5.1-format. In these pieces spaces are constructed, in which other materials can exist and together produce structural effects through the use of convolution. The organisation and convolution of material allows the spectromorphological characteristics of one piece to inform the spatial qualities of another. Furthermore the use of opposed or contrasting planes to achieve this aim is quite common in this thesis, as is the propensity for an often unbalanced sound-world that will, on occasion, give prominence to one plane to produce a musical outcome.

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[10] This does not refer to the sampling of other 5.1-format pieces in the thesis, which were often appropriated in that format.

[11] Perhaps by incorporating Doppler effects, air absorption and other methods of panning beyond those based on amplitude alone.

In 5.1-format films, the centre channel's primary function is to anchor dialogue to the screen. Although there is no spoken dialogue or visual element in my music, this channel often plays a significant role. My music is likely to be played in varying listening situations, and typically those where the stereo image is not compromised by excessive width, as it can be in the front row of a movie theatre. Rather than treating the centre speaker as a solution to a problem, or as something to be avoided altogether in musical composition, it has been used to add value in various ways. It can still be used as an anchor, promoting super-wide images that retain their centre stability, as in the opening minute of *Hemispheric*. In this instance the centre channel also provides significant control over the frontal image, allowing material to collapse to the centre and emerge from it to fill the frontal field. The centre channel can also produce an intimate and close feeling with certain material, which is less easy to achieve when relying upon a phantom-mono centre, as is evident in *Savious* (14:00). In *Hemispheric* (1:31) it is used to anchor rhythmic elements in order to prevent timing disparities in larger spaces. The pieces in this thesis consistently work with individual sounds to create juxtapositions where weak left and right channels are set against strong rears, and in those circumstances when the centre speaker is also strong, the left and right can be used to punctuate or complement a panoramic field. The centre channel is not the most important 'voice' in my works, but it certainly has moments of prominence, and is a significant component in more integrated spaces.

The pieces were composed in 5.1 equipped studios, and tend to lose clarity and impact when reduced to stereo. Composing in 5.1-format enables the sound material to manifest different functions within a piece in a manner that might not be as evident when initially composing in stereo and then 'upmixing' to 5.1-format. Working from conception in 5.1-format allowed greater experimentation and enhanced decisions about space. One example of this can be found in *Upside Outward* (2011), where my awareness of the impact of spectral distribution resulted in the treble reverb continuing above the bass swells (5:17).

This discussion aims to give some sense of the concerns that pervade future pieces in the thesis, and contextualises the analysis and composition of *Hemispheric*, which is the subject of the next chapter. After *Hemispheric*, the thesis moves towards establishing a wider view across multiple pieces, before returning to individual piece commentaries.

4. Input, Sculpt, Output, and *Hemispheric*

Hemispheric is a 5.1-format composition partially influenced by the use of super-wide angle photographic lenses, sometimes known as fisheye lenses. They tend to create an inhuman hemispherical field of vision. Objects toward the periphery become increasingly distorted, often requiring a remapping of the images projection by digital software in an attempt to create a less skewed representation of the elongated images at the periphery. Continual recycling of sonic material in this piece gives rise to viewpoints that are similarly distorted and re-mapped, exploiting the expansive potential of the medium.

Hemispheric is the starting point for a series of pieces that will cumulatively explore the elements in the previous chapter. This piece was composed with a desire to maintain a strong electronica signature through the use of grid-based sections and sourcing of material from software instruments, supported by an acousmatic approach to the structure and deployment of materials. The analysis that follows is underpinned by ISO as explicated in relation to *Sailsong,* but takes a more detailed look at internal processes involved. The diagrams eventually mesh together, progressing from *Sailsong*'s segregated boxes. The meshes foreshadow the hyperlinked diagrams that address connections between pieces in chapters 5-7.

A View into *Hemispheric*

The first difference in workflow between source material for *Hemispheric* and my previous acousmatic pieces is the inclusion of sounds that I did not record at the input stage. To engage with an electronica sound-world, I decided to open up my available sound sources to include software instrument plug-ins. Both 'rompler' instruments (those that do not allow the uploading of user samples) and synthesisers were used. Input source sounds were obtained through two principal methods - by browsing and modifying presets, or by creating a sound from the building blocks, usually a

selection of oscillators or samples, provided by a software instrument. The sculpting stage of this workflow permitted significant modulation of sounds through MIDI/controller data, and allowed some decisions about processing to take place within the instrument (reverbs, EQ etc.) before it reached the track based effect processing of a DAW. These stages might be analogous to decisions over what source material to record, what microphones to use, and how to use those microphones. The relationship of this workflow to that of *Sailsong*'s is clearly indicated in figure 4.1. There, software instrument patches are likened to sounding objects, parameters and trajectories are likened to microphone use, and the final sound object is likened to the chosen recording format.

In *Hemispheric*, the software instrument sounds were swiftly rendered to audio files (until rendered, some sounds may contain modulation effects which vary upon repetition) and reprocessed in various ways, creating a library of fixed sounds from which to begin composing. Once these materials from the software instruments were fixed as audio files, they were treated without reference to their source in conjunction with other sounds in my library. Furthermore, the use of reduced listening allowed the sounds to be heard for their inherent qualities (texture, spectral, spatial), as sound objects in the Schaefferian sense. This workflow demonstrates a sense of re-appropriating sounds from software instruments, originally destined for film sound design and electronica music composition, at the input stage.

Figure 4.2 unravels some decisions made in *Hemispheric* to show that rather than conforming rigidly to tempi and consistent spaces/structure, sculpting was generally guided by acousmatic aesthetics with respect to the development and structure of the piece at the output. Spectromorphological attributes played the dominant role in the process, even when working with beats and looped sections, located in the *sculpt* column and overlapping into the *output* column in figure 4.2. Consequently *Hemispheric* is marked by tensions between spectromorphologically led material, and pulse driven material, culminating in a final flow of sonic information (6:16) which incorporates multiple layers of pulse and texture material indiscriminately.

Recycling in *Hemispheric*

Hemispheric comprises a number of sections while maintaining its sonic identity through a continual process of recycling material. This occurs not just in terms of pulses being a form of recycling, but in a manner influenced by information theory, (Shaoul and Westbury 2011) whereby sections from the end are present as brief fragments in other areas, and vice versa. As a result, when a sonic departure does arrive, this macro level preparatory work aids the transition. In figure 4.3, the non-linearity and wide applicability of ISO is demonstrated. The input is denoted as the opening sequence, while the sculpting is commented upon in the piece itself, in the following minute. The output is the internally active interactions present in a repeated phrase (2:07 to 3:07). All these elements then become inputs, and are sculpted together to form the final section (6:16). In later works the notion of maintaining a sonic identity through recycling on a macro level across pieces is explored. This is analogous to the use of common software instruments across tracks within an album by electronica artists.

A more local mode of recycling sounds in *Hemispheric* is the continual use of 'stutter edits'. A stutter edit lacks formal definition, but can be thought of as the reorganisation of small segments of sound, often conforming to a time signature or rhythm. It is a common sound in electronica, and is sometimes used to the extent that a form of synthesis emerges when engaging with high divisions, (at 130bpm, 1/64 - 1/192 and beyond) where a pitch can emerge as the sound is repeated so frequently. Not unlike a manual granular synthesis, this demonstrates a process similar to that used by acousmatic composers, and reflects on the similarity by engaging with both techniques. In *Hemispheric*, this technique is used continually to create morphologies, and unusually for stutter edits, does not focus solely on noise-type sounds, or always conform to lattice structures. It is not done simply to 'wake up' the listener, but as an aid to move forward in time, spectral, and spatial zones (0:39), and importantly here, as a form of structuring and recycling. There is

a clear line that is being eroded between typical electronica stutter edits for stylistic purposes, and more extreme synthesis edits which verge on techniques such as granular synthesis, and the appropriation of edits as a structuring device. The global use of stutter and micro edits is crucial to the recapitulation section (6:16), which combines many small fragments of sound into a general auditory flow of information. This connotes a re-mapped nonlinear overview of the entire piece thus far - appropriate to the *Hemispheric* aesthetic. The notion of working with objects already in circulation, even if self-created objects, is expanded upon in future pieces and becomes the basis for future diagrammatic excursions.

Other elements of recycling are evident in the overall repeated motifs through thematic transformation in the piece. While main contrasts can be detected between material suggesting the opening and continuation of expansive smooth spaces, and internally active moments, almost all sections can be traced back to the initial theme of internal rhythmic and gesturally led activity, prising open a larger, more textural space. The conclusion for *Hemispheric* is in the blurring together of these contrasts through collage and stratification. By its very structure, *Hemispheric* is reinforcing the notion of interpenetration, resolving the contrasts by merging gestural and textural material (6:16), denying any perception of division. As Emmerson states, "two opposites are juxtaposed and form a new relationship" (1986: 30).

Repetition in *Hemispheric*

Hemispheric engages with repetition on a number of levels. Figure 4.4 demonstrates workflow aspects of the strong pulse (present from 1:17), which includes varied use of spatial motion and spectral configuration applied to the same repeated graduated continuant at the sculpting stage (until 2:06). This is contrasted against a statically repetitive kick drum rhythm largely unaltered from the *input* column in the diagram. Throughout this section the non-tempo conformed continuant exists as a varying relationship against the kick, as suggested by their location in the *output* column. Although the

section has clear repetition, it is the continually changing treatment of the repeated phrase at the sculpting stage that drives it forward. Start and end points, frequency bias, spatial trajectory, and stutter edits are all prominent and continually altered, leading to the section eventually being closed by an equally proportioned mono stutter transitioning abruptly to a stronger tonal pulse. Interest in the loop is maintained because parameters are varied at the sculpting stage, with a balance between fulfilling expectations and subverting them. This technique is similar to that employed by many electronica composers who work with loops. Some sections of *Hemispheric* contain no obvious internal pulse. As many recycled excerpts are taken from rhythmic sections, the pulse is pervasive if at times only through a type of aural association, or internal acousmatic chains (4:42 - 4:52). The material is arguably textural, but the chaining together and cross-fading of background gestures at the sculpting stage, allows a feeling of consistent pulse to surface at the output, even when there is no consistent object to provoke it.

A similar rhythmic contrast occurs in another section (2:06) - this time the tonal and consistent pulse is to the fore, and the background textures are in polyrhythm against it. The consistent foreground pulse is continually stuttered to varying degrees to imply a change to which the pulse does not accede. Introducing a stuttering decelerating and accelerating spiccato string tone in conjunction with dissonant treble continuants, extends this counterpoint. This reflects and reinforces the incongruity of these multiple layers. Eventually the layers are engulfed by a bass-rich large space: enough for these contrasts to exist simultaneously, before being erased by a single pitch tone at the output. *Hemispheric* is engaging with the rhythmic loop and bass of electronica (Chadabe 2000: 10).

One technique used in *Hemispheric* that is expanded upon in future pieces, is the continual cutting and re-arranging of material, exploiting multiple objects with their own internal rhythms. This technique combines with phasing to result in objects continually meshing together in different relationships. Eventually this section dissolves into a loose repetition of a previous section (1:17), most notably lacking any beat element (3:10). In the

absence of a beat, the loop is on the verge of being too long to perceive a pulse, and moving more toward memory of a phrase (Emmerson 2008: 2). This use of looping allows listeners to hear the intrinsic details, akin to Schaeffer's locked groove. Without the strong pulse and underlying entrainment, the listener is more focused on the spectromorphological attributes of the varying phrase. In sections of *Hemispheric* where there is a clear element of entrainment (such as 2:06), our limited "attention bandwidth" (Emmerson 2008: 2) would typically suggest that detailed listening of spectromorphological elements would be more difficult when rhythmic elements are also at play, and working in 5.1-format, with its additional channel bandwidth, can mitigate this masking of elements. Figure 4.5 meshes previous ISO diagrams of *Hemispheric* into one. This allows a view of decisions that smoothly overlaps the previously segmented zones present in *Sailsong*'s analysis. It demonstrates the fuzzy logic of workflows, particularly at the sculpting stage where electronica and acousmatic techniques merge, and the differences between input, sculpt and output are eroded.

Reception

Use of strong pulses alongside fragmenting edit techniques aids this music's ambiguity of role and genre. *Hemispheric* eschews some typical acousmatic gestural techniques, perhaps alluded to by Chion as "the Punch": "the audiovisual point toward which every-thing converges and out from which all radiates" (1994: 61). Instead it includes some idiomatic electronica elements, such as the early pulse sections. As a 5.1-format piece, it is unlikely to fulfil the role of a trance/club/pop/car-friendly composition. Though it features moments of strongly consistent pulses and rhythms, I feel it scales up well to concert environments. This is partially because in more pulse driven areas, the kick drum is located only in the centre channel, and other interlocking elements have leeway to drift a little, such as in a large room where the signal's arrival time may differ according to the listener's position.

5. Towards A Wider View

The investigation of internal technical processes in *Hemispheric* through diagrammatic means, suggested the possibility of a wider analysis. This research therefore moves to utilise diagrams in order to explore what may be learnt through linking up processes across disparate pieces, which continue to engage with electronica and acousmatic music. The diagrams are a core part of this section, and provide a fundamental role in opening up my practice, before returning to individual commentaries in chapter 8.

The pieces that comprise my thesis are sequenced according to their completion dates. With the exception of *Sailsong*, the pieces comment on electronica through their varying use of pulses, limited harmonic development, referential or processed source material, and aesthetic use of samples and recorded sound. But the compositional processes reveal that they are not encapsulated in isolation, and in fact rely on the existence of their neighbour pieces within the thesis. The ISO analysis of *Hemispheric* provides a glimpse into possible internal connections. Subsequent investigations searched for adroit subjects to facilitate a macro view over a number of pieces. Exposition is therefore focussed upon two techniques that allow one piece to permeate another, increasing the nebulously connected nature of the thesis, and enabling investigation within the medium of the possible relationship between acousmatic music and electronica.

Bottom-up

In acousmatic composition, the ability to retrospectively interrogate aspects of process is problematised, as it is "a medium where notation, at least in the conventional sense, is replaced at best by functional descriptions of the technical procedures employed in realising a work, and at worst just the acoustic results" (Manning 2006: 83). Digital music composition involving recorded sound is often an incremental process, (a continuous flow between stages) involving near perfect or perfect copies of information. This data is often archived according to conventional filename principles, and it is possible to trace the nature of certain compositional developments retroactively without needing to document them rigidly over time. If a digital audio workstation (DAW) is used, this documentation is often abstrusely located in the project session through the quasi-common project file management that most DAWs adhere to (e.g. Protools, Logic, Cubase, Ableton). Most projects are saved at various stages, and modifications can be tracked through the changes. It is often possible to open a project and see what processes have taken place, with the majority of digital sculpting taking place within the DAW software – an activity that has facilitated *Hemispheric's* analysis. As acousmatic composition is typically a bottom-up process that develops from the sound, the analysis component of my portfolio began with a near-forensic investigation into exactly how a sound used in one piece might have permeated another, for example how a sound from *Hemispheric* might have made its way into a following piece (e.g. *Drowning)*. This investigation revealed that there are two main techniques through which this has taken place, and they will be addressed in the following two chapters:

1) Sampling: a term used here to describe the use of a file or composed section from one piece, in another.
2) Convolution: a file or composed section that has been used in one piece, is used in another piece through a process of convolution.

Throughout the investigation, I became aware that these techniques were being used in a number of different ways. The complexity of these

relationships is such that a textual representation would not adequately provide the detail and information required in order to successfully present the practice. I therefore decided to represent the result of ISO diagrammatically, in forms determined by the result and focus of the analysis. In this sense the diagrams are most related to the field of infographics, where the form of the diagram conveys some aspect of the message.

The macro diagram in figure 5.1 is where a conglomerated overview of pertinent audio interactions can be viewed in detail, exhibiting a number of inter-piece relationships, such as how a reverb from *Headwind* has permeated through many subsequent works. Although this appears to only loosely resemble the segmented and striated ISO diagram in the introduction, it serves to demonstrate that ISO does not prescribe a particular form or hierarchy, and has become so embedded in my compositional thinking that it is no longer necessary to continually refer to it either diagrammatically or textually. Although figure 5.1 is highly detailed and displays information related to interactions with sampling and convolution, it provides low immediate comprehension of its organisation. Its immediate message in this instance is that the nature of the relationship *is* complex and difficult to represent. The focus of figure 5.1 is determined by those instances where a sound from one piece has permeated another. To show narrower and more specific messages – for instance the relationship between time and the increasing complexity of sampling (for example in figure 5.2, where a number of connections from other pieces into *Epilogue* are presented) – the diagram can be radically simplified to convey a single point, at the loss of finer grained detail. Figure 5.3 represents the increasing use of convolution and sampling on the same diagram.

As the diagrams developed from the traces of sounds through the pieces, it was appropriate to devise a method of embedding sound into them, so that they became a reference with audible evidence. Audio examples are embedded for both sampling and convolution connections on the macro and the reduced diagrams.

This embedding of sound enhances the natural progression from sound to theoretical effect, and is an apt method of opening up the practice to demonstrate the techniques presented. It thus functions as a commentary from within the medium itself, and presents a method of modelling or mapping compositional activity, through various incarnations of the diagrams. The following two chapters will address the use of sampling and convolution respectively, detailing a number of examples that should be read in conjunction with the diagrams. Figure 5.1 tends to contain the highest level of detail, with other diagrams (such as 5.2, 6.1) filtering information from it. Figures 5.1 and 6.1 also include an alphanumeric grid that will be referenced to enhance ease of use.

6. Sampling

The term 'recycling', while appropriate to the internal processes of *Hemispheric* with respect to its internally derived source material, is no longer appropriate when linking up multiple pieces, owing to the relationship of this process to a narrower internal reuse activity in *Hemispheric*, rather than developing wider concerns related to electronica and reuse of external audio. Drawing on the discussion of electronica in chapter 3, the term 'sampling' will therefore be used instead. The use of the term 'sampling' carries with it a number of connotations, particularly in electronica given the use of MIDI samplers that allow sounds to be triggered according to the currency of the note. As discussed, sampling in electronica has extended its reach by 'instrumentalising' unusual sounds as evidenced by artists such as Tobin. The term 'sampling' in this portfolio of music however, concerns "the use of the identical copy of a foreign object which, through technological mediation, is then fitted into a composition" (Fuchs 2004: 309), critically, without the use of a MIDI or software sampler. It does not refer to typical acousmatic workflows, where sound is recorded, manipulated, and often re-manipulated within a piece. Rather it refers to the copying of an excerpt of sound from one of the pieces in the thesis, and pasting into another piece. It may be re-processed, for instance, shifting the pitch, or it may be a sample so short as to be unrecognisable. It may be re-arranged temporally through reversing, or dividing it internally and shuffling the order. It may also be audible and recognisable as a sample. These samples are not integrated with software-samplers or virtual drum machines, and any manipulation takes place directly upon the waveform itself within the DAW.

To extend the above discussion of sampling themes within my work and begin to investigate the ramifications of sampling in my compositions, it is necessary to be able to ascertain whether a sample is recycled within a piece as in *Hemispheric*, or whether it is appropriated from another piece. Therefore the terms 'indigenous' and 'exogenous' are introduced here to describe a sound's origin in relation to the piece currently in focus, and are

utilised more extensively in the next chapter to designate the origin of convolution impulse responses.

1. An indigenous sample's origin is located in another part of the piece in which it resides, or it was created specifically for and then used in that piece.
2. An exogenous sample's origin is located in, or was originally created for, a different piece to the one in which it currently resides.

For instance, excerpting audio from *Hemispheric*, and inserting it into *Little Tension* would be exogenous sampling of *Hemispheric* in *Little Tension*. The focus of the following exposition is on the integration of exogenous samples into a piece.

A study of *Little Tension* and its use in *Savious* will demonstrate how an exogenous sample can be integrated multiple times into a piece and become altered through the assimilation. Excerpts from *Little Tension* are present in a number of other pieces in the form of exogenous samples as demonstrated in figure 6.1. This is not indicative of the effective strength of its presence necessarily, but it does acknowledge that excerpts from this piece have made the greatest number of exogenous connections.

Little Tension is a piece with a spectromorphologically homogenous sound-world in the middle, bookended by contrasting sections. *Savious* however, takes in a variety of spectral, spatial, and compositional ideas with disparate source material. An exogenous sample from *Little Tension* is subjected to a number of transformations in *Savious*, and key aspects of transformations are listed below, to be read in conjunction with figure 6.1 where details are more suitably displayed with audio hyperlinks.

1. The first transformation reframes a legato rhythm in *Little Tension* into a stuttering articulation of a possible melodic riff. It can be heard in isolation by clicking the pink "truncated and organised…" box (figure 6.1: C4) and in context, by clicking the green node that links to

Savious. This sequence had to be constructed by processing a sample, and it was not treated as a precious artefact to be preserved and recognised in its entirety. Rather, it was crafted in order to match the consistency required by its new home, through truncating and pitch shifting. The sample's influence on its new surroundings was in a sense, quite minimal. However, background elements were altered to better develop a cohesive blend between this exogenous sound and the indigenous environment. This alteration took the form of equalisation to avoid conflicting frequencies, and the occasional muting of a sound in order for another to take precedence. These alterations, as stated, are audibly quite slight, and are common practice when inserting new sounds into a piece. However, I recognised this new element as a sound from *Little Tensio*n. This context has a greater affect on its use, as I was aware that I was altering a previous piece, and re-framing the meaning. The awareness of the possible contrasts and subversions taking place by editing such a sound with a new context, is demonstrated by future alterations.

2. The newly constructed melodic sequence, now present in *Savious,* is itself re-sampled. Following the pink arrow to the right, clicking will again reveal the modified sample alone, and in context. Through truncating and looping, the modified sample provides an underlying pulse (figure 6.1: C4), and is eventually brought to prominence as a gesture that precedes other more aggressive foreground gestures. This new use furthers the development of a consistent sound-world across a piece that has a number of different sections, and allows it to be better identified with the other pieces. The use as an underlying pulse moves the sample closer to its indigenous function of a foreground pulse. This pulse then becomes more prominent (figure 6.1: C3).

3. In a further transformation towards the end of *Savious*, the background pulse is given greater prominence (figure 6.1: C2) through further truncation, looping and equalisation. It is subsequently mediated to produce a simple pulse pitch structure (figure 6.1: C1). This is closer to Tobin's use of sound objects as instruments rather than the exploitation of their inherent spectromorphological characteristics.

The above transformations demonstrate that a sample's origin, in this context, is not necessarily always recognisable to the listener. However the motive for choosing the initial sample is important. In *Savious*, which is the first piece to incorporate significant exogenous sampling, it was done in an attempt to create sonic links between the pieces. Given that *Savious* was through-composed, it is likely that the presence of this particular sample did influence future sections, despite the lack of deference to its origin and potential unrecognisability. Even for the listener however, the spectral content may trigger memory, and the sample's previous context can influence the eventual meaning in the new setting. Any extrinsic potential, or mimetic discourse in these pieces can perhaps be adopted to refer to the context of other pieces within the portfolio, rather than to referential or anecdotal sound experienced by humans in daily life. Additionally, as this is a synthesised sound it contains few causal identifiers. Extrinsic references are therefore more likely to be located within electronica than those of typical acousmatic sound objects.

Should a listener recognise the origin of a sample used in *Savious*, there is potential to reinforce or dilute previous meaning. The insertion of the smooth rhythmic drone from *Little Tensile* into *Savious,* and the construction of a different riff-like function with imposed spectromorphologies through stutter edits, produces an entirely different meaning and function in opposition to its genesis. In this sense the identity of one piece is relational to the listener's knowledge of the others.

To provide an overview of the connections between pieces, figure 5.2 indicates how relationships between pieces have developed over time. The diagram indicates increasing sampling complexity against time and the number of connections between pieces tends to grow chronologically as the opportunity to create connections increases with available sources. The composing of *Palette* began in 2008, but was radically revised over time until completion in 2011. This extended period of development on *Palette* allowed samples from its early life to be deployed in *Little Tensile*. Although the older pieces in light brown are classed as samples indigenous to *Upside Outward* for the purposes of this thesis, they actually originate from previous non-thesis compositions, and as a result the diagram allows an accurate indication of this time dimension.

Main Modes of Sampling

The study of *Little Tension* in *Savious* demonstrates the importance of noting whether the sampling is likely to be recognisable or unrecognisable. As previously delineated, recognisable sampling can confer notions of precedence and antecedence, that when recognised can endow meaning in a new context. Unrecognisable samples perform different though not exclusive functions. They can aid in creating a related sound-world between pieces. In addition, as the composer knows the original context, the new context is either a subversion, or reinforcement of the indigenous function of the sample. Listed below are a number of key moments of exogenous sampling that create different affects, and are detailed on figure 5.1.

Recognisable

1. A sample of a marble rolling from *Little Tension* (figure 5.1: E2) is present towards the end of *Little Tensile* (figure 5.1: F2)*.* Clicking on the pink box "Marble rolling…" (figure 5.1: F3) will link to the marble sound in *Little Tensile* out of context, and clicking on the adjacent purple node will link to the sound in context. It relates to the incoming

extrinsic meaning of rolling, which is extended by a subsequent ambiguous motorised transport sound. *Little Tension* is more concerned with stasis, as the marble roll is present to indicate a smooth concave surface. The exogenous marble sound in *Little Tensile* introduces a subversive function of departure implied by the subsequent motorised sound, situated at the end of the piece in a contrasting sound-world. Its shared intrinsic function in both pieces is to connote smoothness to the surface, which also includes a sense of motion after and before the unfolding of more dramatic events. Additionally, it is used as a recognisable artefact, suggesting explicit links between the pieces. This is appropriate, given that they are both investigating pulse-led momentum in opposing ways. *Little Tension* continually alters the beat focussing on internal activity, and *Little Tensile* maintains the beat with superimposed gestural shapes. It also helps to relate one to the other sonically, to maintain a cohesive sound across differing sound-worlds.

2. A recognisable sample from *Hemispheric* (figure 5.1: C2) is present in the track *Drowning* (figure 5.1: B3). *Drowning* is a fixed media composition that takes one of Thirty Pounds of Bone's finished folk songs as the source material for radical transformations. It seemed appropriate therefore to insert recognisable artefacts from my own finished works, in order to complement the process of remixing his. The sample (figure 5.1: A4) from *Hemispheric* has intrinsic qualities that create a significant contrast to the extant sound-world of *Drowning,* while the spectromorphology signals an 'opening up' that matches its conceptual identity. There is therefore a sense that this connection begins the opening up of an archive, activating the listener's memory and allowing them insight into the creation of these pieces. The use of the sample is an adroit parallel to the aesthetic of the piece involving communication and repetition, and also addresses the connectivity of the pieces thus directing the listener to decipher the relationships.

3. A sample of *Hemispheric* exists in *Savious* (figure 5.1: G5), with a primary function in this piece of integrating their respective sound-worlds (figure 5.1: H6). Any memory based extrinsic function may invoke the nature of the sounds transitional function within *Hemispheric*, which is also how it exists in *Savious.* This is a recognisable link, and merges with the acoustic chain of 'wind' that exists in other pieces through spectromorphological similarities.

Unrecognisable

1) Excerpts from the 2009 version of *Palette* (figure 5.1: D7) exist in the track *Little Tensile.* These samples (figure 5.1: G3) unrecognisably reference a very early version of *Palette*. Their function is in equal parts to contribute and fit into the sound-world of *Little Tensile*. Although they originally belonged to the *Palette* sound-world, they are so highly processed that their origin is unrecognisable, and any functional or extrinsic relationship is made void, including any intended by the composer, beyond the reasoning behind the initial choice and connotations of the unmodified sound.

2) Composed toward the end of the thesis, *Upside Outward* (figure 5.1: C7) starts to develop a different type of sampling. Coming to terms at this stage with the ability to self-sample, I wanted to integrate older work – made before commencing with this thesis – which had influenced the focus of my current compositional output. On an intrinsic level, this resulted in a significant widening of the sound-world, and the incorporation of environment recordings, designed sounds, and a live recording of a piano Max/MSP piece. These pieces had little or no conscious engagement with electronica. They exist now in the same piece, that has a clear pulse throughout. In its most basic form this is an attempt to coalesce old sounds into new practice, demonstrating the extent to which my practice of sampling has developed. This mode is similar to the sample as artefact, or as a

respectful acknowledgment of antecedent. The samples also represented a conscious effort to exploit the tool of ISO. These sounds (figure 5.1: B6 - C6) were brought in on occasion knowing that they would inflict unpredictable changes upon the track. For the purposes of this thesis these samples are classed as indigenous to *Upside Outward*. Although they are appropriated from earlier pieces, these pieces are not in the thesis, or in the case of *Sailsong* do not belong in this re-focussed section of the thesis. As these 5.1-format pieces are linked to form a loose conglomerate exploring concerns instigated by the analysis and composition of *Sailsong*, they do not include *Sailsong.*

These examples serve to demonstrate the alteration in workflow from the use of "aestheticised snippets of sound" (Taylor 2001: 140) in *Little Tensile* that helped to develop a workflow, to the later use of samples in, for example, *Upside Outward,* that forces alteration, and *Drowning,* that exposes the sampling as a method for commenting on the process. Initial modes of sampling for the first few pieces (*Hemispheric – Savious*) took place with the aim of a uniform production sound, or a making of sonic links at its core.

It is clear that the use of sampling here is largely recognisable. The degree of recognisability is linked to the immediacy with which a listener can locate the sample's origin. This is the minimum requirement for a listener to start to comprehend the connectivity of these pieces. If they can recognise and locate the sample in another piece, they may begin to connect the extrinsic associations of that sample, including its original function, mimesis, aspects of the original piece surrounding the sample, and so forth. Even when a few seconds of a sound from one track is used in another, as with *Headwind*'s insertion in *Upside Outward*, this can be enough to locate the new track within the thesis, even if the track contains other unrelated sounds.

The listener may often not know from which track the original sample came. Most of the time it is apparent, as the primary track presents the sound in its complete form, and the sampling piece refers to an excerpt, or takes the

sample and develops it as though it were source material. In the latter scenario it demonstrates an alternative development that is a combination of sounds native to the track and the intrinsic quality of the sample when combined with the new sound-world. It exposes the multitude of possible connections and decisions composers can make, when one variable is altered. The use of sampling to create connections between pieces was augmented by convolution. Some of the implications of its use are comparable to those of sampling in this section, but convolution also allows a number of qualities particular to its workflow. These are detailed in the next chapter, before attending to the individual pieces.

7. Convolution

Convolution is the multiplication of two signals, resulting in a combination of the spectral and time information belonging to the original signals. A common application is termed cross-synthesis, where the resulting outputs "bear characteristics of the parent sounds but may resemble neither" (Roads 1996: 420). Previously, the process of convolution was predominantly the domain of the acousmatic composer. In more recent years, convolution has become a common tool, which has enhanced the realistic quality of digital reverb, a development that my workflow exploits.

When a sound is produced in an enclosed space it causes many echoes, often too closely spaced to discern an individual echo, and this is known as reverb. Reverb and simulations of reverb are an integral part of music production. It can be recorded live, applied in an echo chamber, simulated digitally with artificial algorithms or simulated through the use of impulse responses recorded in real spaces. Convolution reverb describes the last of these processes and allows a highly accurate simulation of a space, by creating a digital representation of the acoustic characteristics of the desired space. An impulse response is the recording of the reverberation of a room, when activated by an impulse. The techniques used to gather impulse responses vary, but the impulse is often a pistol shot, a balloon bursting, or swept sine tones. This impulse activates the reverb in the room, which is then recorded and becomes the impulse response. This impulse response is convolved with the input signal in real-time, with each sample of the processed audio being multiplied by the samples in the impulse response file.

The conventional and foremost use for a convolution reverb is to filter a dry signal through a recording of an acoustic reverb from a physical space, creating a realistic sounding reverb that can be manipulated in the digital domain. However it is also possible with most software convolution reverb plug-ins, to insert any sound as the impulse response. It is quite possible to use recordings of eccentric spaces such as a cave or the interior of a metal container for an impulse response, but it is also possible to insert any sound

– a drum loop or a piano chord for instance – as the impulse. The results can vary wildly. The rhythm contained in impulses, if indeed any is present, is often blurred. The aural representation of the impulse depends upon the nature of the signal fed in. A single attack-termination input might result in high rhythmic clarity at the corresponding frequencies, whereas a graduated continuant input would produce significant blurring and loss of ability to determine the decay of the impulse. For impulse responses with strong fundamental frequencies such as the cited piano chord, the frequencies present in the convolved signal are activated only by the corresponding frequencies in the input signal. For instance, if an input signal with no frequency content above 200Hz is used with an impulse response with no content below 400Hz, the wet signal will be silent. If the frequencies are excessively correlated on the other hand, the result will include highly resonant frequencies producing an effect not dissimilar to feedback. This is not a particularly new technical phenomenon, and has been noted in brief by Barry Truax (2003), and Adrian Moore and David Moore (2011) amongst others. Nonetheless, the aesthetic potential of modern convolution plugins, as opposed to the traditional acousmatic use of cross-synthesis, has been relatively overlooked.

Use of impulse responses in this thesis has taken place in a program specifically designed for reverb, Logic's Space Designer. This differs from convolution in programs such as Soundhack, as Soundhack's environment is more tuned toward cross-synthesis. In contrast, Space Designer contains all the parameters one would expect from a convolution reverb dedicated to manipulating space. Impulse responses can be shortened, and allow different envelopes such as frequency or amplitude. The ability to shape the envelope of the impulse response and balance the wet signal against the dry allows the user to focus on the convolution as a reverb, rather than as a tool for cross synthesis. Additionally, as it takes place in real-time and encourages swift experimentation, it facilitates a very different type of engagement to the off-line workflow engendered by Soundhack. It therefore has a set of connotations more consistent with the notion of immediate aural

feedback and play that Schaeffer drew attention to as a characteristic of musique concrète.

Modes of Convolution

The use of convolution reverb has been categorised through two modes. These modes relate to parameters of deployment rather than their creative or aesthetic affect. However it is necessary to distinguish between these modes, as they could inform the intent behind the use of convolution reverb and the affect in each case. The two modes designate the origin of the impulse response, specifically whether it is indigenous or exogenous.

1) An indigenous impulse response has its origin in source material that is also indigenous to the piece. This indigenous impulse response could be electronically synthesised, recorded sound or originate from a sampler instrument. It could also be recorded material that is used primarily in that piece. The response could also be an excerpt of the piece, but is now used as an impulse response for the same piece.

2) An exogenous impulse response is one where the impulse response has been appropriated from another piece. It could be an excerpt of another piece as an impulse response, or an impulse response that is indigenous to the other piece and is now used in the current piece.

Convolution reverb is a pivotal method through which I have actively and materially researched the relationship between electronica and acousmatic music, and together with sampling it has framed the development of many pieces. On *Upside Outward*, certain sounds are played through impulse responses made from a recording of the fizzing of an open soft drink bottle and a miniature music box's tines. The input sounds comprise environmental sounds, masts and rigging from boats at a reservoir, and the sound of rock climbing gear rattling. They are, or are processed into, expansive situations, constrained in the smallness of the reverb. This piece became about

polarities of geography, mass, elevation, and pitch. However it is grounded through the clearly distinguishable use of the convolution reverb, and the pitch material that resonates from it. *Upside Outward* is notable here, for the variety of sound sources played through the same impulse response, and this near constant reference becomes like "a child in the dark, gripped by fear, comfort[ing] himself by singing under his breath" (Deleuze and Guattari 2004: 311), a guide for the listener through the various sounds. Reverb in this context becomes a structural device, and a particularly effective signpost for the listener. Accepting one 'space' as a home, and allowing the composer to choose to leave this home at key moments of tension within the piece can have great effect, as noted by Peter Doyle, "the audience is suddenly impossibly located in intimate proximity to the singer…normal hierarchies have been upset, rearranged…" (2005: 87).

The above use of reverb differs from convention in that its effect is clearly discernible even when room acoustics might normally destroy fragile conventional reverb treatments, for example the "rooms within a room" hypothesis as advanced by Smalley (2007: 53), thus making it especially suitable for the acousmatic composer working in multichannel sound whose work may be heard in both the acoustically dead studio and the reflective concert hall. Examples of prominent uses of convolution reverb are listed below, and can be accessed on figure 5.1.

1) Initial indigenous use of convolution reverb takes place in *Hemispheric* (figure 5.1: C1). Impulse responses and inputs are indigenous to *Hemispheric*. If an impulse response box is clicked, it links to an .mp3 of the impulse response. If a node attached to the impulse response box is clicked, it plays the result of the input sound when convolved with the impulse response. The effect in *Hemispheric* is to increase the pitch instability by adding an overtone in one instance (figure 5.1: C1), or smoothing out the spectral space to reinforce in another (figure 5.1: D1).

2) In *Little Tension* (figure 5.1: E2), the convolution reverb has been used in order to transform a particular sound. A drum track is completely transformed through its convolution with an indigenous drone tone impulse response, activating a more gentle percussion track similar to a mallet instruments rhythm (figure 5.1: E1). Alternatively in this piece, a percussive hit is used to trigger a different sample, activating a different space responding to the frequencies of the impulse (figure 5.1: E1). The use of an impulse response to give a sense of 'space' in this piece is unrecognisable, however both the impulse and the sample are indigenous.

3) In *Savious* (figure 5.1: G5), an indigenous impulse response is used to reinforce pitch space on a temporary basis (figure 5.1: G4). In this instance, pitch material present in the impulse strengthens the existing pitch of the input. The timbral qualities are slightly altered, allowing a more rounded space from which a stuttered object can emerge.

More significantly perhaps, an indigenous sample recorded at Derwent Water in Cumbria of ice cracking is filtered through an indigenous impulse response excerpted from a previous section in the piece (figure 5.1: H4). In this instance the pitch tone produced in the wet signal clearly invokes a particular space and the section from which the impulse response is excerpted. It functions so responsively against the cracking that it does act as a reverb, owing to the rapidly decaying amplitude envelope. The reverb adds unity to the piece, by reaching back in time to a pivotal moment in the piece, and harnessing its spectral distribution. Utilising the previous section as a reverb audibly demonstrates the powerful impetus and on-going affect of the section. Additionally, the reverb helps to balance this excerpt spectrally, against the dominant kick drum, drawing attention to the ice cracking. Convolution reverb exists here as a method of integrating the noise material of the cracking ice into the pitch space of the piece. The presence of the impulse response excerpted from the previous

section, exists as a reverb to provide some context for the otherwise incongruous cracking ice.

4) In *Headwind* (figure 5.1: F8), the reverb *theblur* (figure 5.1: F7) is both exogenous and indigenous. Part of its origin is a processed version of the opening two minutes of *Savious*. This opening two minutes in *Savious* also includes sampled moments from *Little Tension* (figure 5.1: G6 – G8). *theblur* is the result of the recording of waves indigenous to *Headwind*, being convolved with these opening two minutes of *Savious.* In *Headwind, theblur* reverb is used with indigenous input material. The result quite clearly reaches towards the pitch class of *Savious* and *Little Tension*, and certain timbral characteristics of *Savious,* such as the metallic scraping, are perceptible. This use of reverb is explicitly commented on as a use of space, when audio is created that with causal listening sounds like a splash of water. The reverb has a cave-like response, a quality that derives from the characteristics of *theblur* impulse response. The splash is happening in another piece, and thus invokes the breaking ice in *Savious* (figure 5.1: H4)*.

5) In *Palette* (figure 5.1: D8), convolution reverb is used both indigenously and exogenously. *theblur* reverb from *Headwind* is invoked, which helps to situate the piece within the thesis (figure 5.1: F7). *Palette* consists of a number of altered clarinet and stream recordings. The sounds of less processed clarinet playing are present in the reverbs (figure 5.1: D8). Although many of the foreground input sounds are perhaps not recognisable as clarinet, the impulse response is, and it facilitates the continual grounding of the processed sounds in a more familiar sound-world.

At this stage it is possible to summarise the effects of indigenous and exogenous reverb as follows, before moving outward to further discussion on how this relates to use of space:

- An indigenous sample input convolved with an indigenous impulse response is unlikely to introduce significant exogenous meaning. It will most likely have the effect of reinforcing an existing sound-world, or creating an indigenous temporal juxtaposition.
- An exogenous sample input convolved with an indigenous impulse response can be used to group disparate objects together and allow them to coexist.
- An exogenous sample input convolved with an exogenous impulse response can result in a number of possibilities. If the origins are similar, they may create a dual reference to other pieces or environments or objects. However, their identities will not necessarily be easily fixed to the current piece, except by dint of their existence in it or careful integration with the existing sound-world. This use of convolution is perhaps more akin to a sampling aesthetic, where the sound is used for "sound's sake" (Taylor 2001:150) and the reverb is used more as a type of cross-synthesis rather than fixing on its effect as a reverb.
- An indigenous sample input convolved with an exogenous impulse response can be used to place sounds native to the piece in a space belonging to another piece, or in another sound. This can suggest a relationship to the other pieces, as with *Palette* to *Headwind*.

There have been a number of other considerations when working with space that address the macro implications of the collection of pieces in this thesis. Notably, Jean-Paul Thibaud (2007: 329) states that a 'walkman' user moving through a city creates a tension of space where "new sonic territories are composed in the course of this mobile listening experience". The use of impulse responses internal to the 5.1-format pieces but exogenous to the current piece, could be thought of as being analogous to the walkman user's interaction, but in a wholly private, invariant manner. Robert Normandeau's suggestion of a fixed space is appropriate to refer to, as he states "one can imagine that there exists in some works an invariable space where internal and external space are fixed in a standardised relationship, like in cinema with image and Dolby Surround sound…to minimise the role of a hall's

acoustics in a concert situation" (2009: 277). Such an idea relates to a region on a continuum between private invariant space and public variable spaces (concerts, installations, headphones). While extrinsic sonic links can still be exploited and recognised by a listener, space created by an exogenous impulse response is more private still than a walkman user's "new sonic territory" (Thibaud 2007: 329), with links internal to the pieces and experience of sounds in the pieces.

While it is acknowledged that reverb is used to create a space shared by performer and listener (Doyle 2005: 9), its use in these pieces facilitates an active engagement from the listener, demanding and stimulating knowledge of other works in the portfolio, or detailed knowledge of the current work. This enables the piece to be fully situated and for a sound's 'place' in 'space' to be interpreted. Although the space can still be appreciated through an isolated encounter, its meaning is augmented by understanding or appreciating its relationship to a place within the portfolio.

Although conventional reverb has been used, few 'realistic' or imagined room spaces are engaged to create spaces in this thesis. Furthermore the use of sound objects *as space*, while perhaps related to inserting sonic signposts throughout a piece as discrete sound-objects, is pointedly different. The sonic space is measured by the frequencies mapped out by the input signal into these responses, and correspondingly determines how much of the impulse sound is revealed. A related precedent exists in church interiors, which provided a tonal response emphasising certain pitches.

The 'space' for this portfolio of work is its own self-developed space, where convolution acts as a catalyst for exploring relationships between exogenous and invariant space, negotiating through a listener's experience. When a single piece is played, the listener is not just hearing a single piece, but remnants and spaces from other pieces in the collection, spaces that may have been already recursively acquired from conglomerate sound.

Doyle argues that "the spatiality of the concert hall was virtually overlaid upon the space of the home; ...The home listener was granted a virtual access to the acoustic regime of the concert hall…already embedded in it whole ensembles of history and class and race politics, highly ordered codes of privilege and exclusion." An interrogation of space in the portfolio through ISO, or a listen to the entire portfolio can grant access to the codes and spaces of individual pieces. The listener can become privy to the inner workings of the pieces, their construction and development is more clearly penetrable as a gradual accumulation of space, sound, and audible-hyperlinks. The fixation on iterative internal (as opposed to external) links within the thesis, with structures and processes relating both to acousmatic and electronica idioms, suggests a new territory for these works.

Fundamentally, these discussions of space are about sounds that do not exist in a realistic space. They exist in another sound. This level of abstraction can deepen meaning in a piece, but for the pieces presented, this process has also limited their harmonic development. This characteristic deliberately references electronica, a music that typically exists in simple harmonic structures. Furthermore, this reference seems apposite as a responsive and active commentary within the medium, where composition becomes critical practice. As Landy suggests, on a compositional and structural level this can have the benefit of giving listeners "something to hold on to" (1994: 49-60). Paul Lansky similarly notes of Aphex Twin, Matmos and Autechre that "In many of their tracks the focus is on a rich accumulation of electronic effects, and a single harmonic landscape will often be prolonged for ages without any significant change. The function of the static harmony is thus that it acts more like a placeholder, and a change in harmony is therefore more of a change in place than part of a complex grammar. Since a goal of much of this music is the elaborate and progressive design of a sound-world made of rich and novel electronic sounds, it typically eschews noticeable harmonic progression. The listener is invited to contemplate the sounds for him- or herself, and elaborate harmonic changes might in fact prove distracting to that end" (Lansky 2005: 172).

8. Commentaries

In order to indicate the continued investigation into electronica and acousmatic music as an on-going foundation of my compositional intent, it is necessary to detail pertinent aspects of the remaining pieces. The previous diagrammatic representations of convolution reverb and sampling form a significant part of this project's contribution to knowledge. As a direct result of this wider focus, a number of details are presented in these commentaries that would not otherwise have been revealed. The pieces in this thesis are designed to be experienced in the order of completion. Pieces completed towards the beginning of the PhD such as *Hemispheric* through to *Savious*, are more concerned with the progressive integration of pulses, mimesis and the exploration of technical challenges. The approach towards both their composition and analysis here is more technical, and subsequent pieces involve a consistent shift towards introducing recorded sound in *Savious* and beyond. Pieces like *Little Tensile, Savious, Headwind* and *Palette* continue to incorporate aspects of bottom-up acousmatic workflow and the treatment of material as sound objects, but with higher integration of pulses and spectromorphological material. After *Palette,* composition began to return to more recognisably acousmatic traits in *Upside Outward*, with respect to structure and progressive exploration of sound material. *Drowning* and *Epilogue* represent the final steps of this thesis into new compositional terrain and identity.

The following analysis of work should be read in conjunction with figure 8.1 and 8.2, and taken together lead directly to the final piece *Epilogue*, which concludes the practice based element of this research. The audio of *Epilogue* and accompanying text in chapter 9 is designed to act as the conclusion to this thesis.

***Little Tension* (Lancaster, 2010)**

As figure 8.1 demonstrates, it is possible to trace a number of compositional developments over the thesis that are not directly related to the use of convolution reverb or sampling. Developments in one piece tend to flow naturally into the next and so it is to be expected, for instance, that *Little Tension* continues to use software instruments as sound objects, a technique that began while composing *Hemispheric.* Though *Hemispheric* is concerned with reconfiguring sounds in numerous ways to skew structures and sections, *Little Tension* is more focussed on a mimetic discourse of motion against arrangements of locked grooves, and how the use of pulses can facilitate notions of space.

This is partially achieved through mimetic events with varying levels of source bonding. The opening invokes recognisably metallic sounds, existing in an unrealistically large space created by a synthetic reverb with a compressed tail. Causal listening in combination with the spectral weighting and spectromorphological behaviour of the sound objects suggests that they are metallic and large in origin. The non-repetitive morphologies of these sounds, when combined with use of reverb and progressive panning of objects to the Ls and Rs channels, suggests movement through a field of objects.

The final spectromorphologies in the opening (0:45) can be likened to the mimesis of a large metallic object coming to rest, particularly with the receding high frequencies indicating brakes squeaking. This generates a contrast created through juxtaposition, with the smaller and more static sound-world invoked in the next section by more abstract methods. This long central section (1:01) invokes several characteristics to portray a more static observational perspective. The impossibility of continued audibility of a rolling marble suggests that it is enclosed in a small container being tilted into varying perspectives. This is combined with an initially repetitive rhythm that begins with a tonal pulse and eventually moves towards a texturally endowed pulse. The use of limited harmonic development in the central section

reinforces the marble and pulse in suggesting the immobile space and referencing electronica loops.

To emphasise the more static observational perspective of the central section, some sound objects reminiscent of the opening occasionally circle and recede, and invoke flapping/fluttering connotations of a metallic-organic airborne entity (3:43, 3:59). More dissonant and continued metallic gestures refer to a sense of spatial simultaneity, portraying the unrealistic space of the introduction. They also act as a signpost to indicate not only that the other space may return, but also that there is a continued tension between the two spaces.

The near-bookended structure of *Little Tension* also explores switching focus between rhythmic and spectromorphological characteristics. Both the introduction and the conclusion rely largely upon texture-carried spectromorphologies to provoke listener interest. *Little Tension* takes *Hemispheric's* (6:31) juxtaposition of pulse and textural material as the tenet for textural pulses (2:45). Here, *Little Tension* focuses upon arrangements of spliced cuts endowed with time to almost exclusively drive the development. Referencing the loops of electronica, *Little Tension* contains audible cuts at loop points (5:15). Similarly, background pulses are fixed in a short pattern to indicate semi-suspension in space (5:35). This focus is swiftly eroded through the return of the unrealistic large space and previous related gestures and textures.

Little Tensile (Lancaster, 2010)

In contrast to *Little Tension, Little Tensile* maintains a largely consistent rhythm and pulse. The intent in this piece was to oppose and integrate gestural material with the uncompromising common denominator of a 4|4 beat. This complements the exploration of endowed time and textural pulses present in *Little Tension*, where the pulse comprises cut textures and gestures to create a static space. *Little Tensile* on the other hand, exhibits an unremitting beat with gestural material slipping around it.

Although *Little Tensile* engages with repetitive beats (2:33) when it has just commenced, the beat is swiftly subjected to a treatment that conceals it. This suggests that the listener will have to continue to listen closely, rather than relax into the comfort of entrained repetition, and reinforces the notion of fuzzy logic as explicated in *Sailsong*'s analysis.

Elements of this piece were spectrally blurred[12], and the resultant sound object was utilised in the introduction. This allows sounds to emerge more naturally out of spectral space while retaining their clarity (1:14). A reverb might have compromised this clarity, or resulted in unwanted spatial depth. The blurring produces a graduated continuant, which can then be sculpted to fit around the gestural interplay (before 2:32), where the blur is no longer used. This particular technique is built upon in later pieces, notably *Drowning* and *Palette,* and represents a repeatable approach for aurally led processes and organisation. It also relates to a method of creating and integrating idiomatic electronica 'pad' production.

In contrast to *Little Tension*, compositional emphasis on spatial depth is initially low. Spatiality is attended to through rear and frontal accumulation of gestures and sporadic reverb sends (1:09 onwards). There are, however, moments where the beat is subjected to dramatic spatial shifts. This is particularly evident (2:51, 2:58, 3:13, 3:28, and 3:45), where the beat is also

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[12] Using Michael Norris's Soundmagic Spectral Plugins.

subjected to a variety of different spectral intensities, weighting, variously, the treble, mid-range, and bass frequencies in order to lead towards a climax (4:00). As the piece focuses on one pervasive high frequency pitch to complement the repetitive beat, the different intensities allow the listener access to different spatial configurations through which to absorb the variety of sonic transformations. The crescendo and accumulation of gestural and beat material has forced a new section to emerge (4:00). The section is spectrally and rhythmically more permissive than the previous congestion, and depicts a smoother integration of pulse and gesture.

The final section is defined by the entry of more low-frequency sounds including a 4|4 kick drum which also feeds the key input of a side-chain compressor inserted on the reverb tail of the previous section. This references a 'pumping' production technique common to electronica, and the active use of production mimesis. Production mimesis is a term created here, that relates to Emmerson's mimetic discourse and Brian Eno's statement that "reliance on notation as a criterion for aesthetic judgment inevitably leads to the ignoring, by traditional analysts, of aspects of musical style which are extremely important in popular music, but which are difficult or impossible to notate, such as overall "sound" (or what are known as "production values")" (Tamm 1995: 9). In *Little Tensile,* the change in spectral disposition results in a production sound that evokes aspects of electronica. *Savious* and *Headwind* use production mimesis to better depict representations of their source material and conceptual focus.

Acoustic chains in *Little Tensile* provide links to mimetic discourse in *Little Tension*, and are evident through the metallic onset-continuant (0:00), and the use of high frequency granular sounds (1:32) indicative of *Little Tension* (*Little Tension* 1:00). Sampling of *Little Tension*'s rolling marble (4:29), is succeeded by tremulous high frequencies, which serve as a transition between the marble and train spectromorphologies (5:00), and the augmentation of previous and contrasting mimetic discourse. This use of mimesis and acoustic chains defines and reinforces the connection to *Little*

Tension, and comments upon the continuing development and organisation of the sound-world in these pieces.

Savious (Falmouth, 2011)

Savious develops from scene to scene with some variations, and it could therefore be difficult to ascertain its structural logic and identity. However the production mimesis is one of the binding traits of the piece, and was necessary to allow the piece's identity to emerge under a consistent guise. This takes the form of tightly controlled low frequencies with limited conventional reverb, alongside frequency bandwidth limited mid and high components with long reverb tails and elements of clipping distortion. *Savious* also admits a small amount of recorded sound into the piece, in a manner that reflects the production aesthetic of cold, clinical and friable sound. This is particularly clear in the introduction, where unrooted high-frequency material with fragile, repetitive gestures creates an overwrought and strained sound. The extreme panning and rapid sonic development in this introduction (00:50) also reflects the multifarious structure of the piece, enabling the listener to acquire an expectation of this varying macro structure.

The production mimesis of this piece is sterile and technological, and this is reinforced by the mimetic discourse of cracking ice and its treatment as a sound object. The ice is rhythmically quantised (13:47) allowing further smooth integration of the sound into the piece, before its full identity is revealed at the end. Deployment of this recorded sound shifts between acousmatic (13:05 – 13:46), electronica (13:47), and soundscape (14:12) composition where the full frequency bandwidth recording leaves the environmental context intact.

Mimetic discourse is integrated into *Savious* in a number of other instances, developing ideas originating in *Little Tension.* Wind and ice sound objects are integrated into a riff-based section (1:27). The morphologies facilitate a wide spectrum of sonic possibilities in the following section, along with the

semantic possibility of wind bringing instability and development. Later (5:30) the previous bass and treble material is broken into discrete gestural units. This metaphorically cracks the material up and rearranges it into new configurations that provide a pulse and morphological flow. In addition to the acoustic chains of airborne objects from *Little Tension* (4:30) *Savious* adds the mimesis of landing or ascent (2:00) that is also referenced in *Hemispheric*, and this particular idea is explicitly reflected in future pieces.

Headwind (Falmouth, 2011)

In a reversal of the previous 5.1-format pieces in this thesis, the majority of source material present in *Headwind* consists of location recordings. Having recently moved to live by the sea it was inevitable that the local sound-world would have an effect upon my compositions, and mimetic discourse surrounding wave-like morphologies is introduced in this and future pieces.

Recording for *Headwind* took place over one day, on a two-hundred metre stretch of coastline. Noise by the sea comes in many different densities and configurations, yet unique and captivating as it sounds in real life, rarely transfers this essence to a fixed format. The character I wished to impart was based upon a walk through the environment. An iPhone's microphone was used for the ice recording in *Savious* and was used again for *Headwind.* The iPhone was used as it has a naturally brittle quality, but also because it has quite a high noise floor, suiting the sounding object and the desired outcome in this scenario. In addition, at this stage in the thesis, low quality recordings actually facilitated different compositional perspectives on recorded sound that did not rely on the fidelity to the source material. However, an Edirol R-09 portable digital recorder with OKM Classic binaural microphones was used in a spaced pair configuration, and a Cold Gold Basic Hydrophone (a waterproof piezo contact microphone) was deployed into the surf. This was allowed to meander freely, occasionally becoming embroiled in seaweed. In a further effort to communicate this walk, I carried the binaural microphones without a windshield, allowing them to be buffeted by the wind. The iPhone

was used in static locations to record waves. *Headwind* reconfigures these recordings in the same attacking and densely phasing character that is easily encountered in windy coastal locations in Cornwall. Initially this is achieved through a number of segmented spaces consisting of phasing loops with different equalisations (1:58 – 2:38).

Little Tensile demonstrates that the perceived sonic detail and influence of gestures on a piece's construction can be limited if subjected to an unremitting beat. Working with densely noise-based material mitigates this problem to an extent, as there is limited discernable detail present without actively attempting to process morphologies into the material. However, *Headwind* (2:38) initiates a more continuous method of development than is possible when progress is restricted by a dominant beat, and eschews the previous kick drum-led impulsion for morphological and gestural interplay, with an underlying pulse. This segmented juxtaposition of beat and morphologically-led sections, enables the sound-world to develop in an alternate manner to previous abrupt sectional breaks in *Little Tensile* and *Savious*. *Headwind* resumes the beat (3:33) with a new organisation that maintains the previous character, while accepting and integrating the spectromorphologically imposed development.

Despite an introduction (0:00) that utilises 5.1-format to first separate and then unite noise and pitch components between the centre and remaining channels, the spectral balance of *Headwind* is ultimately abrasive and combative. This is a consequence of its fast transients, and the imbalance between dominant noise-focussed high frequencies and pitch-focussed lower-mid range material. Although the sound-world in *Headwind* is harsh, perhaps as a result of its production mimesis, the technique of alternating continuous spectromorphological development with discrete beat based sections is extended, and deployed in *Drowning* and *Epilogue.* It provides a more complete integration of recorded sound into the workflow than *Savious*, and represents a smoother and more functional switching of focus between pulse and morphologically-led sections. Given *Headwind's* noise-based material, it seemed appropriate to return to a previously unfinished piece that

took a clarinet as source material – an instrument that along with the flute, has a very pure pitch tone similar to that of a single oscillator.

Palette (New Zealand, 2009 - Falmouth, 2011)

Palette had an extended period of development. It began in New Zealand in the Douglas Lilburn Electroacoustic Music Studios, where I had the opportunity to record clarinettist Richard Haynes demonstrate his extended technique. This began as a typical acousmatic piece in stereo, after *Sailsong* (2008) was written, and before *Hemispheric* (2010). Although significant work on it took place, this early attempt was not finished. After completing *Headwind* and wishing to continue with my attempts to coalesce sounds I recorded into the new workflow*,* I returned to re-compose *Palette.* This piece is made almost exclusively from clarinet recordings, and the recording of a stream as it joins the sea near Lands End in Cornwall. Accordingly, *Palette* references *Headwind* with an acoustic chain that alludes to the developing wave spectromorphologies and mimesis that are present in other pieces (1:05). In addition, whereas *Headwind* for the most part deals with broadband noise, *Palette* often focuses upon narrow band high frequency detail to facilitate a different kind of listener engagement.

In *Palette*, swathes of material are time-stretched and spectrally blurred, creating new, denser and thicker morphologies. This acousmatic material is then combined with the sympathetic articulation of complementary looping material. Continuous juxtapositions of spectral balance in the component fragments demand detailed listening. The technique of filtering sound with audible filter emphasis is common in electronica and is used as a means to heighten expectations through denial, and gives prominence to the narrowband aspects of a sound and its repetition. In *Palette*, filtering is also used to provide animation, and to fade between spectromorphological and pulse based structuring principles. Pulses emerge (2:45) out of spectromorphologies, isolating sounds with the filters, which allows the deeper tones of the repetitive low-frequency pulses to be preserved. In contrast, mid and high frequency loops are able to phase in and out without

negatively affecting impulsion – this was not possible with the source material and treatment in *Headwind.* The continual phasing and filtering in *Palette* delays the listener's complete entrainment through concealment of a more predictable beat, brought about by varying emphasis on rhythmic and interweaving morphological components.

Palette's textural beds at the beginning and end consist of spectral blurs of circular breathing technique on clarinet multiphonics. The looping of parts and spectral blurring complements both Richard's use of circular breathing, and the locked groove of musique concrète. A clarinet continuant is at one point (0:57) morphed into an analogue snare-like offbeat rhythm. This prepares the listener and actively illustrates the process of the ensuing loops, before returning to a receding continuant and launching into less transparent use of the technique.

Palette is the only piece that works with instrumental sound as a sound source. Commenting on electronica musicians' (such as Tobin) propensity to instrumentalise recorded sounds, this piece instead works with recordings of an instrument as sound objects, whilst engaging with certain characteristics of electronica. Although most of the processing is minimal, any unrecognisable sounds are usually due to granular synthesis breaking the sound into spatially dispersed clouds, equalisation emphasising usually unheard characteristics, or spectral blurring to create long continuants..

Upside Outward (New York, 2011)

Upside Outward takes a step away from the overtly looped moments of the last two pieces, into more acousmatic terrain. *Upside Outward* combines various originally unrelated sound events and applies aspects of electronica music, countering typical acousmatic techniques with a series of transitions that are unprepared on a micro level, and the use of static pitch. This is an overt reaction against the consistent mimesis and morphological imperatives that dictate smooth transition in *Hemispheric, Palette,* and *Little Tension.*

Upside Outward contrasts polarities of size, mass, and pitch. The use of a pulse and common convolution reverb allows these disparate objects to exist comfortably in the same piece. Psychoacoustically, mass and pitch are linked, but objects and spaces are sometimes rendered ambiguous in this piece. For instance, small pieces of climbing gear that sound like large rolling stones, exist in a recording of a fizzing drinks bottle. In particular, the motorbike recording (5:03) is often perceived as thunder, perhaps relating to the windswept *Sailsong* reference (0:58). The material that follows the motorbike recording connotes a Doppler shift as distal motorbikes drive by, but is actually a desktop fan, thereby linking back to the theme of wind and the territory of *Sailsong.*

Spatial information occasionally precedes the sound from which it was extracted, as in the quiet introductory texture (0:20) that forms the convolution reverb for the remainder of the piece. In a variation of this, an orphan reverb tail is introduced (2:26) and attached to an adopted gesture. The texture that causes this reverb is then introduced as a foreground event (2:32). This spatial foreshadowing is extended to spectral space and mimetic discourse, as pitch instability (0:43) foreshadows the volatility created by the wind (0:58).

Although more characteristic of an acousmatic piece than an electronica one, *Upside Outward* still maintains a connection to previous pieces through shared production techniques. Recorded material (2:53) is allowed to coincide with repetitive pulses, suggesting a different range of possibilities for the micro gestures in counterpoint against the pulse, and this is exploited further (3:05). Although moments of stasis are contrasted against rapid cuts that allow textures to be put in motion in common with acousmatic gestural techniques, these are set against the pitch element introduced by the convolution reverb, and occasionally repetitive pulses.

Upside Outward can be viewed as an extension of *Headwind'*s sections with more continuous morphological development. *Upside Outward* hints at a

pulse, but does not fully launch into a strongly pulse-led section. Instead gestures tend to conform to a grid, but also respect spectromorphological imperatives through their careful selection and treatment. The end of *Upside Outward* returns to wave mimesis referring to *Headwind.* The subsequent piece *Drowning* moves to extend the textural focus and frames these through wave-like amplitude envelopes in the opening minutes.

Drowning (Falmouth, 2012)

Drowning takes Thirty Pounds of Bone's (real name Johny Lamb) *The Fishery* as its primary source material in the form of the final stereo track. Lamb has described this track as a "song concerned with distant communication. The song takes an allegorical stance on 19th century maritime practices to address states of 'far away'" (2012). Part of the attraction for this choice is attached to the process of working with an already finished piece. By the time I started work on this piece, the practice of recycling of samples in my own work had already become an integral element of my compositional practice. The opportunity to extend this process into the remixing of another artist's work therefore provided an interesting extension to themes already well established in my work

It is difficult to ascertain how much of this compositional process was influenced by Thirty Pounds of Bone's original track, beyond its spectral composition. *Drowning* is in ternary form, with both sections taking a different transformative procedure as the basis for guiding development and complementary sound organisation, blending an architectonically imposed process with bottom-up activity. Lamb's song is concerned with the difficulty of articulation of distant communication over cables, which are related to the two manual algorithms I employed for sections A and B.

Section A is the result of decreasing transients/noise components relative to the sinus components extracted with Flux's IRCAM Source Filter tool, effectively removing percussive elements and leaving harmonic material.

When listening, this facilitated a greater focus upon the spectromorphological characteristics of the track. This section was then spectrally blurred to produce more graduated continuants, and surround channels were then created from pitch and time-shifted copies. The final step in this procedure for section A was to temporally detach the audio channels so that they were several seconds apart, canon-like, and pan the channels to create a motion that suggests energy. Through this process musical moments arose, and suggested other opportunities for complementary organisation. Thirty Pounds of Bone's song is concerned with space and narrative, and section A takes an approach that fractures the qualities of his track's spatial character, ensuring a dichotomous and ambiguous approach to linear location awareness in his original track, through the use of the canon.

In section B, information is gradually lost and repeated, in a similar way to the packet loss of a non-interleaved ADSL connection – in some respects the modern equivalent of the cables in the song. The foundation for section B (3:44) consists of a short excerpt from Thirty Pounds of Bone's track that is cut into small fragments, the order of which is reversed. Every two to four measures the fragments are subdivided, and one or two fragments switch places. In addition, one or two fragments are copied, which increases the length of the excerpt. About two-thirds of the way through this process more textural sounds were replaced with smoother sounds, one or two fragments at a time. The net result is that the final measure in this section is less than half the speed of the first, and has a related though altered character. Similarly to section A, aspects of this process suggested certain sound organisations, and while these fragments are sometimes at the foreground within the section, their evolving nature allows multifarious sound objects and other external thesis samples to exist within them.

9. Conclusions: *Epilogue* (Falmouth, 2012)

As the final creative output, *Epilogue* forms a tentative conclusion to the various investigations in this thesis, and can be viewed as a gathered response to the various concerns and developments presented heretofore.

Epilogue includes both wind and wave mimesis, focusing upon rotary trajectories, most aptly illustrated by the predominant use of the recordings of the bicycle sprockets and desktop fan. These 'waves' form the basis for the pulse of *Epilogue*, and they are allowed to slide evenly between excerpts from other pieces, eventually coinciding with and receding from a repetitive rhythm. Through these sounds, various ideas are allowed to unfold within the work, relating to the journey through the pieces in this thesis.

At the core of *Epilogue,* lies various interactions between electronica's sound-world and engagement with entrained pulses, the continued development of sound objects, and the various deployments of recorded sound. This approach is sustained for the duration of the piece, and unlike other pieces in this thesis, does so without the various elements conflicting or requiring a focus on a particular element to the detriment of another. Rather, *Epilogue* invites multiple listening possibilities.

Pieces such as *Headwind*, *Savious, and Little Tensile* tend towards a self-conscious acknowledgement of the fuzzy identities first discerned in *Sailsong.* As individual pieces, they are crucial for later works that capitalise on the learning produced by their explorations. Perhaps because of its somnambulistic and quietly relentless nature, *Epilogue* is able to capitulate the various concerns into the territory searched for by this thesis.

It is difficult to demonstrate the importance of this thesis through text alone, though it is possible to pair-up certain pieces that explore particular themes. There is a clear line through the thesis toward *Epilogue*, which can be aurally related to every other piece in this portfolio through sampling, convolution, aural, and abstract connections.

A number of possible methods for diagrammatically investigating interactions with sound have been presented, stemming from the initial theoretical model of ISO that remains relevant to *Epilogue.* The sustained commitment to a continuous development when composing the pieces is uniquely suited to the analytical focus across multiple pieces. The hyperlinked nature of the diagrams provides a solid foundation for further research that might combine practice and textual analysis, opening up research through bottom-up processes, and perhaps forming the core of a future work.

In the introductory chapter my research is framed as a search for contexts through which to interrogate and develop my practice. The research progressed with a bottom-up approach, interrogating a particular piece with ISO, and moving through personal musical concerns, towards possible ways to look at the non-linear processes and the disparate concerns a sound-based composer faces. The 'personal concerns' could feasibly be reduced to my wish to augment my acousmatic output by exploring aspects of sound-based electronica, and the scope of analysis beyond a single piece.

Chapter 2 outlined a view of acousmatic music with ISO that presented and explicated a deceptively simple compositional process across a single piece, and questioned the various identities that the acousmatic composer straddles. The subsequent linking-up of wider processes of sampling and convolution across multiple pieces has allowed for a greater participation with identity than would have been permitted when channelled into a single piece. As a result, development has occurred in several directions from *Sailsong*, which has provided room for exploration. A piece like *Palette* for instance, applies aspects of electronica and acousmatic music, and contains identifiable elements of both genres. However the most fruitful outcomes in this thesis are those that reside towards the end of it: *Upside Outward*, *Drowning*, and *Epilogue*. These pieces deviate from both genres, with their own identity and terrain, and are not just an application of the observed techniques in either genre.

Pieces such as *Epilogue, Hemispheric, Drowning* and *Upside Outward* do not adhere to inherited tropes for the sake of identification, but instead seek to map outcomes where fuzzy identities are embraced. With this in mind, figure 5.1 presents a study of convolution reverb and sampling that could only have been conducted across multiple pieces. As such, the thesis reached conclusions about the use of these techniques, and tentatively moves towards the theoretical ramifications within the context of acousmatic, sound-based, and electronica music.

Bibliography

Books, Journals, Papers, Proceedings, Presentations

ADKINS, Monty. 1999. 'Acoustic Chains In Acousmatic Music'. In conference report: *Australasian Computer Music Conference Proceedings.* Wellington, New Zealand. Pages 56-62. Retrieved July 12, 2012 http://www.hud.ac.uk/media/universityofhuddersfield/content/image/research/mhm/centreforresearchinnewmusiccerenem/downloads/acoustic-chains.pdf

ADKINS, Monty. 2007. 'Schaeffer est mort! Long live Schaeffer!'. Paper presented at the *Electroacoustic Music Studies Conference.* Leicester, Great Britain. June 12-15 2007. Retrieved July 12, 2012 http://www.ems-network.org/IMG/pdfAdkinsEMS07.pdf

BARRETT, Natasha. 2002. 'Spatio-musical composition strategies'. *Organised Sound: An International Journal of Music Technology,* 7(3), 313-323.

BOGDANOV, Vladimir (Ed.), BUSH, John (Ed.), ERLEWINE, Stephen (Ed.), and WOODSTRA Chris (Ed.). 2001. *All Music Guide to Electronica.* San Francisco: Backbeat Books.

BOURRIAUD, Nicholas. 1998. *Relational Aesthetics.* Translated by Simon Pleasance and Fronza Woods. France: Les Presse Du Réel.

BOURRIAUD, Nicholas. 2002. *Postproduction Culture As Screenplay: How Art Reprograms The World.* Translated by Jeanine Herman. New York: Has and Sternberg.

CHADABE, Joel. 2000. 'Remarks on computer music culture'. *Computer Music Journal,* 24(4), 9-11.

CHION, Michel. 1995. *Audio-Vision: Sound on Screen.* Translated by Claudia Gorbman. Foreword by Walter Murch. New York: Columbia University Press.

COULTER, John. 2005. 'Multimedia Composition As Research '. Paper presented at the *Electroacoustic Music Studies Network.* Montréal, Canada. October 19-22 2005. Retrieved July 12, 2012 http://www.ems-network.org/IMG/EMS2005-Coulter.pdf

COX, Christoph (Ed.) and WARNER, Daniel, (Ed.). 2004. *Audio Culture: Reading in Modern Music.* New York: Continuum.

DELALANDE, François. 1998. 'Music analysis and reception behaviours: Sommeil by Pierre Henry'. Translated by Christiane Hoopen and Denis Smalley. *Journal of New Music Research,* 27(1-2), 13-66.

DELEUZE, Gilles and GUATTARI, Felix. 2004. *A Thousand Plateaus: Capitalism and Schizophrenia.* Translated by Brian Massumi. Great Britain, Wiltshire: Continuum International Publishing Group Ltd.

DEMERS, Joanna. 2010. *Listening Through The Noise.* New York: Oxford University Press.

DOYLE, Peter. 2005. *Echo and Reverb: Fabricating Space in Popular Music Recording, 1900-1960.* Middletown: Wesleyan University Press Middletown.

EMMERSON, Simon, (Ed.). 1986. *The Language of Electroacoustic Music.* New York, NY: Harwood New York.

EMMERSON, Simon, (Ed.). 2000. *Music, Electronic Media, and Culture.* Aldershot: Ashgate Aldershot.

EMMERSON, Simon. 2007. *Living Electronic Music.* Aldershot: Ashgate Aldershot.

EMMERSON, Simon. 2008. 'Pulse, Metre, Rhythm in Electroacoustic Music'. Paper presented at the *Electroacoustic Music Studies Conference.* Paris, France. June 3-7 2008. Retrieved July 12, 2012 http://www.ems-network.org/ems08/papers/emmerson.pdf

ESHUN, Kodwo. 1998. *More Brilliant than the Sun: Adventures in Sonic Fiction.* London: Quartet Books London.

EVENS, Aden. 2005. *Sound Ideas: Music, Machines, and Experience.* Minneapolis: University of Minnesota Press.

FINK, Robert. 2005. *Repeating Ourselves: American Minimal Music as Cultural Practice.* Berkeley: University of California Press Berkeley.

FISCHMAN, Rajmil. 2008. 'Mimetic space: Unravelled'. *Organised Sound: An International Journal of Music Technology,* 13(2), 111-122.

FUCHS, Mathias. 2004. 'Monster'. In BIDNER, Stefan (ed.) and FEUERSTEIN, Thomas (ed.). *Sample Minds: Materials on Sampling Culture*. Cologne: Verlag Walter König, 309-315.

FULLER, Peter. 1983. *Aesthetics after Modernism.* London: Writers and Readers.

HARRISON, Jonty. 1998. 'Sound, space, sculpture: Some thoughts on the 'what', 'how' and 'why' of sound diffusion'. *Organised Sound: An International Journal of Music Technology,* 3(2), 117-127.

HARRISON, Jonty. 2006. 'Dilemmas, Dichotomies and Definitions: Acousmatic music and its precarious situation in the arts'. Keynote presented at the urbanNovember *SoundAsArt Blurring of the Boundaries* Conference. Aberdeen, Great Britain. November 24 – December 26 2006. Retrieved 12 July, 2012
http://www.urbannovember.org/conference/viewpaper.php?id=31&cf=2

HEGARTY, Paul. 2008. 'Just what is it that makes today's noise music so different, so appealing?'. *Organised Sound: An International Journal of Music Technology,* 13(1), 13-20.

HUGILL, Andrew. 2008. *The Digital Musician.* New York: Routledge New York.

KAHN, Douglas. 1999. *Noise, Water, Meat: A History of Sound in the Arts.* Massachusetts: MIT Press Cambridge.

KIM-COHEN, Seth. 2009. *In the Blink of an Ear: Toward a Non-Cochlear Sonic Art.* New York, NY: Continuum.

LAMB, Johny. 2012. *The New Independent School of Philosophy Research Presentation*, University College Falmouth, England.

LANDY, Leigh. 2007. *Understanding the Art of Sound Organization.* Massachusetts: MIT Press Cambridge.

LANSKY, Paul. 2005 'My Radiohead Adventure'. In TATE, Joseph (Ed.). 2005. *The Music and Art of Radiohead.* Aldershot: Ashgate Aldershot.

LEOPOLSEDER, Hannes (Ed.), STOCKER, Gerfried (Ed.) and SCHÖPF, Christine (Ed.). 2011. *Cyberarts 2011: Origin – Wie alles beginnt.* Ostfildern: Hatje Cantz Verlag.

MANNING, Peter. 2006. 'The significance of techné in understanding the art and practice of electroacoustic composition'. *Organised Sound: An International Journal of Music Technology,* 11(1), 81-90.

MCKINNON, Dugal. 2007. 'The Acousmatic and the Language of the Technological Sublime'. Paper presented at the *Electroacoustic Music*

Studies Conference. Leicester, Great Britain. June 12-15 2007. Retrieved July 12, 2012 http://www.ems-network.org/IMG/pdf_McKinnonEMS07.pdf

MOORE, Adrian and MOORE David. 2011. *Sonic Art: Recipes and Reasonings* (Book edn). The University Sheffield: unpublished. Retrieved July 12, 2012 http://www.shef.ac.uk/polopoly_fs/1.152862!/file/sonicart_recipesandreasonings.pdf

NEILL, Ben. 2002. 'Pleasure beats: Rhythm and the aesthetics of current electronic music'. *Leonardo Music Journal,* 12, 3-6.

NORMAN, Katharine. 2004. *Sounding Art: Eight Literary Excursions through Electronic Music.* Aldershot: Ashgate Aldershot.

NORMANDEAU, Robert. 2009. 'Timbre spatialisation: The medium is the space'. *Organised Sound: An International Journal of Music Technology,* 14(3), 277-285.

OTONDO, Felipe. 2007. 'Creating sonic spaces: An interview with Natasha Barrett'. *Computer Music Journal,* 31(2), 10-19.

OTONDO, Felipe. 2008. 'Contemporary trends in the use of space in electroacoustic music'. *Organised Sound: An International Journal of Music Technology,* 13(1), 77-91.

PRENDERGAST, Mark. 2000. *The Ambient Century: From Mahler to trance—The Evolution of Sound in the Electronic Age.* Foreword by Brian Eno. New York: Bloomsbury New York.

REYNOLDS, Simon. 1990. *Blissed Out: The Raptures of Rock.* London: Serpent's Tail London.

ROADS, Curtis. 1996. *Computer Music Tutorial.* London: MIT Press.

SAARIO, Antti. 2004. *Lancaster University Research Presentation*, Lancaster University, England.

SCHAFER, R. Murray. 1974. *New Soundscape : A Handbook for the Modern Music Teacher.* BMI: Canada.

SCHAFER, R. Murray. 1977. *The Soundscape: Our Sonic Environment and the Tuning of the World.* Destiny Books: Vermont.

SHAOUL, Cyrus and WESTBURY, Chris. 2011. 'Formulaic sequences: Do they exist and do they matter?'. *Mental Lexicon,* 6(1), 171-196.

SMALLEY, Denis. 1997. 'Spectromorphology: Explaining sound-shapes'. *Organised Sound: An International Journal of Music Technology,* 2(2), 107-126.

STOCKHAUSEN, Karlheinz. 2004. 'Stockhausen vs. the "Technocrats"'. In COX, Christoph (Ed.) and WARNER, Daniel, (Ed.). 2004. *Audio Culture: Reading in Modern Music.* New York: Continuum.

SWISS, Thomas (Ed.), SLOOP, John (Ed.), and HERMAN Andrew (Ed.). 1998. *Mapping the Beat: Popular Music and Contemporary Theory.* Malden: Blackwell Malden U.S.A..

TAMM, Eric. 1995. *Brian Eno: His Music and the Vertical Color of Sound.* New York: Da Capo New York.

TARKOVSKY, Andrey. 1986. *Sculpting in Time: Reflections on the Cinema* Translated by Kitty Hunter-Blair. Austin, TX: University of Texas Press.

TAYLOR, Timothy. 2001. *Strange Sounds: Music, Technology and Culture.* New York: Routledge New York.

THIBAUD, Jean-Paul. 'The sonic composition of the city'. In BULL, Michael,(Ed.) and BACK, Les (Ed.). 2003. *The Auditory Culture Reader.* Oxford: Berg Oxford.

TRUAX, Barry. 2008. 'Soundscape composition as global music: Electroacoustic music as soundscape'. *Organised Sound: An International Journal of Music Technology,* 13(2), 103-109.

WARNER, Timothy. 2003. *Pop Music: Technology and creativity—Trevor Horn and the Digital Revolution.* Aldershot: Ashgate Aldershot.

WINDSOR, Luke. 'Through and around the acousmatic: the interpretation of electroacoustic sounds'. In EMMERSON, Simon, (Ed.). 2000. *Music, Electronic Media, and Culture.* Aldershot: Ashgate Aldershot.

ZADEH, Lotfi. 1994. 'The role of fuzzy logic'. *Modeling, Identification and Control*, 15(3), 191-203.

Online Publications

DAULTREY, Stephen. 2011. Interviewing Amon Tobin in *Clash Music*
[online]. Retrieved July 12, 2012
http://www.clashmusic.com/feature/electronic-fairytales-amon-tobin-interview

HARRISON, Jonty. 1999. 'Imaginary space: Spaces in the imagination'.
MikroPolyphonie, 5 [Online]. Retrieved July 12, 2012
http://pandora.nla.gov.au/pan/10054/20011007-
0000/farben.latrobe.edu.au/mikropol/volume5/harrison_j/harrison_j.html

HERBERT, Matthew. 2011. ' PERSONAL CONTRACT FOR THE
COMPOSITION OF MUSIC [INCORPORATING THE MANIFESTO OF
MISTAKES**]** '. Matthew Herbert [Online]. Retrieved July 12, 2012
http://www.matthewherbert.com/manifesto

LEE, Alastair. 2005. 'Matthew Herbert's Plat du Jour challenge'. *BBC
Collective* 19 August [Online]. Retrieved July 12, 2012
http://www.bbc.co.uk/dna/collective/A5110363

OTONDO, Felipe. 2005. 'Some considerations for spatial design and concert
projection with surround 5.1'. *eContact!* 8(3) [Online]. Retrieved July 12, 2012
http://cec.sonus.ca/econtact/8_3/otondo.html

RAMSEY, Ben. 2012. 'Analysis of 'Internal Clock' by Monolake'. *Online
Repository for Electroacoustic Music Analysis* [Online]*.* Retrieved July 12,
2012 http://www.orema.dmu.ac.uk/?q=content/ben-ramsays-analysis-
'internal-clock'-monolake

TOBIN, Amon. 2011. Interviewed by Scott Thill in *Wired UK* [Online].
Retrieved March 28, 2012 http://www.wired.co.uk/news/archive/2011-
06/07/amon-tobin-isam?page=all

Optical Media

ADKINS, Mathew. 2006. *Mondes inconnus* [sound recording: DVD]. Canada: empreintes DIGITALes.

BARRETT, Natasha. 2010. *Bouteilles de Klein.* [sound recording: DVD]. Canada: empreintes DIGITALes.

BEREZAN, David. 2008. *Le Face Cachée* [sound recording: DVD]. Canada: empreintes DIGITALes.

BT. 2006. *This Binary Universe* [sound recording: CD and music video: DVD). California: DTS Entertainment.

DEVINE, Richard. 2003. *Asect:Dsect* [sound recording: CD]. Miami: Schematic.

DEVINE, Richard. 2009. *Cautella* [sound recording: CD]. San Diego: Darla Records.

HARRISON, Jonty. 1996. *Articles indéfinis* [sound recording: CD]. Canada: empreintes DIGITALes.

HARRISON, Jonty. 2000. *Évidence matérielle* [sound recording: CD]. Canada: empreintes DIGITALes.

HENRY, Pierre. 1997. *Messe Pour Le Temps Present* [sound recording: CD]. France: Polygram.

HOPKINS, Jon. 2009. *Insides* [sound recording: CD]. London: Double Six Records.

LEWIS, Andrew. 2007. *Miroirs obscurs* [sound recording: DVD]. Canada: empreintes DIGITALes.

LUSINE ICL. 2007. *Language Barrier* [sound recording: CD]. Lappersdorf: Hymen Records.

SCHNAUSS, Ulrich. 2004. *A Strangely Isolated Place* [sound recording: CD]. Manchester: City Centre Offices.

SKRILLEX. 2010. *Scary Monsters and Nice Sprites* [sound recording: CD]. U.S.A.: Mau5trap.

TOBIN, Amon. 2007. *Foley Room* [sound recording: CD and documentary: DVD]. London: Ninja Tune.

TOBIN, Amon. 2011. *ISAM* [sound recording: CD]. London: Ninja Tune.

TREMBLAY, Pierre Alexandre. 2006. *Alter Ego* [sound recording: DVD]. Canada: empreintes DIGITALes.

Appendix A: Notable Accolades, Publications, and Performances

Accolades

Hemispheric awarded Second Prize at Computer Space 2011, in the Category Computer and Digital Music, Bulgaria	10/2011
Hemispheric awarded Honorary Mention at Prix Ars Electronica 2011, in the Category Digital Sound Arts and Music, Austria	07/2011
Awarded Competitive Place on Hans Tutschku: Composing for Large Scale Multi-Channel Loudspeaker Environments Residential Seminar, USA	06/2011
Awarded Competitive Place on Big Ears three-day public engagement course, funded by the Arts and Humanities Research Council Collaborative Research Training Fund, Belfast	04/2011
Lynchpin awarded Prix Résidence at Bourges/Institut International de Musique Electroacoustique, France	03/2009
Arts and Humanities Research Council Doctoral Competition Maintenance and Fees	2008-12

Publications

CyberArts 2011 (Technical notes in catalogue, *Hemispheric* and animation included on DVD), Hatje Cantz ISBN 978-3-7757-3181-2	2011
Chopped and Stretched (*Upside Outward* on compilation CD), Drift Station Gallery	2011

Performances

Sailsong

Framework Radio FM, UK, New York State, Greece, Portugal, Slovenia, Belgium	05/2012
Sound Art Gallery curated by Margaret Noble, online	10/2011
British Science Festival: Science of Sound Fringe, Bradford Playhouse, UK	09/2011
Acousmatic Concert, Lancaster, UK	03/2009

Hemispheric

Electronic Spaces, Kansas City Electronic Music and Arts Alliance, USA	11/2011
Ai-Maako, International Festival of Electroacoustic Music Chile	10/2011
Interrogations into Music Experimentation Symposium, Coventry University, UK	09/2011
Ars Electronica Origin, Festival for Art, Technology and Society, Cyberarts Exhibition, Austria	09/2011
LICA Inaugural Electroacoustic Concert, Lancaster University, UK	11/2010

Little Tension

Audiograft Jukebox, Oxford Festival of Sound Art and Contemporary Music, Online	02/2011

Headwind

The School of Noises, The Jacobs Ladder Falmouth, UK	08/2011

Palette

The School of Noises, The Jacobs Ladder, Falmouth, UK   08/2011

Upside Outward

International Festival for Innovations in Music Production and   04/2012
Composition, Leeds, UK

Hear This Space, St. David's Church, Leicester, UK   10/2011

Interrogations into Music Experimentation Symposium, Coventry   09/2011
University, UK

British Science Festival: Science of Sound Fringe, Bradford   09/2011
Playhouse, UK

Drift Station Gallery 'Chopped and Stretched' Exhibition Nebraska   09/2011
USA, 1-30 September

The Seventh Biennial International Conference on Music Since   05/2011
1900, Lancaster University, UK

The Curtis R. Priem Experimental Media and Performing Arts   05/2011
Center, New York, USA

Drowning

Noisefloor Festival, Staffordshire University, UK   05/2012

Appendix B: 5.1 Playback Guide

The 5.1-format compositions are presented as 44.1 kHz, 24-bit, mono files. Each 5.1-format piece therefore comprises six separate mono files and these are labelled to ensure correct channel configuration. As an example, *Hemispheric* is labelled as follows:

02_Hemispheric_24_44.L.wav

02_Hemispheric_24_44.C.wav

02_Hemispheric_24_44.R.wav

02_Hemispheric_24_44.LFE.wav

02_Hemispheric_24_44.Ls.wav

02_Hemispheric_24_44.Rs.wav

 They should be played back on an ITU 775 compatible system, as figure B.1 suggests. For example, this can be done by importing the tracks into the DAW on separate channels, and assigning the channels to the matching speaker output of the interface. As my compositions do not use the LFE, it is not necessary to import this file, and is only provided to dispel any notion of incompleteness.

Figure B.1: A typical ITU 775 configuration
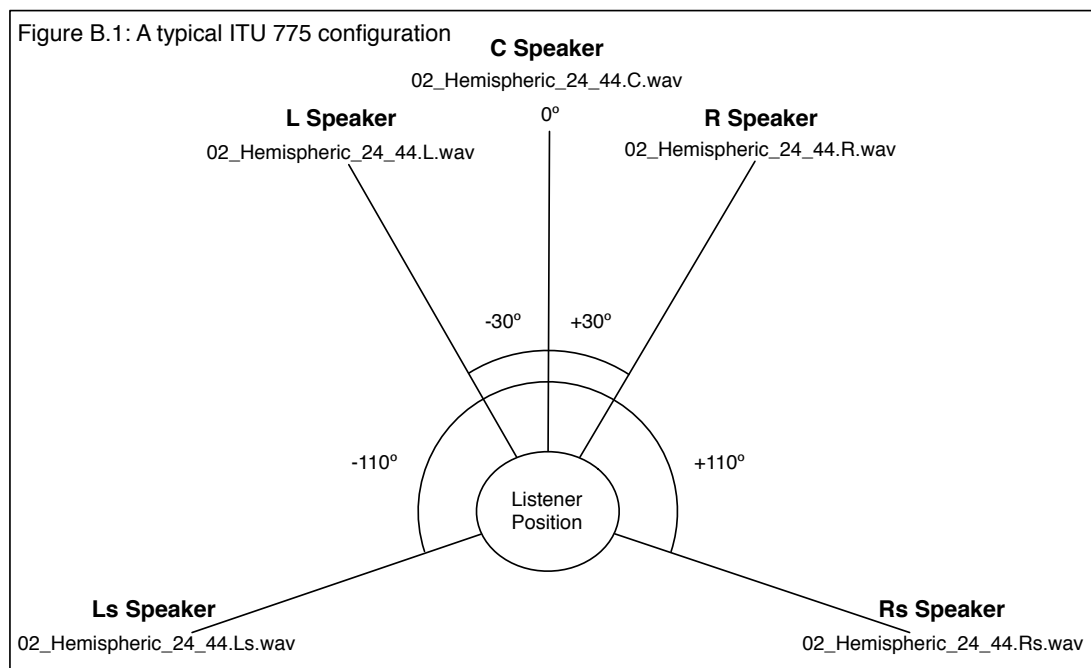
Appendix C: Programme Notes

This appendix includes programme notes for a number of pieces. Many pieces do not have programme notes, in keeping with electronica compositions which tend not to include them.

Sailsong

At a remote reservoir in rural Northern England, the clattering of rigging from sailing dinghies is captured and played by jets of wind. A dry stone wall whistles a singular melody in conversation, as many delicate sounds are revealed between the imposed passing of dislocated cars pushing air. Processing of sound is kept to a minimum - most of the compositional work is achieved through careful microphone technique, as a camera might explore perspective and light.

Hemispheric

Part of *Hemispheric's* aesthetic stems from the use of super-wide angle photographic lenses, sometimes known as fisheye lenses. They tend to create an inhuman hemispherical field of vision, with objects toward the periphery becoming increasingly distorted, often requiring a remapping of the images projection in an attempt to create a less skewed representation of the elongated images at the periphery. Continual recycling of sonic material in this piece gives rise to viewpoints that are similarly distorted and re-mapped, exploiting the expansive potential of the medium.
Awarded Second Prize at Computer Space 2011, in the Category Computer and Digital Music. Awarded Honorary Mention at Prix Ars Electronica 2011, in the Category Digital Sound Arts and Music**.**

Upside Outward

Teasing out polarities of physical size, spectrum, motion and location, *Upside Outward* imprisons manually cut micro-orphan events through a touring carbonated carriage - a miniature music box. Working with cutting edge convolution, spectral granulation, and extreme time stretching of varied sources that lose their sense of scale (fizzing drinks, rolling rocks, thunderbikes, desktop fans) *Upside Outward* requests a deep listening into the sound and its space. *Upside Outward* premiered at The Curtis R. Priem Experimental Media and Performing Arts Center, NY.

Drowning

Folk singer Johny Lamb of Thirty Pounds of Bone wrote a track called *The Fishery*, which appears on his album *Method*. Lamb's song is concerned with distant communication, and takes an allegorical stance on 19th century maritime practices to address states of 'far away'. Not exactly a remix, *Drowning* is an acousmatic portrait that takes his finished track as the source material for radical transformations.