Sonic Images and Multimedia Aesthetics in Electroacoustic Music

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# Table of Contents

ABSTRACT .......................................................................................................................... I

DECLARATION ..................................................................................................................... II

ACKNOWLEDGEMENTS ...................................................................................................... III

LIST OF TABLES .................................................................................................................. IV

LIST OF FIGURES ............................................................................................................... V

INDEX OF NAMES ............................................................................................................ VI

LIST OF WORKS .................................................................................................................. VIII

CHAPTER 1: ELECTROACOUSTIC MUSIC AND MULTIMEDIA ........................................... 1

  1.1 INTRODUCTION .............................................................................................................. 1
  1.2 DEFINITION OF NEW MEDIA AND COMPARISONS WITH ELECTROACOUSTIC MUSIC  ... 2
  1.3 MONTAGE AND BLENDING IN NEW MEDIA AND ELECTROACOUSTIC MUSIC ............. 5
  1.4 ELECTROACOUSTIC MUSIC AND MUSICAL MULTIMEDIA ......................................... 6
  1.5 OVERVIEW .................................................................................................................... 9

CHAPTER 2: SONIC IMAGES ................................................................................................. 17

  2.1 PERCEPTION OF SONIC IMAGES THROUGH SOURCE BONDING AND MIMEISIS .......... 17
      2.1.1 Introduction ........................................................................................................... 17
      2.1.2 Distinguishing between Source Bonding, Mimesis and Metaphor in Relation to Sonic Images ........................................................................................................... 17
      2.1.3 Forms of Discourse - Aural and Mimetic ............................................................... 19
      2.1.4 Listening Modes ..................................................................................................... 19
      2.1.5 Abstract and Abstracted Syntax ........................................................................... 20
      2.1.6 Affordances and Acoustic Chains ........................................................................ 21
  2.2 PERCEPTION OF SONIC IMAGES THROUGH METAPHOR ........................................ 23
      2.2.1 Introduction ........................................................................................................... 23
      2.2.2 Pitch Relationships are Relationships in Vertical Space ........................................ 24
      2.2.3 Timbral Relationships are Relationships in Tactile Space ..................................... 25
      2.2.4 Time-energy Relationships are Relationships in Physical Space ............................ 26
  2.3 ENTRAINMENT, KINESTHETIC THOUGHT AND PROJECTIVE IDENTIFICATION ........... 27
      2.3.1 Entrainment .......................................................................................................... 27
      2.3.2 Kinesthetic Listening ............................................................................................. 28
      2.3.3 Motor Imagery and Mirror Neurons ...................................................................... 29
      2.3.4 Projective Identification ......................................................................................... 30
      2.3.5 Kinetic Imagery and Metaphor ............................................................................. 31
      2.3.6 Biomorphic Sounds .............................................................................................. 32
      2.3.7 Entrainment with Sound and Image ..................................................................... 32
      2.3.8 Entrainment as Compositional Technique ........................................................... 33
  2.4 THE SONIC IMAGE IN OTHER FORMS ........................................................................ 34
      2.4.1 Gestalt Image ......................................................................................................... 34
      2.4.2 Image of Depth ..................................................................................................... 35
      2.4.3 Image of the Medium ............................................................................................ 36
      2.4.4 Amplified Reality ................................................................................................. 38
      2.4.5 Conceptual Images ............................................................................................... 39
CHAPTER 3: VISUAL CONCEPTS AND MULTIMEDIA AESTHETICS

3.1 INTRODUCTION................................................................................................................. 42
3.2 SYNESTHESIA .................................................................................................................... 42
3.3 LIGHT AND COLOUR AS FORMS OF EXTRINSIC REFERENCE ......................................... 45
   3.3.1 Introduction .................................................................................................................. 45
   3.3.2 Brightness Associations with Pitch or Frequency ......................................................... 46
   3.3.3 Colour and Timbre Associations .................................................................................. 46
   3.3.4 Colour and Pitch Associations .................................................................................... 47
   3.3.5 Hue, Saturation and Brightness ................................................................................... 48
   3.3.6 Transparency and Opacity ........................................................................................... 49
   3.3.7 Source Bonded Light/Colour Associations .................................................................. 50
3.4 AESTHETICS OF MULTIMEDIA AND VISUAL CONCEPTS ............................................ 51
   3.4.1 Surfaces and Edges ....................................................................................................... 51
   3.4.2 Motion and Plasticity .................................................................................................... 52
   3.4.3 Compositing ................................................................................................................ 54
   3.4.4 Spatial and Temporal Montage .................................................................................... 57
   3.4.5 Vectors ........................................................................................................................ 58
   3.4.6 Space-medium ............................................................................................................ 60
   3.4.7 Analysis of Jonny Harrison’s Hot Air ......................................................................... 61
   3.4.8 Mathew Adkins – Melt and Aerial ............................................................................. 64
   3.4.9 Conclusion .................................................................................................................. 66

CHAPTER 4: AUDIO-VISUAL ANALYSIS ............................................................................... 68

4.1 INTRODUCTION................................................................................................................. 68
4.2 MODELS FOR ANALYZING MULTIMEDIA ....................................................................... 70
   4.2.1 Conformance, Contest, Complementation ................................................................. 70
   4.2.2 Attribute Transfer ....................................................................................................... 71
   4.2.3 Conformance, Contest, Complementation and Electroacoustic Music ...................... 71
4.3 ANALYSIS OF THE DREAMMACHINE .......................................................................... 73
   4.3.1 Overview .................................................................................................................... 73
   4.3.2 Analysis ...................................................................................................................... 73
   4.3.3 Spatial Interactions between Images and between Sound and Image ......................... 76
   4.3.4 Vectors ...................................................................................................................... 78
   4.3.5 Conclusion .................................................................................................................. 79
4.4 ANALYSIS OF MISSING AND AC-2 .............................................................................. 81
   4.4.1 Overview .................................................................................................................... 81
   4.4.2 Visual Imagery and its Influence on Sound ................................................................. 82
   4.4.3 Film Analysis – Temporal Structure, Space and Symbols of Time.............................. 84
   4.4.4 Vectors ...................................................................................................................... 87
   4.4.5 Visually Informed Musical Structure and Attribute Transfer .................................... 89
   4.4.6 Synchresis ................................................................................................................ 91
   4.4.7 Conclusion ................................................................................................................ 93
4.5 ANALYSIS OF WARP & WEFT AND AC-3 ................................................................. 94
   4.5.1 Overview .................................................................................................................... 94
   4.5.2 Analysis of Visual and Sonic Images ......................................................................... 95
   4.5.3 Conclusion ................................................................................................................ 99

CHAPTER 5: ANALYSIS OF ACOUSMATIC WORKS............................................................. 101

5.1 INTRODUCTION................................................................................................................. 101
5.2 ANALYSIS OF AC-1 ...................................................................................................... 101
   5.2.1 Overview .................................................................................................................... 101
   5.2.2 Background ............................................................................................................... 102
   5.2.3 Compositional Structure ......................................................................................... 103
   5.2.4 Sonic Images in ac-1 ............................................................................................... 105
Sonic Images and Multimedia Aesthetics in Electroacoustic Music

Abstract

This thesis and the accompanying body of work explore the relevance of sonic images to the composition and analysis of electroacoustic music. While the importance of intrinsic sonic properties is not overlooked, an approach to composition and analysis of electroacoustic music is explored where meaning is discovered through source bonding, metaphor and mimesis. Through these three concepts electroacoustic music affords extrinsic references, which are suggestive of images. Other ways that sonic images can be perceived in electroacoustic music are also explored including gestalt images, images of depth, images of the medium, amplified reality and conceptual images.

Source bonding, metaphor and mimesis are also highlighted as relevant to moving images in certain audio-visual works. Similar forms of analysis are thus shown to be useful towards moving images in audio-visual works and sounds in electroacoustic music. A useful analogy is also described between sound combined with visual images in audio-visual works and intrinsic sonic properties combined with extrinsic references in electroacoustic music.

Through this analogy between audio-visual works and electroacoustic music, this thesis describes how concepts related to structuring visual images in multimedia are meaningful for creating and analyzing sonic images in electroacoustic music. Ultimately, this exploration of sonic images and multimedia aesthetics has provided me with a language for creating and analyzing electroacoustic music through what Simon Emmerson refers to as a quasi-visual mindscape.

The body of work accompanying this thesis consists of five acousmatic works: ac-1 – ac5. Two of these works, ac-2 and ac-3 were composed as music to audio-visual works. This process of composing for images was influential towards ideas in this thesis and composition of standalone acousmatic works. Ac-2 and ac-3 are also intended to exist as standalone acousmatic works.
Declaration

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Thesis Defended 23rd September 2011

Declaration by Candidate:
This Thesis is presented in partial fulfillment of the requirements for the degree of Doctor of Philosophy. It is entirely my own work and has not been submitted to any other higher education institution, or for any other academic award in this university. Where use has been made of the work of other people it has been fully acknowledged and fully referenced.

Signature

________________________

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24th November 2011

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List of Tables

TABLE 1. ORIGINAL CONCEPTS ................................................................. 14
TABLE 2. ADAPTED CONCEPTS ............................................................... 15
TABLE 3. ESTABLISHED CONCEPTS ..................................................... 16
List of Figures

FIGURE 1. THE THREE MAIN CONCEPTS RELEVANT TO SONIC IMAGES. ........................................... 11
FIGURE 2. AESTHETICS OF VISUAL IMAGES IN MULTIMEDIA APPLIED TO SOUND. ...................... 11
FIGURE 3. ‘CAPTURED/REAL WORLD’ IMAGES IN The DREAMMACHINE. ................................. 74
FIGURE 4. COMBINATION OF ‘CAPTURED/REAL WORLD’ AND ‘SYNTHETIC/ABSTRACT’ IMAGES IN
   The DREAMMACHINE. ...................................................................................................................... 74
FIGURE 5 A, B AND C. IMAGES THAT REPRESENT THE FIRST VISUAL CATEGORY FOR SOUNDS IN
   Missing – noise. ................................................................................................................................. 83
FIGURE 6 A AND B. IMAGES THAT REPRESENT THE SECOND VISUAL CATEGORY FOR SOUNDS IN
   Missing – coarse textures with visual rhythms.............................................................................. 84
FIGURE 7. IMAGE THAT REPRESENTS THE THIRD VISUAL CATEGORY FOR SOUNDS IN Missing –
   glass. .................................................................................................................................................. 84
FIGURE 8. ‘SOFT’ IMAGE THAT WAS ACCOMPANIED BY A ‘HARSH’ SOUND IN Missing. ............ 91
FIGURE 9. FLAME SCENE IN Missing. ............................................................................................ 92
FIGURE 10. TEMPORAL MONTAGE THROUGH LIGHTS SCENE AND SPARKLER SCENE IN Missing. 92
FIGURE 11. DANDELION SCENE IN Missing. .................................................................................. 93
FIGURE 12. VERTICAL OBJECT SCENE IN Warp & Weft. ............................................................... 96
FIGURE 13. HORIZONTAL LINE SCENE IN Warp & Weft. ............................................................... 96
FIGURE 14. PLASTIC TEXTURE AND HAND SCENE IN Warp & Weft. .............................................. 97
FIGURE 15. TRANSLUCENCY IN Warp & Weft.............................................................................. 98
FIGURE 16. TRANSPARENCY IN Warp & Weft. .............................................................................. 98
FIGURE 17. HAND GESTURE AND PLASTIC/GLASS-LIKE SCENE IN Warp & Weft..................... 99
# Index of Names

**A**
Adkins, Mathew  
Acoustic Chains ........................................................................................................ 21

**C**
Chion, Michel  
Synchresis ................................................................................................................. 33
Cook, Nicholas  
Conformance, Contest and Complementation ..................................................................... 70

**E**
Emmerson, Simon  
Abstract and Abstracted Syntax ..................................................................................... 20
Froms of Discourse - Aural and Mimetic ............................................................................. 19
Metaphor ............................................................................................................................ 18
Mimesis ............................................................................................................................... 18
Quasi-visual Mindscape ...................................................................................................... 1

**J**
Jones, Mari Riess  
Entrainment ................................................................................................................... 28

**K**
Korakidou, Veroniki and Charitos, Dimitri  
Projective Identification .................................................................................................. 30
Krasner, John  
Linear and Nonlinear Velocity ....................................................................................... 52

**M**
Manovich, Lev  
Compositing ................................................................................................................... 54
Space-medium .................................................................................................................... 60
Spatial and Temporal Montage ......................................................................................... 57
Transcoding ....................................................................................................................... 3
McCourt, Stephen  
Biomorphic Sounds .......................................................................................................... 32
Conceptual Images ............................................................................................................ 39
Gestalt Image ...................................................................................................................... 34
Image of Depth ................................................................................................................... 35
Image of the Medium ........................................................................................................ 36

**P**
Pierre Schaeffer  
Grain .................................................................................................................................... 26
Pseudo-instrument .............................................................................................................. 56

**R**
Rizzolatti, Giacomo et al  
Mirror Neurons ............................................................................................................. 29
S

Seashore, Carl E.
  Motor Imagery................................................................................. 29

Smalley, Denis
  Granular Noise........................................................................... 26
  Source Bonding ........................................................................... 17
  Spectral Density .......................................................................... 49

T

Takada, Mari
  Synesthetic Metaphor .................................................................. 43

Thom, Randy
  Amplified Reality ......................................................................... 38

W

Windsor, Luke
  Affordances ................................................................................. 21

Z

Zettl, Herbert
  Vectors .......................................................................................... 58
List of Works

All of these works can be found on the accompanying DVD.

ac-1 (15’09) Quadrophonic and Stereo

ac-2 (7’24) Stereo and also as music for the film Missing (Kennedy, 2008a)

ac-3 (4’38) Stereo and also as music for the film Warp and Weft (Wychereley, 2010)

ac-4 (14’59) Quadrophonic and Stereo

ac-5 (9’48) Stereo
Chapter 1: Electroacoustic Music and Multimedia

1.1 Introduction

The following quote from Simon Emmerson sheds light on the first main aspect of this thesis: perception of sonic images:

The images I perceive are not strictly synesthetic. The acousmatic condition deliberately reduces information on source and cause, which we (products of evolution) attempt to ‘fill in’. For me - and I believe many others - that process has a visual component. The imagination constructs a quasi-visual mindscape with many of the characteristics of ‘real’ vision. There are also interesting cross-references to other sense modes, most notably that I might be able to ‘feel’ sound textures and even sense heat - though at a distance, much as one might when viewing a volcano from a distance.

(Emmerson, 2007, p.169)

The next quote from Francis Dhomont relates to the second main aspect as it highlights the kind of affinities that an electroacoustic composer can have with the work of artists in the visual domain, particularly artists who work with film:

Just as a filmmaker works with images, with shots...we work with recorded sounds fixed on a medium...on a film, on recording tape, a disc, media. And then, we intervene, as the filmmaker intervenes with his film. He cuts, links, mixes, he speeds it up, slows it down, rewinds, goes forward again, stops on a particular image, etc. We have more in common with the filmmaker or the sculptor, the painter... with the plastic artist, than with the traditional musician. I really have that feeling, even though my origins are in traditional music.

(Dhomont) (Aumüller, 2002)

Both of these aspects have become essential to my own work particularly since being asked to compose sounds to accompany visual images. Through this process I have discovered that for me, composing sounds to accompany visual images is similar to working with the kind of quasi-visual mindscape referred to by Emmerson. The former involves sonification of a visual image, the latter a mental one. Aspects of visual images such as texture, rhythm or
meaning can be imitated or contrasted through sound. In the absence of visual images raw sound material suggests an image, which I then shape through manipulation and/or juxtaposition. In both situations this process of working with ‘sonic images’ gives me a sense of affinity with artists who work with moving visual images. For this reason it has been important for me to form a synthesis of ideas related to ways of creating and analyzing sonic images. Due to the influence of sonic images in my work and the moving visual images for which I have composed it has also been important for me to explore the visual domain itself and aesthetics that relate to moving visual images. The meaning of the phrase ‘multimedia aesthetics’ is thus twofold in the context of this thesis. It relates to aesthetics derived from the field of creative multimedia and also to the fact that my own aesthetics are influenced by concepts from the sound and visual domain. I have thus discovered that a combination of ideas related to sonic images, visual concepts and multimedia aesthetics provides a meaningful language for composition and analysis of electroacoustic music.

As well as the comparisons made by Dhomont, other comparisons can be made between computer based electroacoustic composers and computer based visual artists. Both work with graphical user interfaces. Various processes may be applied to a sound or an image before they are used and both sounds and images can be assembled to create virtual environments. Having made these comparisons the next section investigates how new media is defined today and how it compares with electroacoustic music. This investigation is useful as concepts from this field are utilized throughout this thesis to discuss my approach to electroacoustic music.

1.2 Definition of New Media and Comparisons with Electroacoustic Music

In his book *The Language of New Media* Lev Manovich (2001) has defined a new media object through five main principles of new media. He points out that they “should not be considered as absolute laws but rather as
general tendencies of a culture undergoing computerization” (Manovich, 2001. p.27). These principles are outlined below and it is considered whether they apply to electroacoustic music created with the computer:

The fifth principle, *transcoding*, relates to how cultural aspects of a medium are affected by that medium’s contact with computer technology. For example, although printed text retains many of its cultural forms on the World Wide Web, it has been culturally transcoded through, for example, hyperlinks, which offer the reader a non-linear form of navigation not found in books (Manovich, 2001). Electroacoustic music created with the computer is a form of music that has also been culturally transcoded. The listener’s perceptual interaction with this music is affected by how it has been transformed by computer technology. For example, music containing an acoustic instrument, which has been manipulated by the computer, invites ways of perceiving that differ from perception of an acoustic instrument heard without processing. The instrument heard without processing generally draws the listener to its source and context within the piece of music. However, the use of sound manipulation not only suggests an additional source: the computer/graphical user interface; it also gives more affordance to the use of mimesis and metaphor, which are discussed in Chapters 2 and 3 respectively. Electroacoustic music offers a large palette of real world sounds, which can be culturally transcoded through computer programs and ideas from texts related to sound manipulation. The use of sound manipulation can provide various perspectives on a sound to the listener within the context of an electroacoustic composition. The principle of transcoding is thus present in this thesis wherever the computer plays a vital role in the creation of sonic images. This role of the computer also applies to the new media concept of compositing, which will be discussed in Chapter 3.4.3.

The first principle *numerical representation* implies that the object can be represented in numerical/binary form and can be “subject to algorithmic manipulation” (Manovich, 2001, p.27). The fact that electroacoustic music can
be represented as digital audio in the form of samples that can be manipulated assures that it fits this category.

The second principle *modularity* implies that the object consists of separate elements that can be individually accessed and manipulated. This principle can apply to electroacoustic music composed on computers as separate audio files within a project can be accessed and manipulated individually. However, this principal does not apply to a finished electroacoustic work, which in many cases is considered a fixed-medium.

The third principle *automation* relates to the inclusion of computer algorithms in the creation of the object in addition to the input of the user. Sound manipulation processes in electroacoustic music utilize computer algorithms. They are also utilized in the automation of parameters related to volume, spatialization, effects and so on in a project.

According to Manovich, the fourth principle of *variability* implies that a “new media object is not something fixed once and for all, but something that can exist in different, potentially infinite versions” (Manovich, 2001, p.36). An electroacoustic work does not fit into this category as it is considered as a fixed-medium with the exception of certain genres such as live electronics. However, the same also applies to many new media objects.

It is true that the above principles can apply to any form of music created through the assistance of the computer. However, some of these principles apply to a greater extent depending on the genre or the individual work, particularly the principles of automation and transcoding. My own electroacoustic work utilizes automation to a far greater extent than computer music I have composed based on rhythm and pitch. A reason for this is that it is sometimes necessary to apply various sound manipulations to achieve a required result in an electroacoustic work. Large groupings of sounds within a work can also require a large amount of detailed automation to achieve a desired structure. Although the principle of ‘variability’ does not apply to fixed-medium works, Manovich’s four other principles of new media can apply to electroacoustic music created through computers. It is thus useful to explore
how new media aesthetics relate to aesthetics of electroacoustic music created using the computer.

1.3 Montage and Blending in New Media and Electroacoustic Music

Manovich has described how cinema has been influential on the evolution of new media. One of the main features of cinema that he attributes to this influence is montage, an editing technique that originated in cinema where elements are juxtaposed in order to create new meanings. He defines two kinds, temporal montage: “Separate realities form consecutive moments in time” and montage within a shot: “Separate realities form contingent parts of a single image” (Manovich, 2001, p.148). Temporal montage is the traditional form of montage in cinema. Montage within a shot is more rare. It has been used in avant-garde films such as Vertov’s *Man with a Movie Camera* (1929) and Godard’s *Histoire(s) du cinéma* (1989) (Manovich, 2001). In this technique, different frames of film are superimposed to form a surrealistic image. Due to advances in technology, this technique was eventually utilized for more standard reasons in television and the term keying was used:

When electronic keying became part of standard television practice in the 1970s, the construction not only of still but also moving images finally began to rely on montage within a shot. In fact, rear projection and other special effects shots, which had occupied a marginal place in classical film, became the norm: the weatherman in front of weather map, announcer in front of news footage, singer in front of animation in a music video.

(Manovich 2001, p.150)

Since the introduction of computers, the modern technique of digital compositing has developed within new media. Compositing in cinema can be used to seamlessly integrate the worlds of computer animation with real film footage. It is also used to combine various layers of animation in computer games and various multimedia elements on a web page. However, even though compositing is considered a development that has derived from montage, it
actually obeys anti-montage aesthetics. Manovich describes the difference between the two:

Montage aims to create visual, stylistic, semantic, and emotional dissonance between different elements. In contrast, compositing aims to blend them into a seamless whole, a single gestalt. (Manovich, 2001, p.144)

This development from montage towards digital compositing is relevant to electroacoustic music, as many forms of electroacoustic music have followed a similar trajectory. As cinema has progressed in general from the montage aesthetics of tape splicing towards the use of graphic user interfaces so too has electroacoustic music. Also, as the computer has become more powerful it has provided electroacoustic composers with more freedom to work through similar aesthetics of digital compositing. Through modern technology it has become less difficult to create virtual unified spaces and seamless transformations of sound. The latter can be compared to computer-generated morphs in the visual domain which “allow for a continuous transition between two images - an effect which before would be accomplished through a dissolve or cut” (Manovich, 2001, p.142). It is important to note that virtual unified spaces and sound transformations did exist before the digital computer came into prominence and that the use of sound transformations can incorporate montage aesthetics. However, the above comparisons demonstrate how a similar pattern has emerged from the early days of musique concrète to today’s electroacoustic music as the one from the early days of cinema to today’s new media. Some comparisons will now be made between electroacoustic music and musical multimedia.

1.4 Electroacoustic Music and Musical Multimedia

In his book “Analysing Musical Multimedia” Nicholas Cook proposes the idea that ‘multimedia’ is a broader and more encompassing term than its common usage would suggest. He demonstrates this by defining what a ‘medium’ is in terms of “‘dimensions’ of variance” (Cook, 1998, p.263).¹

¹ Cook borrows the term ‘variance’ from Jerrold Levinson.
For example:

in ballet there is a degree of autonomy as between music and dance; they constitute independent ‘dimensions’ of variance…and the aesthetic effect of ballet emerges from the interaction between the two.

(Cook, 1998, p.263)

These variable dimensions of music and dance and the new outcome that results from their interaction effectively qualifies ballet as a form of multimedia. Interactions that take place between music and other media such as film, ballet, text etc., give rise to new meanings that were not originally present in either the music or the attached media (Cook, 1998). The ways that these new meanings arise are described through three models of multimedia analysis: conformance, contest and complementation. These models are described fully in Chapter 4.2.1.

Cook describes how this principle of variance is shown to be present even when music is ‘seemingly alone’ and the idea proposed is that “music never is alone” (Cook, 1998, p.265) [his emphasis]. This idea is related to the fact that there is always some form of media attached to music in one way or another. Cook describes how this attachment is more obvious with songs, as music and text together is generally considered the original form of multimedia, but it can also apply to instrumental music. For example, new meanings are possible through the attachment of less obvious forms of media such as CD covers, musical analysis, program notes and musicology in general. In this respect every word that is spoken or written about music has the ability to attach new meaning to it (Cook, 1998). The principle of variance is present in electroacoustic music through similar external attachments.

Cook blurs the definition of medium even further when he discusses how interactions between purely musical parameters such as pitch and duration can also be described as ‘dimensions of variance’. He thus states that his models for analyzing musical multimedia are useful for analyzing variance between sonic parameters (Cook, 1998).
However, Cook’s argument that ‘music is never alone’ omits an important aspect of musical perception: Pierre Schaffer’s idea that sound can be listened to purely for its own sake through reduced listening (Chion, 1983). As described by Chion, reduced listening “consists of stripping the perception of sound of everything that is not ‘it itself’ [his quotes], in order to hear only the sound, in its materiality, its substance, its perceivable dimensions (Chion, 1983, p.31)”. Therefore, when a listener is engaged in reduced listening music is alone as any consideration of external attachments is suspended. There is no ‘variance’ between the sound and anything outside of it. However, Chapter 2.1.4 will discuss the fact that although a function of reduced listening is to suspend our consideration of external attachments this mode is beneficial to our perception of sonic images.

Although Cook’s idea of ‘music never being alone’ is debatable, it is useful to consider his principle of variance in electroacoustic music in relation to extrinsic references: references in the music to objects or events outside of the music itself. Extrinsic references afford interpretation of meanings, which can vary from one listener to another. The principle of variance can thus operate in electroacoustic music in three ways:

The first is through intrinsic references. In this situation meaning is created through ways that interactions between internal properties of sounds are perceived. The second is through extrinsic references where meaning is created through ways that interactions between external associations of sounds are perceived. Finally, variance can operate between intrinsic and extrinsic references where meaning is created through ways that interactions between internal sonic properties and external associations of sounds are perceived. Previous discussions on the importance of intrinsic and extrinsic references to acousmatic music can be found in Windsor (1995) and Smalley (1997).

The second and third points above are most relevant to this thesis. How meaning is created through interactions between extrinsic references is demonstrated through montage. Meaning through interactions between intrinsic and extrinsic references is demonstrated through ways that manipulation or
perception of intrinsic sonic properties can enhance perception of extrinsic references or suggest alternative ones by providing different perspectives.

When extrinsic references are perceived they are suggestive of images, particularly in acousmatic music where, as quoted from Emmerson at the beginning, we attempt to ‘fill in’ to compensate for the lack of visual information. Although part of the beauty of acousmatic music is the way it can be perceived as ‘pure sound’ without visual distractions; perception of intrinsic and extrinsic references is a way of perceiving sound combined with a quasi-visual mindscape/sonic images. My own approach is thus one where it is creative to view intrinsic and extrinsic references in acousmatic works as analogous to sound and images in audio-visual works. Sonic images, visual concepts and aesthetics of visual images in multimedia provide me with a language for this approach.

However, it is important to highlight the fact that audio-visual works in a sense ‘prescribe’ images to accompany sounds. On the other hand, during the performance of an acousmatic work there are no actual images to interfere with perception of sounds and the images they suggest to the listener. In this respect acousmatic music gives the imagination more freedom to contemplate the many different images that a sound can suggest. This point is an important distinction between acousmatic music and musical multimedia. It is also central to this thesis as sonic images are explored from many different perspectives throughout.

1.5 Overview

My approach to electroacoustic music is illustrated in Figures 1 and 2, which are useful for reference. Figure 1 illustrates the three concepts of source bonding, metaphor and mimesis and their relevance to sonic images. These concepts are described and differentiated in Chapter 2.1.2. This figure also provides examples of non-sounding concepts that will be discussed as relevant through metaphor as well as examples of mimesis. Figure 2 illustrates the four main multimedia concepts that are relevant to my approach: montage,
compositing, space-medium and vectors. These concepts are described in detail in Chapter 3.4 and their relevance to composition and analysis is discussed in Chapters 4 and 5. The second level of this diagram contains a short definition of these concepts as I have applied them to sound. The last two levels describe the type of image that the application of these concepts suggests, as well as the relation of these concepts to the overarching concepts of source bonding, metaphor and mimesis.
Sonic Images

- **Mimesis**
  - Images suggested through imitation of sound sources
  - Examples: Environmental, machine, living, objects/materials, causality (eg, imitation of fragmentation of objects)

- **Source bonding**
  - Images of sound sources

- **Metaphor**
  - Images related to non-sounding concepts
  - Examples: Space, depth, texture, surface, edge, size/weight, light/colour, transparency/opacity, motion, gesture, plasticity, conceptual, chaos, entropy etc.

**Figure 1.** The three main concepts relevant to sonic images.

Multimedia Aesthetics

- **Spatial and temporal montage**
  - Juxtaposition of diverse sounds in space and/or time to create new meaning
  - Examples: Contrasting images suggested through sources and/or imitation of sources

- **Compositing**
  - Integration and blending of sounds to create a seamless sonic image/environment
  - Examples: Image of composed visual space suggested through metaphor

- **Space-medium**
  - Suggestion of ambiguous figure-ground relationships through similarity and blending
  - Examples: Image of visual objects/textures mapped onto space suggested through metaphor

- **Vectors**
  - Relationships between directional behaviour of sounds
  - Examples: Directional relationships in visual space suggested through metaphor
  - Also, through shared intrinsic characteristics sounds can be perceived as having similar sources or as mimetic of each other

**Figure 2.** Aesthetics of visual images in multimedia applied to sound.
The following overview provides an outline of the rest of this thesis. Chapter 2 discusses first the relevance of source bonding and mimesis to perception of sonic images including the relationship of these concepts to Michel Chion’s causal listening mode and Pierre Schaeffer’s reduced listening mode. Simon Emmerson’s forms of discourse are also considered. The relevance of James Gibson’s concept of affordance as adapted by Luke Windsor and Mathew Adkins’ idea of acoustic chains are also discussed. Three forms of metaphor in electroacoustic music are then explored. Next connections are made between the concept of entrainment, the phenomenon of mirror neurons and the idea of kinesthetic listening. It is suggested that through these connections sonic images can be a product of ‘projective identification’, a term which Korakidou and Charitos (2006) have discussed as relevant to perception of abstract animation. The remainder of Chapter 2 discusses various other ways that sonic images can be perceived in electroacoustic music such as through gestalt images, images of depth, images of the medium, amplified reality and conceptual images.

Chapter 3 explores the relevance of the visual domain and multimedia aesthetics to composition and analysis of electroacoustic music. It begins with an investigation into the phenomenon of synesthesia, which highlights similarities between this condition and more common modes of perception. This investigation reaches the conclusion that ‘synesthetic analysis’, a term used by Galeyev (2007), can be a meaningful approach to electroacoustic music. Next is a discussion of ways that light and colour can be suggested by sound. While it is acknowledged that this form of perception is subjective and it is not feasible for non-synesthetes to discuss specific colours or degrees of brightness, there are ways that sound can suggest introductions of colour or brightness as a generality. It is also discussed how colours can be perceived by a listener through recognition of a sound’s cause and associated colours through source bonding. Next comparisons are made between sounds and visual objects and it is discussed how sound can suggest surfaces, edges, motion and plasticity in the visual domain. The chapter proceeds with a discussion of concepts
related to structuring moving visual images in multimedia and how they can be applied to a compositional and analytical approach to electroacoustic music. The relevance to form of compositing, spatial and temporal montage and space-medium as defined by Lev Manovich is described and demonstrated through musical analysis. The relevance of vectors, as defined by Herbert Zettl (1999), in creating or analyzing various relationships between sounds is also described and demonstrated. This approach to composition and analysis is further supported by shared perceptual phenomena between sound and image such as figure-ground organization.

Chapter 4 explores how audio-visual works provide inspiration for my approach to sound composition. It begins with a description of Nicolas Cook’s models for analysis of multimedia. These models and the multimedia concepts discussed in the previous chapter are utilized in the analyses of audio-visual works that follow. The first analysis is an audiovisual work by Amanda Feery called The Dreammachine. This analysis highlights how source bonding, mimesis and metaphor are relevant to visual images in certain film works just as they are to sounds in acousmatic works. For this reason my own approach towards sonic images in acousmatic music takes inspiration from interactions between visual images in this type of film work. Next is an analysis of an audiovisual work called Missing by Holly Kennedy for which I composed the piece ac-2. This analysis discusses how visual images were considered as models for composing sounds. It also discusses how the structure of a visual work provided inspiration for the structure of an acousmatic work. A similar analysis follows of the film Warp & Weft for which I composed the piece ac-3.

Chapter 5 provides analyses of three standalone acousmatic works. These analyses take into consideration all of the ideas discussed in the previous four chapters in order to describe how sonic images, visual concepts and multimedia aesthetics are relevant to my approach to acousmatic music.
The following three tables contain the main concepts that will be discussed as relevant to my approach and they are useful for reference. Table 1 contains terms that I have devised myself to describe particular forms of sonic image. Table 2 contains concepts that I have borrowed from areas outside of music. These concepts have been adapted for the purpose of composition of electroacoustic music and/or to describe ways of perceiving sonic images. Table 3 contains established concepts from other authors that are utilized to help describe my approach.

**Table 1. Original Concepts**

<table>
<thead>
<tr>
<th>Concept</th>
<th>Author</th>
<th>Section and Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomorphic Sounds</td>
<td>Stephen McCourt (2011)</td>
<td>2.3.6, 32</td>
</tr>
<tr>
<td>Conceptual Images</td>
<td>Stephen McCourt (2011)</td>
<td>2.4.5, 39</td>
</tr>
<tr>
<td>Gestalt Image</td>
<td>Term used by Stephen McCourt (2011) to describe not only a form of musical recall discussed by Nicholas Cook (1990) that relates solely to sound, but also one that involves internalised visual imagery. The term ‘gestalt’ is borrowed from the Gestalt psychologists Max Wertheimer, Kurt Koffka and Ivo Kohler (Goldstein, 2010).</td>
<td>2.4.1, 34</td>
</tr>
<tr>
<td>Image of the Medium</td>
<td>Stephen McCourt (2011)</td>
<td>2.4.3, 36</td>
</tr>
</tbody>
</table>
Table 2. Adapted Concepts

<table>
<thead>
<tr>
<th>Concept</th>
<th>Author</th>
<th>Section and Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compositing</td>
<td>As discussed by Lev Manovich (2001), adapted by Stephen McCourt (2011) for acousmatic music</td>
<td>3.4.3, 54</td>
</tr>
<tr>
<td>Linear and Nonlinear Velocity</td>
<td>Jon Krasner (2008), adapted by Stephen McCourt (2011) for acousmatic music</td>
<td>3.4.2, 52</td>
</tr>
<tr>
<td>Projective Identification</td>
<td>Melanie Klein (Korakidou and Charitos 2006), adapted by Veroniki Korakidou and Dimitri Charitos (2006) for abstract animation, adapted by Stephen McCourt (2011) for acousmatic music</td>
<td>2.3.4, 30</td>
</tr>
<tr>
<td>Space-medium</td>
<td>Pavel Florensky (Efimova, A. and Manovich, L., 1993), adapted by Lev Manovich (2008) for new media, adapted by Stephen McCourt (2011) for acousmatic music</td>
<td>3.4.6, 60</td>
</tr>
<tr>
<td>Spatial and Temporal Montage</td>
<td>Lev Manovich (2001), adapted by Stephen McCourt (2011) for acousmatic music</td>
<td>3.4.4, 57</td>
</tr>
<tr>
<td>Vectors</td>
<td>Herbert Zettl (1999), adapted by Stephen McCourt (2011) for acousmatic music</td>
<td>3.4.5, 58</td>
</tr>
<tr>
<td>Concept</td>
<td>Author</td>
<td>Section and Page Number</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Abstract and Abstracted Syntax</td>
<td>Simon Emmerson</td>
<td>2.1.5, 20</td>
</tr>
<tr>
<td>Acoustic Chain</td>
<td>Mathew Adkins (1999)</td>
<td>2.1.6, 21</td>
</tr>
<tr>
<td>Affordance</td>
<td>James Gibson (1986), adapted by Luke Windsor (1995) for acousmatic music</td>
<td>2.1.6, 21</td>
</tr>
<tr>
<td>Amplified Reality</td>
<td>Randy Thom (n.d.)</td>
<td>2.4.4, 38</td>
</tr>
<tr>
<td>Conformance, Contest and Complementation</td>
<td>Nicholas Cook (1998)</td>
<td>4.2.1, 70</td>
</tr>
<tr>
<td>Entrainment</td>
<td>As discussed by Mari Riess Jones (2004)</td>
<td>2.3.1, 27</td>
</tr>
<tr>
<td>Forms of Discourse – Aural and Mimetic</td>
<td>Simon Emmerson (1986)</td>
<td>2.1.3, 19</td>
</tr>
<tr>
<td>Grain</td>
<td>Pierre Schaeffer (Chion, 1983)</td>
<td>2.2.3, 26</td>
</tr>
<tr>
<td>Granular Noise</td>
<td>Denis Smalley (1994)</td>
<td>2.2.3, 26</td>
</tr>
<tr>
<td>Metaphor</td>
<td>As discussed by Simon Emmerson (2007)</td>
<td>2.1.2, 18</td>
</tr>
<tr>
<td>Mimesis</td>
<td>As discussed by Simon Emmerson (2007)</td>
<td>2.1.2, 18</td>
</tr>
<tr>
<td>Mirror Neurons</td>
<td>As discussed by Giacomo Rizzolatti et al (2006)</td>
<td>2.3.3, 29</td>
</tr>
<tr>
<td>Motor Imagery</td>
<td>As discussed by Carl E. Seashore (1938)</td>
<td>2.3.3, 29</td>
</tr>
<tr>
<td>Pseudo-instrument</td>
<td>Pierre Schaeffer (Chion, 1983), discussed by John Dack (2002)</td>
<td>3.4.3, 56</td>
</tr>
<tr>
<td>Quasi-visual Mindscape</td>
<td>Simon Emmerson (2007)</td>
<td>1.1, 1</td>
</tr>
<tr>
<td>Source Bonding</td>
<td>Denis Smalley (1997)</td>
<td>2.1.2, 17</td>
</tr>
<tr>
<td>Spatial and Temporal Montage</td>
<td>Lev Manovich (2001)</td>
<td>3.4.4, 57</td>
</tr>
<tr>
<td>Spectral Density</td>
<td>Denis Smalley (1997)</td>
<td>3.3.6, 49</td>
</tr>
<tr>
<td>Synchresis</td>
<td>Michel Chion (1994)</td>
<td>4.4.6, 91</td>
</tr>
<tr>
<td>Synesthetic Metaphor</td>
<td>As discussed by Mari Takada (2008)</td>
<td>2.3.7, 33</td>
</tr>
<tr>
<td>Transcoding</td>
<td>As discussed by Lev Manovich (2001)</td>
<td>1.2, 3</td>
</tr>
</tbody>
</table>
Chapter 2: Sonic Images

This chapter explores various ways that sonic images can be suggested or perceived in electroacoustic music. Section 2.1 primarily discusses source bonding and mimesis, as well as ways that electroacoustic music is perceived and communicated in relation to these two concepts. Section 2.2 is an exploration of metaphor in electroacoustic music. Section 2.3 discusses the role of entrainment, mirror neurons, gesture and the concept of projective identification as defined by Korakidou and Charitos in perception of sonic images. Entrainment between sounds and images and entrainment as a compositional technique are also briefly discussed. Section 2.4 discusses other ways of considering sonic images such as gestalt images, images of depth, images of the medium, amplified reality and conceptual images.

2.1 Perception of Sonic Images through Source Bonding and Mimesis

2.1.1 Introduction

This section explores perception of sonic images primarily through the concepts of source bonding and mimesis. The relationship of these concepts to two listening modes is considered: Michel Chion’s idea of causal listening which refers to perception of the cause of a sound and Pierre Schaeffer’s idea of reduced listening which describes listening to a sound for its own sake.

2.1.2 Distinguishing between Source Bonding, Mimesis and Metaphor in Relation to Sonic Images

According to Smalley, source bonding is:

the natural tendency to relate sounds to supposed sources and causes, and to relate sounds to each other because they appear to have shared or associated origins.

(Smalley, 1997, p.110) [his emphasis]
Source bonding thus reveals images that are related to the listener’s perceived cause of sounds. However, removal of traces of a cause does not mean that the listener will not perceive an image. According to Emmerson:

By deliberately removing the visual clues as to the cause of sounds, indeed by removing or reducing visual stimulation of any kind, the composer is almost challenging the listener to re-create, if not an apparent cause, then at least an associated image to ‘accompany’ the music.

(Emmerson, 1986, p.18)

Beyond recognition of a known or apparent cause the listener can perceive images through mimesis or metaphor. While source bonding is closely connected to mimesis, as a listener’s perception of a supposed/apparent cause can be the result of imitation, listeners can also impose their own imaginative mimesis upon a sound. This imaginative mimesis may bear no relationship with their perceived notion of the sound’s actual source. A distinction can also be made between source bonding and mimesis when the composer is more concerned with imitation than the actual sound source. For the purpose of this thesis the term source bonding will thus be utilized when referring to sonic images related to the actual sound source, while mimesis will be utilized while referring to sonic images related to imitation of a sound. There is also a close connection between mimesis and metaphor as it is possible to suggest imitation of something non-sounding through metaphor. However, Emmerson distinguishes the two terms, defining metaphor as meaning “the translation of something from one sense (or art form) to another”, while mimesis is “a direct imitation” (Emmerson, 2007, p.58). Therefore, although Emmerson defines mimesis as “the imitation not only of nature but also of aspects of human culture not usually directly associated with musical material” (Emmerson, 1986, p.17), it is nevertheless related to imitation of sounding bodies. Therefore, a distinction will also be made in this thesis between mimesis and metaphor. The former will relate to sonic images suggested through imitation of sounding bodies while the latter will refer to suggestions of images not directly related to the sound domain. Figure 1, in Chapter 1.5 illustrates the three
concepts of source bonding, mimesis and metaphor and their relationship with sonic images.

2.1.3 Forms of Discourse - Aural and Mimetic

Emmerson discusses electroacoustic music in terms of aural and mimetic discourse. The former relates to situations where the composer intends to draw attention purely to aural aspects of his material such as pitch or rhythm. Mimetic discourse concerns situations where extrinsic references are relevant to the composer’s dialogue. A combination of aural and mimetic discourse is also discussed, where the composer intends to draw attention to both aural aspects and mimetic features of sounds. Emmerson mentions Stockhausen’s Studie II as an example of a piece where a purely aural discourse was intended by the composer (Emmerson, 1986). However, even though the sounds in this piece are purely synthetic and it was composed using serial principles, this does not prevent the listener from perceiving mimesis of, for example: metallic objects, or raindrops. Listeners may impose their own imagery on any sound world. Any piece of music can, therefore, be perceived through both aural and mimetic features regardless of the mode of discourse intended by the composer.

2.1.4 Listening Modes

This section considers the relevance of listening modes to perception of sonic images. For example causal listening (Chion, 1994) is essential to perception of source bonding and mimesis. Even when listening is directed away from a known sound source and towards imitation of a sound source, mimesis is perceived through a listener’s previous knowledge of actual causes. However, the importance of Shaeffer’s mode of reduced listening is just as important within the context of this thesis. As Smalley has stated “reduced listening mechanisms…are necessary to any investigation which seeks to reveal those intrinsic features which invest the extrinsic threads with their psychological power” (Smalley, 1997, p.111). This statement highlights the fact that while reduced listening can draw a listener’s attention purely towards sound for its own sake, this mode can also give increased clarity to sonic
images. A reason for this is that internal sonic patterns need to be perceived first before they are cognitively translated into patterns related to imitation of sounding bodies, or visual patterns such as those described in Section 2.2.2. This last point relates to sonic images perceived through mimesis and metaphor respectively. The next paragraph highlights that reduced listening is also beneficial for perception of an actual perceived cause.

Suk-Jun Kim has provided an investigation into reduced listening, which highlights further the relationships between reduced and causal listening. Kim’s investigation looks at the original idea of reduction as it was intended by Husserl and suggests that Schaeffer omits an important aspect of reduction in his concept of reduced listening. According to Kim:

the phenomenological reduction, rightly understood and executed, begins with the epoché, whose only goal is to suspend our commitment to our natural attitude towards the world. But then the reduction proceeds with its phenomenological investigation by returning to, but not assuming, the natural attitude because it is in this natural attitude that our experience to things in the world is situated, and also because only by returning to it can we examine things in the world and our intentionalities to them.

(Kim, 2010, p.8)

Kim has stressed that it is this “return” to the natural attitude that is missing from Schaeffer’s implementation of reduction. Through this epoché, or suspension, our initial experience of an image revealed through the cause of the sound can be subsequently transformed by our awareness of the sound’s inherent properties. We can then return to the cause and experience it in a new light. While Kim’s criticism of Schaeffer is controversial, this interpretation of reduction is a revealing description of a full experience of a sonic image that includes both a sound’s inherent properties and its perceived cause.

2.1.5 Abstract and Abstracted Syntax

While Emmerson considers music as “having either an aural or mimetic discourse” he also discusses how “either of these may be organized on ideas either abstracted from the materials or constructed independently of them in an abstract way” (Emmerson, 1986, p.24). A combination of abstract and
abstracted syntax is also considered (Emmerson, 1986). Both forms of syntax can be demonstrated in relation to *ac-1*. This piece was initially inspired by chaos theory, a process that involved imposing chaotic characteristics on sounds. The work’s structure was also informed by concepts from chaos theory such as self-similarity, turbulence and attractors. This external influence on both sonic design and musical structure is an example of an abstract syntax. However, the structure of the piece was also gradually formed through patterns discovered within the sonic material and ways that sounds interacted when juxtaposed: an abstracted syntax. This piece was thus formed through a combination of abstract and abstracted syntax.

2.1.6 Affordances and Acoustic Chains

Related to source bonding and mimesis is the concept of affordance. This concept was originally used by James Gibson (1986) to describe how through an ecological approach to perception an object in the environment provides structured information, for example, a chair affords sitting. Luke Windsor has described how this approach can be applied to perception of sounds in acousmatic music. According to Windsor “sounds, as Gibson would assert, do not identify the causes, or signify them, they specify objects or events that *afford*” [his emphasis] (Windsor, 1995). This approach thus considers that a sound’s meaning in a work is subjectively *afforded* through a listener’s experience of sound as related to his or her own environment.

Mathew Adkins (1999) has discussed how affordances provide connections or ‘acoustic chains’ between two or more acousmatic works. Adkins distinguishes between a concrete sounding object, which a listener assigns affordances to through previous knowledge of “acousmatic works or environmental or social-cultural models” and a sound object, which has been assigned meaning by the composer (Adkins, 1999, p.5). Adkins thus highlights a “potential dichotomy in perception of a sounding object and its assigned ‘meaning’ as a sound object within a given work” (Adkins, 1999, p.2), which is central to the concept of acoustic chains. Through this dichotomy a work is thus
perceived through both a listener’s interpretation of a composer’s assigned meaning and also through the listener’s experience of a previous work.

To give an example, an acoustic chain can be perceived between Jonty Harrison’s *Hot Air* (1995) and Bernard Parmagiani’s *Étude Elastique* (1990) which both make use of the sound of a balloon. Adkins points out that acoustic chains can extend to many works and can also involve abstract sounding objects “by means of timbral and spectromorphological similarity” (Adkins, 1999, p.6). An acoustic chain can be perceived between all five works accompanying this thesis through sounds of noise. Each piece contains similar forms of noise including static interference and computer-generated noise. Any of these works can thus bring any other to mind through source bonding with this form of material.

A listener can assign affordances to sound in an acousmatic work based on previous experience of sound in any form of work. Therefore, while Adkins discusses acoustic chains in relation to acousmatic music they can extend to all forms of music.

I will now extend the idea of chains further through consideration of visual images. For example, Adkins own work *Melt* (2006b), which will be discussed further in Chapter 3.4.8, contains sounds of a train journey and was inspired by J.M.W. Turner’s painting of a train titled *Rain, Steam, and Speed* (1844). The listener’s perception of *Melt* can be influenced by a connection made between train images it suggests and those in Turner’s painting, or indeed train images recalled from any form of visual art.

A comparison between *Melt* and the film *A Scanner Darkly* (Linklater, 2006) can illustrate how wide the notion of chains can be considered. *Melt* contains ‘real’ train sounds that are processed to the extent that they suggest surreal and animated images. *A Scanner Darkly* was filmed digitally and then animated afterwards, which infuses it with a surreal quality. The ‘sonic animation’ of normal everyday train sounds in *Melt* can thus be compared to the animation of ‘real’ images in the film *A Scanner Darkly*. Another ‘image’ chain can thus be formed through perception of surreal and animated images in both
works. Similar to an acoustic chain, this chain is formed through an understanding of Adkin’s intended meaning, which is to suggest surreal images through real sounds and through previous experience of another work of art such as the film *A Scanner Darkly*. A similar chain can be made between *A Scanner Darkly* and my own work *ac-5* as the latter suggests surreal and animated images of a jet fighter aircraft. In both of the above cases the chain is afforded through image ‘effects’.

A final example of a chain can be described in relation to *ac-5* and the television series *Lost* (2011). This series is based around an aircraft crash and the surreal experiences of the survivors on an island. *Ac-5* begins with suggestions of ‘lost contact’ as aircraft sounds become obscured by sounds of static interference. This introduction is followed by suggestions of a surreal environment relative to the aircraft sonic image, which itself undergoes surreal transformations. The inclusion of a speech transmission also signifies human involvement in the narrative and can bring to mind events in *Lost*. An ‘image’ chain is thus afforded through aircraft images as well as surreal narratives and environments in both *ac-5* and *Lost*.

### 2.2 Perception of Sonic Images through Metaphor

#### 2.2.1 Introduction

Having discussed the sonic image in terms of source bonding and mimesis, this section looks beyond the sonic domain at how images can be suggested or perceived through metaphor. Three forms of metaphor are discussed. The first *pitch relationships are relationships in vertical space*, which was discussed by Turner (2006), enables pitch to suggest movement through vertical space. Based on this metaphor I have considered two more for the purpose of this thesis. The second: *timbral relationships are relationships in tactile space*, enables timbre to suggest movement through or contrasts in tactile space. The third: *time-energy relationships are relationships in physical space*; enables time manipulation to suggest movement through various forms of physical space.
2.2.2 Pitch Relationships are Relationships in Vertical Space

When pitches are described as high and low, or up and down, pitch is mapped onto the domain of virtual space. This cognitive process is known as cross-domain mapping (Turner, 2006). Verticality of space can thus be a metaphor for pitch height. Turner calls this a conceptual metaphor. The concept of conceptual blending “extends cross-domain mapping to include correlations between a number of integrated domains” (Turner, 2006). This means that as one domain is mapped onto another, they can be conceptually blended to create a third imaginary domain. For example: “the correlation between the domain of physical space and the domain of music created by the conceptual metaphor pitch relationships are relationships in vertical space makes it possible to blend concepts from the two domains to create a unique imaginary domain in which pitches describe all manner of fantastic journeys through two and three-dimensional space” (Turner, 2006, p.124). Through this imaginary domain pitch can suggest shapes or paths formed through time.

Guck (1994) gives an example from Chopin’s Prelude in B Minor, Opus 28, No. 6, where movement through pitch space can be perceived as a metaphor for an image of an arch. The section he describes starts on a low register, arpeggiates upwards, is left to linger and falls in pitch again. The arch shape is “abstracted from the material features of arches as a line ascending to curve toward a focus of structural tensions and curving again to descend” (Guck, 1994, p.206). The arch is formed over time but can be viewed in retrospect as a gestalt. This type of image can be effectively formed through spectral space in electroacoustic music. It can be suggested through anything from a single sound to the development of a whole piece. The use of real space is not necessary but the image can be enhanced through simultaneous movement in real space.

An example of a spectral image is the lines of glissandi at the start of Metastasis by Xenakis. It is well known that Xenakis was thinking the same things in this composition as he was later during the design of the Philips Pavilion, on which he worked with Le Corbusier. The design of the Philips Pavilion included a geometrical feature known as a hyperbolic paraboloid,
where individual lines converge to form a curve. According to the composer: “I believe that on this occasion music and architecture found an intimate connection” (Xenakis, 1992, p.10). Xenakis’ use of glissandi is thus frequently compared to this architectural image.

A spectral image can also be considered through layers of spectral elements spread across space. This idea of was considered across four loudspeakers for the end of ac-1 (13’12-end). Sustained high frequencies were centered, slightly lower sustained frequencies were panned equally to a slight left and right position of these, and this process was continued until the lowest frequencies were panned fully left and right. All frequencies were equally spread between the front and back loudspeakers. This positioning of frequencies is analogous to a spectral roof, triangular in shape, with its highest point in the centre. If a listener is not aware of this image it is not easily perceived, but the visualization of spectral elements is a good compositional aid. By distributing these elements in a larger multichannel setup, the image would be more vivid. As the sound elements are more textural than gestural, the use of time is necessary only to sustain the image rather than to create it.

2.2.3 Timbral Relationships are Relationships in Tactile Space

When conceptual blending is considered in relation to timbre in electroacoustic composition, the tactile domain is blended with the timbral domain when a word such as sharp or rough is used to describe a sound. Similar to the previous conceptual metaphor involving pitch and space, the correlation between the tactile domain and the domain of music created by the conceptual metaphor timbral relationships are relationships in tactile space, enables the blending of the concepts of timbre and tactility to suggest many forms of movement through the tactile domain. Through this metaphor, tensions can be created or resolved through the use of sounds that suggest tactile references. Images can also be suggested and contrasted based on imitation of tactile surfaces, which can be real or surreal.
Schaeffer’s concept of grain is useful when considering suggestions of movement through the tactile domain. As described by Michel Chion: “Grain is a microstructure of the matter of sound, which is more or less fine or coarse and which evokes by analogy the tactile texture of a cloth or a mineral, or the visible grain in a photograph or a surface” (Chion, 1983, p.171). Chion also highlights how grain can be described in the same way for the sense of vision and touch as it can for the sense of hearing. Smalley’s description of granular noise is useful for considering types of progressions through sonic grain as well as choice of sonic materials:

Granular noise is textured impulses…ranging from roughness through granularity to grit. Beyond roughness granular noise smooths out, and somewhere beyond grit the texture starts to fragment…Granular noise has strong source-cause bondings which are extremely wide-ranging – sea, water in general, wind, foliage (living or dried), fracturing materials (wood, stone), motions of friction, unvoiced vocal behaviours, certain types of breathing and fluid congestion, types of mechanical noise, static interference.

(Smalley, 1994, p.44-45)

In an audio-visual context, the tactile reference contained within a sound can create conflict with the visual image. There is an example of this conflict at the start of Missing. The artist who filmed the visual element to this piece was aiming towards a representation of the fragility of time. The film starts with the smooth motion of a pendulum. Rather than a smooth sound that conformed to this image, a sharp, harsh, abrupt gesture was used. As well as creating a form of audio-visual tension, this juxtaposition can be interpreted as a metaphor for the fragility of time. The same effect can be achieved in music alone through montage of different sound images. Sounds can be suggestive of contrasting textures in tactile space. Sonic interactions can also be suggestive such as a sharp sound ‘cutting through’ a smoother sound.

2.2.4 Time-energy Relationships are Relationships in Physical Space

Another conceptual metaphor time-energy relationships are relationships in physical space, affords the idea that manipulation of time in a composition
can suggest images related to motion through space, particularly when the concept of energy is considered. For example, in *ac-1* an arch shape can be perceived through the speed of events. Its rise begins as fast chaotic sounds gradually give way to slower material. As the sounds become less chaotic they also appear less frequently. Gestures also become slower in their rate of change, which is suggestive of increased effort. The piece arrives at a period where stasis is suggested through textural sounds and repetitive gestures. This period of stasis represents the top of the arch. After this period, events gradually speed up and the piece builds up a momentum through more dynamic and an increased amount of gestures until there is a chaotic rush of events. This increased momentum is suggestive of decreased effort. This final section represents the final downward section of the arch. Another metaphor for this piece is a hill, where sounds rise with effort, rest and then fall with decreased effort, building up momentum along the way back down. Alternatively, a U-shaped metaphor is afforded where the slowing down of events represents a downward motion and the subsequent speeding up represents an upward motion.

### 2.3 Entrainment, Kinesthetic Thought and Projective Identification

#### 2.3.1 Entrainment

So far this chapter has discussed different ways of perceiving sonic images. This section approaches perception of sonic images in relation to the self-conscious listener and the body. This approach can be discussed through an integration of ideas related to hearing, cognition and physiology. Relationships between sound and the body can be considered through the rhythm related concept of *entrainment*. 
While entrainment can be applied to various aspects of physiology, Jones has discussed it in terms of our perception of sound in the environment:

Animate things connect with and adapt to their environment through the common medium of time. Rhythmic organisms interact, more or less effectively, with dynamic flow patterns of events via entrainment: An event’s driving rhythm shapes an organism’s driven rhythm through adaptations of period and phase. (Jones, 2004, p.50)

This idea essentially means that sound events we perceive function as driving rhythms that interact with our physiological system resulting in internal driven rhythms. We are thus continuously entrained by rhythmic details within sounds. This concept is of relevance to the electroacoustic composer as it relates to our interaction with complex sounds. It suggests interactive kinetic links between complex sounds, the composer and the listener.

2.3.2 Kinesthetic Listening

Relationships between the nervous system and the body shed more light on the body’s role in perception of images. In his essay on neurodynamics, Stafford offers insight into dynamical relationships between the body and thought:

What is exciting about the dynamical hypothesis from the perspective of art is that it acknowledges that thought is deeply physical, spreading beyond the confines of a supposedly encapsulated brain. The inner microcosm of the nervous system, together with the sensing and feeling body, as well as the evolving outer macro-milieu are thus kinetically linked as subject-events. Their interlocked processes continually influence one another.

(Stafford, 2006, p.180)

A kinesthetic form of thought that is connected to the sensing body thus regularly informs the listening experience. Keil alludes to this form of thought when he discusses kinesthetic listening, which relates to the idea of musicians “feeling the melodies in their muscles, imagining what it might be like to play what they are hearing” (Keil, 1995, P.10).
2.3.3 Motor Imagery and Mirror Neurons

Seashore has discussed how a composer or listener can “act or feel the action” through motor imagery (Seashore, 1938). According to Seashore, perception of this form of imagery through music can be compared to the way someone in a dream “is always the actor or an active observer of action”; and when someone dreams of performing they have “all the experience of performing that comes through the kinesthetic (motor) sense” (Seashore, 1938, P.168). The composer or listener can thus experience a similar state while deeply engaged in listening.

Kinesthetic thought and motor imagery can also be related to the scientific discovery of mirror neurons in the brain. According to Rizzolatti et al:

ACTION PERFORMED by one person can activate motor pathways in another’s brain responsible for performing the same action. The second understands viscerally what the first is doing because this mirror mechanism lets her experience it in own her mind.

(Rizzolatti et al, 2006, p.54)

This in essence describes a form of entrainment between two people, where one is entrained by the other’s patterns of movement. It helps to explain for example why a person might be compelled to imitate the actions of a musician on stage at a concert. This mirror mechanism can also come into effect while listening to music over loudspeakers, as our mind follows actions we imagine to be in a recording. Motor pathways can thus be activated through actions that a listener perceives in an acousmatic composition, related to the cause of sounds and what Smalley describes as their ‘energy-motion trajectory’ (Smalley, 1997). A listener can also perceive actions suggested by the composer, such as an action suggested from the juxtaposition of sounds. However, listeners also bring their own meaning to a composition so this type of entrainment can be experienced at two levels. At one level listeners can be entrained by actions suggested by the cause of a sound or by the composer; and at another by actions that listeners perceive related to their own experiences and imagination, whether through a single sound or multiple sounds in
juxtaposition. It is at this second level that a work essentially becomes interactive.

2.3.4 Projective Identification

This interactive role of the listener can be considered as a form of *projective identification*, which is a term that Korakidou and Charitos (2006) borrow from Klein to describe how people relate to abstract animation. Projective identification describes:

- a mechanism observed in infants up to four months old, meaning the projection of primitive aggressiveness of internalized objects and self-images or object-images. The subject thinks it is the object he sees. Because of this empathic relationship to the object the object obtains great power and becomes a menace to the infant, therefore it has to be in permanent control in order not to get attacked by it.

(Klein, 1946, cited in Korakidou and Charitos, 2006, p.8)

Korakidou and Charitos thus argue that “the reception of abstract animation works can be fundamentally attributed to this human capacity for *empathy or projective identification*” and highlight the relevance of mirror neurons to this form of engagement with a work (Korakidou and Charitos, 2006, p.10). I consider the same to be true for electroacoustic music. A listener can thus identify themselves and their experience of the world in a piece of music, regardless of how abstract the sound material is. Stockhausen alluded to this idea of projective identification when he said: “The listener becomes the music. And by that the music is influenced by the listener because he changes the music” (Stockhausen) (Cott, 1974).

To summarize at this point, awareness of entrainment during compositional and listening processes can enhance connections between sonic rhythm and kinesthetic listening or thought. Mirror neurons can be considered as a gateway between this form of thought and sonic images. As well as recognizing causes and interpreting a composer’s intentions, a listener can also be engaged in a form of empathy or projective identification, where images of self and self-experience are projected onto sonic material.
A listener’s level of engagement in projective identification can depend on whether sounds in an electroacoustic work suggest images related to the human body. Kim has discussed sonic images in terms of body versus non-body. Body images are perceived through our awareness of human presence behind the cause of sounds while non-body images are removed from human presence (Kim, 2008). When body images are perceived a listener can either think about how sounds were made or at a deeper level imagine creating these sounds through gesture.

2.3.5 Kinetic Imagery and Metaphor

When sounds are distanced from human presence a listener can still relate their morphology to images of human gesture. In this case human gestural images are perceived through metaphor rather than through source bonding. As Smalley has highlighted, movement through spectral space can be suggestive of kinetic motion and can also imply the use of energy, force, tension, gravity etc (Smalley, 2007). Guck describes the following gesture of throwing a ball, relating it to a simple melodic line that rises and falls: “the initial impetus that increasingly opposes gravity as the arm rises, stretching to the point of fullest extension, then decreasing tension as the arm yields to gravity” (Guck, 1994, p.6). This example is just like the arch metaphor discussed in section 2.2.2 except with added connotations of human gesture.

A sonic gesture in ac-I (6’21-6’31), which rises and falls through spectral space, is suggestive of the type of opposition of and yielding to gravity described above by Guck. The rate of change of this and many other sounds between 4’44 and 9’26 in this piece are suggestive of environmental phenomena and/or living entities rising and falling relative to a textural surface. These sounds can also suggest the profile of a landscape. Gesture can thus suggest animated or non-animated metaphors. Which metaphor is perceived depends on both the imagination of the listener and the context of sounds within a piece. As Guck further explains, metaphors can also be used that are connected to human concepts such as urgency, for example, through “a faster
rate of events, a disorienting metric shift, an unfinished line, yet unchanged harmony” (Guck, 1994, p.9). A combination like this can suggest a metaphor for “an individual tearing around heedlessly, while talking on and on about getting nothing done” (Guck, 1994, p.9).

2.3.6 Biomorphic Sounds

On the other hand sonic gestures that do not suggest human presence through source bonding can evoke images of non-human gesture. In the visual arts “biomorphic forms or images are ones that, while abstract, nevertheless refer to, or evoke, living forms” (Tate, n.d.). I have borrowed the term biomorphic, to describe sound that evokes living forms through metaphor or mimesis. Sonic gestures can follow energy-motion trajectories that have visual analogues in the animal world, for example, the erratic trajectory of a butterfly or bird, or the scurrying motion of an insect. For example, the beginning of ac-1 features a chaotic sequence of events, where sounds that contain fast erratic motions through spectral space are also juxtaposed to create unpredictable rhythms. Through these characteristics and the fact that their source is not bound to connotations of human gesture, these sounds afford images of ‘living non-human’ visual motion.

Sounds can also be mimetic of sounds related to non-human life forms or suggest to our imagination what the inaudible in the animal kingdom might sound like if it was audible. An example of the latter is Natasha Barrett’s Red Snow (Sound Example 1, 10’19-end). According to Barrett "Red Snow is snow coloured rose to blood red by a growth of algae or diatoms" (Barrett, 2002). In this piece Barrett combines textures suggestive of snow and ice with gestures that bring to mind living organisms.

2.3.7 Entrainment with Sound and Image

Returning to entrainment, as well as sonic images this concept is also relevant to sound and image in an audio-visual context.
According to Sonnenschein:

We seem to be wired for imposing order on our perceptions, as the brain will pull out patterns from chaos even if none objectively exist. Watching a person walk on screen and putting music to that image, it will seem that their steps are in sync with the music, just because we tend toward entraining sound and image.

(Sonnenschein, 2001, p.99)

The idea of us entraining sound and image is essentially the same as Michel Chion’s idea of synchresis, which he describes as “the spontaneous and irresistible weld between a particular auditory phenomenon and visual phenomenon when they occur at the same time” (Chion, 1994, p.63). Synchresis is a subjective phenomenon and Chion points out that it occurs “independently of any rational logic” (Chion, 1994, p.63). However, when composing sound for a visual image I consider synchresis a useful term to describe the moment when I perceive perceptual fusion between sound and image. I sometimes also consider this concept during sound design in acousmatic music, by looking to achieve a sense of synchresis between a sound and an image in the mind’s eye. A sense of synchresis was achieved in ac-l at 1’48 when a sound evoked an image of something being sucked through a pressurized chamber. An iterative process of manipulation and listening gradually led towards perception of synchresis between this image and the sound being developed.

Another form of entrainment can occur when we listen to sounds that are rhythmically dissimilar simultaneously. Through continuous listening we can become entrained by the rhythmic gestalt and perceive entrainment between sounds. Through imagery, this type of gestalt can be considered as a form of synchresis between sounds.

2.3.8 Entrainment as Compositional Technique

As well a listening strategy, entrainment can also be used as a compositional technique. Just as we are entrained by sounds in the environment, we can also simulate entrainment between one sound and another.
A particular sound can function as a driving rhythm entraining another sound which functions as the driven rhythm. This idea was utilized in *ac-4* where a sound was side-chained through a physical model, suggesting entrainment between the original sound and the model. Entrainment was also suggested by delaying the model to follow the original sound. The result of this process was a more organic suggestion of entrainment than when sounds were completely synchronized. The resulting sonic image is one where the entrained model suggests a shadow or reflection of the original sound. The original sound begins at 3’01. Entrainment begins at 3’16 and lasts until 3’59.

### 2.4 The Sonic Image in Other Forms

#### 2.4.1 Gestalt Image

While discussing ways of imagining music, Nicholas Cook has made reference to Sartre’s description of imagining a thimble. According to Sartre:

> Your image will probably incorporate a visual awareness the back of the thimble as well as its front, its inside as well as its outside. In other words, the imagination synthesizes within a single awareness contents, which in the real world are incompatible with each other; it presents not simply a series of visual aspects of the thimble, but rather an integration of these into an experienced whole.

(Sartre, 1972, cited in Cook, 1990, p.88)

Cook suggests that music can be imagined in a similar way; that “it is as if what is heard sequentially in the concert-hall were distilled into a single, heightened experience that embodies everything that is characteristic of the music” (Cook, 1990, p.89). This experience can involve sound alone but it can also be shaped and enhanced through metaphor, such as the arch metaphor described in section 2.2.1. Analysis through metaphor can thus collapse time into a single image and benefit the type of experience described by Cook. However Cook also highlights the illusory nature of imagining a piece in this way (Cook, 1990).

Another perspective on collapsing time into a gestalt is Smalley’s idea of holistic space, described as: “An analytical stance, realised by mentally amalgamating an array of spatial forms into a unified spatial view” (Smalley,
The holistic spatial image is essentially ‘frozen in time’ or, as described by Smalley, is where “time becomes space” (2007, p.38). This type of image inspired a section of ac-1, where stasis and a natural setting are suggested through texture and the recurrence of biomorphic sounds.

A piece can also be viewed as a gestalt through a relatively consistent sonic image. For example, in Denis Smalley’s Valley Flow the sound material was inspired by the Canadian Rocky Mountains. Mountainous imagery is thus prevalent throughout this piece. According to Smalley "The formal shaping and sounding content of Valley Flow were influenced by the dramatic vistas of the Bow Valley in the Canadian Rockies. The work is founded on a basic flowing gesture. This motion is stretched to create airy, floating and flying contours or broad panoramic sweeps, and contracted to create stronger physical motions, for example the flinging out of textural materials” (Smalley, 1992b). Valley Flow can be recalled as a spatial image where all sounds suggest an environmental gestalt. Although this piece has a specific musical structure, listening to any section can bring to mind this overarching image. In a sense this piece can be recalled from memory like a sonic photograph. I have thus chosen the term gestalt image to describe any situation whereby time is collapsed and a whole work or section can be recalled as a single image through internalized sound or visual imagery. The term ‘gestalt’ is borrowed from the Gestalt psychologists Max Wertheimer, Kurt Koffka and Ivo Kohler who defined the idea that the whole is more than just the sum of its parts (Goldstein, 2010).

2.4.2 Image of Depth

I use the term image of depth to describe sound that evokes a three dimensional image in the visual domain through its intrinsic sonic properties. As discussed by Elezovic, Scelsi believed in the idea of depth as a musical parameter, which he felt gave a spherical shape to sound; he referred to this parameter as the ‘third dimension of sound’ (Elezovic, 2008). Scelsi considered this dimension as separate from the usual dimensions of pitch and duration.
Rather it is made up of “other musical parameters such as articulation (microtonal clusters, trills, tremolos, glissandos, wide vibrato, fluttrotongue), instrumentation, dynamics, and texture, upon which Scelsi heavily relied in his music” (Elezovic, 2008, p.7). Essentially the depth of a sound reveals its substance as a complex sound object. This substance is revealed through stasis in Scelsi’s works as parameters besides pitch and duration are foregrounded (Elezovic, 2008). For example, his Quatro Pezzi (2007) from 1959 were each based around a single note and feature stasis above movement. While changes in pitch and duration are suspended, depth is revealed through other parameters in a form of textural composition. This type of spherical sound or depth can also be alluded to through parameters such as, for example, texture and dynamics in acousmatic music.

Varèse elaborated the idea of sonic depth in a different manner:

We have actually three dimensions in music: horizontal, vertical, and dynamic swelling or decreasing. I shall add a fourth, sound projection - that feeling that sound is leaving us with no hope of being reflected back, a feeling akin to that aroused by beams of light sent forth by a powerful searchlight - for the ear as for the eye, that sense of projection, of a journey into space. (Varèse, 1998, p.197)

Varèse’ third dimension of dynamic swelling or decreasing is somewhat compatible with Scelsi’s third dimension as it also alludes to a spherical nature of sound. I consider both as particularly relevant to textural sections in my compositions, such as in ac-5 (1’42-4’14) and in ac-1 (2’45-4’22) and (13’14-14’55). Varèse’ fourth dimension also highlights the extra musical nature of his approach towards sound and alludes to a sense of sonic images being created outside of the loudspeakers in the performance space.

2.4.3 Image of the Medium

Technology itself often becomes part of or evokes an image in electroacoustic music, which I call the image of the medium. For example, in acousmatic music in particular, there are often references made to the use of loudspeakers as instruments. Listeners tend to look towards loudspeakers during the performance of a piece where no performers are visible, so it can be
useful to consider the role of loudspeakers in the creation of a sonic image. Simon Emmerson has made reference to the “grain” and “spectacle” of the loudspeaker in terms of the effect of sonic “character” and “presentation” of loudspeakers respectively upon listeners. He has thus questioned whether loudspeaker music can truly be called acousmatic (Emmerson, 2007). The composer can draw a listener’s attention to loudspeakers not only through spatialization techniques but also through the use of noise.

For instance, as loudspeakers are associated with sounds of static interference and hum, the use of these types of sound can draw the listeners attention to the loudspeakers themselves as well as images that are external to the medium. These sounds can be perceived as contained in the piece or technical intrusions related to the mode of transmission. In ac-4, sounds of static interference formed part of a machine image, (particularly from 0’00-5’15) which is described in Chapter 5. These sounds can also bring to mind interference or flaws within the playback sound system, which can raise the listeners awareness of technology in the room as well as images suggested by the composer. The use of noise can thus bring the worlds of the real and the imaginary closer together for the listener. To give another example, at the end of ac-1, unprocessed mobile phone loudspeaker interference is introduced at the end. This could signify that a phone in the room was active but it also makes sense within the work’s narrative, which features processed manipulations of this sound². It also brings to mind poor loudspeaker cabling. In both contexts it can take the listener from the imaginary back to the real. Stan Link has also highlighted how noise:

becomes a metaphor attaching a kind of tactility to sound. Radio static becomes the feel of a tuning knob. The crackle of dust becomes the vinyl itself. The hum of tubes evokes their warm temperature. A stylus dropping carries the weight of a tone arm.

(Link, 2001, p.38)

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² This sound of mobile phone interference does not exist in countries such as North America, which operates on a different frequency band.
Interference or noise can thus suggest a technological presence within the space itself or can allude to an external imaginary technological presence.

As well as through the use of noise, there are other ways of drawing a listener’s attention to loudspeakers. For example, a loudspeaker cone and its vibrations can be used during the recording process. In \textit{ac-4} a very low frequency sound was played through a loudspeaker so that the vibrations of the plastic speaker cone could be recorded. When this sound is played back within the piece, due to the fact that the frequency itself is almost inaudible the listener is literally hearing the sound of the playback speaker cone vibrating. There is also a sound of objects that ricochet off wood and metal in this piece that was recorded with the use of a loudspeaker. When played back it literally sounds like objects are inside the loudspeaker.

2.4.4 Amplified Reality

It is useful for the composer to keep an eye on techniques that film sound designers use. Sound design is after all a part of the process of acousmatic music. Randy Thom discusses how in film sound design \textit{amplified reality} can make a sound more exaggerated than it actually is.

As Thom describes, to produce sounds that have amplified reality you:

begin by trying to forget for a while what the Nazi tank in an Indiana Jones film would "really" sound like, and start thinking about what it would FEEL LIKE in a nightmare. The treads would be like spinning samurai blades. The engine would be like the growl of an angry beast. You then go out and find sounds that have those qualities, or alter sounds to make them have those qualities.

(Thom, n.d.)

Sounds used for amplified reality should have similar timbral qualities to the original sound. Similarity in pitch, envelope, and reverberation is also desirable. These other sounds are eventually layered beneath the real sound such as the recording of a tank (Thom, n.d.).

The effects of amplified reality are subliminal. The viewer is unaware of the sounds that are used to amplify the real ones. This technique can be used in
electroacoustic music particularly if the composer wants a source to be amplified and given a particular image.

I often apply the idea of amplified reality in a reversed manner, and place recognizable sounds such as vocal or machine sounds subliminally behind sounds that do not have an easily defined source. In the normal use of amplified reality the listener should have a good idea what sound is being suggested but its amplification gives it a new form. In the reversed context of amplified reality the listener may not recognize a sound but may have a feeling for it without knowing why, as there is a recognizable sound hidden in the background. An example of this is in *ac-4* at 11.15, where the sound of a racecar engine revving up is fused with an abstract sound. It is particularly the arching rise and fall in pitch and volume envelope within both sounds that enhances their fusion. This form of sound design is one that I frequently consider during composition.

2.4.5 Conceptual Images

Conceptual forms of extrinsic reference are also useful when considering a sonic image in electroacoustic music. Concepts, which are not inherently auditory or visual, can point towards analogies between the two domains. I use the term *conceptual image* to describe this approach to a concept.

For example, the concept of chaos, suggested through noise, randomness or irregularity can be evocative of images related to chaotic scenes in the world. Concepts related to chaos theory were influential during the composition of *ac-1*, and these are discussed in the analysis of that piece in Chapter 5.2.

Also related to chaos, the concept of entropy is a useful conceptual image when considering a gradual increase in the appearance of sounds, particularly when sounds related to noise and information systems are used.
Entropy can signify the clarity of a signal amidst noise and chaos, as described by Worby:

In information and communication systems entropy is manifested by noise. Entropy is low when the signal is very strong, noise is minimised and the message is clear... When entropy reaches a maximum all is chaos and communication ceases. The signal can no longer be discerned.

(Worby, 2000, p.143)

An increase in entropy can thus signify a decrease in the presence of a signal. In ac-1, sonic gestures that signify the main message or signal in the first half of the piece multiply and become gradually lost in the overall texture towards the end. However, although they become lost, this new chaotic textural field essentially becomes the new signal.

This integration of gestures into an increasingly entropic texture can be compared to the idea of the holonic field, as defined by Filimowicz and Stockholm. Within a holonic field a sound can “possess dual qualities of self-assertion and field integration” (Filimowicz and Stockholm, 2010, p.9). At times in the entropic section of ac-1 gestures appear to come to the surface and make themselves heard, while at others they can be heard as part of the whole textural entity.

In his essay on Entropy and Art, Arnheim discusses how an increase in entropy leads towards equilibrium: “A system is in equilibrium when the forces constituting it are arranged in such a way as to compensate each other” (Arnheim, 1971, p.25). An increase in entropy thus signifies a progression towards disorder, while simultaneously signifying a progression towards equilibrium. Arnheim’s essay thus suggests a paradox: although equilibrium implies maximum entropy and disorder, there is order in the sense that all elements carry equal weighting. In the final section of ac-1, a gradual increase in sounds suggests an increase in chaos, while a progression towards a textural macrostructure suggests order or equilibrium. Arnheim’s following description of Pollock’s paintings provides a visual analogy to this idea of sonic equilibrium: “a random distribution of sprinkled and splashed pigment controlled by the artist's sense of visual order... the overall texture is even and
balanced... the elements of shape and color leave each other sufficient freedom” (Arnheim, 1971, p.23). This analogy describes a spatial form of equilibrium. *Ac-1* creates a state of equilibrium through time and space. The gradual introduction of sounds towards the end of the piece suggests something being filled to its maximum capacity. An increase in entropy fills the space with sound until equilibrium has been reached over time. Many sonic elements also become balanced throughout space. As the composition has been veering towards this state there is also a release of tension. Another visual analogy borrowed from Arnheim describes the combination of chaotic noise and calm sense of equilibrium suggested through this increase in entropy: “the swirling of molecules constituting a pool of water microscopically shows no kinship with the quiet sight of the pool looked at with the naked eye” (Arnheim, 1971, p.21).
Chapter 3: Visual Concepts and Multimedia Aesthetics

3.1 Introduction

When Pierre Schaeffer released his *Traité des objets musicaux* in 1966, his idea of reduced listening placed emphasis on the sound object considered only for its inherent qualities. Since then, Denis Smalley has introduced new ideas to electroacoustic music that can be related to the visual domain through the concept of spectromorphology, which relates to the development of a sound’s spectrum over time. According to Smalley:

spectromorphology is concerned with motion and growth processes, which are not exclusively or even primarily sonic phenomena: sonic motion can suggest real or imagined motions of shapes in free space. Spatial experience itself can involve sounds or not. Energy, which is inherent in spatial motion, is part of both sounding and non-sounding experience.

(Smalley, 1997, p.110)

Smalley’s ideas have opened doors for composers to explore the visual domain further for compositional and analytical approaches. In Chapter 2, various forms of sonic images were discussed. This chapter discusses sonic images through a more direct approach towards referencing the visual domain. It begins with a discussion on synesthesia. While this phenomenon is acknowledged here as a neurological condition this discussion offers insight into more general cross-modal thinking. Through this discussion the concepts of synesthetic analysis and synesthetic metaphor are introduced, which afford direct reference to the visual domain during composition and analysis. Properties of the visual domain are then explored and comparisons are made with the sound domain. Following this, the use of multimedia concepts normally applied to moving images that are meaningful for my own approach to composition and analysis are discussed.

3.2 Synesthesia

While discussing associations of gesture and texture with vision, Denis Smalley has referred to “music, and electroacoustic music in particular” as “not
a purely auditory art but a more integrated, audio-visual art, albeit that the visual aspect is frequently invisible” (Smalley, 1992a, p.90). This integration of sound with imagery is described as “a weaker, voluntary, associative synaesthesia which will vary in consciousness and activity among listeners” (Smalley, 1992a, p.90). Synesthesia is commonly discussed as a relatively rare neurological condition, where perception through one sense can elicit activity in another. However, Smalley is not the only one to use this term to denote associative links between the senses. While discussing musical analysis Galeyev has suggested that, clinical cases aside, synesthesia can be viewed as:

a normal and common ability of intersensory association, a particular manifestation of imaginative thinking or (when it appears in verbal form) a double metaphor, in which the transfer of meaning inherent in metaphor is accompanied by the transition into another sensory modality.

(Galeyev, 2007, p.285)

This form of metaphor that involves transition of meaning between the senses is commonly referred to as a synesthetic metaphor3. Examples of synesthetic metaphors are bright sound and harsh sound, which respectively reference the visual and tactile domains. However, even common literary metaphor shares similarities with synesthesia as highlighted by Ramachandran:

One skill that many creative people share is a facility for using metaphor ("It is the east, and Juliet is the sun"). It is as if their brains are set up to make links between seemingly unrelated domains--such as the sun and a beautiful young woman. In other words, just as synesthesia involves making arbitrary links between seemingly unrelated perceptual entities such as colors and numbers, metaphor involves making links between seemingly unrelated conceptual realms. Perhaps this is not just a coincidence.

(Ramachandran, 2003, p.57)

3 For an in depth discussion on this concept see Takada (2008).
If Ramachandran is suggesting that the use of metaphor is cognitively related to synesthesia, then the use of synesthetic metaphor is very much so. The relationship between synesthetic metaphor and synesthesia is supported by Timothy L. Hubbard’s (1996) experiments, which have shown evidence of synesthesia-like mappings between pitch and lightness in non-synesthetic participants. These participants tended to match higher pitches with lighter stimuli and lower pitches with darker stimuli (Hubbard, 1996). The relationship is further supported by experiments of Ward et al (2006), which show similarities between the way that pitch-lightness mappings function in non-synesthetes and how these mappings function in sound-colour synesthetes. Their results suggest that synesthesia is a result of cross-modal mechanisms common to all, rather than unimodal pathways exclusive to synesthetes (Ward et al, 2006). It is also interesting to note that the majority of people with synesthesia experience it not as an outward hallucination, but as an inward experience in the mind’s eye (Carpenter, 2001). Sacks gives an example of a synesthete who described his synesthetic colours as: “wholly inward and never confused with external colors” (Sacks, 2007, p.170).

This inward aspect of synesthesia suggests that the synesthetic experience is not far removed from the type of quasi-visual acousmatic experience described by Emmerson at the beginning of Chapter 1.1. In my own experience, the “attempt to ‘fill in’” that Emmerson describes is a means towards resolution of meaning, which is frequently more immediate than the “voluntary associative synesthesia” discussed by Smalley. This internal visual resolution can be so instantaneous as to appear to precede thought and can thus be described as involuntary. Resolution through internalized images can be considered an associative connection between music and multi-sensory experience stored in the conscious or subconscious mind. As Galeyev has highlighted, even architectonic music is synesthetic by nature as “the ephemeral, abstract nature of music simply calls for embodiment, and this
process is accomplished through the associative (in this case synesthetic) psychic mechanism” (Galeyev, 2007, p.286).

The quasi-visual mindscape that Emmerson refers to can thus be a composer’s main reference point for construction of an acousmatic piece in a similar way as a synesthetic composer might ‘compose with colours’. This idea may not seem beneficial to an analyst who looks to discuss tangible sound qualities. However, the composer can use synesthetic metaphor and various other forms of extrinsic reference as tools for both composition and communication. As stated by Galeyev, synesthetic analysis “not only fixes the link to reality, but also exposes the emptiness of extremely formal and narrow-minded positions in the study of art” (Galeyev, 2007, p.288).

3.3 Light and Colour as Forms of Extrinsic Reference

3.3.1 Introduction

Theodoros Lotis has highlighted the fact that extra-musical parameters such as those associated with light, can be more meaningful to the composer and listener than the physical properties of sound such as pitch and amplitude. He describes associations with light as the textural value of sound. According to Lotis:

While investigating the textural value of a sound, the listener needs to be distanced from the physical properties of the stimulus in order to grasp its innermost character and interpret a meaningless acoustic signal into a meaningful art.

(Lotis, 2006, p.9)

He compares this listening strategy to Schaeffer’s concept of reduced listening.

The purpose of this section is to form a synthesis of ideas related to light/colour associations with sound and discuss how light and colour are useful forms of extrinsic reference in electroacoustic music. Various associations between light/colour and sound are considered, including those made by Lotis. Light and colour associations are subjective, so there is no attempt to prescribe
particular colours or light intensities to sonic parameters. However, sound can be discussed in terms of light and colour variation. Connections made between light/colour and sound discussed in this section can thus give meaning to the use of terms related to light and colour to describe changes that occur during composition.

3.3.2 Brightness Associations with Pitch or Frequency

The use of the terms lightness/brightness and darkness to describe changes in pitch or frequency is supported by perceptual research. As discussed in section 3.2 Timothy L. Hubbard’s research has shown evidence of synesthesia-like mappings between pitch and lightness in non-synesthetic participants. Participants tended to match higher pitches with lighter stimuli and lower pitches with darker stimuli. This research also showed correlations between lightness and melodic interval.

The last section of Valeurs D’ombre by Patrick Ascione (1986) (1995) contains suggestions of brightness through pitch and frequency (Sound Example 2, 21’54-25’19). The section is called Lumière Entrevue (A Glimpse of Light). In the last few minutes of this section, which closes the piece, he uses repetitions of sustained sounds beginning at different frequencies. Each repetition moves towards higher frequencies as if suggesting movements towards light. He also uses fast upward arpeggios played on an organ, which are suggestive of brief glimpses of light. He contrasts suggestions of movements towards light and glimpses of light with low frequency sounds and the occasional introduction of an arpeggio that moves downwards in pitch. It is this contrast that particularly brings to mind light related images.

3.3.3 Colour and Timbre Associations

In his book Perceptual Coherence, Stephen Handel (2006) explores similarities and differences between hearing and seeing. He gives comparisons between colour and timbre, noting that both “are source attributes and therefore are properties of objects” (Handel, 2006, p.293). Handel prefers the comparison of colour with timbre than with pitch for this reason. Timbre distinguishes
sound sources just as colour distinguishes objects in the visual domain. When this comparison of timbre and colour is considered in terms of extrinsic reference in electroacoustic music, a change in timbre can suggest a new colour, a new visual object, or both. The relationships formed in music between timbre and colour may also be related to the way that these attributes are similarly perceived. According to Handel:

What is important about timbre is that it is in some way unchanged across changes in loudness and pitch, so that the listener can track the trajectory of that object. Similarly, what is important about color is that in some way it is unchanged across changes in illumination. (Handel, 2006, p.294)

This comparison between timbre and colour can also provide connections between changes in loudness and pitch, and changes in brightness. Loudness and pitch have a similar subtle effect on timbre as brightness has on colour. An approach to colour as an extrinsic reference can thus be one where timbre suggests colour, while changes in pitch and loudness suggest changes in a colour’s illumination.

3.3.4 Colour and Pitch Associations

Handel has also highlighted the main similarities between colour and pitch. It should be noted that these comparisons and those made by Handel between colour and timbre in the last section were simply perceptual explorations. None were intended by the author to be mutually exclusive. According to Handel:

We specify a color by its frequency and we similarly specify pitch by its frequency. Moreover, color and pitch are the classic examples of secondary perceptual attributes: The perceiver creates color and pitch; they are not inherent in the frequency of the energy.

(Handel, 2006, p.292-293)

The way that relationships are frequently formed between these attributes from different senses may thus be related to the fact that colour and pitch are both cognitive constructs.
I personally find that pitched material is particularly evocative of colour in acousmatic music when it has been absent and is then introduced. A point to consider is the fact that timbral material in acousmatic music has more potential to suggest real world events than pitched material does, through source bonding and mimesis. Pitch can thus have less attachment to real world events within a piece. Pitched material can be used to imitate real world events but the concept of pitch by itself does not. Therefore, to apply pitch to a non-pitched sound that has already established its imagery through its source or mimesis of a real world event can be analogous to introducing colour to a visual image. Colour is effective as an extrinsic reference in this situation, which is one that signifies not a change in pitch but its introduction. Pitch can thus lead the listener away from perception of sources and mimesis of real world events towards suggestions of colour, which is more abstract.

3.3.5 Hue, Saturation and Brightness

Lotis’ discussion of textural value, mentioned at the beginning of this section, suggests that three elements of the theory of light combined: hue, saturation and brightness, are beneficial towards analysis and appreciation of electroacoustic music. Within the theory of light, hue refers to colour itself, saturation to the purity of a colour and brightness, naturally, to the brightness of a colour. Lotis has applied these attributes of colour in a similar way towards sound. He describes hue as “the wavelength classification of a sound within the low, medium or high regions of the spectrum. Hue may also specify the prominent frequency of a complex sound thus indicating the primary spectral region (low, medium or high)” (Lotis, 2006, p.3). As saturation refers to the purity of a colour, it is defined as “how much a sound differs from white noise” (Lotis, 2006, p.4). White noise would thus be considered “completely unsaturated because it lacks a dominant hue and accordingly should be called
achromatic” (Lotis, 2006, p.3). A sine tone would signify a purely saturated sound⁴.

The paired concepts of hue and saturation are useful because they afford an integration of pitch and timbre when suggesting colour. An increase in saturation can suggest the emergence of a colour/hue or pitch in its purest form. A less saturated hue can suggest a mixture of colours or a complex timbre.

Lotis associates brightness with a subjective continuum from transparency towards opacity, where opacity relates to presence of masking and transparency to its absence. This association is useful when applied to Lotis’ approach, which involves a subjective analysis of sound through hue, saturation and brightness; a process he calls the “maypole of textural value”. According to Lotis:

The maypole of textural value enacts, in a way, the process of musical perception. When a listener hears a sound, he/she decodes very quickly its spectral position and its main or fundamental frequency/ies, thus gathering the first information regarding the hue of the sound in question. The next step concerns the sound’s texture. Then, the investigation of the texture that has just started, moves a step further: how far this texture is subjected to masking effects that occur due to co-existence with other spectrally close frequencies, or, how transparent or opaque the spectrum sounds.

(Lotis, 2006, p.9)

This approach is very useful and can engage a composer or listener in a rich and meaningful listening experience based on light and colour as extrinsic references.

3.3.6 Transparency and Opacity

Denis Smalley previously made the relationship of masking with transparency and opacity when he defined:

qualities of spectral density which can be imagined as a fog, curtain or wall of broader or narrower spread which allows sounds to penetrate or not...Thus a packed or compressed spectral space is compacted so that it suffocates and blots out other spectromorphologies. A transparent spectral

⁴ It should be noted here that white noise differs from achromatic colours in the respect that it is averaged over time. However, this does not detract from the fact that a pure frequency can suggest a saturated colour, while a combination of frequencies can suggest a mixture of colours.
space lets other spectromorphologies through, while something in between (translucent, opaque) has a masking effect.

(Smalley, 1997, p.121)

Smalley’s description of spectral density is comparable to brightness in Lotis’ maypole of textural value. However, Lotis’ description of brightness is intrinsic to a particular approach. It is thus useful to utilize Smalley’s qualities of spectral density when discussing concepts such as transparency, translucency and opacity in relation to masking/revealing sonic images. When this distinction is made suggestions of brightness can simply be discussed in relation to the introduction of high frequency content. Brightness will thus be considered in this context during analysis while Smalley’s qualities of spectral density will be utilized to discuss the masking or revealing of sonic images.

3.3.7 Source Bonded Light/Colour Associations

Light and colour can also be evoked through source bonding. For example, in Jonty Harrison’s *Hot Air* (1995) light and darkness are evoked through sunlight-associated sounds such as bees and farm animals and night-associated sounds such as fireworks. Sounds also evoke their own colour associations, particularly sounds related to the elements such as fire, water or wood. Even sounds that do not suggest a particular colour can gain colour associations within a piece. For example, balloon sounds are frequently juxtaposed with heat related sounds in *Hot Air*. I immediately imagined the balloons as being red upon hearing this piece because of these heat related juxtapositions. In *ac-4*, the sound of a vibrating loudspeaker can be associated with the colour black if the source is recognized. The dark quality of this sound is also enhanced by its low frequency. This example thus suggests that there can be perceptual interaction between source bonded colour associations and other quasi-synesthetic colour associations made by the listener.

Source bonded light/colour associations are subjective and depend on whether or not the listener recognizes the cause. Although most sound sources can appear in various colours the introduction of new sources can suggest new
source bonded colours. This idea of new source, new colour, can be related back to the comparisons between timbre and colour in section 3.3.3 that showed both timbre and colour to be source attributes of objects. A work that uses heterogeneous sound material can thus be perceived as rich in source bonded colour imagery.

3.4 Aesthetics of Multimedia and Visual Concepts

The remainder of this chapter discusses how concepts derived from multimedia and the visual domain can be applied to a compositional and analytical approach to electroacoustic music. In particular compositing, spatial and temporal montage and space-medium as defined by Lev Manovich can be applied to form. And, vectors as defined by Herbert Zettl can be applied to create or analyze various relationships between sounds. This approach to composition and analysis is further supported by shared perceptual phenomena between sound and image such as figure-ground organization. Before discussing multimedia concepts related to visual images and applying them to sound, it is useful to consider comparisons between sounds and visual objects.

3.4.1 Surfaces and Edges

Stephen Handel makes comparisons between sounds and visual objects where he first highlights how a visual object has edges that mark its boundaries in space. An edge can also represent the intersection of surfaces, a change in illumination, or a change in texture (Handel, 2006). He then considers edges in relation to sound:

In sound, edges can be translated as rapid spectral or amplitude changes that can also represent different properties. An edge can mark the boundaries of an object, a louder sound heard against a quieter background, the intersection of two sounds, or the replacement or masking of one by another. But a rapid spectral or amplitude sound edge can also represent a change in illumination such as removing a shadow when the listener (or the sound source) moves out from behind an absorbing or reflecting object such as a wall.

(Handel, 2006, p. 397)
According to Bregman (1990) the auditory system primarily reveals sources whereas the visual system primarily reveals surfaces. In electroacoustic music however, sonic textures can be suggestive of visual surfaces. When edges are also considered in this context, analogies can be made between composing with sounds and composing with moving visual images. Sonic textures can represent continuous surfaces, while spectral and amplitude changes can represent discrete surface boundaries, surface intersections, changes in surface texture, and changes in surface illumination. Edges can also be marked off in space when spectral or amplitude changes are made at different points. This approach to sound can benefit from the fact that figure-ground organization and Gestalt organizational principles can be applied to sounds and visual objects. Therefore a compositional approach to electroacoustic music can be considered that is similar to composing with moving visual images. This approach will now be discussed through concepts that are normally applied to structuring moving visual images in multimedia projects such as film.

3.4.2 Motion and Plasticity

A sound’s development in time can be considered as analogous to an image’s development in time in a visual work. Through this analogy aesthetics related to the temporal development of images are useful for sonic material. In his book *Motion Graphic Design* (2008), Jon Krasner discusses design of animation in media such as film, computer games and music video. While considering the temporal development of images he describes the concept of nonlinear velocity:

It is seldom that living things in the natural world move at a constant, linear pace. Natural movements of living things typically begin slowly, speed up, and slow down, unless an obstacle interrupts them. Human and animal motion, as well as motion caused by natural forces, is very erratic and unpredictable, involving acceleration and deceleration. Newton’s laws of motion state that objects that have mass naturally accelerate as they move through space.

(Krasner, 2008, p.151)
Although this description relates to rate of change in visual motion it can be applied to rhythmic motion within a sonic gesture. A sound that changes unpredictably in its rate of change can suggest natural motion in the visual domain even if that sound is derived from a mechanical source.

On the other hand, linear velocity in visual graphic design relates to “motion graphics presentations that are intended to look fluid or mechanical” (Krasner, 2008, p.150). Repetitive sonic rhythms are analogous to mechanical motion in the visual domain. A sound that is suggestive of visual mechanical motion can be found in ac-4, where a shaker-like sound repeats at a constant rate (9’54-end). While it sounds mechanical it also brings to mind mechanical motion in visual space. To make an analogy for fluid visual motion such as, for example, an abstract object that glides at a constant rate across a screen is not as straightforward, as rhythm can disrupt a sense of fluidity, so it is useful to consider pitch space. A sound that moves through pitch space at a constant rate such as a pitch glide is fluid but it also has the connotations of movement through the vertical domain. A sine tone that stays constant in pitch may bring to mind a horizontal line formed over time. However, this is not an example of linear velocity, as it does not contain motion and is thus more suggestive of an image that remains still in space. There is thus no straightforward sonic equivalent of horizontal fluid motion in visual space. However, although strictly speaking rhythm can disrupt a sense of fluidity, subtle repetitive rhythms or modulations applied to sound that is constant in pitch can be suggestive of horizontal fluid motion. Sustained computer-generated sounds that are static in terms of pitch were used in ac-3 to suggest the motion of horizontal lines contained in the film Warp & Weft (0’24-41). Motion is suggested through subtle amplitude modulations and changes in timbre.

Other repetitive rhythms were used in this piece that are suggestive of linear velocity and relate to horizontal and vertical lines throughout.⁵ More unpredictably rhythmic sounds were used in this piece to represent human gesture, which are more suggestive of nonlinear velocity even though these

⁵ An aesthetic choice was made not to use pitch space to suggest movement of vertical lines.
sounds were also computer-generated. An unnatural/natural dialectic in the film through vertical and horizontal lines combined with human gesture is thus imitated by sound through linear and nonlinear velocity, even though all sounds are derived from an unnatural source. A comparison can also be somewhat made between linear/nonlinear velocity in the visual domain and Schaeffer’s concept of allure, which relates to subtle fluctuations in pitch, duration or intensity (Chion, 1983). As explained by Dack: “Individual types of allure are designated as ‘mechanical’ if they are extremely regular or ‘living’ if slight fluctuations are perceived” (Dack, 2002, pp.15-16) [his quotes].

I have thus borrowed the paired concepts of **linear and nonlinear velocity**, to describe motion of sonic images related to the mechanical and natural world. These concepts afford ambiguities between natural/mechanical sound material and natural/mechanical images. For example, a sound recorded from a mechanical source that behaves erratically can suggest an image of something natural. Also, a sound that is recorded from a natural source can suggest an image of something mechanical. A large majority of gestures in *ac-1*, which are mostly derived from mechanical sources, are particularly suggestive of nonlinear velocity in the visual domain through their erratic motions.

### 3.4.3 Compositing

In Chapter 1.2, comparisons were made between digital compositing in new media and how the graphical user interface makes it easier to create virtual unified spaces and seamless sound transformations in electroacoustic music. Through compositing, images from various types of visual media can be layered and blended to create a new virtual space/image.
According to Manovich:

Once all the elements are ready, they are composited together into a single object; that is, they are fitted together and adjusted in such a way that their separate identities become invisible. The fact that they come from diverse sources and were created by different people at different times is hidden. The result is a single seamless image, sound, space, or scene.

(Manovich, 2001, p.137)

An example of compositing is the integration of real and animated footage in modern science fiction films, such as the more recent Star Wars films (Manovich, 2001). Elements within a composite “are all aligned in perspective, and modified so that they have the same contrast and color saturation. To simulate depth of field, some elements are blurred while others are sharpened” (Manovich, 2001, p.137). This feature of compositing involves attention to intrinsic visual properties such as colour and visual texture and is thus comparable to the way extrinsic references of sounds are disregarded in favour of intrinsic sonic properties during reduced listening.

I have utilized the idea of compositing as an approach to the creation of sonic spaces/environments. Sounds from different sources can be composited by applying similar processes to integrate diverse sound sources into a cohesive form. This approach is analogous to the creation of virtual spaces in the visual domain for new media. Sounds can be blurred or sharpened through spectral processes. Compositing real and synthesized sounds in electroacoustic music is analogous to compositing real and animated footage in film. For example, the film artist studies intrinsic properties of filmed/real world images such as visual texture, grain and colour to inform the creation of similar animated images, so that both can be seamlessly integrated into a composite. In a similar way, I pay attention to intrinsic properties of recorded sounds such as sonic texture, grain and pitch/frequency to inform the creation of synthesized sounds so that both can be integrated into a seamless sonic image. This approach was beneficial to the creation of a virtual space/environment during the composition of ac-1.
A composite can also benefit from careful selection of sound material. Pierre Schaeffer suggested the idea of combining sound objects in a way that they appear to derive from a similar source, thus creating a genre of sound objects, or pseudo-instrument (Chion, 1983). Dack (2002) explains how the pseudo-instrument is implemented through consideration of the value/characteristic dualism. Common characteristics of sound objects are identified first. From these characteristics musical values can emerge, which enable sound objects to be structured even if they are dissimilar in other ways. Once values and characteristics have been identified, variance of values can be used as a structural function. Other characteristics stay permanent and contribute to the homogeneity of the genre (Dack, 2002). An example of a pseudo-instrument is the combination of piano, cymbals and electronic sounds in Stockhausen’s *Kontakte* (1992): “Sound objects from these three distinct sources combine to produce the impression of a ‘metallic percussion-resonance’ genre and thus a pseudo-instrumental source” (Dack, 2002, p.17) (Sound Example 3, 25’47-26’19). The pseudo-instrument is a useful concept for choosing sound material from diverse sources that can be effectively integrated into a composite.

The idea of the pseudo-instrument was considered for *ac-1* to create a turbulent-chaotic genre of sound objects. Turbulent textures and chaotic gestures emerged as structural values. These values contributed towards compositing a turbulent-chaotic sonic environment, which also suggests images of a surreal visual landscape (0’50-2’46).

Compositing can be considered as a way of combining sounds to form a consistent sonic virtual space/environment that affords the type of gestalt image discussed in Chapter 2.4.1. Although compositing can be approached through attention to sonic properties it can lead the composer or listener from the intrinsic microstructure of sounds towards suggestions of an extrinsic macrostructure by suggesting an environmental image.
3.4.4 Spatial and Temporal Montage

Whereas compositing is as an approach to blending and cohesiveness in the creation of a virtual space/environment, a more disjointed approach to sonic juxtaposition is effective through spatial and temporal montage. While Lev Manovich has discussed these concepts in relation to visual spaces in new media, I have applied them to electroacoustic composition and analysis.

In Chapter 1.3 it was discussed how unlike the aesthetics of unity and blending attached to the concept of compositing, montage is concerned with “visual, stylistic, semantic, and emotional dissonance between different elements” (Manovich, 2001, p.144). Temporal montage and ‘montage within a shot’ as defined by Manovich were also discussed. Manovich has used the term spatial montage to describe how the cinematic idea of ‘montage within a shot’ can be applied to new media. According to Manovich, spatial montage:

- could involve a number of images, potentially of different sizes and proportions, appearing on the screen at the same time. This juxtaposition by itself of course does not result in montage; it is up to the filmmaker to construct a logic that determines which images appear together, when they appear, and what kind of relationships they enter into with one another.

(Manovich, 2001, p.322)

I have borrowed Manovich’s idea of spatial montage to describe an approach to the juxtaposition of two or more sounds in space in electroacoustic music. For this approach sounds should be dissimilar in one respect, but some form of logic for their appearance and relationship is necessary. When juxtaposed sounds are heterogeneous, the listener can perceive different sources whether real, apparent or imagined. Sounds in a spatial montage can thus suggest contrasting images through extrinsic reference. A logic for appearance of heterogeneous sounds can be related to the meaning that results from their combined extrinsic references. A logic can also arise through similar changes in their intrinsic characteristics, which is a feature of compositing. A combination of spatial montage and compositing aesthetics is discussed in section 3.4.7 in the analysis of Jonty Harrison’s Hot Air. Ideally, the listener should question why heterogeneous sounds appear together and resolve their curiosity through
an understanding of the composer’s logic. The same logics described above apply to temporal montage when heterogeneous sounds are juxtaposed consecutively in time.

3.4.5 Vectors

Herbert Zettl describes how in film, television and other forms of multimedia, vectors are considered for achieving structural relationships between images (Zettl, 1999). Although graphic vectors are discussed in relation to still images in print, motion vectors, which apply to moving images, are of interest when sound is considered. Zettl describes a vector as “a force with a direction and magnitude” (Zettl, 1999, p.106). The main attributes of vectors are vector field, vector magnitude and vector direction. Vectors interact within the vector field. The vector field can exist either spatially within a screen or temporally from one shot to the next, as long as a strong enough connection between vectors is established. Vector magnitude signifies how strong or weak a vector is. The three properties of vector magnitude are direction, mass, and speed. Objects that have strong directional tendencies, are of large mass, or are moving fast are considered high-magnitude vectors. There are three kinds of vector direction in multimedia: “Continuing vectors point in [move toward] the same direction. Converging vectors point [move] toward each other. Diverging vectors point [move] away from each other” (Zettl, 1999, p.109). An example of continuing vectors would be two cars traveling in the one direction. Continuity of these vectors “can be established in a single shot or a shot sequence” (Zettl, 1999, p.109). “Two cars racing toward each other represent converging motion vectors” while cars “traveling in opposite directions” would signify diverging vectors “regardless of whether they appear in a single shot or a series” (Zettl, 1999, p.110). These three types of vectors are important during editing as they can establish a sense of continuity from one scene to the next. Their use in film can thus be described as a form of intrinsic reference. However, they can also enhance the meaning of events by creating a sense of tension or release.
I have utilized Zettl’s idea of vectors in multimedia to establish and analyze relationships between sounds in electroacoustic music. The vector field can exist both simultaneously within a sonic space, and through time across the length of a composition. In terms of spatial motion, converging vectors are created when sounds move towards the same destination. When sounds move away from a shared point they form diverging vectors.

Vectors can be applied to any sonic parameter that can be said to have direction. As discussed in Chapter 2.2.2, when pitches are described as high or low, up or down, this is essentially a mapping of pitch onto the domain of virtual space. Verticality of space becomes a metaphor for pitch height (Turner, 2006). Vectors can be applied to pitch, as direction can be perceived in pitch space. For example, in Metastasis by Xenakis (2001) glissandi can be heard diverging from a G, with one group moving upwards while the other is moving downwards (Sound Example 4, 0’00-1’04). Converging vectors are formed at the end of Metastasis, as glissandi moving from various points high and low in pitch space converge towards a Gsharp (Sound Example 5, 8’00-8’54). In Xenakis’ Syrmos (2005), glissandi continuously moving from high to low in pitch space form continuing pitch vectors (Sound Example 6, 6’32-6’57).

As well as the verticality of space metaphor, a more basic ‘movement through space’ metaphor affords the application of vectors to any sonic behaviour. Sounds can thus converge towards or diverge from a point that relates to their shared behaviour. Sounds can also continue similar behaviours indefinitely. Converging vectors are formed through sonic behaviour in ac-4. After a rhythmic sound enters, two vibrating sounds increase in tension and converge towards a breaking point, where it appears as though the rhythmic sound has been squeezed out. The rhythmic sound reenters at the end of this chaotic point of convergence, where sounds then appear to break apart (12’11-12’58). The two vibrating sounds can be considered as high magnitude vectors through their intense behaviour and how they also converge in space. As Zettl points out, converging vectors can be used to “increase the aesthetic energy of an event” (Zettl, 1999, p.110).
Vectors can be applied as structural functions and consideration can be made towards direction, mass, and speed as well as the strength/weakness of these parameters. As well as space, pitch and sonic behaviour, further research can provide analysis of vectors applied to other musical parameters.

3.4.6 Space-medium

As well as compositing and spatial montage, another approach to the creation of virtual spaces in new media is the concept of space-medium. Manovich illustrates one of the problems of most virtual spaces within new media: “Although new media objects favor the use of space for representations of all kinds, virtual spaces are most often not true spaces but collections of separate objects” (Manovich, 2001, p.253). He describes Florensky’s concept of space-medium as a useful approach to the creation of virtual environments. According to Florensky:

The space-medium is objects mapped onto space...We have seen the inseparability of Things and space, and the impossibility of representing Things and space by themselves.

(Florensky, 1985, cited in Efimova and Manovich 1993, p.xxvi)

When space is treated as space-medium, there is no real separation between space and the objects within. Therefore space-medium relates to the substance of space, where figure-ground relationships can be perceived as ambiguous.

Manovich refers to Disney animations when explaining space-medium and how it relates to substance:

Although all objects in cartoons have hard edges, the total anthropomorphism of the cartoon universe breaks distinctions both between subjects and objects and objects in space. Everything is subjected to the same laws of stretch and squash, everything moves and twists in the same way, everything is alive to the same extent. It is as though everything - the character’s body, chairs, walls, plates, food, cars, and so on - is made from the same bio-material. This monism of the cartoon worlds stands in opposition to” the dualism of foreground and space which are normally perceived as “fundamentally different substances.

(Manovich, 2001, p.256-257)
I have utilized the idea of space-medium as an approach to form in electroacoustic music. Like compositing, space-medium involves blending. Space-medium however takes the concept of blending further through ambiguity of figure-ground relationships. Through a merging of foreground and background, sounds can be given a fluid quality or appear to be made from the same substance. In the visual medium, Manovich compares this treatment of space to paintings of modern artists such as de Kooning, who “depicted a dense field that occasionally hardens into something that we can read as an object” (Manovich, 2001, p.255).

The concepts of compositing and spatial montage will now be utilized in an analysis of Jonty Harrison’s *Hot Air*. An example of vectors is also discussed. Following this in section 3.4.8 is a discussion of space-medium and compositing in relation to the music of Mathew Adkins. This discussion also considers comparisons between sounds and visual objects.

### 3.4.7 Analysis of Jonty Harrison’s *Hot Air*

Throughout Jonty Harrison’s *Hot Air*, sounds are suggestive of images related to their source. Sounds are also suggestive of concepts such as heat, air and energy. When sounds are juxtaposed spatially, simultaneous images and concepts are suggested that form dialectical relationships. These relationships afford new interpretations of meaning and can thus be described as a form of spatial montage.

As well as sounds forming dialectical relationships through suggested images and concepts, they are also effectively integrated sonically through shared features and spectral processes. This sonic integration can be considered as a form of compositing.

Just as spatial montage relates to referential features of images and compositing to the intrinsic substance of images in film, these concepts can simultaneously be applied to referential features of sounds and the internal substance of sounds in a piece such as *Hot Air*. This approach to the analysis of
Hot Air suggests that experience of this piece benefits from both causal and reduced listening.

Initially inspired by children’s party balloons, Harrison eventually incorporated “other concepts of air (breath, utterance, natural phenomena) and heat (energy, action, danger)”. Objects moving in space and the energy of interactions between air molecules themselves led him to a structure that involved “a free association of sounds and references, each linking and influencing its neighbour”. Eventually, associations within the piece led him to an image “of the inflated balloon as a metaphor of the fragility of that very environment, of the Earth itself - capable of being manipulated, but not infinitely so” (Harrison, 1995).

The piece contrasts sounds of nature with sounds of technology. Heat is suggested by fire-related sounds and through sunlight-associated scenes containing birds, bees, farm animals and farm machinery. As well as suggesting air and energy, the balloon sounds introduce an almost tactile, textural element. The piece can be described as containing sounds related to the following categories: air/energy, heat, nature, and technology. A narrative can be followed through relationships formed by spatial juxtapositions of sounds related to these categories. The following sound examples help to describe how this narrative is explored through consideration of spatial montage enhanced by compositing. A useful application of vectors is also demonstrated.

The piece begins with the sound of a balloon being inflated. The spring-like sounds and sounds of friction that are provided by balloon manipulations following this inflation and throughout the piece are suggestive of energy. These balloon sounds are always related to human contact through source bonding (Sound Example 7, 0’00-1’01).

The first spatial montage involves sounds of processed balloon sounds juxtaposed spatially with the sound of thunder. This association of air/energy caused by human contact with nature sounds begins a narrative related to the environment. These sounds also form a composite through their similar texture and spectral evolution, which reinforces their association (Sound Example 8,
In this example heterogeneous sounds become more similar in form through compositing.

When balloon sounds are juxtaposed with sounds of sparks, associations of air/energy with heat are suggested, which develops the narrative further and also relates to the title of the piece. At the same time, the transient and erratic nature of both of these sounds enhances their fusion as a composite. The initial sound of an inflating balloon can be interpreted as an input of air and energy that causes the introduction of heat (Sound Example 9, 5’14-6’34).

In a later scene, balloon and heat-related sounds are so effectively fused as a composite that it is difficult to distinguish between them. The idea of converging vectors is also useful here, as these sounds follow similar behaviours until they converge towards what can be perceived as a high frequency fusion of both sounds, which also contains the sound of computer processing. In this instance, the air/energy and heat related sounds have fused and converged towards a sound related to technology, as well as towards higher frequencies. This trajectory is made more meaningful by the aircraft sounds that follow, which enhance the convergence towards height through metaphor, while also enhancing the convergence towards sounds of technology (Sound Example 10, 9’38-11’10).

Suggestions of the influence of technology continue throughout the rest of the piece. After associations have been made between air/energy, heat, and technology, associations are made between air/energy, heat, technology, and nature. These associations are formed through a spatial montage that contains machine, nature and processed balloon sounds. Heat can be perceived as part of this scene through an intense machine sound that suggests a generator of heat, which continues from previous fire related sounds and sunlight-associated nature scenes (Sound Example 11, 16’35-17’20).

A narrative related to climate change is thus formed through associations made progressively throughout the piece.
The associations demonstrated are summarized as follows:

Air/energy + nature
Air/energy + heat
Air/energy + heat + technology
Air/energy + heat + technology + nature

Through spatial montage, Harrison has transformed the meaning of sounds by making associations between various forms of sound material. Spatial montage is enhanced by the way sounds are composited, through consideration of shared features and application of spectral processes. Spatial montage is evident when causal listening is employed, as images and concepts are revealed through attention to the perceived sources of sounds. When sources are disregarded reduced listening can draw our attention to the way sounds are composited. Attention to internal qualities of sounds can then enhance our experience of the external images and concepts suggested. Hot Air can thus be considered as a piece where sounds are sonically integrated in space through compositing, and simultaneously form image/concept relationships through spatial montage. This approach offers an almost cinematic experience of the piece when compositing and spatial montage are considered as a gestalt, just as they are when images are viewed on a screen.

3.4.8 Mathew Adkins – Melt and Aerial

A treatment of space and form that suggests space as space-medium is revealed in Melt by Mathew Adkins. For this piece, Adkins was partially inspired by J.M.W. Turner’s painting Rain, Steam, and Speed (Adkins, 2006b). Turner uses light and colour to merge foreground with background in this painting, and Adkins employs a similar approach through sound to merge various sounds from a train journey. This approach to space is relevant to the structure of the piece, as sounds at times emerge into the foreground and at others submerge into a fused, surreal sonic space. In the following example various sounds from a train journey dissolve through sonic processes that create ambiguous figure-ground relationships. The voice of the train announcer in particular takes on a fluid like quality, and appears to melt into the sonic substance of the piece (Sound Example 12, 1’43-3’05). Adkins has described
how his composition has been influenced by techniques of Futurist painting. One of those techniques is Divisionism, which is described as follows in the *Technical Manifesto of Futurist Painting*, which was first published in 1910:

> Our bodies penetrate the sofas upon which we sit, and the sofas penetrate our bodies. The motor bus rushes into the houses which it passes, and in their turn the houses throw themselves upon the motor bus and are blended with it...The construction of pictures has hitherto been foolishly traditional. Painters have shown us the objects and the people placed before us. We shall henceforward put the spectator in the center of the picture.

(Boccioni *et al*, 1973)

It is clear from the above quotation that divisionism is quite similar to the idea of space-medium described in section 3.4.6 as both concepts relate to interpenetration between foreground and background.

Comparisons between sounds and visual objects are also useful in relation to works where sound is suggestive of visual structures. An example of such works is Matthew Adkins’ *Aerial*. According to Adkins: “*Aerial* is a sonic photograph of the hills and mountains that surround where I live in the north of England. The work is not an attempt to depict one particular location but a response to the landscape as a whole” (Adkins, 2006a). When listening to a work such as this, attending to continuous sonic textures can reveal suggestions of different forms of visual surface, while attending to discrete spectral and amplitude changes can reveal suggestions of more detailed features such as surface boundaries, surface intersections and changes in surface illumination (Sound Example 13, 0’00-1’30). This piece can also be considered as formed through aesthetics of compositing rather than spatial montage, as sounds do not form dialectical relationships but are combined to suggest a particular form of landscape. Another piece that affords imagery of surfaces and edges as well as of a compositited sonic environment is Denis Smalley’s environmentally inspired piece *Valley Flow*, which was discussed in Chapter 2.4.1.
Multimedia is a rich source not only for audio-visual composition but sound composition also, particularly when comparisons between sound and visual objects are considered. The concepts of compositing, spatial montage and space-medium can be combined or used separately as an approach to form in electroacoustic music. Heterogeneity can be effective through spatial montage, while disjointed sounds from different sources can be integrated into a more cohesive or homogeneous form through compositing. A balance can be achieved between heterogeneity and homeogeneity through spatial montage and compositing combined. This combination of spatial montage and compositing was discussed through analysis of Jonty Harrison’s *Hot Air*. Space-medium can be applied to suggest space as homogeneous substance, where figure-ground relationships are ambiguous. The concept of space-medium was demonstrated through ambiguity between foreground and background in Mathew Adkin’s *Melt*. In Mathew Adkin’s *Aerial* and Denis Smalley’s *Valley Flow* sounds are suggestive of visual landscapes. In this form of composition, perception of sonic textures as surfaces, and discrete spectral and amplitude changes as boundaries, intersections and changes in illumination, can enhance a listening experience. Further relationships between sounds can be considered through the concept of vectors. Vectors have been demonstrated through Xenakis’ use of pitch glissandi in particular, but they can also be applied to various other parameters. An example was also given where the concept of vectors was considered to shed light on how the directional behaviour of sounds contributed to the structure of Jonty Harrison’s *Hot Air*. The approach to analysis described here considers a sound’s extrinsic reference and its inherent properties to be equally relevant to situations where both contribute to a work’s structure. Images and concepts revealed through causal listening can be enhanced after attending to internal properties of sounds through reduced listening. Therefore, the approach described here also illustrates how Pierre Schaeffer’s ideas can be integrated with new forms of analysis developed through multimedia concepts. Figure 2, in Chapter 1.5 illustrates how the four
main multimedia concepts discussed in this chapter: montage, compositing, space-medium and vectors are relevant to my approach.
Chapter 4: Audio-Visual Analysis

4.1 Introduction

This chapter demonstrates an approach towards analysis of audio-visual works that applies similar methods of analysis towards sounds as towards images, highlighting similar ways that both media are perceived. Consideration of both intrinsic and extrinsic reference is shown to be relevant to both media. Metaphor is demonstrated as relevant to extrinsic reference as is Denis Smalley’s concept of source bonding, which is shown to be relevant to visual images as well as sounds. A similar approach is thus applied towards analysis of acousmatic works in Chapter 5. Chapters 4 and 5 together thus demonstrate this similar approach to audio-visual and acousmatic works. In this chapter, previously discussed concepts related to multimedia analysis such as spatial montage and vectors are utilized and demonstrated further in relation to their relevance to visual images as well as interactions between sound and image. As these concepts are utilized in Chapter 5 they form part of this similar approach to audio-visual and acousmatic works.

This chapter also introduces Nicholas Cook’s models of multimedia analysis: conformance, contest and complementation. While the use of these models is beneficial for analysis of audio-visual works, they are also described as useful in relation to acousmatic works.

The first analysis in this chapter is of an audio-visual work called The Dreammachine by Amanda Feery. This analysis discusses relationships between visual images as well as between visual images and sounds. It follows with analysis of two audio-visual works that I composed the music for: Missing by Holly Kennedy and Warp & Weft by Mary Wycherely. Ac-2 and ac-3, the two musical works composed for these films form part of the body of work for this thesis. The analyses consider these works in relation to their interaction with film and also as standalone acousmatic works. Through analyses of audio-visual works it is explored how the composition of ac-2 and ac-3 was influenced by the structure of a visual work.
It is also shown how images were considered as models to inspire the creation of sounds. Simon Emmerson has discussed how both scientists and musicians have utilized models. He describes how the scientist uses models to demonstrate theories. He gives an example of how a “water ripple tank” can be used as a model to demonstrate wave motion and behaviour such as “propagation, reflection, refraction and diffraction” (Emmerson, 2007, p.41). However, he describes how in situations like this the “‘unknown’ [his quotes] to be explained is already there – something observed which we want to understand” (Emmerson, 2007, p.41). In the case of the musician the model is “used to create something new”. It “may (but need not) help us to understand this new music” [his emphasis]. (Emmerson, 2007, p.42). An example given that is somewhat relevant to the creation of sounds for Missing and Warp & Weft is Stockhausen’s Gesang der Jünglinge. According to Emmerson, in this work “the model of the sung voice was actually present in the piece and directly informed the approach to the electronic sounds used” (Emmerson, 2007, p.43). The visual models are present in the audio-visual works Missing and Warp & Weft. Even though they are not visually present in ac-2 and ac-3 as standalone acousmatic works they can be described as sonically present and they help describe my approach to sound composition. It is important to mention what Emmerson describes as ‘reanimation’ because composition of sounds for ac-2 and ac-3 was not completely dominated by the influence of visual images. As pointed out by Emmerson the use of models need not be one-way traffic. Rather: “They become animate through this relationship with us...Thus the composer becomes a kind of shaman, drawing forth and revealing rather than setting down and representing” (Emmerson, 2007, p.53).

Before beginning analysis it is beneficial to discuss some multimedia concepts that have not previously been introduced.
4.2 Models for Analyzing Multimedia

4.2.1 Conformance, Contest, Complementation

It was mentioned in Chapter 1.4 that Nicholas Cook (1998) has devised three basic models for analyzing musical multimedia: conformance, contest and complementation. These models for analysis should not be confused with the type of models discussed in the previous section. Conformance is a term for describing situations where sound and visual elements conform to each other and no new meaning is created from their juxtaposition. With conformance it should be just as possible to speak of the images projecting the sounds, as it is to speak of the sounds projecting the images. Cook gives an example in relation to conformance between images in Disney’s Fantasia and Stravinsky’s Rite of Spring. He refers to “visual motions of the stars and other semi-abstract images being appropriated by the audible rhythms of the score”. However, he points out that he “could equally well have put it the other way round; if the images take on the rhythmic properties of the sounds, then equally the sounds take on the connotations of the images” (Cook, 1998 p.210). This reversibility is the essence of the concept of conformance. A simple example would be a line being extended vertically on-screen accompanied by a tone that glides up in frequency at a similar rate. The line and the tone would simply reinforce each other in our perceptions, each conforming to the other’s upward direction.

Contest is when different media are “vying for the same terrain, each attempting to impose its own characteristics upon the other” (Cook, 1998, p.103). Contest holds possibilities for the creation of new meaning and when the model of contest is in full effect no singular media predominates. For example, at the very beginning of the audio-visual work Missing, a sharp, harsh, abrupt gesture was combined with an image containing the smooth motion of a pendulum. The gesture does not take on the connotations of the image or vice versa. Instead a form of audio-visual tension is created and contest between sound and image affords new meaning through a metaphor for the fragility of time.
With complementation “the difference between the constituent media is recognized - this is what distinguishes complementation from conformance - but at the same time the conflict between them that characterizes the contest model is avoided because each is assigned a separate role” (Cook, 1998, p.104). In other words, with complementation one media becomes a servant to the other, as is the case with music scores for Hollywood films (Cook, 1998). However, with complementation there is opportunity for one media to project new meaning onto the other.

As mentioned in Chapter 1.4, Cook defines the word medium in terms of ‘dimensions of variance’. With this in mind he singles out ‘contest’ as the ultimate form of multimedia as through contest there is the most potential for dimensions of variance and thus new meaning.

4.2.2 Attribute Transfer

Cook stresses that a sensitive approach to analysis will not single out one model as ultimately relevant to a particular work but will “characterize the relative preponderance of conformance, complementation and contest” (Cook, 1998, p.106). He also advises that we analyze multimedia from the perspective of each media and its effect on the other: sounds effect on the visual image and the visual images effect on sound. According to Cook: “we can do justice to multimedia only by means of a theory that is based on the concept of attribute transfer, and on the structural framework within such transfer takes place” (Cook, 1998, p.115).

4.2.3 Conformance, Contest, Complementation and Electroacoustic Music

It was mentioned in Chapter 1.4 how Cook considers his models of multimedia as applicable to music alone as well as multimedia. According to Cook: “similar principles operate within music as between it and words, moving pictures, and so on. One consequence of this, of course, is that the concepts of conformance, complementation, and contest should be useful in the analysis of ‘pure’ or absolute music” (Cook, 1998, p.264) [his emphasis]. As Cook is referring to traditional forms of music, the idea is that there can be
conformance, complementation and contest between musical parameters such as pitch and duration. Cook particularly highlights contest and conformance as useful in relation to these parameters.

In relation to electroacoustic music, contest and conformance can be compared to the concepts of spatial montage and compositing respectively. For example, Cook states that: “Conformance begins with originary meaning, whether located in one medium or diffused between all; contest, on the other hand, ends in meaning” (Cook, 1998, p.103). Spatial montage, which has been used in this thesis to describe situations where heterogeneous spatially juxtaposed sounds create meaning through extrinsic references, can thus be described as a form of contest. Contest is thus a useful term when discussing instances of spatial montage. The term contest can also be useful for considering situations of contest between intrinsic sonic parameters. As was highlighted in Chapter 2.1.4, attention to intrinsic references can reveal extrinsic ones. This consideration of contest can thus point towards meaning in juxtapositions of sonic images that may not be immediately apparent. With the help of reduced listening contest can thus be revealed between more subtle forms of sonic images through mimesis and/or metaphor. The same as above can apply to sounds in the temporal domain: just as temporal montage can be described as a form of contest, contest can also be considered between intrinsic references juxtaposed in time, which in turn can reveal extrinsic references.

Compositing on the other hand can be described as a form of conformance as it involves the juxtaposition of sounds that conform to a cohesive sonic image or virtual environment.

Cook’s third model, complementation, can also be considered in electroacoustic music. Just as Cook has described music in film as being complementary to the story and images; a background sound can at times be considered a complementary addition to the overall sonic image being suggested. In this case the sound does not particularly conform or contest but appears to exist behind the sonic narrative in a similar way that film music does. This of course depends on the subjective perception of the listener.
4.3 Analysis of *The Dreammachine*

4.3.1 Overview

This section provides an analysis of an audio-visual piece titled *The Dreammachine* by Amanda Feery (2009), which provided some inspiration for works that accompany this thesis. While this piece can be admired without search for a narrative, one can be revealed through an investigation into the work’s structure. This is a quality that *The Dreammachine* shares with my own work. Also, the visual images in this piece can be analyzed in a similar way to its sounds and to sounds in acousmatic works analyzed later in this thesis. This analysis is not intended to reveal the intentions behind the author of this work but rather to highlight how a work such as this is rich in terms of its affordance of interpretations, particularly through metaphor.

4.3.2 Analysis

*The Dreammachine* contains synthesized and ‘captured/real world’ imagery combined with synthesized sounds and sounds from more traditional instruments. This combination affords a pairing between synthesized imagery and synthesized sounds as well as between real world imagery and traditional instruments. Synthesized imagery and sounds in this piece can be categorized together as synthetic and abstract. Sounds of traditional instruments on the other hand can be perceived as captured by microphones in a way that is analogous to images of the world captured by a camera. Through this analogy and through images suggested by their source these sounds can be associated with the ‘real world’ images in this piece.

A perceptual search for recognition of captured images in this piece can be considered as analogous to the search for a source or cause behind sounds of traditional instruments as both have been abstracted from their context through a recording medium. Images resembling crossed steel wires and strings of an instrument can be recognized, these are shown in Figure 3. Sound sources
including stringed instruments and a prepared piano can also be recognized, but recognition of images and sounds requires a similar perceptual search. Smalley’s idea of source bonding for sounds can thus have a similar relevance towards images as towards sounds in this piece. Through the comparisons made between sounds and images described in the last paragraph, a narrative can be followed through a dialectic between ‘synthetic/abstract’ and ‘captured/real world’ sounds and images. When the title of the piece is considered this dialectic suggests a metaphor for a dialectic between the subconscious and conscious mind. Figure 4 illustrates the combination of ‘synthetic/abstract’ and ‘captured/real world’ images in this work.

![Figure 3](image1.png)  

**Figure 3.** ‘Captured/real world’ images in *The Dreammachine.* (Feery, 2009)

![Figure 4](image2.png)  

**Figure 4.** Combination of ‘captured/real world’ and ‘synthetic/abstract’ images in *The Dreammachine.* (Feery, 2009)

As well as through source bonding, there are other ways in which *The Dreammachine* is rich in its potential for metaphor and meaning. Visually and sonically there is an increasing sense of depth, which through the title of the

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6 A performance of this piece was viewed personally at SARC in Belfast. Knowledge of the use of a prepared piano is related to a conversation with an academic present that knew the filmmaker.
piece can be perceived as analogous to a person going deeper into REM sleep where we have most of our dreams. The piece is made up of three sections, two long dream-like sections separated by a short section.

In the first section a gradual appearance of images and sounds suggest the first stages of dreaming.

The middle section is almost empty besides some white noise, a sine tone and some visual specks of noise and it suggests a transition between two dream states. This section also functions as an image of the medium of transmission itself, which is particularly effective when viewed on a large projector screen. Awareness of the image of the screen can result due to the absence of images that were previously contained in it. Similarly, the absence of previously established sound material and the simplicity of the sine tone and the white noise in the background can draw our attention to the medium of sound transmission, the loudspeakers. This highlighting of the media of transmission highlights the ‘present’ through a pause in the narrative and suggests the end of a dream state or movement back to reality.

Events in the third section suggest movement into a second stage of dreaming and a deeper sleep. The introduction of low frequency sounds at the beginning of this section suggests a metaphor for a deeper sleep. The continuation of white noise in the background supports the transition, as the image of the whiteness of the section before remains metaphorically through white noise. This final section gradually moves towards suggestions of an increasingly surreal REM sleep through juxtapositions of real world and synthesized imagery as well as the use of a fast strobing/flashing of images. This section thus suggests something akin to rapid eye movement through speed of imagery while suggesting increasingly surreal image juxtapositions. The introduction of synthesized sounds contributes to the otherworldliness of this section. This final section is also enhanced by a sense of depth, which suggests a deeper sleep or movement towards the sub-conscious.

An increasing sense of depth is achieved in the two main sections through various factors. While these factors are essential towards the intrinsic structure
of the piece, they also contribute towards the extrinsic reference implied by the metaphor of deep sleep described above. These factors are as follows:

Between the beginning and end of the first section (0’00-2’27) an increasing number of layers gradually appear, which suggest different screens combined in one. The appearance of these layers/screens contributes to a widening of the screen space, which is accompanied by a gradual introduction of sounds and a widening of sonic space. In this first section there is also an overlay of screens and images so that they appear in front or behind one another. Images also have a tendency to move across boundaries. The metaphor of deep sleep is complete at the beginning of the second section, as it begins with a full screen containing a single image, which suggests that you are fully inside an image or dream.

In the first section, the sense of depth is also achieved through the use of staccato sounds and breaking up of visuals. The images alone suggest the sensation of a three-dimensional space protruding from a two-dimensional one and the contest between rhythm of sound and image enhances this effect. This factor is particularly relevant from 4’29 in the third section. When rhythms of staccato sounds are off sync with the visuals it adds an extra dimension, as if the sounds are adding invisible structures around visible ones. The sounds can also reinforce a sensation of penetration of one visual through another. The form of pseudo-three-dimensional imagery described in this example can also be suggested through interactions involving discontinuous sound in acousmatic music. Further spatial interactions are now discussed.

4.3.3 Spatial Interactions between Images and between Sound and Image

One of the first things that is visually striking about The Dreammachine is its use of spatial juxtapositions of images as opposed to the traditional form of sequential editing. The piece utilizes overlays of screens and images of various sizes. With the exception of the occasional appearance of an image resembling some form of light, the images in the first section primarily belong to the

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7 Such as interactions between a biomorphic sound with a shaker-like sound from 9’54 onwards in ac-4.
synthetic/abstract category. However, the presence of ‘captured/real world’ sounds in this section creates contest between visuals and sounds. This contest affords new meaning related to connections between the conscious and the subconscious, where ‘captured/real world’ sounds suggest the former and ‘synthesized/abstract’ images suggest the latter. This contest can be considered as a form of spatial montage between images suggested by sounds and images on screen. Spatial montage can thus work across perceptual modes through real and source bonded images. However, this idea will be demonstrated further in section 4.4.5. An example will be demonstrated that also integrates the tactile domain through synesthetic metaphor.

When ‘captured/real world’ images are introduced in the third section spatial and temporal montage is more apparent between these and synthetic images as well as between images and sound. The bottom of Figure 1 illustrates spatial montage between images. There is also occasional ambiguity between synthetic and real world images. Images such as one shown in Figure 1 that resembles a bubbling lava-like substance may have been synthesized or captured and manipulated. This ambiguity can also suggest connections between the conscious and subconscious.

Contest between sound and image in this piece can also alter our perception of either medium. Features can emerge in each medium that we may not have perceived or that may not have existed had we listened to the sound or watched the visuals alone. An example of this emergence can be perceived through the combination of a high looping string sound that dominates the introduction and fast moving green lines (0’00-1’05). When listening to the sound alone the introduction can appear slower but the fast visuals latch onto the sound, lending their animation to it. However, the string sound is not without its own motional characteristics. As well as the looping motion of this sound, a close listen reveals micro fluctuations in the timbre of the instrument. These two features of the sound latch onto the fast fluctuations of the visuals just as the visuals latch onto this sound. The result of the combination is a new aesthetic result that would not have existed through the sound or visuals alone.
A similar effect is obtained when the visual grey specks of noise in the middle section latch onto oscillations in the high-pitched sine tone (2’27-2’52). When listening to the sine tone alone and imagining the visual grey specks I perceived a similar animation of the tone, which highlights a similar latching effect that can occur between a sound and a mental image. It may be interesting to see experiments carried out with a group of subjects in relation to this idea, which suggests that sounds can be animated by visuals in the minds eye. I personally perceive this animation of sound regularly when listening to acousmatic music.

*The Dreammachine* also contains instances where sound and image can evoke a tactile experience. For example, there are some very thin glass-like sounds that can evoke a similar glass-like texture in some of the appearing screens (0’39-2’05). This textural effect is an example of cross-domain mapping between timbral space and tactile space as described in Chapter 2.2.3. In another example, sounds of the tensioning of strings can evoke a tactile experience in two ways: the first is through the external image of source bonded gestures and the second is through synchresis between these sounds and glass-like images within the film (1’06-1’58). Another use of texture that can evoke a sense of synchresis is the juxtaposition of a bubbling electronic sound and an orange lava like substance, beginning at 4’46 of the third section. The similar sonic and visual textures described above create fusion between sound and image and are thus an example of conformance between sound and image rather than contest.

### 4.3.4 Vectors

Analysis of *The Dreammachine* reveals examples of vectors. While vectors enhance the intrinsic structure of the piece through a sense of symmetry, motion and continuity some can also contribute towards narrative. Three vectors will now be described:

The first example is a simple one related to the visuals (0’00-0’10). The three screens at the beginning of the piece show a sense of symmetry where each of the outer two screens displays a downward motion of the same visuals.
This is a simple example of continuing vectors, as these images are moving in parallel. They continue to do so as they change direction simultaneously.

Next is a more dynamic example of vectors (0’21 - 1’07). In this example green and orange visuals push and pull against each other, sometimes acting as continuing vectors, sometimes converging and at others diverging. From 0’58 until the middle section at 2’28 the green and orange visuals are vectorized in their behaviour. A continuous growth can be seen in the green visuals, while the orange visuals grow and change shape. A simultaneous expansion of these visuals can particularly be seen at 2’18, which lasts until 2’28, which shows how they ultimately converge towards full occupation of the central screen space until they disappear for the middle section. The expansion and convergence of these visuals creates a sense of depth and thus contributes towards the narrative.

An example of vectors with sound and visuals in the piece is from 0’20-00’35, where a circular white and orange light moves in and out of the picture at the same time as a looping upward glissando of what sounds like an electric guitar. This sound moves from a low to high pitch at the same time as the visual moves from outside to inside of the screen. This is another example of cross-domain mapping, where pitch height is mapped onto motion of the visual object. This mapping gives the object a pendulum like stability. The pitch glide also affords a metaphor for brightness, which enhances its connection with the bright image. There is also a timbral/tactile dimension to this example, where the grain of the attack of the sound and its timing creates an effect of the image striking against a glass screen from the inside. Through source bonding the pairing of the light image and guitar sound described here enhances the narrative through allusion to the conscious mind.

4.3.5 Conclusion

A similar approach towards analysis of images and sounds was possible here due to the fact that both were considered in terms of intrinsic and extrinsic reference. While sounds and images were discussed in terms of relationships
that benefit the intrinsic structure, particularly through depth of sonic and visual space, both showed similarities in their potential for extrinsic reference through source bonding and metaphor. Source bonding was considered for sounds and images and was discussed in terms of how both could refer to the ‘captured/real’ and the ‘synthetic/abstract’. This duality was discussed in terms of a metaphor for dialectic between the conscious and the sub-conscious. An increasing sense of depth through both sounds and images was described as a metaphor for movement towards the sub-conscious. Also, the fast movement of images was described as a metaphor for rapid eye movement. Although it was not discussed mimesis can also be considered in relation to visual images. For example, the abstract fast moving green lines discussed in section 4.3.3 (0’00-1’05) can be described as imitative of something in nature such as rainfall. This type of mimesis through seemingly abstract visuals or indeed sounds provides a link between the real and abstract or the conscious and sub-conscious.

Both sound and image were discussed in terms of texture, with sound being described as effective in enhancing a sense of visual texture. This analysis also demonstrated how vectors could be applied to the analysis of sounds and images and introduced Nicholas Cook’s models for analysis of multimedia through the concepts of contest and conformance. Contest was demonstrated primarily between ‘synthetic/abstract’ images and ‘captured/real world’ sounds. Contest between rhythm of image and sound was shown to create a sense of depth. Conformance on the other hand was shown to exist through similar textural effects created by both sound and image. This piece thus contains both tension and fusion between sound and image through contest and conformance respectively. Although this interpretation of The Dreammachine was afforded by the title, this analysis demonstrates how seemingly abstract works in general can be interpreted through a conscious/sub-conscious dialectic, which may ‘consciously’ or ‘sub-consciously’ be at the heart of the creation of such works.
4.4 Analysis of Missing and ac-2

4.4.1 Overview

Missing is an audio-visual work with real world images and acousmatic music. Similar to The Dreammachine, it contains images that have been divorced from their context and the term source bonding is thus applicable to images as well sounds. The concept of time is central to the film’s structure. According to the filmmaker Holly Kennedy, Missing is a reflection on distortions of time that were experienced after a personal loss (Kennedy, 2008a). The filmmaker suggested distortions of time through changes in the temporal structure of the film and through symbolic imagery. Each shot represents one of the elements and its connection with the passing of time (Kennedy, 2008a).

Ac-2 was composed specifically for the film but is also intended as a standalone acousmatic piece. Composing while viewing the finished film was treated as an experiment in how visual images and film structure could inspire or affect the composition of acousmatic music. Composing much of the initial sound material was an iterative process where an image would be repetitively looped while a sound was sculpted to represent the image. The concept of synchresis was very influential during this process. When I first viewed the film I highlighted four categories of visual texture as prevalent throughout. Three of these textures were considered as models to inspire the creation of sounds.

This influence of visual imagery on sound will be described first in section 4.4.2. In section 4.4.3 the structure of the film is analyzed largely from the perspective of the silent film, which includes visual, temporal, spatial, and metaphorical aspects. However, some commentary is included on how sound was used to augment the visual language. The temporal aspects of the film are relevant to the musical structure as it was shaped to some extent by these

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8 The fourth category related to liquid images in the film. An aesthetic choice was made not to use the sounds composed for this category.
aspects. For much of the first half of the film sonic gestures were synchronized with visual edit points but the musical temporal structure gradually deviated from the visual one as the piece progressed. Section 4.4.4 describes how visual vectors contributed to both intrinsic and extrinsic references in the film. The final section discusses other ways that the film influenced the music. This includes the influence of the film in terms of temporal structure as well as how the music deviated from the film’s temporal structure. This section also discusses spatial and metaphorical considerations between sound and image and examples of synchresis between sound and image.

4.4.2 Visual Imagery and its Influence on Sound

As mentioned in the overview the concept of synchresis was very influential in the creation of sounds for *Missing*. Three categories of visual textures were considered as models to inspire the creation of sounds. Placing images and sounds together into three particular categories contributed towards a coherent structure. These categories are noise, coarse/rhythmic and glass. With the exception of sounds composed for the glass category and some of the more gestural sounds, most sounds in the piece can be described as granular noise, as described in Chapter 2.2.3.

Some of the sounds composed are mimetic of the perceived sound source of visual images. Others are suggestive of the grain, texture or gesture of images.

This piece contains various forms of sonic grain ranging from smooth to coarse and the metaphor *timbral relationships are relationships in tactile space* described in Chapter 2.2.3 is relevant throughout. Factors such as colour, size and shape of images were also an influence on the sounds. Sound and image do not always conform to one another as contest is occasionally suggested between a sound from one of the three categories and an image from another. The film’s use of colour also inspired my use of pitch. The three visual categories considered during sound composition are described below through examples of images that influenced the conception of each category:
The first category involved imagery suggestive of visual or sonic noise. For example, clouds are suggestive of noise through their association with whiteness and their fine-grained texture (3’45-4’14 and Figure 5a). Sea waves are visually suggestive of noise through fine-grained imagery of spray and vapor and their sound is similar to white noise (2’09-2’32 and Figure 5b). The film also contains images that relate to breath or wind. For example, wind noise is suggested through the image of the child blowing seeds off a dandelion and the subsequent image of a dandelion blowing in the wind (3’38-3’48). There are also instances where a fine-grained visual noise forms part of the intrinsic texture of an image (Figure 5c). Finally, images of sparklers suggest noise through their actual sound and images suggestive of visual noise. The grain of these images is coarser than the above examples and so is the grain of the sounds that represent them. Due to the presence of these and other fire related images throughout the film much of the pitched and non-pitched noise is suggestive of sonic images related to fire, sparks and the source bonded light and colour associations that go with them.

![Figure 5 a, b and c.](image)

Figure 5 a, b and c. Images that represent the first visual category for sounds in Missing — noise. (Kennedy, 2008a)

The second category involved images that have visual rhythms. These images have a larger/coarser visual grain than images in the previous category. For example, images such as the butterfly/lights image (0’50-0’58 and Figure 6a) and fast moving hedges (1’50-2’10 and Figure 6b), have a coarse texture and visual rhythms (Chion, 1994). While the hedges scene creates visual rhythms through motion, visual rhythms can be seen in the details of the

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butterfly/lights image through movement of the eye (0’50-58). Mixing images and/or sounds from the first category with images and/or sounds from this category is analogous to mixing fine and coarse grains together.

**Figure 6 a and b.** Images that represent the second visual category for sounds in *Missing* — coarse textures with visual rhythms. (Kennedy, 2008a)

The third visual category involved images of glass (Figure 7). Physically modeled glass-like sounds accompany light bulb images from 2’33-3’01. There is thus conformance between the glass materials that were filmed and the glass-like sounds that accompany them. Some sounds suggest tapping on glass and others suggest bowing or friction of glass.

**Figure 7.** Image that represents the third visual category for sounds in *Missing* — glass. (Kennedy, 2008a)

4.4.3 Film Analysis – Temporal Structure, Space and Symbols of Time

One of the principle aims of *Missing* for the filmmaker was that it would be suggestive of distortions of time (Kennedy, 2008b). These distortions of time can be perceived through a progression from shorter scenes with gestural imagery towards longer scenes containing more textural images. Symbolic imagery and metaphors related to time are also present.
The film starts with a pendulum swinging (0’00-0’40). The pendulum image reappears and can be perceived as a stable timekeeper or marker from which various distortions of time throughout the rest of the film move faster or slower. The pendulum image lingers for 40 seconds and it can evoke both a sense of passing time and of suspense. After this scene, shorter scenes containing more images and visual rhythms contribute to a sense of time moving faster. After 1’00 the screen almost goes black with the exception of traces of dust and this scene suggests a pause in the film. This pause is followed by time distortion suggested through an image that appears to splash first in forward slow motion and then in reverse. The pacing changes again with a short bright flash of lights followed by sparkling images that have visual rhythms. A fluid scene further increases the speed with dynamic visual rhythms from 1’40 - 1’52, which also symbolizes time through the idea of conception, as it is suggestive of fertilization.

The next scene contains three spaces in one image including fast moving hedges on the left, a road seen inside a mirror and an image of a child on a beach superimposed inside the mirror (1’52-2’09). Taking the car mirror frame itself into consideration there are actually four images as this frame has its own visual texture and is like a divider between the left and right images. The addition of the child in the mirror creates a spatial montage of images, as it is suggestive of a different time than the other images, which suggest the present. This spatial montage suggests a metaphor of looking into the past. The road being left behind and the faded image in the mirror also support this metaphor. The past metaphor is contradicted by the sharp image of the fast moving hedges, which can be interpreted as a fast moving present. A spatial juxtaposition of sounds was used for this scene and three visual elements were considered: fast moving hedges, the car mirror frame itself and the child dropping stones. For the fast moving hedges a sound that moves rapidly through different pitches was composed, which suggests a metaphor for motion and speed. For the child image different sounds were used to accompany the slower rhythm of the gestures of the child’s hand, which appears to be dropping
stones. Some of these sounds are gestural in relation to the child’s movements while others are mimetic of objects being dropped. The car mirror frame has a smooth visual dynamic texture, so a smooth glass-like texture was composed which also enhances the mirror image. These three sounds are suggestive of the imagery in the film when the music is heard alone through a metaphor for speed and motion, gestural and mimetic sounds and source bonding of a glass-like texture.

The tempo of the film then decreases, first with an image of the sea (2’10-2’33) which is often used to symbolize concepts of time such as eternity (Ferreira, 1997). Sounds used for this scene are mimetic of waves crashing. The metaphor of time is enhanced by a long section of stasis that follows containing an unchanging image of a heart, shaped from lights (2’34-3’04). Glass-like sounds were used which conform to these glass objects. Some of these sounds suggest friction of glass objects while others suggest striking of them.

The next scenes enhance the temporal structure as time moving in reverse is suggested, first by an image of water moving in reverse (3’05-3’22) and then by the hand of a clock moving anti-clockwise (3’23-3’26).

Time appears to move faster again through an image of the child bouncing on a trampoline gradually moving from slow motion towards normal speed (3’27-3’40). It is from this point onwards that there is general contest between the temporal structure of the film and that of the music.

The pacing of the film continues to move faster through the short length of three scenes that follow and the visual rhythms within them. The first scene contains the image of the child blowing a dandelion (3’40-3’45). The second scene contains the image of a dandelion blowing in the wind (3’46-3’48). The third scene contains another clock image except this time its hand is moving forward instead of reverse (3’49-3’52), which supports the faster change in the temporal structure implemented through these three scenes.

The next three scenes show a contrast between fast and slow pacing. In the first scene distortion of time is suggested through a combination of slow
rotating clouds that occasionally stall as they move and abstract white objects that move upward across the screen displaying fast visual rhythms (3’53-4’14). The fast visual rhythms are contrasted in the second scene, which contains a blue liquid substance that pours slowly downward (4’15-4’27). Although it occurs over time between two scenes converging vectors are formed between the upward visual rhythms and downward blue substance. This temporal juxtaposition contains meaning as a symbol of time distortion through contrasts in speed. The pacing changes yet again in the third scene, as a white texture appears at various points across a black screen in a regular pulsating rhythm (4’28-4’43).

A symbolic scene follows containing a spatial montage of the child picking flowers superimposed over the image of a swinging pendulum (4’44-5’01). Metaphorically, this scene is also a spatial montage of two different forms of time, experiential and clock time. The child in this scene is involved in pure experience, oblivious to the march of time suggested by the swinging pendulum.

The last sequence contains all of the elements, earth, water, wind, and fire (5’02-End). The four elements display each of their own rhythms throughout the film and this was the filmmakers intention as they are suggestive of a “natural life cycle” (Kennedy, 2008b). The way that the elements come together in this final sequence thus gives weight to the films structure. The sequence ends with an image of the person that the filmmaker has been speaking of from the start through the language of film.

4.4.4 Vectors

As well as the vectors mentioned in the last section, there are several other examples of vectors in Missing. Similarly to The Dreammachine, vectors enhance the intrinsic structure of the piece through a sense of symmetry, motion and continuity, while some are beneficial towards narrative.
Six examples are described as follows:

In the first example vectors create a dynamic relationship between three images (0’45-1’06). A flame following an arrow shaped group of lights represents continuing vectors. These images then converge when the flame moves back across the lights in the opposite direction. The flame disappears off-screen and reappears to continue up the vertical axis of a butterfly image. The flame disappears off-screen again and reappears to converge with both the arrow shaped group of lights and the butterfly image. When the flame reappears it moves across the screen before two parallel vaporous lines are revealed. A mimetic flame-like sound is used as a continuing vector that moves from left to right with the flame.

The second example involves the spatial montage example from the previous section 4.4.3 containing the moving hedge images and the image of the child superimposed in a car mirror. This montage includes a continuing vector involving human gesture (1’52-2’09). In this instance the child’s arm repeatedly stretches out from left to right continuing in the direction of the hedges outside the mirror that are also continuously moving from left to right. These simultaneous motions are a visual form of intrinsic reference as they form internal continuity and harmony between images. At the same time, this internal continuity and harmony enhances the power of connections between extrinsic references of these images and gives weight to the aforementioned metaphor in section 4.4.3 of the past combined with the present.

From 3’23-3’26 there is an example of converging vectors. In this instance clouds are moving in a clockwise direction in opposition to the hand of a clock, which is moving in an anti-clockwise direction. These vectors thus suggest an extrinsic reference, which contributes to meaning in the film as it alludes to time moving backwards and forwards.

The next is an example of continuing vectors (3’27-3’40). This example contains clouds revolving in an anti-clockwise direction and the movement of the child bouncing on a trampoline, moving in the same direction. The motions of the images in this scene also continue as vectors from the anti-clockwise
movement of the clock’s hand in the previous example. Vectors can occur simultaneously or consecutively as long as the connection is strong enough (Zettl, 1999).

A similar example of vectors to the fourth above happens from 3’49-3’52. In this instance the clock and clouds are moving in the same direction as continuing vectors. Their clockwise motion suggests that time is moving forward again, which is emphasized by a fast cut to the next scene.

Finally, from 5’25-5’39 there is an image of the child walking on a beach. An image of clouds is superimposed over the child image. At first the clouds are still, then after a moment they follow the child as a continuing vector. This pause followed by movement is suggestive of time momentarily standing still and then moving forward again.

4.4.5 Visually Informed Musical Structure and Attribute Transfer

The temporal structure of the film had some influence on the use of time in the music. The music was intended to add another dimension to the distortions of time suggested in the film. An example of sound/image time distortion is the sequence of three sonic gestures separated by pauses during the continuous swinging pendulum scene at the very beginning of the piece. Each of these sonic gestures is also extended in time from the previous. The development of the film from short scenes containing gestural images and visual rhythms towards longer scenes containing textural imagery influenced a progression from gesture towards texture in the music. This progression is another example of conformance between music and film. However, although the film reintroduces gestural images and increases in tempo from 3’32 onwards the music continues through sounds of texture. This contest between visual gesture and sonic texture suggests a distortion of time between sound and image. When this section in the music is listened to on its own it suggests something close to stasis through texture. The film infuses a sense of added motion in the sound by marking off points in time through its cuts and visual rhythms. At the same time, the sonic texture has an effect on perception of
speed in the images. Metaphorically the film alone with its fast towards slow towards moderately fast structure is somewhat arch or U-shaped whereas the music alone with its fast towards slow structure is better defined by a downward or upward slope. Music and film together suggest contest between these temporal shapes of structure.

There is also a progression from synchronous changes of sound and image towards more asynchronous overlaps where sounds become increasingly less likely to change at the same time as visual scenes. The musical temporal structure thus diverged progressively further from the visual temporal structure as the piece progressed.

As visual textures were used as models for the creation of sounds, there is generally conformance between sound and image. Even though sound and image is not synchronized in every instance, the imagery of the film influenced the placement of sounds in time and space as well as the type of sounds used and the quantity that would appear at any one time. However, there are also instances of contest. For example the film starts with the smooth motion of a pendulum. Rather than a sound that conformed to this image such as a smooth gliding bell-like tone, a sharp, harsh, abrupt gesture was used. As described in section 4.2.1, the use of this gesture creates a form of audio-visual tension and suggests a metaphor for the fragility of time. It also creates an “emotional dissonance between different elements” (Manovich, 2001). This example thus demonstrates further that, as suggested in section 4.3.3, contest can create a form of spatial montage between sound and image. It is a further example of spatial montage across perceptual modes. However, in this instance three perceptual domains are involved: sonic, visual and tactile. There is a trace of the grain of this gesture throughout the piece particularly through some of the rhythmic/coarse sounds. A recognizable transformation of it appears at 4’51 that contests with the image of the child picking flowers. The timbre of this transformation can be described as harsh through the metaphor \textit{timbral relationships are relationships in tactile space}. When combined with the child image of softness and beauty this harshness can extend the metaphor further to
suggest harshness of life and signify a disturbance or threat towards the image. The image is shown in Figure 8 below. However, the use of this sound and others related to it through their harshness enabled a release of tension through smoother sounds, softer textures and a three chored pitched gesture at the very end of the film.

![Image](image.png)

**Figure 8.** ‘Soft’ image that was accompanied by a ‘harsh’ sound in *Missing.* (Kennedy, 2008a)

The way that images were used in the film also inspired the use of sounds that were not necessarily connected to images onscreen. An example of this use of sounds is from 4’45-1’16 where images disappear off-screen but the continuation of sounds suggests that they are still present off-screen. This use of sound affords the idea that an image can continue to exist through sound, or sound through image. This idea was also utilized throughout the composition through the reappearance of sounds associated with earlier images. Sounds were thus treated as sonic images and created spatial montage with visual images as well as between themselves. This idea was assisted by the fact that some of the visual images reappear in different forms throughout the film.

### 4.4.6 Synchresis

It has been described how the visual imagery informed the generation of particular classes of sounds. The following are examples where a sense of synchresis was achieved between specific sounds and images. These examples highlight how sounds were created through the use of visual models:

The sound that accompanies a flame that moves across the screen at 1’00 was sculpted until it was mimetic of the sound of a flame in the wind. This is an
example of conformance between sound and image. The flame image is shown in Figure 9 below.

As shown in Figure 10, at 1’22 there is an instant transition from an image of glowing lights to an image of sparks. Sounds with source bonded characteristics that were related to the visual images were used to accentuate this transition. A transition was generated between a smooth glass-like texture and a sound that is mimetic of the striking of a match. An elastic-like sound was also used that infuses a tactile sensation while pitched and non-pitched noise infuses a sense of heat, which continues through this image. This example demonstrates temporal montage through sounds as well as through images.

A sense of synchresis was also achieved at 3’41 where the image of the child blowing a dandelion’s seeds apart was accompanied by a sound that is rhythmically similar to the visual rhythms of the dandelion image. This sound is also mimetic of the sound of small fragments being blown apart. The image is shown in Figure 11.
4.4.7 Conclusion

Composing *ac-2* for the film *Missing* was very much inspired by Michel Chion’s concept of synchresis. This inspiration resulted in a process where images were considered as models for sounds. Three categories of images were treated as models for three classes of sounds. This idea can also be utilized in standalone acousmatic works where real or mental images can be used as models to create sounds.

Composing for film reveals interesting results in relation to musical structure. When heterogeneous images are used as models for the creation of sounds the sonic results can be as effective as the integration of images. This influence of heterogeneous imagery can be a useful way of creating heterogenous sound material that interacts in a positive way. This analysis has also provided another example of how images in film can be analyzed in a similar way to sounds in acousmatic music. It has thus highlighted similarities between visual and sonic images.

The way time is composed in a visual structure can be influential on the temporal structure of a piece of music and can be viewed as a positive constraint on musical structure. When *ac-2* is heard alone temporal sonic events in the first section can bring to mind montage in the visual domain. A film’s temporal structure can also inspire ways of working against it that can have a positive impact on both audio-visual work and music alone.

Working with sound and image can also reveal potentials for meaning through synesthetic metaphor such as a harsh sound combined with a soft image. This idea can also be applied in terms of contest between sonic images.
4.5 Analysis of *Warp & Weft* and ac-3

4.5.1 Overview

*Ac-3* was composed as the music to the film *Warp & Weft*. The filmmaker Mary Wycherley summarizes the concept of the film as follows:

This film portrays tensions between real and abstract movement. It examines borders and intersections between parallel and perpendicular lines of motion in the body and abstract image. It is a study on how the physicality of movement, including rhythmic and dynamic aspects, integrate and influence the process of editing.

(Wycherley, 2010)

Similar to *ac-2*, *ac-3* features spatial juxtapositions of heterogeneous sounds inspired by the visual material. *Ac-3* features a combination of pitched synthetic sounds, plastic-like textures, sounds of computer-generated noise and glass-like tones. Another similarity between *ac-3* and *ac-2* is that both feature only computer-generated sounds.

Both of these films were utilized as an exercise in creating sonic images that corresponded to visual images, solely through computer-generated sound design rather than through juxtaposing images with recorded sounds. However, *ac-3* suggests a more synthetic sonic work overall than *ac-2* due to the fact that besides images of a dancer, the visual landscape of *Warp & Weft* appears more synthetic as a whole than *Missing*. *Missing* contains primarily natural imagery, while *Warp & Weft* contrasts human gesture with imagery that can be perceived as synthetic.

An example of this synthetic imagery is red and white horizontal and vertical lines that move across the screen.\(^\text{10}\) This synthetic element inspired the use of pitched synthetic sounds in the music. These sounds have smooth textures that correspond with similar textures in the film. The glass-like tones were also composed for this purpose. The pitched synthetic sounds can be described as having the kind of saturated hue discussed in Chapter 3.3.5, which

\(^{10}\) It should be noted that although the end result is one that looks synthetic, these images were initially captured by film.
connects them with the saturated red lines. The sounds and images described above are thus connected through texture and saturation.

Plastic-like sonic textures were composed due to the presence of almost transparent plastic-like visual textures in the film. Some of these sonic textures suggest a tactile handling of thin plastic. Other sonic textures suggest a thicker form of plastic more characterized by vibration and friction than handling. Many of these plastic-like textures can also be related through a similar form of rhythmic progression. Textures throughout the piece suggest layers that vary in thickness.

As many of the sounds in this piece are mimetic of handling or friction of plastic, plastic-like sonic images are afforded through causal listening. The pitched synthetic sounds also have a plastic-like quality. However, as all sounds in this piece are computer-generated, they suggest images related to graphical user interfaces, as well as images of plastic through mimesis. Real world materials are also suggested through the glass-like tones. Mimesis thus provides a connection between computer-generated sounds and real world materials. The film provides a similar connection through synthetic visuals combined with plastic-like images.

4.5.2 Analysis of Visual and Sonic Images

The film begins with a vertical object appearing on a blank white screen (Figure 12). A glass-like sound is used to accompany the image of brightness, while a thick low frequency sound creates contest with the thin vertical object giving it extra perceptual weight. This low frequency sound gradually slows down, which infuses a similar effect on the vertical object even though this object moves at a steady pace. This effect is enhanced by the weight suggested by the low frequency sound. A new perceptual result thus arises from contest between speed and weight/size suggested by image and sound.
Figure 12. Vertical object scene in *Warp & Weft*. (Wycherley, 2010)

The red and white horizontal lines that enter in the next scene vary in speed of motion and at times appear to stall (00’24). One of the red lines is shown in Figure 13 below. The pitched synthetic sound that accompanies these lines creates similar motions through amplitude modulation. The relatively low frequency of this sound is suggestive of the thickness of the lines while its pure pitch is suggestive of the saturated hue of the red lines. A thin vibrating plastic-like texture forms the edge of this sound and represents the fuzzy edges of the lines. Through synchresis these sounds also act like glue between foreground and background of the visual scene. The use of low frequencies enhances this glue-like effect throughout the piece as a result of the black background, which suggests low frequencies in the visual domain.

Figure 13. Horizontal line scene in *Warp & Weft*. (Wycherley, 2010)

The plastic-like texture in the next scene accompanies a similar plastic-like visual texture and follows a similar speed of motion (00’42, Figure 14). Contrasting this texture is a low frequency sound that is separated in time in a way that is suggestive of the hand gestures in this scene as are the sounds accompanying the hand gestures in the scenes that follow. These gestures and
the vertical object in the scene that follows them stall in time, which is enhanced by the sonic motions that accompany them.

![Image: Plastic texture and hand scene in Warp & Weft. (Wycherley, 2010)](image)

**Figure 14.** Plastic texture and hand scene in *Warp & Weft.* (Wycherley, 2010)

In a scene shortly after at 1’12 sounds suggest edges through the way they end in synchrony with the visual squares on screen.

At 1’33 a sense of synchresis is afforded through a sound that slows down at the same time as visual horizontal lines stall in time. The horizontal lines are then represented at 1’36 by a low-frequency sound, which is suggestive of a horizontal line through a subtle repetitive rhythm implying motion while there is no motion through pitch space.

From 1’45-1’53 a hand gesture appears, which follows the motion of the horizontal lines from right to left as a continuing vector. A sonic gesture that is mimetic of something akin to a thumb piano being plucked accompanies this hand gesture. Here there is conformance between tactility and rhythm of sonic and visual gesture.

In the next scene from 1’53 to 1’58, sounds follow the speed of squares while plastic-like transients mark off their edges as they expand and contract.

When the hand gesture reappears from 2’00 to 2’08 the same tactile sonic gesture accompanies it while high frequency rhythmic noise represents the translucency in the image (Figure 15).
The next image at 2’09 and shown in Figure 16 is transparent compared to the previous image and this transparency is enhanced by the absence of noise. At 2’22 the rhythmic noise is reintroduced and infused with a faster motion through the addition of a dynamic low frequency synthetic sound. These sounds combined represent faster activity in the images, particularly the motions of the dancer. The fast-moving sounds of noise also combine with the blurred edges of the horizontal lines moving across the screen.

From 3’10 to 3’24 continuing vectors are formed between the slow hand gesture of the dancer moving from left to right across the screen and a fast-moving near transparent plastic/glass-like image moving in the same direction. The sound used here it moves in one particular direction from fast to slow thus interacting with the image vectors. This example demonstrates how sound can become part of a vector field\textsuperscript{11} involving images. This sonic direction in speed

\textsuperscript{11} As described in Chapter 3.4.5
also acts as a medium between the fast and slow visual images and can create a perception that they are slowing down also. This sound has a glass-like texture, which conforms to the near transparent plastic/glass-like image.

![Figure 17. Hand gesture and plastic/glass-like scene in Warp & Weft. (Wycherley, 2010)](image)

In the next scene at 3’25 converging vectors are formed between sound and image: the dancer moves upwards while a sound converges with this upward visual motion through a rise in pitch. The unchanging pitch of a glass-like tone that continues throughout the rest of the film infuses the sense of a glass screen in front of the filmed dancer. It is also suggestive of the pure unchanging whiteness of the horizontal lines. This sound becomes thinner in frequency at the end to signify the thinness of the object that moves horizontally across the screen in the final scene.

4.5.3 Conclusion

Of all the works accompanying this thesis ac-3 may initially appear to contain the most abstract sonic material. However, this analysis has shown how a work such as this is ripe in its affordance of extrinsic references. Although sounds in ac-3 are entirely computer-generated, this piece contains potential for source bonding with or mimesis of real world materials such as plastic and glass. Ac-3 can thus allude to both the real and the synthetic, which the film does also through real and synthetic imagery. Through a description of how sounds represented visual images this section implemented the type of synesthetic analysis mentioned in Chapter 3.2. Sounds were discussed in terms of their relationship to concepts such as visual motion, size, edge, transparency, saturation, brightness and tactility. Although these concepts were discussed in
relation to sound that corresponds to images in the film, they also represent my perception of sonic images within ac-3 as a standalone acousmatic piece. This type of analysis will thus be further utilized in Chapter 5 in relation to standalone acousmatic works.
Chapter 5: Analysis of Acousmatic Works

5.1 Introduction

While ac-2 and ac-3 are intended to exist as standalone acousmatic works as well as forming part of audio-visual works, the three works analyzed in this chapter were composed without the influence of moving visuals in film. However, the creation of sonic images was just as important to the works in this chapter as those in the last. This chapter thus uses similar concepts for analysis as Chapter 4 such as source bonding, mimesis and metaphor as well as considering other forms of sonic images discussed in Chapter 2 such as conceptual and gestalt images. Use is also made of visual concepts and multimedia aesthetics discussed in Chapter 3 that were influential due to my visually oriented approach to sound.

5.2 Analysis of ac-1

5.2.1 Overview

Ac-1 features an integration of sounds of loudspeaker interference caused by mobile phones with some other recorded sounds and computer-generated sounds. The relevance of a pseudo-instrument and of compositing to this piece was discussed in Chapter 3.4.3. Through the idea of the pseudo-instrument sounds were carefully selected to reflect a sense of chaotic gestures combined with turbulent textures. Through this selection of sound material, sound manipulations and blending, a turbulent-chaotic sonic environment was created. This process was considered as analogous to digital compositing in new media, as described in Chapter 3.4.3. The concept of space-medium, discussed in Chapter 3.4.6 was also an influence during the formation of this piece. While the concept of compositing influenced the creation of a particular sonic environment through choice of sound material, sound manipulations and blending, there are various points in the piece where fusion between sounds creates the sense of space as homogeneous substance. At times the piece thus affords perception of sounds as being in the foreground or background in

101
relation to other sounds in space. There are also points where it is suggested that sounds are either sinking below or emerging from the overall substance of the sonic environment.

5.2.2 Background

The piece was largely inspired by James Gleick’s book Chaos (1987). The essence of chaos theory is that scientists discovered a strange order behind chaotic patterns in nature, such as the formation of snowflakes, clouds, leaf patterns and our own biological systems. For example, they would see similar patterns in the microstructure of a snowflake as they would in its macrostructure, a phenomenon known as self-similarity. The idea of attractors is also a feature of chaos theory. An attractor can be described as “something that causes something else to approach or draw near” (Madden, 1999, p.6). Scientists studying chaos theory noticed a strange attraction of elements in various natural processes, particularly in the onset of liquid turbulence, such as boiling water. Something that astounded scientists was that all of these features of chaos theory such as self-similarity and attractors seemed to be universal whether applied to a snowflake, a leaf or a rock.

Ideas from chaos theory are useful when considered during electroacoustic composition. The idea of turbulence was particularly inspirational in the development of ac-1. Scientists researching chaos theory discovered that “fluid turbulence did not develop gradually, but rather, suddenly in a cascade of increasingly complicated motions” (Madden, 1999, p.5). This idea became the basis for the first section of the piece, where chaotic gestures develop into a more textured turbulent section. Smalley has included turbulence as a form of texture motion in electroacoustic music. His description of turbulence as “irregulation, fluctuation, possibly stormy” involving “confused spectromorphological entwining” (Smalley, 1997, p.117) was also considered during composition of the turbulent section.

The idea of self-similarity was also utilized throughout the piece. A good description of self-similarity is given by Madden (1999): “The parts must scale;
that is, a self-similar image has smaller pieces that are similar to each other and to the whole”. Self-similarity was considered through the use of variations of the same sounds throughout the piece. For example, some of the sounds derived from static interference appear both as short chaotic rhythms and long sustained textures. This approach to the material was achieved by time stretching and pitch-shifting. This process gave me a perspective that was analogous to magnifying a sound to reveal more of its inner details. Various other processes were used to alter the characteristics of sounds while preserving the idea of self-similarity. Consideration of this concept conformed to the creation of a pseudo-instrument and virtual environment.

Certain sounds from the piece can be compared in a self-similar way to the macrostructure or gestalt image of the piece. Sounds were designed to have chaotic and turbulent characteristics. The gestalt image is also one of chaos and turbulence. Self-similarity can thus be compared with the micro-macro continuum as described by Stockhausen when he discussed “the relationships between the structuring within the sound and the structuring of sounds in order to build larger entities” (Stockhausen) [his emphasis] (Cott, 1974).

As well as self-similarity, attractors and turbulence, the idea of the butterfly effect was inspirational in forming the structure of the piece. This phenomenon was discovered by meteorologist Edward Lorenz and was later referred to as ‘sensitive dependence on initial conditions’ in the scientific community (Gleick, 1987). Lorenz created a computer program to study weather patterns. One day, he accidentally discovered that a slight change in initial conditions could lead to a drastic change in results. This led to the idea that the flapping of a butterfly’s wings might ultimately lead to a tornado appearing in another part of the world (Gleick, 1987).

5.2.3 Compositional Structure

The first sound is analogous to a butterfly flapping its wings and is derived from the Lorenz opcode in Csound, which is based on Edward Lorenz’s mathematical formula. A recurrence of this gesture appears transformed in
different ways throughout and the gestural contour (Smalley, 1997) of this sound was also considered in relation to other sounds in the piece. The idea of cause and effect was kept in mind throughout the process of composition. Sequential sounds were used at the beginning to form rhythmic motifs that maintain a sense of gestural chaos (0’00-1’21) until a turbulent section is reached, which lasts from 1’22 until 4’43. This section remains turbulent but a sense of order is gradually introduced through a pitched turbulent section (2’39-4’43). The progression from chaotic gestures towards turbulence was inspired by the concept of attractors. As the turbulent section was considered as the attractor, the chaotic gestural section was composed to suggest a gradual development or attraction towards turbulence. This attraction is suggested through turbulent and textural characteristics within the chaotic gestures. Also, a textural sound at the end of the chaotic section glides downward in pitch to suggest a descent into turbulence.

This pitched turbulence develops into a section where fast chaotic gestures gradually give way to slower ones (4’44-9’26). As gestures become less chaotic there are larger separations in time between them. The idea was to create a sense of time slowing down and reaching stasis. A third element was introduced, a slowly evolving texture, which alone would represent stasis. However, this sound appears gradually through an increase in intensity over the course of the section and reinforces the sense of slowing down infused by extended temporal spaces between gestural sounds. This section comes to an end through converging vectors as sounds gradually come to rest through behaviour, pitch and speed. These sounds converge at the beginning of a section of stasis, which follows from 9’27 until 11’05. This section was influenced by the idea of holistic space, which is “realised by mentally amalgamating an array of spatial forms into a unified spatial view” (Smalley, 2007, p.55). Smalley (2007) uses this concept to describe the idea of time becoming space, which is something that this section and all of the temporal events leading up to it suggest.
The final section (11’06-end) involves a return to the type of chaos suggested by the beginning of the piece. However, the intensity of chaotic gestures is increased in this final section and it develops towards entropy. This section begins with pitched sounds (11’06-11’42) and is followed by non-pitched sounds (11’43-end). These sounds suggest elements that spiral out of control and lead to an extremely chaotic section, which becomes entropic from 13’13 until the end of the piece.

5.2.4 Sonic Images in ac-1

While the previous two sections are descriptive of sonic images there is more to be discussed in this respect. Chapter 2.2.4 describes how an arch metaphor was considered for the temporal structure of this piece. An analogy of a hill signifying increased and decreased effort was also described. As well as being suggestive of decreased effort, the chaotic rush of events towards the end of the piece can suggest many images such as an avalanche, a river bursting its banks, or a virus spreading and multiplying.

While gesture is a prevalent feature of ac-1, none of the gestures derive from sounds connected to human gesture. Smalley has discussed the idea of gestural surrogacy, which relates to “mechanisms whereby musical gesture and texture are linked to their sources” (Smalley, 1986, p.82). While Smalley discusses gesture in terms of having “its origins entirely in the human body” (Smalley, 1986, p.83) the origins of gestures in ac-1 derive mainly from sound manipulations of static interference and computer-generated sounds. Despite this lack of gestural surrogacy, sounds in ac-1 can be imagined as suggestive of human gesture through plasticity and nonlinear velocity as discussed in Chapter 3.4.2. Smalley’s idea of remote surrogacy (Smalley, 1997), which is concerned with vestiges of human gesture, is thus apt to describe the gestures in this piece.

However, through their chaotic and irregular rhythmic fluctuations many of the sounds in ac-1 have a quality I would describe as biomorphic: suggestive of living organisms that are not necessarily human. An acoustic chain can

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12 Biomorphic sounds were discussed in Chapter 2.3.6.
thus be formed between this and works that share similar biomorphic qualities such as Natasha Barrett’s *Red Snow*. At the same time most of the sounds are derived from mechanical sources, which can also suggest machine images depending on the listener’s perspective. This perspective can depend on whether attention is towards gestural contour, the actual source of sounds, or both. Many of the gestures in this piece contain an internal texture that is an important element of their sound quality. Smalley has described this situation where “we are conscious of both gesture and texture, although the gestural contour dominates” as “gesture-framing” (Smalley, 1997). This internal texture can infuse a sense of naturalness within gestures. As these sounds are as a whole gesture-carried, where gesture dominates (Smalley, 1997) the sense of naturalness within these sounds can enhance their biomorphic quality. This type of gesture can particularly be heard during the section of stasis from 9’27-11’05 also appears frequently throughout the piece.

Many of the textural sounds in *ac-l* are mimetic of environmental sounds. Also, while the piece was being composed sounds began to suggest images of surfaces and edges within a landscape. The piece thus suggests images related to environmental events as well as still environmental images such as rock formations.

Because sounds are not actually derived from natural sources, this piece affords images of a surreal or alien environment, which can be enhanced by source bonding with sounds derived from mechanical sources. The pitched turbulent section in particular, can bring machines to mind (2’39-4’42). Sounds of computer-generated noise are also used in the piece without manipulations during the stasis section to accentuate this machine element of the narrative. The use of these sounds can be described as a form of spatial montage as they point towards a new source and conflict with the gestural and textural content they surround as well as the content that dominates the majority of the piece.

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13 This piece was also discussed in Chapter 2.3.6.
5.2.5 Conclusion

Through the use of source bonding, mimesis, metaphor and multimedia concepts a similar form of analysis was applied here as towards audiovisual works in Chapter 4. The initial seed of the idea for this composition was born out of the concept of chaos. However, this concept gradually led to suggestions of many different sonic images and different perspectives. This analysis thus illustrates how the manifestation of various sonic images and perspectives continuously informs the creative process of my composition. It also highlights some of the different perspectives available to the listener. Meaning in this composition is afforded through any one or any combination of sonic images discussed here or imagined by the listener, or simply through appreciation of the sonic and musical content. Although many different sonic images were discussed, a specific and consistent sonic environment pervades throughout due to consideration of a pseudo-instrument and compositing. The next analysis will demonstrate a work that intentionally opposes this type of consistency, while simultaneously finding ways to justify the existence of sounds through spatial and temporal montage.

5.3 Analysis of ac-4

5.3.1 Overview

Ac-4 features vibrations, static interference and fragmentation of sounds. The piece forms a machine/human dialectic, and is influenced by spatial and temporal montage, as new images are suggested through the juxtaposition of sounds in space and time.

Through spatial and temporal montage, one of the key aims of this piece was to use heterogeneous sounds and find ways that they can exist when juxtaposed spatially and temporally. For example, sounds of static interference, glass, wooden poker chips, plastic loudspeaker cones and acoustic strings are heterogeneous elements but are brought together through the simple concept of vibrations. Heterogeneous elements also connect in this piece through fragmentation, which is prevalent throughout and is an example of mimesis
through imitation of causality. The structure of this piece was also formed through a machine/human dialectic. This dialectic suggests conflict between machine and human presence throughout the piece.

5.3.2 Section 1

The gestalt of sounds that comprise the first section suggests a mechanical image. Sounds were considered as layers that combine as if part of one unit. The main layer contains low frequency vibrations. The low frequency of these sounds and the way they were recorded close can evoke a sense of weight and something large. The sense of closeness, weight, size, and lack of gaps in the temporal development of sounds can also evoke a sense of an enclosed space. Continuously connected to the layer described above is a fast clicking sound, which becomes gradually more turbulent as it progresses. The third continuous layer contains high frequency sounds of static interference. The mechanical repetition and vibratory nature of each layer creates a sense of fusion between the three layers. At the same time interpenetration can be perceived between higher and lower layers through rhythm, timbre and dynamics. The final layer that completes this section consists of intermittent glass sounds that have characteristics of friction and turbulence and there is a causal relationship between these sounds and low frequency vibrations. The fusion of layers and repetitive nature of this section give it a mechanical quality, as though a machine has been set in motion. Energy is suggested through a gradual increase in the intensity of sounds. However, the intermittent glass sounds and an increasing sense of turbulence hint at something that is becoming gradually unstable. This instability is enhanced towards the end of the section by intermittent bursts of high frequency static interference that suggests images of sparks. Gestures at the end of this section suggest an image of something breaking down or coming apart.

5.3.3 Section 2

The next section introduces rhythmic biomorphic qualities to sounds of static interference, suggesting an image of a machine coming to life. These
short chaotic bursts of static interference are suggestive of small sparks and create contest with the more solid, mechanical sounds of vibration from the previous section. These sections thus connect through the idea of sounds fragmenting in a form of temporal montage, creating meaning through opposing a machine image with a ‘live’ biomorphic one. The chaotic bursts of static interference continue from the instability of the last section, suggesting an image of a machine out of control.

These sounds entrain a glass-like texture, which sustains a trace of the intermittent glass sounds heard previously. This form of entrainment was discussed in Chapter 2.3.8. The static interference sounds are also framed by sustained pitched textures that have a smooth grain. There is a sense of penetration between the sharp static interference sounds and both the glass and sustained pitched textures. The lack of low frequency content and the spaces between static interference sounds in this section suggest a more open space where sounds are free from the confines of the enclosed space of the first section. The sense of an open space is also enhanced by the sustained pitched textures, which have a reverberant quality. There is a release of tension through this sense of open space and a gradual slowing down of the piece through a gradually more intermittent use of static interference sounds. This section finishes with a convergence through the behaviour of two sounds. As one sound slows down another simultaneously falls in pitch. Through their simultaneous behaviour these sounds suggest that something that is coming to rest and converge towards the beginning of the next section. These vectors act as a structural function between the two sections and imply a shift from mechanical and biomorphic sounds towards human presence.

5.3.4 Section 3

The third section begins with the sound of an acoustic string vibrating layered with other vibrations, which conflicts with previous sounds through its relationship with a real instrument and human presence. However, through its vibration this sound connects with the layers of vibration in the first section.
This simultaneous conflict and connection creates temporal montage. Meaning is afforded through a vibration created by human gesture human following a section of biomorphic static interference, which followed a section of mechanical vibrations. In other words, the piece progresses from a ‘machine’ image towards a ‘live’ image towards a ‘human’ image. From this point on a human/machine dialectic becomes more obvious.

A manipulation of the acoustic vibration, which changes its quality from metallic to plastic, rises to meet a higher pitched scene at 7’02. This scene combines plucked string sounds with gesture related to other physical objects. It also contains sounds related to an electrical device and hints of computer manipulations and thus a human/machine dialectic. The machine element of this dialectic becomes more dominant in the next scene at 8’23 as the previous sounds are in effect taken over by computer manipulations. However, there is also a biomorphic quality to these sounds and intermittent voices are present beneath the surface. The use of these voices was inspired by the idea of amplified reality, discussed in Chapter 2.4.4. In this scene, sounds from the previous section are fragmented and rearranged through brassage and editing in a form of cubist reassembly. An unraveling gesture, which appeared at the end of the first section brings this one to a close, while a trace of the material from this section is carried forward into the next through a sound that brings to mind a release of energy or steam.

5.3.5 Section 4

A rhythmic sound, which is a time manipulation of the fast clicking sound discussed in the first section, is central to the structure of the final section. Its repetitive rhythm also makes it sound mechanical. This section thus shares a mechanical quality with the first section but sounds that bring to mind human gesture can be perceived as it progresses. This rhythm is framed by biomorphic sounds and intermittent pitched sounds from the previous section. While these biomorphic sounds follow a similar sense of organic progression as the material
from the previous section, the rhythmic sound creates contest with these biomorphic sonic images by suggesting a mechanical one.

Causal reactions between sounds (Smalley, 1986)\textsuperscript{14} are also suggested at various points and are examples of mimesis. The first reaction is at 10’12 when a sound that is mimetic of the sound of stress applied to a material, is followed by a suggestion of fragmentation through sounds of impact in relation to multiple objects. An unraveling gesture has a causal effect on objects at 11’14. Then at 12’11 there is causality between sounds of stress and the main rhythmic sound. As the former becomes more tense, the latter loses energy. In the climax of this example there is a simultaneous reaction between an unraveling gesture and the impact of objects. This example contains converging vectors, which are explained in Chapter 3.4.5. The piece ends with the rhythmic sound fragmenting, as its elements become objects falling on the floor of a room, thus ending on an image of human presence. The final sound is of the recording equipment being turned off.

5.3.6 Perspectives

\textit{Ac-4} affords various shifts in listening perspectives. It begins with sounds of loudspeaker cones vibrating and thus simply suggests the presence of loudspeakers in the room. The beginning of this piece basically fills the room with a sense of sonic energy. However, when sounds of friction enter, the listener’s perspective can change. The loudspeaker vibrations become part of another image in a narrative, which is one of mimesis, as the gestalt of sounds imitate a machine. While this mimetic image can continue throughout the piece through the machine/human dialectic, some scenes afford shifts between this and other perspectives. For example, while the acoustic string scenes from 6’03-8’24 form part of a human/machine mimetic image they can also be perceived from the perspective of a live performer playing an instrument. However, the processing of string sounds at 8’25 can provide a shift in

\textsuperscript{14} While discussing structural relationships Smalley states: “\textit{Reaction} implies either a \textit{causal} or \textit{competitive} relationship, either of which may involve degrees of active-passive role-playing” (1986, p.89).
perspective back towards the mimetic machine image. The end of the piece also affords a shift in perspective.

While the majority of the piece creates a fictional space, the sounds of objects falling on the floor of the room take the listener into a real one. Finally, the quiet sound of recording equipment being turned off can take the listener’s attention back towards an image of the recording medium\(^{15}\), just as the beginning can draw their attention to the medium of playback. The piece thus takes the listener into the machine/human narrative at the beginning and back out at the end. More on how the image of the medium was considered for this piece is discussed in Chapter 2.4.3.

5.3.7 Light and Colour

As discussed in Chapter 3.3.1, light and colour associations with sound are subjective. This section thus describes my own perspective of light and colour in this piece, which was influential during the creative process.

The first section of *ac-4* suggests a dark image of the inner workings of a machine, which is enhanced by the presence of low frequency sounds. These sounds are recordings of a loudspeaker cone vibrating at a very low frequency. The listener is essentially hearing the vibrating plastic itself of loudspeaker cones. I thus associate these sounds with a source bonded black colour, which enhances the perceived darkness of the machine image. While I would not expect all members of an audience to perceive these ‘loudspeaker’ images I like to think that this first section suggests the simple concept of vibration in its purest form. Through their fusion with these low frequency sounds other layers become part of the internal machine image and do not suggest much in terms of brightness or colour. However, there is a hint of brightness through high frequency sounds of static interference.

The beginning of the second section is dominated by fast bursts of high frequency static interference, which can evoke colours related to sparks. This type of sound also gives me a sense of metallic colours through association with

\(^{15}\) And the composer.
electric circuits and technology. Another layer of colour is also suggested through the introduction of pitch. The section continues with more sounds of static interference. These sounds are followed by the introduction of vibrating string sounds, which have a metallic quality and can take on source bonded bronze or silver sounds through source bonding. As there is not much variation in pitch initially with these sounds attention can be drawn particularly towards the source and its colour. However, when richer melodic content is introduced from 7’01 until the beginning of the final section at 9’54, more variations in colour are suggested. The string sounds also suggest a new colour through their timbre, which contrasts with previous sounds.

The rhythmic sound in final section is not initially coloured by pitch. However, suggestions of colour from the previous section are gradually introduced through short burst of similar pitched material and a gradual introduction of pitch to the rhythmic sound as the section progresses. However, this colouring of sound decreases towards the end of the piece, which leaves me with a source bonded image related to the impact of several objects in a room.

5.3.8 Conclusion

Whereas a consistent environmental image is suggested in ac-1, ac-4 juxtaposes conflicting sonic images as a result of the former being influenced by compositing while the latter was influenced by spatial and temporal montage. Ac-4 thus affords meaning suggested through conflicting juxtapositions of sounds, whereas meaning in ac-1 is suggested more through sonic integration. However, although sounds in ac-4 suggest heterogeneous elements in relation to their source, they are brought together through a machine/human dialectic and the concepts of vibration and fragmentation. A dialectic between vibration and fragmentation also enhances the narrative of the machine/human dialectic as vibration suggests stability while fragmentation suggests instability throughout the piece.

I find it easier to imagine a gestalt image for ac-1 than ac-4 due to the consistent suggestion of a specific environmental image in the former. Another
reason for this is that the gestalt image can be imagined in ac-1 through the arch metaphor discussed in Chapter 2.2.4 in relation to that piece. However, through montage ac-4 moves through more diverse sonic images. This analysis also utilized non-sounding concepts such as weight, size, light and colour.

5.4 Analysis of ac-5

5.4.1 Overview

Ac-5 was composed using sounds of a jet fighter aircraft that I recorded at the Paris Air Show in 2009 combined with sounds of static interference. A narrative based on an aircraft’s surrealistic journey is created through juxtapositions of these sounds and also through sound manipulations. Sounds of interference bring to mind media spaces such as radio or television. At the same time, layers of texture throughout the piece are suggestive of visual landscapes.

During composition the juxtaposition of sounds inspired the idea of an aircraft becoming lost and entering a new and surreal world. The use of static interference brought to mind loss of communication as well as surreal spaces and environments. An aircraft image moves in and out of focus in relation to the sounds of static interference and is transformed in different ways each time. By the end of the piece the aircraft image fully emerges in a newly transformed state only to be lost again. A dialectic between the power and weakness of technology is thus also embedded in the narrative.

5.4.2 Spatial Montage and Compositing

The two main sources of sound material: aircraft and static interference are layered throughout the piece in a form of spatial montage. The juxtaposition of these sounds thus creates new meaning as the listener interprets a narrative formed through their juxtaposition. Associations can be made between sounds of static interference and what Smalley has described as mediatic space, which is “an amalgam of spaces associated with communication and mass media, creating an image of spaces, places, distances, events, etc” (Smalley, 2007, p.55). Sounds of static interference in this piece are thus suggestive of images
related to transmissions from the aircraft through the concept of communication. In this case the listener can perceive images related to the inside of the aircraft or reception of its transmissions from somewhere else.

While spatial montage is prevalent throughout the piece, the sounds of aircraft and static interference are also compositied through the way they are layered and integrated as textures. Therefore, while at one level a narrative can be followed through the meaning of these juxtapositions, at another level the piece suggests sonic blending through layers of texture. Aircraft sounds and sounds of static interference at times suggested a similar form of granular noise, as discussed in Chapter 2.2.3, which facilitated their blending. The grain of textures in the piece varies ranging from smooth to coarse. When the piece is viewed from this textural perspective and there is less attention towards the source and meaning of sounds, it can form a somewhat homogeneous field that is suggestive of a visual landscape between 2’12 and 5’25. Between these times the overall homogeneous substance also suggests space as space-medium.

An example of spatial montage from 5’30-5’53 contains human speech, which conflicts with the two main sound categories. However, this sound itself is derived from a transmission that contains static interference. The low fidelity of the speech and the static interference that surrounds it enables this sound to be compositied into the surrounding textures. A relationship is also suggested between this sound and the static interference sounds throughout the piece. This sound influences the narrative as it suggests a mediatic space, which was defined earlier in this section. It also suggests a form of command as it precedes a sound resembling the launch of an aircraft.

A more subtle example of spatial montage appears from 4’30-5’00, where a singing voice and music appears behind the sound of the aircraft. This sound is blended in a way that is sounds very distant and also blends with the sound of the aircraft through pitch and sustainment. This sound was recorded in China and was included to give the sense of another location in the narrative, as though it was heard in the distance from the aircraft. The use of this sound was inspired by the concept of amplified reality, discussed in Chapter 2.4.4.
5.4.3 Transparency/Opacity, Colour and Metaphor

The piece contains static interference derived from radio and television. As well as suggesting mediatic spaces, these sounds can at times mask and at others reveal images of the aircraft. However there are various states of clarity and obscurity of the aircraft image, which can be described through Smalley’s qualities of spectral density, discussed in Chapter 3.3.6. These states can be described as follows:

From 0’00-1’43 an aircraft sound is unobstructed and goes through a transformation that implements a gradual rise in frequency while the low frequency components disappear. This transformation suggests a metaphor for height and arrives at a point where aircraft sounds are still present but sound small and distant among sounds of static interference at 1’44. Between this point and 3’38 the spectral space can be described as packed with sounds of static interference when aircraft sounds are perceived as completely obscured; and opaque when traces of them are perceived. Because of similarities between the grain of aircraft and static interference sounds, traces of aircraft sounds can be perceived at times within the static interference itself.

When an aircraft sound appears between 3’39-4’14 the spectral space formed by static interference surrounding it is translucent. The aircraft sound in this example is also coloured by pitch, which is a feature throughout the rest of the piece. In the section from 4’15-5’53 there are shifts between translucency and opacity until the aircraft sound disappears again beneath the static interference.

At 5’53, an aircraft sound continuously rises in pitch while breaking its way through a translucent curtain until the final section at 7’46. When it reaches this final section a machine sound falls in pitch forming a diverging vector: the rising aircraft sound at 5’53 meets the falling machine sound at 7’46. Tension is created between these sounds and also between the machine sound and a simultaneous aircraft sound at 7’46 as the former is stable in pitch while the latter falls. The machine sound’s fall in pitch suggests a metaphor for a failure of technology while the rise and subsequent stability of pitch of the
aircraft sounds, as well as their increased amplitude, suggests technological power. In this final section there is no obstruction: the spectral space surrounding the aircraft sounds is transparent. This clearing of spectral space enhances a suggestion of a dominant hue infused by clarity of pitch in this final section. The piece ends with pure static interference, which suggests a complete loss of transmission.

5.4.4 Conclusion

Whereas ac-1 was mainly influenced by compositing and ac-4 by montage, ac-5 features a combination of these concepts. The two main opposing sound categories considered for montage: aircraft and static interference, were also compositied through similarity in sonic grain. Narrative in this piece was discussed in relation to an aircraft’s surreal journey and a dialectic between the power and weakness of technology. The aircraft’s journey was described through transformations of an aircraft image moving in and out of a focus. Smalley’s qualities of spectral density were utilized to describe this journey through states of transparency, translucency and opacity. Other perspectives on sonic imagery were noted such as how the piece can at times suggest a visual landscape through texture and how it can suggest space as space-medium.
Chapter 6: Conclusion

While works from other artists were used to describe various concepts throughout this thesis, this conclusion summarizes my approach primarily with reference to my own works. The form of this conclusion thus summarizes Chapters 1-3 while cross-referencing relevant examples from the analyses in Chapters 4 and 5. Occasional reference is made towards examples that referred to the work of other artists for the sake of clarity.

To reiterate the core basis of my approach, it is one where I find meaning in composition and analysis of electroacoustic music through sonic images. While these sonic images are primarily revealed through extrinsic reference, intrinsic sonic properties are just as essential. The three concepts of source bonding, mimesis and metaphor have been utilized to demonstrate different forms of sonic image. Concepts from both the visual and tactile domain and aesthetics related to structuring moving visual images in multimedia have also been demonstrated as meaningful to my approach.

While no specific theory has been developed for electroacoustic music there is a wealth of ideas and approaches a composer can avail of. This thesis has benefited from borrowing elements from different approaches to electroacoustic music and integrating them with ideas and concepts from other fields such as cognitive psychology and creative multimedia. This thesis has thus provided a synthesis of ideas that are all related through extrinsic reference and can be considered in relation to any composition that communicates through sonic images. An approach such as this affords endless scope for expansion, and there are many more relevant ideas out there already within the field of electroacoustic music that have not been utilized. The ideas and concepts that have been used were selected due to their relevance to specific works composed and when they are considered as a whole, this approach towards electroacoustic music can be understood.

In Chapter 1 new media was defined through Manovich’s five principles. Through these principles comparisons were made between new media and electroacoustic music due to the influence of new media concepts on my
approach to composition and analysis. Four of these principles were shown to apply to electroacoustic music created with the computer. However, transcoding, which relates to the effect of technology on cultural aspects of a media, was highlighted as the most relevant principal shared by new media and computer-based electroacoustic music. This relevance was described in relation to both the availability of a large palette of sounds and how they can be culturally transcoded through computer programs and ideas from texts related to sound manipulation. The variety of perspectives on a sound/sonic image afforded by sound manipulation was highlighted as particularly relevant. It was thus stated that cultural transcoding would be present in this thesis wherever the computer played a vital role in the creation of sonic images, such as, for example, those created through mimesis, metaphor and compositing.

A historical trajectory in cinema described by Manovich from montage aesthetics of tape splicing towards aesthetics of digital compositing was then compared to a similar trajectory in certain forms of electroacoustic music. It was thus highlighted how the modern computer provides the composer with greater tools than in the past to create virtual unified spaces and seamless transitions comparable to the compositing of visual images in new media.

Due to the influence of multimedia and the visual domain on my work, comparisons were also made between electroacoustic music and multimedia. Based on Nicholas Cook’s idea that music and multimedia can both be analyzed in terms of dimensions of variance, it was described how variance can operate in electroacoustic music in three ways: between intrinsic references, extrinsic references and between intrinsic and extrinsic references. As this thesis is primarily concerned with sonic images the second and third forms of variance were described as most relevant. Meaning between extrinsic references was demonstrated through montage. Meaning between intrinsic and extrinsic references was demonstrated though ways that manipulation or perception of intrinsic sonic properties can enhance perception of extrinsic references or change their meaning by providing different perspectives. Based on this an analogy was made between intrinsic and extrinsic references in electroacoustic
music on the one hand and sound and images in audiovisual works on the other. The relevance of Emmerson’s idea of a quasi-visual mindscape to my approach was emphasized as this type of mindscape continuously informs my composition. This chapter reached a conclusion that a meaningful language for my approach to electroacoustic music is provided by sonic images, visual concepts and aesthetics of visual images in multimedia.

Chapter 2 made distinctions between source bonding, mimesis and metaphor and highlighted these three concepts as particularly relevant to suggestions of different forms of sonic images. Based on distinctions made by Simon Emmerson it was established that the term mimesis would be used to refer to sonic images concerning imitation of a sound source while metaphor would refer to sonic images involving non-sounding concepts. A distinction was made between source bonding and mimesis due to the fact that listeners can impose their own imaginative mimesis upon a sound that can bear no relation to their perception of its source. It was also highlighted that mimesis is useful to composers as a concept distinct from source bonding when they are more concerned with imitation than the actual source of sound material during composition.

Next Emmerson’s distinctions between aural and mimetic discourse were discussed, which highlighted the fact that even if a composer communicates through an aural discourse the listener can perceive mimesis. Emmerson’s ideas of abstract and abstracted syntax were also considered. An example was given through ac-1, which was initially informed by an abstract syntax through ideas derived from chaos theory, but was also formed through an abstracted syntax as the structure of the piece was also influenced by meaning abstracted from the sound material itself.

In a discussion on listening modes the relevance of causal listening to perception of sonic images was discussed but it was particularly highlighted how reduced listening is beneficial, as perception of intrinsic references can suggest or enhance extrinsic ones.
The concept of affordances, a concept used by James Gibson, which was appropriated by Luke Windsor was discussed to highlight the subjectivity of a sound, as a listener’s knowledge of the environment influences their perception of a sound source. Related to this was Mathew Adkins idea of acoustic chains, which describes connections between works formed through similar sound material afforded to/identified by the listener. It was described how acoustic chains could be formed between all works accompanying this thesis through source bonding with sounds of noise and static interference. It was also highlighted how acoustic chains can extend to all forms of music and that chains can be formed between sonic images and visual images. An image chain was described between *ac-5* and Mathew Adkins *Melt*, between both of these works and the film *A Scanner Darkly* and between *ac-5* and the television series *Lost.*

A discussion proceeded on the use of metaphor to suggest sonic images. Three forms of metaphor were described: *pitch relationships are relationships in vertical space, timbral relationships are relationships in tactile space* and *time-energy relationships are relationships in physical space.* The first was described in relation to glissandi in *Metastasis* by Xenakis, which are suggestive of his architectural ideas. This metaphor was also described in terms of frequency and a spectral image was demonstrated in *ac-1.* This image was of compositional use, as an image of a spectral roof influenced the overall spread of frequencies. The next metaphor: *timbral relationships are relationships in tactile space* was essentially linked with texture and the concept of grain. This metaphor was particularly demonstrated in *ac-2,* which contains different forms of sonic grain ranging from smooth to coarse. However, sonic grain and texture are prevalent throughout all five works. *Ac-5* demonstrated how these concepts are present within sounds of aircraft and static interference, which highlights a perspective of sound material that has nothing to do with its source. As sounds in *ac-2* are entirely computer-generated and those in *ac-5* derive from aircraft and static interference, these examples demonstrate how electroacoustic music
affords suggestions of tactility even if sounds are not recordings related to surface materials.

The third metaphor *time-energy relationships are relationships in physical space* was demonstrated in *ac-1* through a gradual slowing down and subsequent speeding up of temporal events, which suggested an arch or U-shape. It was also shown how the temporal events in *ac-1* are suggestive of increased and decreased effort through the analogy of going up and down a hill. Then in the analysis of the audio-visual work *Missing*, conflicting temporal shapes were demonstrated. The film was shown as defined by an arch or U-shape, while the music was more defined by a downward or upward slope.

The metaphors *pitch relationships are relationships in vertical space* and *time-energy relationships are relationships in physical space* were also essential to the use of pitch and time in the formation of vectors. How vectors were formed through consideration of both pitch and time is summarized later in this chapter.

It was also described how perception of sonic images can be a product of projective identification, through which the listener projects self-related images onto sonic material, or to re-quote Stockhausen: “The listener becomes the music. And by that the music is influenced by the listener because he changes the music” (Stockhausen) (Cott, 1974). The relevance of entrainment was first discussed. Entrainment can be summarized as a form of synchronization between the rhythmic patterns of sounds and the physiological system of a listener. The relevance of this physiological connection with rhythmic patterns to kinaesthetic listening and thought, mirror neurons and motor imagery was discussed. This discussion provided a synthesis of ideas relevant to the role of the self-conscious listener/composer in perception of sonic images. Connections between the above concepts were thus made to shed light on the type of feedback that occurs between sonic images and listeners/composers in which the latter have a sense of their own imagined actions within a piece of music. The idea of projective identification was essentially linked with gesture but it was pointed out that imagined gestures do not always necessarily relate to
sounds created by human gesture. They can also relate to metaphor where movement through spectral space suggests human gesture. The idea of biomorphic sounds was also described where sonic gestures bring to mind living organisms in a more general sense. Sounds in ac-1 were shown to be detached from human gesture and to contain erratic behaviour suggestive of ‘living non-human’ visual motion. It was also described how an internal texture can infuse a sense of naturalness within some of the gestures in this work, enhancing their biomorphic quality.

It was then discussed how we entrain sound and image in an audiovisual work and how this is connected with Michel Chion’s concept of synchresis: perceptual fusion between sound and image. A form of synchresis was described between sound and an image in the mind’s eye during sound design. An example was also given of how the concept of entrainment inspired a compositional technique where a complex sound entrains a physical model, suggesting a shadow or reflection.

Some other forms of sonic image were described in Chapter 2. One of these was the gestalt image, which relates to how a mental image/memory of a work can be unified as a gestalt. Reference was made to Nicholas Cook’s discussion on music and imagination, which made comparisons between memory of a work and Sartre’s description of imagining a thimble. Through this comparison it was discussed how the structure of a work can be combined as a gestalt in memory, which is analogous to how the inside, outside, front and back of Sartre’s thimble can be unified as a mental image. Ac-1 was shown to afford this type of image through the arch/U-shaped metaphor described in the previous paragraph and also through a consistent sonic environment suggested throughout. The temporal shape of this work was contrasted that with that of ac-4, with the latter more defined by separate sections and contrasts in sonic material.

Images of depth were considered through a ‘third dimension’ of sound suggested by both Scelsi and Varèse. Through Scelsi’s third dimension sound was described as having a spherical shape which is articulated through
parameters besides pitch and duration, while Varèse’s third dimension was described as a dynamic swelling or decreasing. These descriptions were considered relevant to depth in sonic texture, which was particularly demonstrated in *ac-5* and in *ac-1*.

It was also described how noise, interference and loudspeaker related sounds point towards the medium of transmission: the sound system in the room of audition. This use of sound can provide a link between the present reality of audition and an imagined narrative. The inclusion of static interference in all works accompanying this thesis affords this perspective. This image of the medium was also demonstrated through vibrations and sounds of friction between objects and loudspeaker cones in *ac-4*, low fidelity noise in the same work and mobile phone loudspeaker interference in *ac-1*.

Another form of sonic image was discussed through the film sound design concept of amplified reality. This concept inspired an approach that involves blending a sound with other sonic material so that its source-related image is present but almost subliminally so. This approach was demonstrated in *ac-4* through the fusion of a car engine revving sound with abstract sounds and the blending of voices with manipulations of acoustic string sounds. It also inspired the use of a recording from China behind an aircraft sound, which suggested another space in the distance.

Conceptual forms of extrinsic reference were also described as relevant to sonic images as they point towards analogies between the sonic and visual domain. The concept of chaos as well as chaos theory was shown to have inspired the work *ac-1*, which suggests a turbulent-chaotic sonic environment and is generally suggestive of images related to chaos and turbulence in nature. The concept of entropy was shown to have influenced the final section of this work. This concept influenced creation of a sonic image that moves towards disorder while suggesting equilibrium through the way that individual sonic elements are given equal weighting within a textural macrostructure. This sonic image was compared to something being filled to its capacity. An analogy was
also made between this approach to sound and Arnheim’s description of equilibrium created through random elements in Jackson Pollock’s paintings.

At the beginning of Chapter 3 the relevance of synesthesia to the non-synesthetic composer or analyst of electroacoustic music was discussed. Smalley’s description of electroacoustic music as an “audio-visual art” involving “a weaker, voluntary, associative synaesthesia” (Smalley, 1992a) was considered, as were both and Galeyev and Ramachandran’s comparisons of synesthesia and metaphor. Experiments were then discussed that showed relationships between synesthetes and non-synesthetes. Timothy L. Hubbard’s experiments were of particular interest as they revealed synesthesia-like mappings between pitch and lightness in non-synesthetic participants. An inward ‘mind’s eye’ aspect of synesthesia discovered by Sacks was then compared with Emmerson’s description of a quasi-visual mindscape he experiences while listening to electroacoustic music. Galeyev’s description of an associative embodiment required by the abstract nature of music was compared to my own experience of an internal visual resolution of the meaning of sounds electroacoustic music. It was concluded that Emerson’s quasi-visual mindscape is a good reference point for composition while synesthetic metaphor and other forms of extrinsic reference are useful tools for composition and communication. This section paved the way for synesthetic analysis, a term used by Galeyev (2007), to be utilized in this thesis. Through this form of analysis concepts such as light, colour, transparency/opacity, weight, size, line, surface and edge would be considered as meaningful descriptors of sonic images.

A discussion proceeded on ways that light and colour can be considered as forms of extrinsic reference in electroacoustic music. Although it was stated from the outset that perception of light and colour in music is subjective, it was useful to explore cross-domain mappings in this respect. Brightness associations with pitch or frequency, colour and timbre associations and colour and pitch associations were discussed. Although I consider all of these associations as perceptually useful, suggestions of colour through pitch and
brightness/darkness through frequency were primarily demonstrated as relevant to works accompanying this thesis. Pitch was described as a way of introducing suggestions of colour to a sonic image due to the fact that source bonded or mimetic timbral material points towards real-world events while both pitch and colour are more abstract and removed from real-world events. However, another perspective was given that described how light/colour associations are made with the source of sonic material. It was also suggested that there can be perceptual interactions between source bonded colour associations and other quasi-synesthetic colour associations.

Suggestions of light through frequency, and colour through pitch and source bonding were demonstrated in the analysis of ac-4 and described as relevant to ac-2. Suggestions of colour through pitch were demonstrated in the analysis of ac-5. This analysis also demonstrated the use of static interference sounds to mask and reveal an aircraft image through different states of transparency, translucency and opacity. These states were based on Smalley’s qualities of spectral density. Based on Lotis’ ideas on use of the ‘theory of light’ in sound composition the concepts of hue and saturation were also considered in relation to the presence or absence of a dominant pitch within a sound. Application of these concepts was demonstrated in the analysis of Warp & Weft and ac-3.

The rest of Chapter 3 described an approach to composition and analysis that utilized concepts related to moving images in multimedia. As this approach considers sound composition as analogous to working with moving images it was useful to first consider comparisons between sounds and visual objects. These comparisons highlighted how sonic texture can represent surfaces while spectral or amplitude changes can represent discrete surface boundaries, surface intersections, changes in surface texture, and changes in surface illumination. This perspective on sound was described as particularly relevant to works that are suggestive of a visual environment such as Mathew Adkins’ Aerial and Denis Smalley’s Valley Flow. Ac-I was demonstrated as a similar form of work. This perspective was also shown as relevant to ac-5.
Aesthetics related to an images development in time in motion graphics design were then considered. Through the concept of nonlinear velocity it was described how a sound that changes unpredictably in its linear progression can be suggestive of natural motion and plasticity in the visual domain. Mechanical and fluid motion in the visual domain was described through the concept of linear velocity. Repetitive rhythm was described as an analogy for visual mechanical motion. An analogy for fluid motion in the vertical domain was described as linear movement through pitch space. Suggestions of horizontal fluid motion were discussed in relation to subtle repetitive rhythms or modulations applied to sounds of constant pitch. Linear and nonlinear velocity were discussed in relation to ac-3 and the film Warp and Weft. Nonlinear velocity was shown as relevant to ac-1 due to the presence of erratic gestures.

The multimedia concept of compositing, which applies to the blending of various visual images whether real or computer-generated, was described as an approach towards the creation of virtual spaces in electroacoustic music. This approach was described as one where sounds from different sources are combined to suggest a cohesive sonic image. At the macro level compositing is an approach towards creating a specific virtual space/environment throughout a work. This approach is applied through the use of spectral processes to blend sounds and through consideration of sonic material. Schaeffer’s concept of the pseudo-instrument was described as useful towards selection of sound material. Through this concept a genre of sound objects is created through common values that have been identified. At the micro level compositing is considered in terms of blending juxtapositions of sounds in work, for example, by using spectral processes to suggest fusion within a sonic image created through spatial montage and thus enhance its meaning. Therefore, although compositing is approached through attention to intrinsic sonic properties, its end result points towards the extrinsic through a consistent sonic environment at the macro level or enhancement of meaning within a montage at the micro level.

Compositing was demonstrated through the work ac-1. For this piece chaotic and turbulent values were identified in sounds to create a chaotic-
turbulent genre of sounds. A chaotic-turbulent sonic environment was thus compositied through these common values and the use of spectral processes. Therefore, meaning in this piece was demonstrated through this compositored image. Compositing was also demonstrated in ac-5. Its relevance to this work is summarized in the latter half of the next paragraph.

A different approach to the creation of virtual spaces was discussed through spatial and temporal montage. With this approach meaning is afforded through juxtaposition of contrasting sonic images in space and/or time. This approach was demonstrated in ac-4 through juxtapositions of sounds that suggest a machine/human dialectic. The narrative of this dialectic is also enhanced by another dialectic between vibrations and fragmentation, which suggests stability and instability. Spatial and temporal montage were also demonstrated in ac-5 through a narrative involving juxtapositions of aircraft sounds and sounds of static interference.

The use of blending in this piece also enhances the meaning of the juxtaposition of these sounds. At the same time a consistent sonic environment is suggested through similarity of aircraft and static interference sounds in terms of sonic grain and texture. Therefore meaning in this piece was demonstrated through montage and through compositing. This piece and ac-1 also demonstrated the influence of the concept of space-medium through suggestions of space as homogeneous substance, which invite the listener to perceive ambiguity between foreground and background.

Vectors, which are used in multimedia to analyse the directional behaviour of images were shown to be useful in creating or analysing relationships between sounds in terms of their directional behaviour. Just as paths of images can converge, diverge or continue on a screen it was described how sounds form similar paths in relation to motion in space, motion in pitch space or motion in terms of their behaviour.

Converging, diverging and continuing vectors in pitch space were described in relation to works of Xenakis. Vectors were described through relationships between visual images in The Dreammachine and Missing.
Continuing vectors between sound and image in space were demonstrated in the analysis of Missing and ac-2. In the analysis of Warp and Weft and ac-3 it was demonstrated how sound can interact with image vectors through a sound that moves from fast to slow in its direction while a hand gesture and a plastic/glass like image continue in a direction from left to right. In this example it was shown how change of speed in sonic direction could affect perception of speed in image vectors.

In the same analysis converging vectors between sound and image were demonstrated through a sound rising in pitch converging with the upper motion of a dancer.

In ac-5 diverging vectors were demonstrated purely through sound. In this example, an aircraft sound was shown to rise in pitch to meet a machine sound that falls in pitch and a simultaneous aircraft sound of stable pitch. It was shown how these vectors create tension and release and enhance the narrative by alluding towards both the power and weakness of technology. Meaning was thus created in this example through vectors and through montage. The last two examples are further demonstrations of the metaphor pitch relationships are relationships in vertical space.

Convergence of sonic behaviour was also demonstrated. Converging vectors were demonstrated in ac-4 through vibrating sounds that converge to a breaking point through their behaviour. This breaking point is enhanced by subsequent sounds of fragmentation. Convergence towards a structural change was also demonstrated in this piece through a sound slowing down while another falls in pitch. In ac-1 an example of vectors was demonstrated, which described sounds that gradually come to rest through behaviour, pitch and speed and converge towards a section of stasis.

Although an example of continuing vectors through sonic behaviour was not given, the example of entrainment between a sound and a physical model mentioned earlier in this chapter and discussed in Chapter 2.3.8 demonstrates this idea. Because one sound entrains the other both continue a similar
behavioural pattern and do not suggest convergence or divergence. A continuing vector was also described in relation to pitch in Xenakis’ Syrmos.

The use of vectors to describe relationships between both images and sounds formed an element of a similar approach to analysis of audiovisual and acousmatic works. Another concept applied to both images and sounds was montage, which was demonstrated in a visual context through analysis of images in the film Missing and as discussed, was demonstrated in a sonic context through ac-4 and ac-5. Also relevant to this approach was the fact that both sounds and images can be analysed in terms of intrinsic and extrinsic reference. The concepts of source bonding, metaphor and mimesis were thus described as relevant to both sound and image in relation to extrinsic reference.

In relation to visual images intrinsic reference was described as relevant to a sense of symmetry, motion and continuity through vectors in both The Dreammachine and Missing. In relation to sound intrinsic reference was discussed primarily through sonic blending in ac-1 and ac-5. In both the sonic and visual domain intrinsic reference was shown to enhance meaning created through extrinsic reference.

The equal relevance of extrinsic reference to sounds and images was evident in the analysis of The Dreammachine. This analysis showed how source bonding is relevant to images as well sounds as they both require a similar perceptual search in this work.

An example of the relevance of mimesis to visual images was given in this analysis through abstract green lines, which can suggest imitation of something natural such as rainfall. Examples of sonic mimesis are the plastic-like and glass-like sounds described in the analysis of Warp & Weft and ac-3. Another example of sonic mimesis was demonstrated in ac-4 where sounds from various sources are combined to imitate the sound of a machine.

Metaphor in a visual context was described through an increasing sense of depth in The Dreammachine. Meaning through metaphor in an audio-visual context was described through a duality between ‘captured/real’ and ‘synthetic/abstract’ sounds and images. This duality was discussed in terms of a
metaphor for a dialectic between the conscious and the sub-conscious. Both metaphor and source bonding are essential to this dialectic. Similarly, both of these concepts are essential to the machine/human dialectic in ac-4 and the dialectic between power and weakness of technology in ac-5.

In the analyses of audiovisual works Nicholas Cook’s models for analysis of multimedia were considered, with conformance and contest described as most relevant. While conformance relates to a direct perceptual mapping between sound and image where no new meaning results from their juxtaposition, contest describes situations where sounds and images are, to reuse Cook’s description “vying for the same terrain, each attempting to impose its own characteristics upon the other” (Cook, 1998).

It was also described how conformance and contest can be considered in relation to spatial juxtapositions of sonic images in acousmatic works. Contest was shown to be a useful term for discussing spatial montage in ac-4.

Conformance and contest were utilized to reveal meanings behind interactions between sound and image in the analysis of Missing and ac-2 as well as Warp & Weft and ac-3. The use of these concepts to analyze sound and image interactions also revealed meaning in ac-2 and ac-3 as standalone acousmatic works due to the fact that the sounds and structure of these works were influenced by the images and structure of the films.

In the analysis of Missing and ac-2 there was shown to be contest between temporal structures. In this instance the metaphor time-energy relationships are relationships in physical space proved useful as it was shown how the film is temporally defined by an arch or U-shape whereas the music is better defined by a downward or upward slope. The music was shown to initially conform to the visual temporal structure but then diverge through contest between sonic texture and visual gesture as the piece progressed.

Contest was also demonstrated in this analysis through tension created by a juxtaposition involving a harsh sound and a soft image. This was another demonstration of the metaphor timbral relationships are relationships in tactile space summarized earlier in this chapter. This example also demonstrated how
contest between sound and image can be considered as an example of spatial montage and how the latter can be perceived across perceptual modes. While an example was shown in the analysis of The Dreammachine of spatial montage between real and source bonded images, this example integrated the visual, sonic and tactile domains. A similar example was given through a harsh sound juxtaposed with a pendulum image suggesting a metaphor for the fragility of time.

The analysis of Warp & Weft demonstrated a different perceptual result between sound and image where a low frequency sound that slows down gradually is juxtaposed with a thin vertical object that moves at a constant pace. In this example contest through both time and weight/size of sound and image created a perceptual effect where it can appear that the image is slowing down.

The use of the concepts of weight and size provided another example of synesthetic analysis, which was particularly relevant to this work as images were considered as models to inspire the creation of sounds. As sound design and composition was influenced by motion, size, edge, transparency, colour, brightness and tactility in relation to visual images these concepts were used to analyze the music. This form of analysis was also demonstrated in ac-4 through contrast between sustained low frequency sounds in one section and short high-frequency sounds in another. An enclosed space with large heavy objects is suggested in the first section, while an open space with short/small chaotic bursts of sparks is suggested in the second. Descriptions of grain within a work and the use of any other non-sounding concept can also be described as a form of synesthetic analysis. However, the approach described in this thesis as a whole is effectively a form of synesthetic analysis as any consideration of extrinsic reference in relation to sound involves a certain crossing of perceptual modes.

Models for sonic images that continuously and iteratively informed me during composition of ac-2 and ac-3 are visibly available through the films Missing and Warp & Weft respectively. They are particularly visible through conformance, which was demonstrated in the analysis of Missing and ac-2 as
well as of *Warp & Weft* and *ac-3*, as instances of conformance in these audio-visual works are the result of a perceptual mapping between image and sound. The use of images as models was also demonstrated in the analysis of *Missing* and *ac-2* through three categories of visual texture that were applied to sound. It was also described how synchresis was essential during sound design based on visual models.

Models are also relevant to the three standalone acousmatic works discussed in this thesis. For example, models used to compose *ac-1* included the compositied chaotic-turbulent environment, the entropic image that becomes filled as it reaches equilibrium, the arch/U-shaped image created through time and the holistic image where time become space. Models for *ac-4* included the machine image, the machine/human image, images of vibration and images of fragmentation. As these models are not visually available the words in this thesis provide a physical manifestation of them. However, models are ultimately revealed through music.

Somebody recently told me that they dislike acousmatic music, as they get bored looking at loudspeakers and would prefer if there were visuals accompanying it on a screen. While I respect their preference for me this would miss the point, as I find that acousmatic music leaves the mind’s eye free from distraction and reveals a relentless flow of fantastic sonic images that give additional form and meaning to sound. When particularly good acousmatic works come to mind I can recall visual images without even thinking about sound. These images become established, modified and enhanced the more familiar I become with a work. This form of recall iteratively informs my approach to sound and structure in my own work. However, these images are not the product of an overactive visual imagination but are initially formed because reduced listening reveals different perspectives of sounds. Reduced listening can be a fully immersed experience where I think about nothing but sound itself but this process enhances images or reveals new ones that I would not have perceived through causal listening alone. These images are essential for contemplation and communication of my work. Research, analysis and
description of sonic images heightens my awareness of them, helps me to communicate my experience of music and points towards endless new ideas. Through sonic images and multimedia aesthetics, this thesis provides the field of electroacoustic music with a direct and cohesive approach to composition and/or analysis that also has great scope for expansion.
References


