Exploring Hybridity

An investigation into the integration of instrumental and acousmatic structural strategies

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Contents:

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Composition portfolio

Scores

-*Horus*, for trombone and cello (2009) (revised 2011) Duration:6'
Performance: Elision Ensemble, St. Pauls Hall, Huddersfield 12/2010.

-*Scratch*, for Viola, Cello and Double Bass (2010) Duration: 5'

-*Panorama*, 7 electroacoustic pieces (2008-2010) Duration: 54'
Performances: Corfu University Hall, Corfu 30/10/2010, Huddersfield Contemporary Music Festival, Huddersfield, November 2011 (Live performance), ICMC 2012, Ljubljana, September 2012 (Live), Beton 7, Athens (Live), 24/11/2012 (Live).

-*Calcination*, for amplified cymbal (2010) Duration: 6'
Performance: Joby Burgess, St. Pauls Hall, Huddersfield, 29/11/2010

-*Voyage*, 10 short pieces for piano and electronics based on Timothy Leary's 'The Psychedelic Experience' (1966), for piano and electronics (2010) Duration:12'

-*Beck*, for soprano saxophone, piano and percussion (2011) Duration: 9'
Performance: Nikel ensemble, Tzlil Meudcan Festival, Tel Aviv, 7/7/2011

-*Dreamscape,* electroacoustic poem in two parts (2012) Duration: 34'
Part 1: *Rainforest,* Part 2: *Black Moon*
Performances: Days of Electroacoustic Music 2012, Public Theatre of Lixouri, Lixouri, Kefallinia, 8/12/2012, performance of *Rainforest* at Centre San Fedele, Milan, 13/10/2012

Components of *Magical Theatre,* for seven instrumentalists and 8-channel electronics:

-*Electric Serpent*, for piano and 4-channel electronics (2011) Duration: 16'
Part 1: *Serpent on the edge of an abyss,* Part 2: *Electric Currents*
Performances: Sarah Nicolls, Huddersfield Contemporary Music Festival, Huddersfield, 21/11/2011, Noise Non-Ference, Dixon Place, New York, 29/3/2013

-*Liquid Glass*, for two percussionists and electronics (2011) Duration: 14'
Part 1: *Glass Flowers,* Part 2: *Liquid Drums*
Performance: London Sinfonietta, Huddersfield Contemporary Music Festival, Huddersfield, 19/11/2011

-*Spider Web*, for string quartet (2012) Duration: 10' (can also be performed together with *Acid Drops* as *Spider Web B*)

-*Acid Drops*, 8-channel electroacoustic music (2012) Duration: 10' (can also be performed together with *Spider Web* as *Spider Web B*)

-*Fissure,* for solo cello (2012-13) Duration: 6' (can also be performed together with *Waterfall* as *Fissure B)*

-*Waterfall*, stereo electroacoustic music (2012-13) Duration: 6' (can also be performed together with *Fissure* as *Fissure B*)

Recordings

-CD1 *Panorama*
Tracks:
1. *Panorama 1*
2. *Panorama 2*
3. *Panorama 3*
4. *Panorama 4*
5 *Panorama 5*
6. *Panorama 6*
7. *Panorama 7*

-CD2 *Panorama Mixes*
live laptop improvisational mixes of *Panorama* (studio edits)
Tracks:
1. *Panorama Mix 1*
2. *Panorama Mix 2*

-CD3 Instrumental works
Tracks:
1. *Horus* (2009 version), for trombone and cello
2. *Calcination, f*or solo amplified cymbal
3. *Beck,* for saxophone, piano and percussion

-CD4 *Dreamscape*
Tracks:
1. *Dreamscape Part 1: Rainforest*
2. *Dreamscape Part 2: Black Moon*

-CD5 Components of *Magical Theatre*
Tracks:
1. *Electric Serpent* (stereo mix), for piano and electronics
2. *Fissure B,* for cello and electronics
3. *Acid Drops* (stereo mix), electroacoustic music
4. *Liquid Glass* (stereo mix), for two percussionists and electronics

Data CD
-Max/MSP patches for *Magical Theatre* and *Voyage*:
1. stereo cue player,
2. 8-channel cue player,
3. 8-channel cue player with video
-Audio files in different folders:
Electric Serpent,
Waterfall,
Acid Drops,
Liquid Glass,
Voyage.

Abstract

The aim of this commentary, which accompanies a folio of electroacoustic/acousmatic, instrumental and mixed compositions, is to investigate the relationship of instrumental and acousmatic compositional practices and to find common integrating structural strategies. These practices are also related to the handling and organization of disparate and large amounts of sound information in both media.

Multi-dimensional aural spaces are very common in both instrumental and acousmatic media when timbre becomes a dynamic and form shaping parameter. The listener may perceive the musical discourse in multi-dimensional musical spaces through multiple perceptional modes. A musical syntax of those - usually indeterminate and ambiguous - aural spaces may be achieved through a hybridization of interconnected temporal concepts, connected to motion, gesture and shape, and spatial concepts, connected to sound source and timbre.

The narrative structure of the musical discourse is linked to conceptualizations of physical and conceptual musical spaces through cognitive schemas and patterns and can be approached through visual and spatial metaphors that resemble film and TV montage structures. A sound montage theory provides a basic framework for the organization of narrative structure in sound composition.

Introduction

My interest in the relationship between acousmatic and instrumental practices began with some personal observations that were the catalyst for this project and will be addressed in more detail in the following chapters:

- Instrumental and acousmatic musical materials may share some common structural qualities.
- A huge amount of sound information (coming from both media) is at the disposal of contemporary composer.
- Multiple perceptual approaches to sonic phenomena in both media may be a particularly important characteristic of textures that combine diverse aural informations.
- I observed that improvisational and generational approaches create a kind of immediate acousmatic vocabulary which is related in some ways to instrumental vocabulary. This observation led me to notice that the improvisational and generative approach are both connected to an embodied perception of musical discourse and reveal intrinsic structural potential of the sound material that are not yet clearly or systematically articulated.
- A gap seemed to exist between how instrumental and acousmatic sound is perceived and how is expected to function in a concert context.

Finding a common ground between instrumental and acousmatic materials seemed to be an important first step on my attempt to integrate a multiplicity of aural information coming from both media. A transference of instrumental structural strategies to the acousmatic medium though, may not be compatible with its materials and interfaces and thus may limit compositional imagination. The transference of acousmatic practices to the instrumental medium may also heavily distort the original acousmatic ideas for the same reasons. Additionally, structural strategies based on instrumental musical thought may not be compatible with an acousmatic approach. In the composition of mixed works the above issues become even more relevant. A series of basic questions arose through my investigation of the

relationship between the two media. How much instrumental thought can influence acousmatic thought without opposing the nature of the medium? How much acousmatic thought can influence instrumental thought considering the various limitations of the medium? What are the common structural strategies in the two media?

A seemingly simple but important issue that I faced is the finding of a common vocabulary for the description of sound phenomena. In an attempt to organize musical discourse, the composer of acousmatic music may borrow instrumental terms for describing acousmatic musical material. Especially in mixed works, the composer conceptualizes the abstract acousmatic sounds and it becomes unavoidable to use terms borrowed from instrumental practise. Instrumental terms, though, are linked to the sound making mechanisms of the instruments and may be misleading when applied to a medium with a different interface between the composer and the sound. For example, in instrumental music the basic note gesture may be considered to be the minimal hierarchical element of various textural shapes.[1] Transferring the notion of the note gesture as the minimal hierarchical element of complex acousmatic textural shapes may be incompatible with textures resulting from recordings of everyday world sounds or with textures transformed through electronic studio techniques. Finding then a terminology able to describe both instrumental and acousmatic materials and methods seems to be of great importance when working in both media. Lasse Thoresen's graphical revision of Pierre Schaeffer's typomorphology of sound objects (Thoresen, 2007) provides useful basic concepts and terms which describe acousmatic sound and can also provide a link with the instrumental medium.

Iannis Xenakis is a composer who, like Schaeffer, attempted to form a new general musical theory that could involve sound material not yet accepted and formalised as musical material. In his theory, Xenakis incorporated concepts from mathematics, chemistry, geometry and architecture. Xenakis moved instrumental musical thought closer to the natural world or everyday sound world (his metaphors about sound masses in relation to natural phenomena such as rain testify to that). In my view, by approaching both instrumental and acousmatic musical material through some common extra-musical systems of organization, Xenakis's

1 Denis Smalley refers to the "...note as the basic gesture-unit of instrumental music" and proposes that it is comprised of three temporal phases: *onset*, *continuation* and *termination* (Smalley, 1997, p.112).

conceptualizations and metaphors facilitated the contact of the two media (for example, the application of probabilistic methods of sound organization, previously applied in purely acoustic works, in electroacoustic pieces such as *Gendy 3* (1991) or *S.709* (1994)).[2]

A parametric approach of various physical gestures of the performer allows the creation of multi-dimensional musical spaces (such a physical multi-dimensional musical space is, for example, the one defined by simultaneous bow motion along the strings and bow pressure on a violin). Multi-dimensional musical spaces are also very common in acousmatic music. Generation or transformation of acousmatic sound objects is usually achieved through automation of multiple software parameters which define musical spaces with multiple co-ordinates. The morphology of these acousmatic sound objects may be simulated in instrumental music by either generation or transformation of instrumental sound through similar procedures. These procedures can be found in the works of Brian Ferneyhough (e.g. *Unity Capsule,* for solo flute (1973-76)) and Helmut Lachenmann (e.g. *Pression,* for solo cellist (1969-70)).

Technology in the acousmatic medium is usually the interface between composer and material and is thus related to the notational interface of the instrumental medium, between the composer and the instrument. While technology certainly influences compositional methods, aural approach of musical material seems to be of great importance for evaluating relations between different materials and making decisions concerning higher structures. Denis Smalley's *spectromorphology and* Lasse Thoresen's *aural sonology* may provide aural tools for a formalised approach to structure in the acousmatic medium. Taking into account that these theories are concerned with diverse musical materials, an aural theory of instrumental music may be seen as a subgroup of this general theory. Spectromorphology and aural sonology can link instrumental and acousmatic musical thinking through an aural investigation of the morphology of texture and gesture.

A final issue, concerning both media, is the perception and functionality of musical structures and the narrative structure of a composition as a whole. The notion of function is tied to tonal musical structures, especially in relation to harmonic functions. The composer of

2 A detailed investigation of the issue can be found in Makis Solomos' article: 'The Unity of Xenakis's Instrumental and Electroacoustic Music: The Case of “Brownian Movements” ' (Solomos, 2001).

acousmatic music is also intuitively or consciously working with structural functions. Cognitive psychology, applied to tonal music, as shown by Candance Brower, can offer an abstract explanation of functionality of tonal musical structures (Brower, 2000).[3] Cognitive psychology and metaphorical concepts borrowed from the visual arts applied to morphological shapes and structures of acousmatic and instrumental music may offer insights into the functionality and narrative structure of instrumental and acousmatic material. I will use some concepts borrowed from the visual arts and film montage in order to explain my approach to narrative structures in both media.

It is obvious that this research does not involve an exhaustive investigation of the relation between instrumental and acousmatic music. I am mainly interested in morphological relations and common structural strategies between the two. My work involves acousmatic, instrumental and mixed works. Instrumental concepts may be incorporated in acousmatic works while acousmatic concepts and methods may be employed in instrumental works, but more importantly, I aim to integrate the two media and find common metaphors able to conceptualize diverse musical material in mixed works.

To summarize, the notion of hybridity between acousmatic and instrumental structures and methods is an important concept in contemporary musical practice. I will investigate certain aspects of this complex relationship through the aid of spectromorphological analysis, Pierre Schaeffer's theories, cognitive psychology and also Sergei Eisenstein's montage theories. In the first part I will investigate the nature of the media and musical material and the basic concepts that can provide a link between them. In the second part I will explore certain spatial and temporal structures and strategies that unite the two media and provide examples from my work. In the third part I will investigate higher level structural strategies, extra-musical concepts that may unite diverse structural approaches and provide examples.

3 Candance Brower in her article 'A Cognitive Theory of Musical Meaning' proposes an explanation of traditional tonal harmonic functions through an application of image schemas (patterns abstracted from bodily experience) borrowed from cognitive psychology (Brower, 2000).

1. Context, media, musical materials

1.1. Differences between acousmatic and instrumental material

1.1.1. Properties of gesture

Physical gesture is the basis for the generation of sound in instrumental music. The word gesture though is somewhat vague. The action of hitting the keys on a mechanical piano and blowing a tube have little in common. Furthermore, the oscillation of a loudspeaker which generates sound may also be considered as a type of physical, gestural activity. Smalley, describes gesture as 'an energy-motion trajectory which excites the sounding body, creating spectromorphological life' (Smalley, 1997, p.111). In instrumental music, because all sounds are physical, we usually do not distinguish between the signifier of gesture - the notation on a score - and the actual physical gesture. Notation though, carries some abstract musical information about movement in time that may not be connected to a particular physical gesture and thus, sound. It is easy for the composer to overvalue the abstract or the physical properties of gesture. If the abstract properties are prioritized then the composer may lose important sound qualities and details of the physical gesture, while on the other hand, when the physical properties are prioritized the ability to manipulate and organize gesture through abstract systems or notational or other interfaces may diminish. Particularly when working in both media the composer has to find a balance between these two approaches to gesture through a reconciliation of structural methods and compositional and notational interfaces.

1.1.2. Technological and aural approach of acousmatic music

Concerning the large and diverse amount of software and hardware available today and the different possibilities (often complementary) and interfaces that they offer to the composer, I believe that a unifying way of approaching them from a technological point of view would be futile. Additionally, an approach to acousmatic musical structure based on instrumental concepts (i.e. employing notions such as melodic lines, counterpoint, harmony, etc.) can be extremely limiting and usually incompatible with acousmatic material and

technology. An aural approach (as opposed to a technological approach) to both instrumental and acousmatic media is the basis for finding common concepts and structural strategies.

Spectromorphology, invented by Denis Smalley, and Lasse Thoresen's *aural sonology* are aural tools employed for analysis and description of music and are generally applied to the analysis of acousmatic music. I am approaching spectromorphology and aural sonology as general tools for the description of the musical discourse in both media, considering that much of today's instrumental music may no longer be approached through traditional concepts such as pitch, rhythm or theme, but rather through concepts such as sound spectra, motion and behaviour. When common concepts are found, then a compositional methodology which takes them into consideration may provide solutions to problems that arise from differences between types of interfaces and materials.

1.1.3. Notation and interface

Compositional decisions in instrumental and acousmatic music may vary according to the interface between the composer and the musical material. Creative imagination can be heavily influenced by musical instruments and their performance tradition and also by instrumental notation, which may be considered as the interface between the composer and the instrument. The composer of acousmatic music records sounds, produces sounds and transforms sounds, usually without the need of notation. If we should find a concept similar to the instrument in acousmatic music, that, in my opinion, would be the devices used for recording sounds, the software or hardware that is used to process them and the sound producing equipment. Denis Smalley, referring to types of timbre that are indigenous to electroacoustic music, mentions that one is the *processing timbre* of the software and hardware equipment and the other is the *loudspeaker* (Smalley, 1994, p.46). We could consider that the loudspeaker is the equivalent of the instrument in acousmatic music, but taking into account that it is rarely in the control of the composer (the composer is rarely composing for a particular type of loudspeaker), I think that this would be an overstatement. The studio equipment on the other hand offers usually specific compositional possibilities, it has its own characteristic timbre and it may even be activated through gesture, characteristics

which mirror similar properties of the instrument.[4] The composer of acousmatic music may be considered to be also the performer of his music in that he creates and shapes, to a certain extent, the sound materials himself.

Brian Eno was one of the first to suggest the idea of the studio as an instrument (Eno, 1979). Eno suggests that while working in the studio 'one becomes empirical in a way that the classical composer never was. You're working directly with sound, and there's no transmission loss between you and the sound-you handle it. It puts the composer in the identical position of the painter... ' (Eno, 1979, p. 129). If we consider that the acousmatic composer works similarly to the painter, the notational interface, which was very important in instrumental music, loses its importance or disappears completely in the case of acousmatic music. The disappearance of notation, on the one hand, offers a huge amount of new possibilities that were not even imaginable when the notational interface was inserted between the composer's imagination and the sound material, but on the other hand brings a great amount of responsibility to the composer, who now has to perform or produce the final sounding result without the intervention of the performer. We may also observe a similar situation in the instrumental medium, in the case of instrumental free improvised music, where the role of performer merges with that of the composer.

Although there is no need for notation in acousmatic music, there are still limitations and interfaces that are dictated by the particular technological equipment used. An interface between the composer's imagination and the sound material still exists in acousmatic music and that is the technological equipment. The ability to move easily between various technological and notational interfaces is certainly most desirable for the acousmatic and mixed music composer.

1.1.4. Listening intentions and the musical and narrative layers

Gesture as a physical activity is linked to a specific sound source. Denis Smalley uses the term *source-bonding* to 'represent the intrinsic-to extrinsic link from inside the work

4 This definition of acousmatic instrument is made from the point of the composer rather than the listener and is quite different from the traditional general definition of instrument according to Schaeffer. A distinction should also be made between the physical instrument, the recording of an instrumental sound and its manipulation in the studio.

to the sounding world outside' and he terms the gradual remoteness from gesture to sound *gestural surrogacy* (Smalley, 1997, p.110). The intrinsic musical properties of sound and the extrinsic, concrete properties of sound (see also Nattiez, 1990, pp. 115-119) point to two different types of listening intentions that became more relevant with the emergence of acousmatic music. Michel Chion terms casual listening the mode in which we gather information about the sound source, and reduced listening the listening mode in which we hear the sound as itself (Chion, 1994, p. 25-9).

James Andean observes about *musique concrète* that '...the unique beauty of the genre lies precisely in this duality: the pure musical world on the one hand...and on the other hand, the stream of sources and images these sounds evoke' (Andean, 2010, p.108). He terms these two layers as the *musical* and the *narrative* and he also proposes that maybe 'what we experience as dual layers in acousmatic music, is in fact, the result of different processing times for different aspects of the same stimuli' because perception of these two aspects rely on same processes and reflexes of the mind' (Andean, 2010, p.114).

It is obvious that the more immediate perception of the concrete, source-bonded layer may enforce the musical layer and interact with it in various ways. For example, in the first 30 seconds of my piece *Panorama 5*, a phrase articulated by a synthesized gestural layer with no clear source-bonding is presented. In order to enforce its ending at 0.26''-0.30'' a second source-bonded layer is added that resembles falling wooden objects. The two layers have similar musical characteristics which enable them to blend smoothly. The insertion of the wooden layer to the end of the phrase then creates the illusion that the synthesized layer morphed into falling wooden objects, which enforces the cadence-like perception of its ending. Furthermore, the characteristics of the source-bonded layer have been linked in our perception with the synthesized layer because of their similar behaviour, and even if the source-bounded layer is not heard we can still perceive the synthesized layer as a continuation and distortion of the source-bonded layer.

In instrumental music, although we are usually aware of the clear instrumental source of the sound, we tend to perceive music through the musical, reduced listening mode. The fixed articulations of the instruments aim to direct the listener's attention to the abstract,

musical layer. Smalley though suggests that gesture in instrumental music refers to the extrinsic matrix (the sounding world outside the musical work (Smalley, 1994, p.37)) that acousmatic music also refers to.

> 'Lest anyone should think that the extrinsic matrix is irrelevant to instrumental source-cause – that instrumental music refers only to itself – it needs to be underlined that behind the causality of instrumental gesture lies both a broader experience of the physicality of gesture and its proprioceptive tensions, and a deeper, psychological experience of gesture. In instrumental music human-bonded source-cause texture represents these primal levels of gesture found in the extrinsic matrix' (Smalley, 1994, p.39).

Instrumental gesture is not without extrinsic references, which may also be indispensable for its perception and function. These references may be vocal articulations, natural sounds or physical experiences of gesture and are of particular importance when we want to emphasize the narrative, source-bonded layer and also when we wish to connect, through source-bonding, instrumental and acousmatic materials.

In section five of my piece *Electric Serpent* for piano and electronics, the performer scrapes the bass strings of the piano with a coarse, plastic, rectangular object (a plastic ruler). The physical action of scraping the strings is a characteristic violent, gestural activity, which is linked to a specific physical experience of gesture and physical material outside the musical work. In that case, the physical activity of scraping the strings is more important than the abstract musical layer perceived through reduced listening (expressed mostly through the notated speed and direction of scraping) and for that reason I indicate on the score that the performer may perform freely a range of circular motions on the strings, which cannot be precisely notated (and even if they were, the difference between the different types of motion would not be perceived, the complexity of the notation would be dramatically increased and the spontaneity of the physical activity of the performer could be lost). It is also important to note in this example that my intention was to blend and play with the abstract or *reduced* and the concrete or *casual* ways of perceiving the musical discourse throughout the piece. This

type of perceptual multi-dimensionality is the basis for the construction of *Magical Theatre,* for seven instrumentalists and electronics, part of which is *Electric Serpent*.

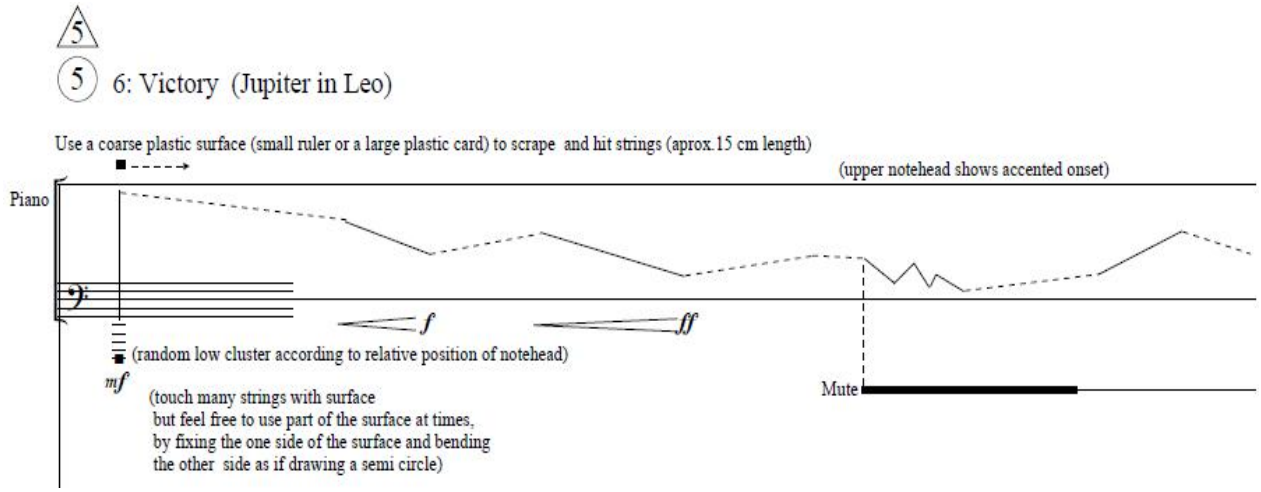

Figure 1. *Electric Serpent*, beginning of section five, notation of scraping of the strings with a plastic object.

1.1.5. Texture and behaviour

Gestures combined, linearly or simultaneously, construct higher-level structures such as phrases or textures. Texture may refer to a higher level organization of gesture or it may also refer to the inner details of gestures, as in the case of granular sounds. A traditional definition of texture could be the description of 'the vertical build of the music - the relationship between its simultaneously sounding parts - over a short period of time' (Newbould, 2002, 'texture'). Texture can be perceived either in an additive way as an accumulation of sounds or in a subtractive way as a container of sounds. Considering that vertical and linear aspects of music are two different aspects of the same united musical space (sound always has a vertical dimension), texture may refer to both linear and vertical dimensions of music. Gesture and texture can be considered complementary notions. Smalley observes that 'individual gestures can have textured interiors, in which case gestural motion frames the texture' and that 'gestures can stand out in foreground relief from the texture' (Smalley, 1997, p.114). The change of aural focus from texture to gesture and vice versa can have great implications in the narrative structure of music. Texture can acquire gestural identity when its constituent elements behave as a unity and gesture can acquire textural

identity when its unity is scattered through different sound layers.

Monophonic, polyphonic and homophonic textures are the most common traditional types of textures. These types of textures define different behavioural relationships between layers. Traditional notions of texture are much linked to tonal music with its clear separation of instrumental layers in pitch space. Smalley's concept of behaviour is closely related to textural types:

> 'The metaphor of behaviour is used to elaborate relationships among varied spectromorphologies acting within a musical context...Behaviour has two interactive, temporal dimensions, one vertical the other horizontal. The vertical dimension is concerned with motion coordination (concurrence or simultaneity), while the horizontal dimension is concerned with motion passage (passing between successive contexts)' (Smalley, 1997, p.118).

There is a temptation to define under a single term a new type of texture, considering the materials of acousmatic music. However, Smalley argues that 'acousmatic music is not necessarily composed of discrete elements; nor can we find that (consistent) measure of minimum movement density' and '...there is no permanent type of hierarchical organisation for all electroacoustic music, or even within a single work' (Smalley, 1997, p. 114). Claus-Steffen Mahnkopf also observes a similar notion in instrumental music: 'music now bids farewell to the ONE structure that functioned as the ideal of all integralist conceptions from Bach to Boulez. We are dealing with a structure that simply no longer knows this one totality, as it deconstructs itself within itself' (Mahnkopf, 2004, p.11). Although we cannot define a single textural type for today's acousmatic or instrumental music, that does not mean that textural types are not important. Actually I would argue that the opposite is true. The absence of a single textural type that defines the composition makes changes in textural types or behavioural relationships an even a more important shaping parameter, because textural changes draw more attention from the listener.

This is something that I have exploited in most of my works, in both media, in order to facilitate change and to differentiate between various sections and create clear

narratives. For example, in my string trio *Scratch*, each section is defined by a significantly different type of texture. Specifically, the first section starts with the three instruments moving their bow along the strings, from sul ponticello to extreme sul tasto, while pitch remains stable (although heavily distorted through extreme bow pressure). The shape of the bow motion, which is the main sound producing gesture, is similar in all instruments (it has a type of triangular waveform shape), though they are not precisely aligned but are rather out of "phase". Bow speed changes are also not aligned.

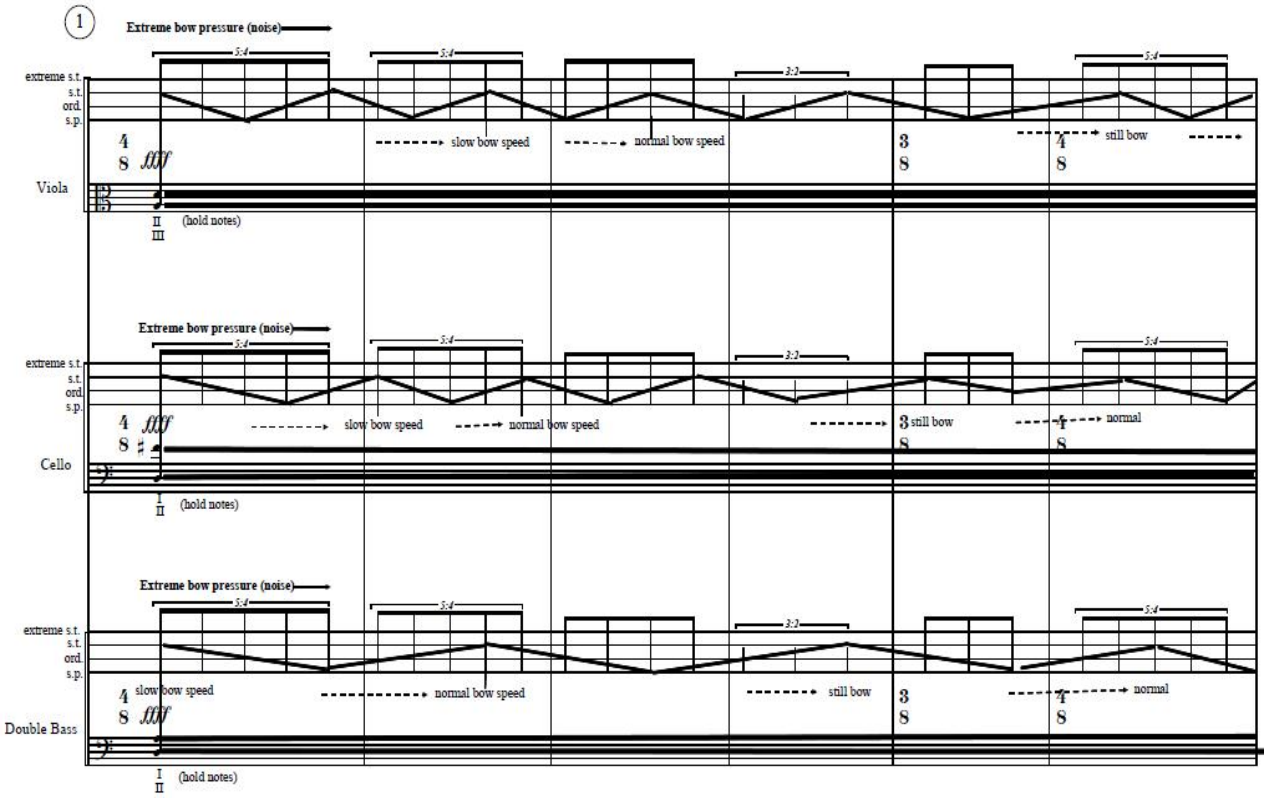

Figure 2. *Scratch*, section one, bars 1-6, out of "phase" gestures.

In section three, pitch is now in motion but not rhythmically aligned; actually, now pitch motion has a shape which is similar to the bow motion in section one. Bow motion along the strings, bow pressure, bow speed and dynamic changes have irregular patterns, creating an unstable musical texture consisting of multiple different instrumental sounds.

In the last, fifth section of the piece, pitch and bow pressure are stable, while bow speed, bow motion along the strings and dynamic changes are aligned in all instruments. The similarity of timbre of the three instruments and the gestural "unison", facilitates the

perception of texture as a single sound entity rather than a combination of three instrumental layers.

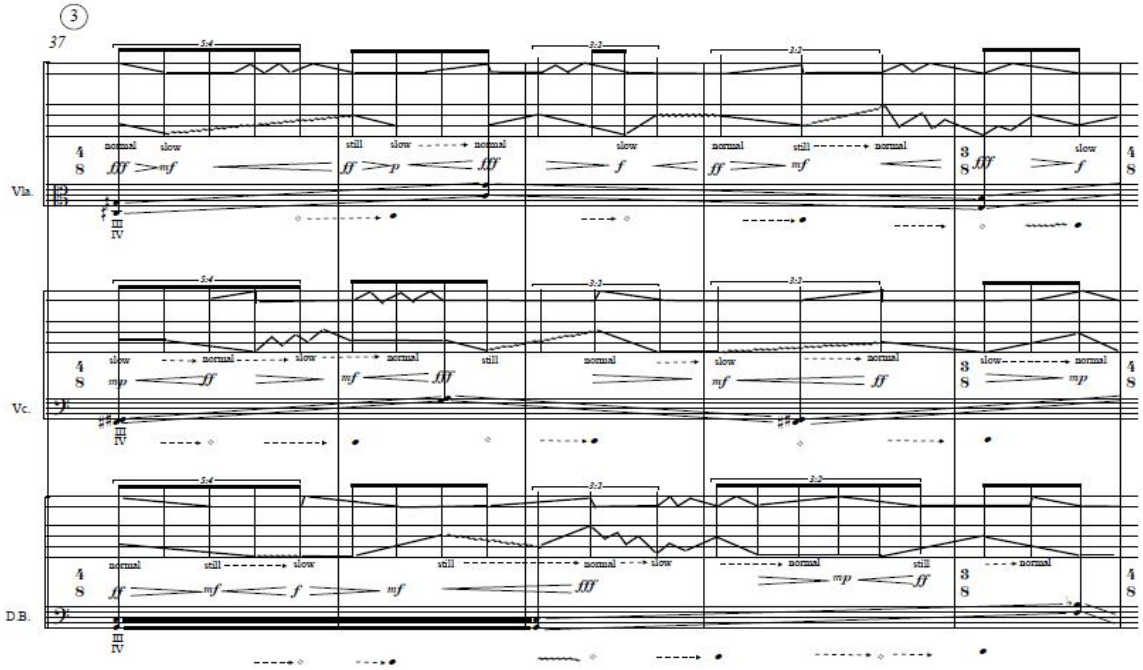

Figure 3. *Scratch*, section three (bars 37-41), irregular changes of parameters in three instruments

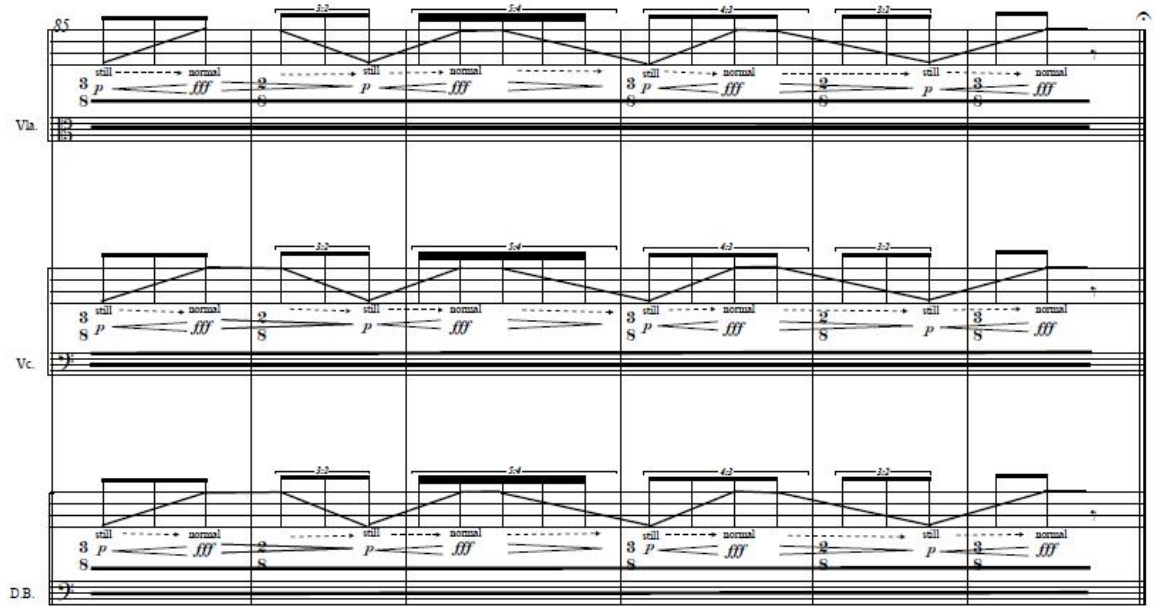

Figure 4. *Scratch*, ending of piece (bars 85-90), alignment of all gestures.

Similarly, in my piece *Horus*, for trombone and cello, I have started the piece with a texture consisting of irregular gestural shapes in multiple sound domains. The trombone sound is defined by the opening and closing of the harmon mute with the hand which is notated in the first staff, change in embouchure pressure notated in the second staff, and slide motion

notated in the third staff. The cello sound is defined by bow activity (bowing of strings and motion along the strings), left hand fingerboard motion, and pressure, which affects the pitch. Various articulations and dynamics are used in both instruments. The fast irregular changes of articulations and sounds, produce a kind of "pointillistic" and multi-timbral texture with an exaggerated, almost cartoon-like behaviour.

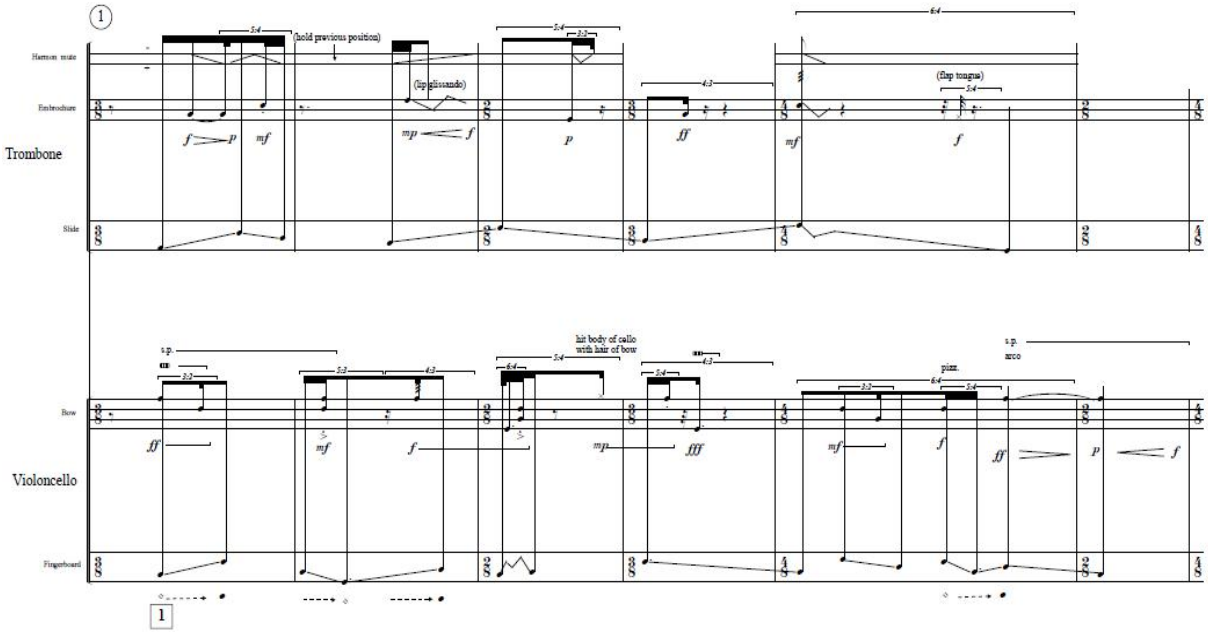

Figure 5. *Horus*, beginning of section one (bars 1-6), "pointillistic" texture.

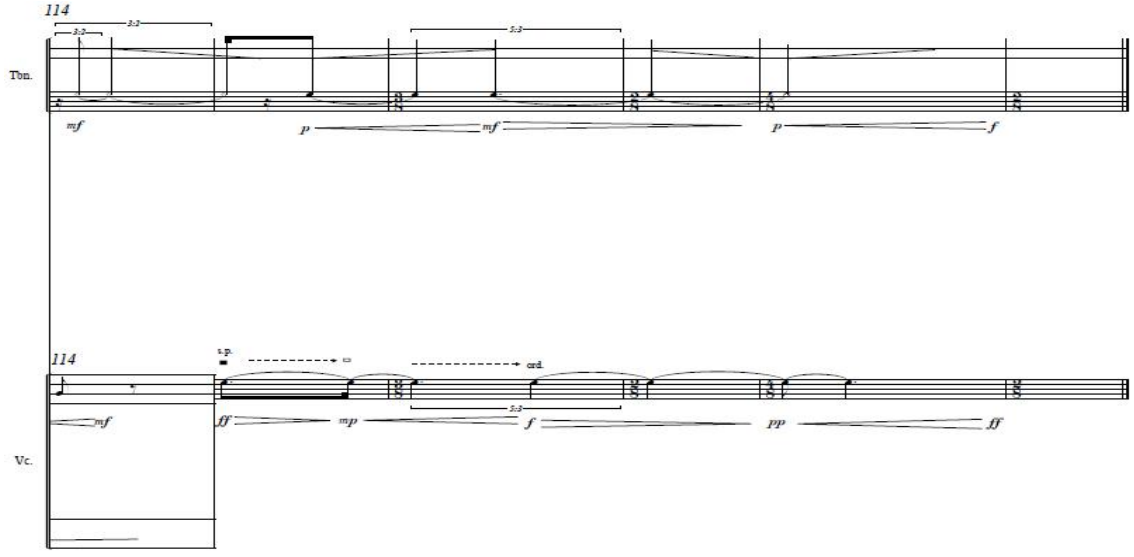

Figure 6. *Horus*, ending (bars 114-119), pitch unison and dynamic alignment.

Gradually, towards the end of the piece, the texture becomes calmer and sustained tones prevail. The last measures of the piece consist of a single sustained G in both instruments, with a dynamic shape which is slightly out of phase. In this texture, gestural alignment and pitch

unison creates the illusion that the instruments have transformed to a single hybrid instrument comprised of both trombone and cello timbres.

In my acousmatic and mixed works I have also used a type of gestural "unison" in order to create textural change and connect different sound materials. The first part of *Electric Serpent* ends with a homogeneous white noise texture which has a single dynamic shape and can be perceived as the integration of the noisy electronic texture and the piano sound, which is produced through scraping (with variable pressure) and hitting the bass strings of the piano with a long plastic, rectangular object. The harsh noise texture masks the spectrum of the piano cluster, while its temporal envelope has much in common with the source-bonded scraping of the strings, creating thus the illusion that both electronic and instrumental textures have been united into a single abstract noise texture.

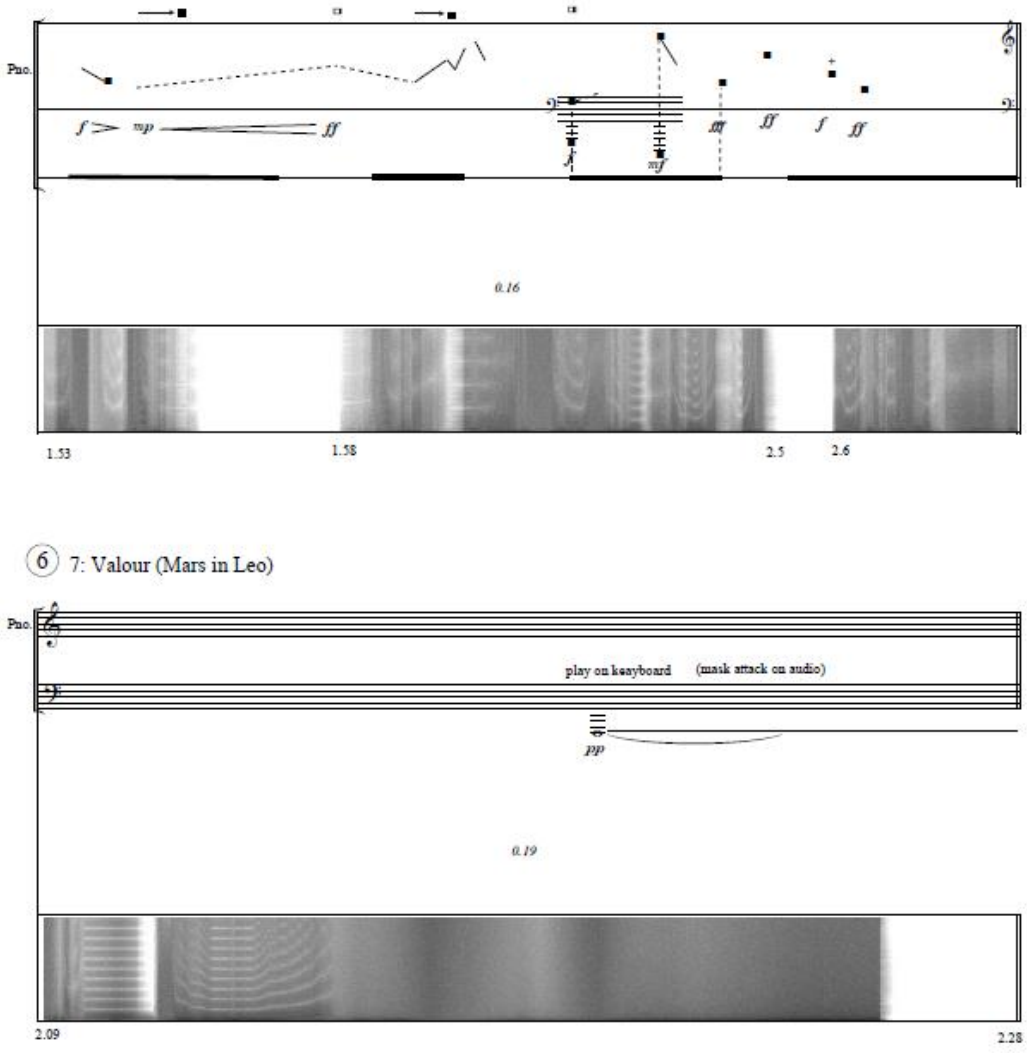

Figure 7. *Electric Serpent*, ending of section five and section six, integration of piano and electronic sound.

1.2 Structural issues

1.2.1. Spatial structures

Both instrumental and acousmatic sound objects (I use the term to describe sounds perceived as parts of a musical composition) have some properties that are temporal and some properties that are spatial. Xenakis's concept of outside-time structures, such as scales or sets of pitches, is an example of structures that are spatial, and time serves only to manifest them; in the case of scales, the spatial feature is a selected part of pitch space. Besides pitch space, or spectral space in general, the sound object may move in many other spaces that are of particular importance in acousmatic music. Smalley's notion of the *holistic view of space-form* is quite similar to Xenakis's outside-time structures. Referring to a personal aural experience of a natural soundscape Smalley observes that:

> 'Possibly the most important strategy in arriving at an holistic view of the space-form of this experience is that I disregard temporal evolution: I can collapse the whole experience into a present moment, and that is largely how it rests in my memory. The temporal disposition of, and relations among, sounds serve to articulate and shape spectral and perspectival space, but even though my perception of sound is a product of time, I ultimately sideline time's formative role' (Smalley, 2007, pp.37-8).

If we disregard temporal evolution of the sound object then we may extract its essential character. Outside-time, space is what gives identity to the sound object. Its identity could be defined by a specific timbre in spectral space, a sound source in source-bonded space, a behaviour in behavioural space, etc. Instrumental and acousmatic sound objects may then be connected through a proximity of musical spaces.

1.2.2. *Characters, Values* and multi-dimensionality

Relevant to spatial structural concepts are the concepts of *characters* and *values*, proposed by Schaeffer to describe qualities of sound objects and ensure the unity of musical discourse:

> 'The *values* are the features of a given sound-character that through their differentiation form the pertinent elements of musical structure; the *characters* are the remaining, less changing, more repetitive features of sound, those that do not constantly change but through their static quality serve as a common background facilitating the integration of differential values into a unified pattern' (Thoresen, 2009, p.310).

These are general concepts which are applicable to both instrumental and acousmatic structures. Lasse Thoresen expands on the issue:

> 'In traditional music the structural discourse consists in motives, melodies, harmonies, themes; the timbre of the instruments playing the music serves a subordinate role. However, in sound-based music using relatively short sound-events *the differential play with the single elements usually establishes no identifiable pattern of its own; it is the difference between characters that clearly is the most prominent aural feature while the play with the values within each character establishes no 'structure' nor any recognizable identity.* Therefore, the play with the differential values serves only a subordinate role in creating variation, while the sound character is the dominant element of the two in that it represents the listener's primal focus. The function of the play is, using a word that evokes Schenker's theory of tonality, *prolongation* – in our case not of a tonality but of a timbral character and behaviour. Accordingly, the character of the sound object (its timbral dimension) and its prolongational, temporal behaviour can be subsumed under the same category: we propose that the u*nion of sound-character and temporal behaviour be termed integral sound character*' (Thoresen, 2009, pp.314-5), (italics in the original).

I consider that the sound characters are outside-of-time spaces, while the values are movements of parameters in time, inside the spaces of the sound characters (values may also be spaces inside spaces). The integral sound character is the aural image of the

prolongated space of the sound character in time and is important in designing large scale structures.

Taking into consideration that spaces may have multiple dimensions, the characters may be approached on different levels and refer not only to timbre but to various structural elements. Trevor Wishart observes that sound composition rejects the traditional, simplistic two dimensional musical structure (time versus pitch), and that multi-dimensional spaces, defined by multiple sound parameters, offer the possibility to create stepped lines in any direction instead of any preferred axis of space (Wishart, 1994, p.103-4). In acousmatic music, that is possible through multiple time-varying envelopes applied on different parameters. In instrumental music this is also possible through parametrization of instrumental gestural activity or, mostly in orchestral music, through combining and morphing of instrumental layers.

I will employ the term space and various spatial metaphors throughout my text in order to describe sonic phenomena that relate to change and stability. The term space is connected to an embodied perception of music that is appropriate for the description of the abstract, musical layer of the musical discourse that operates in spectral space. Space should also be understood as having multiple levels that refer to different perceptual information coming from sound material that may be perceived through different listening modes. I will basically refer to Smalley's general definitions of musical space (Smalley, 2007). Physical space would refer mainly to gestural space when it is used to describe middle level structures (the physical space of the instrument-performer interface) and performance space the space where the sound is projected or performed. Spectral space is the acoustic space that we perceive through a reduced listening mode with pitch space being its subset. Aural space is a general term that implies both a perception of spectral space and any other type of semantic information linked to the sound.

While working in multi-dimensional spaces and with multiple sound characters and in various listening modes, it is important to prioritize the parameters that are most prominent. In a texture comprised of multiple different timbres ranging from noise to pitched sounds, the pitch motion would be perceived as a relatively insignificant parameter, while the density of the various timbres would probably be perceived as the most prominent feature in defining the

identity of the musical texture.

Examples of this can be found in my pieces *Horus,* for trombone and cello and *Spider Web*, for string quartet. In those pieces I have employed textures comprised of multiple instrumental timbres. On the string instruments I have employed sounds such as the ones produced by hitting the bow on the wood of the instrument, extreme bow pressure on the strings, bouncing bow, pizzicato, etc. When all these sounds are rapidly alternating, the importance of pitch is diminished and thus I have left decisions concerning pitch (such as the opening and precise position of the left hand) to the performers although in parts where the texture is more stable timbrally (i.e. at the end of *Horus* or at the first and second parts of *Spider Web*) pitch gains in importance and thus it is precisely notated.

2. Hybridity in lower and middle level structures

2.1.The three listening intentions

I have already suggested that the musical work can be perceived through different listening modes, which may interact with each other. We can connect these listening modes to different time scales. Curtis Roads distinguishes nine objective time scales ranging from the infinite short to the infinite long (Roads, 2001, p.3). Lasse Thoresen's aural sonology, which aims to analyze the observable aspects of the aural experience, defines three listening intentions directly related to listening memory (Thoresen, 2007b). The first is concerned with *reductive listening*, or the intention to listen for how the sound-object is constituted (Thoresen, 2010, p. 84). In a second listening level we are listening to sound patterns through a *taxonomic listening*, and in a third listening level we perceive "form-building patterns" produced by level two sound patterns (Thoresen, 2010, p. 84). We have then recognition of aural space or timbre, patterns or temporal behaviour, and higher level form units.

On the micro level of the first listening mode, we usually instantaneously recognize the sound and we may link it to a real or imaginary source. Timbre, either as sound source or as neutral temporal vibrations, is recognised in this listening level. In the second listening level we perceive sound patterns, shapes or gestures. That is the level closer to human and bodily perception of time and it is also connected to human gesture. When we have enough time to establish sound spaces and perceive sound sources then we may perceive patterns and changes inside the already established spaces. Instrumental gesture would fall into that level. In the third listening level we are removed from the more immediate and physical level of second level sound patterns and we move to a more cerebral perception of narrative structures.

Michel Chion defines three listening modes (see figure 8), which address three different qualities of the aural experience. The *casual* listening mode has to do with source recognition and general information gathering. The *reduced* listening mode, first coined by Pierre Schaeffer, 'focuses on the traits of the sound itself, independent of its cause and of its

meaning' (Chion, 1994, p. 29). Finally, the *semantic* listening mode is the listening mode in which we treat sound as a sign and we assign meaning through a code similar to language (Chion, 1984, pp.19, 26). Of course, in order to comprehend and perceive signs we need an interaction of all three listening levels. We need to perceive first-level sound spaces, patterns inside those sound spaces and finally an organization - or conceptualization - of patterns.

It is obvious then that an interaction of all three listening levels is required for perceiving the musical work, and that space, time and form could be approached as different aspects of the same sound phenomenon that our memory processes through different speeds. I am particularly interested in exploring hybrid musical textures which take advantage of the ambiguity that is present when musical text can be perceived through different and sometimes conflicting listening modes. That is usually achieved when sound colour becomes a dynamic, malleable and multi-dimensional parameter which shapes the musical work, for example when a musical texture alternates rapidly between clear source-bonded sounds and more abstract musical sounds, so that casual and reductive listening modes compete, as is the case in my electroacoustic pieces *Acid Drops* and *Dreamscape*, or when multiple time scales are superimposed, so that micro (timbre, sound) and middle level (gestures, shapes) structures interact, as is the case in the granular works of Horacio Vaggione.[5]

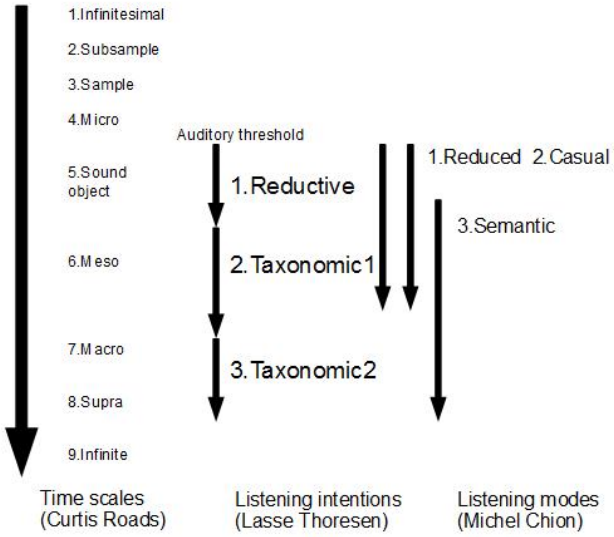

Figure 8. A graphical comparison between Roads' time scales, Thoresen's listening intentions and Chion's listening modes. The arrows starts from the infinite small and points to the infinite large. Distinctions between levels should not be understood as objectively defined limits.

5 Vaggione argues that time-scales are both independent and interactive and that the composer may continually move between time-scales (Vaggione, 2005, pp.340-1).

For reasons of convenience and simplicity, I will mostly employ definitions of the listening levels from Thoresen's aural sonology and I will describe separately first-level spatial structures, second-level temporal patterns and shapes and how I organize all of them in higher levels in order to create narrative structures.

2.2 Relations of fixed spaces

2.2.1. Physical extension of instrumental spaces

Gesture is the basis for generation of sound in instrumental music. An extension of instrumental aural space - with limited aural dimensions (i.e. pitch versus time) - is usually achieved through extended techniques, connected to gestural activity. Physical gesture may modify the aural space/timbre of the instrument, which is defined by its construction and history, and may also modify its articulations. Examples may include *Pression,* for solo cellist (Lachenmann, 1970) by Helmut Lachenmann, and Ferneyhough's *Unity Capsule*, for solo flute (Ferneyhough, 1975).

Pression's method of notation is 'named *prescriptive* or action notation and describes the musician's actions or methods in creating sounds, as opposed to *descriptive* (i.e. traditional) notation, which describes the sounding result in terms of parameters such as pitch, rhythm, dynamics and articulations' (Orning, 2012, p.19) although elements of descriptive notation are also present. Mieko Kanno notices that '...there are many sounds that cannot be "described". While it is a long and arduous process for a new (promising) sound to enter into the established vocabulary of descriptive notation, many new sounds don't even begin the process or, if they do, become lost in it' (Kanno, 2007, p.234). Wishart also suggests that timbre is multi-dimensional, defined by various different parameters (such as noise characteristics, grain, inharmonicity) and should not be compared to the one dimensional and ordered pitch space (Wishart, 1996, p. 81). Timbral parameters such as grain and noise characteristics produced through gestural activity, are controlled and articulated with great detail in *Pression* through emphasizing the notation of actions/gestures rather than the desired sound. Furthermore, sounds or gestures that are not part of the traditional descriptive

notational vocabulary, could also be perceived as coming from outside the musical work and perceived through a *casual listening mode* (Chion, 1994, p.29)*,* especially in cases where source recognition is not clear (i.e. the almost silent left hand gestures on the cello - without bowing - could be perceived as "wrong" or as part of a theatrical performance) although that is greatly diminished in a live performance situation. In *Unity Capsule*, Ferneyhough employs a detailed descriptive notation paired with prescriptive layers (indicating vocal utterances, position of the flute in relation to the lips, key slapping, etc.), which affect in many different ways the main instrumental line. Ferneyhough notes that, 'although the final sonic result is, in large part, monodic, the initial point of departure for the composition was thus an interweaving of skeins' (Ferneyhough, 1995 p.100). In that case, the one-dimensional pitch domain is altered by the multiple prescriptive notational layers.

Pression and *Unity Capsule* are examples of extensions of instrumental aural spaces through gestural activity notated through a combination of descriptive and prescriptive instructions. Although motion in a multi-dimensional timbral space may not be notated in the same way that motion in pitch space is, we can notate actions/gestures that produce specific aural spaces or modify existing ones. Additionally, the human actions/gestures are usually connected to '...a broader experience of the physicality of gesture and its proprioceptive tensions...' (Smalley, 1994, p.39) that can be found in the the sound world outside the musical work (see also the example from *Electric Serpent* at chapter 1.1.4.).

In my piece *Scratch,* for viola, cello and double bass, left hand pressure (notated below the left hand staff) muffles the string and modifies the brightness of the resulting sound. Degrees of bow pressure distort the sound adding noise to the sound spectrum. Lateral movement of the bow on the strings (from ponticello to extreme tasto) affects the brightness of the sound, while bow speed affects the grainy texture of the sound generated through friction of the bow on the string. These gestural activities modify the descriptive, left hand, pitch layer and thus create different but interrelated aural spaces. For example, if bow pressure remains constant and relatively normal, we can hear the movement in pitch space created by left hand gestures. If bow pressure is extreme and remains constant, then we can only hear a noise sound, little affected by left hand pitch movement. In the example below we

see that bow pressure, lateral movement of the bow (from extreme sul tasto to sul ponticello), and left hand gestures are notated on separate staves because of their structural importance in shaping the timbre of the instrument and the texture of the piece, while left hand pressure and bow speed are notated below the appropriate staves.

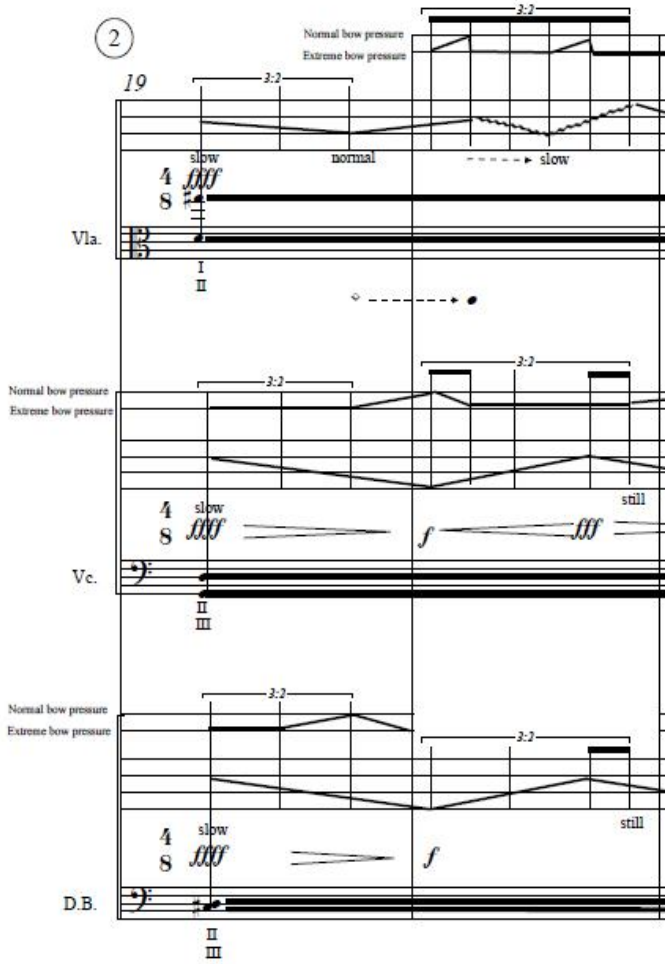

Figure 9. *Scratch,* beginning of section two, bars 19-20, notation of bow pressure, bow motion along the strings, left hand pitch and bow speed.

The normative behaviour of the string instruments, which is usually defined by the movement of the bow and left hand gestures affecting pitch, is extended by modification of these same gestures (motion of bow along the strings becomes the main sound producing gesture, normal bow speed is modified and left hand gesture remains fixed on the fingerboard but with variable pressure on the strings). In this case, actually, the gestures are extended by moving in additional dimensions of physical space (i.e. bow movement is lateral, horizontal and vertical in relation to the string) in a way very similar to Lachenmann's *Pression*. I should finally note that the notation I am employing combines a prescriptive notation of gestural activity together with a descriptive notation of the desired sound (left hand pitch gestures are

notated on a traditional five line staff). The combination of the two types of notational practise gives more flexibility to the composer who works with multi-dimensional aural spaces, and textures which do not retain a stable hierarchy of parameters throughout the musical work.

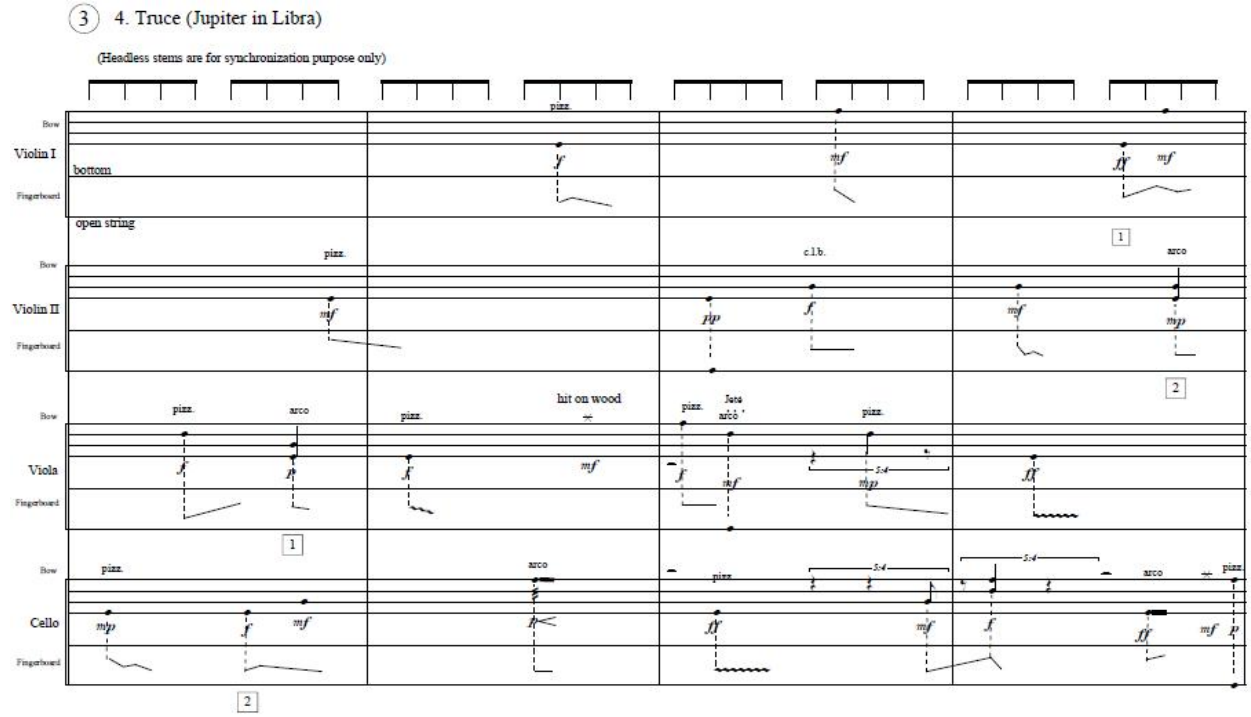

Figure 10. *Spider Web*, beginning of section three, bars 34-37, tablature notation.

In my piece *Spider Web,* for string quartet, notational types change in almost each section, depending on the texture that I want to create and thus the specific parameters that I want to prioritize. In the first two sections, a precise, descriptive notation on a five line staff indicates pitches, rhythms and articulations. In section three, a tablature notation is employed in all instruments. The upper staff indicates right hand bowing or plucking of the four strings while the lower staff indicates left hand pitch motion on the fingerboard. The notation deconstructs gestures and shapes that could be notated as a unity through an ordinary five-line staff notation. This aims towards a simplification of the notated shapes (a descriptive notation of the same shapes would require far more information) and a prioritization of articulation and timbre. The musical texture moves in a multi-dimensional aural space, defined by the different timbres produced by the instruments. These timbres are produced through plucking, bowing or hitting the strings and through hitting the wood of the instrument with the bow. Furthermore, bow pressure and bow motion along the strings (from ponticello to tasto) produce new, interrelated aural spaces. Now, left hand motion on the fingerboard, which

affects pitch, becomes a rather secondary sound parameter. Pitch motion is perceived as prominent when strings are bowed with normal pressure, but when strings are bowed with high pressure, or when hit with the wood of the bow, notated as c.l.b. in the score, pitch motion cannot be perceived, or it is perceived as a coloration of a specific timbre. Prioritization of timbre and articulation is the result of the need to create a string quartet aural space which is highly unstable timbrally, and to take advantage of the physical characteristics of gestures. Thus, bouncing bow, hitting, plucking and scraping are characteristic physical gestures almost equal in importance to the timbres they generate.

2.2.2. Extension of instrumental aural spaces through electronic aid

The aural spaces of the instruments can also be extended through the use of electronics. We can identify two very general categories, which can be combined: 1) instrumental aural spaces extended through the use of live electronics and/or amplification of the instrument. Boulez's *Anthèmes II* and Ferneyhough's *Time and Motion Study II*, for example, use live electronics to transform the instrumental sound and to add other instrumental layers in addition to the live part; 2) instrumental aural spaces extended through the use of a fixed electroacoustic part (tape). Mario Davidovsky's *Synchronisms* series of pieces, Milton Babbit's *Reflections,* Horacio Vaggione's *TILL* and Stockhausen's *Kontakte* are pieces that would fall into this category. In this case, the electroacoustic part either blends with the instrumental sound (probably extended through extended techniques and/or amplification), or adds new sound layers contrasting to the live instrument.

In the case of electronic aided extension of instrumental space, important is Schaeffer's notion of *genre*: 'If each member of a sound family can be described in a similar manner the psychological impression of a single source and thus a potential genre might be created' (Dack, 1998, p.90). Genres concern the creation of instrument-like sound families through source-bonding, though various degrees of gestural-surrogacy are also possible. We should note here that instruments may also contribute to different genres (e.g. a violin produces bowed sounds and pizzicato sounds) and that also instrument-like layers can easily be produced in orchestral contexts, through the mixing of various instrumental timbres. Genres

are important in mixed works because they move in a more or less consistent spectral space, which allows the blending of the electroacoustic sound with the instrumental sound. Babbit's *Reflections* is an example of a consistent use of a genre (a consistent synthesized timbre which simulates the piano sound) throughout the piece in order to blend the electronic and the instrumental sound. *Registers* and *Jeu* are Schaeffer's concepts which facilitate the formation of genres and connections between different sounds or sound layers:

> 'Registers occupy areas of the three perceptual fields of pitch, intensity, and duration. The discipline of analysis facilitates the development of 'scales' which have potential for ordered groups with the possibility of directional tendencies in one or more perceptual fields...Jeu expresses the idea of 'interplay' both on the local level of aesthetically pleasing interactions between morphological criteria in a single sound and also in larger structures between several sound objects' (Dack, 1998, p.90).

The electronic aided extension of instrumental space involves the use of genres but also the use of sounds with a more distant relation to the instrumental sound source. Taking into account that the sound of the instrument may be extended through various instrumental techniques and amplification, I believe that acousmatic sound not directly related to the instrumental sound may be justified as an extension of the instrument because the remote sounds may blend with the instrumental sounds due to their musical properties (the musical layer, established through temporal patterns and behaviour), i.e. a gesture of a falling glass object could match with a piano gesture with similar temporal behaviour.

From 1.21'' to 1.38'' (at about 5.47''-6.5'' of the recording) of section 6 of my piece *Liquid Glass,* for two percussionists and electronics, I use two timpani played with superball mallets. In the electronic part there are some re-synthesized and slowed down timpani sounds in the beginning, while a processed cymbal sound comes in the mix at 1.34'' and gradually morphs to a scraped cloth sound. The re-synthesized timpani sound functions as a genre which blends smoothly with the live timpani sound. According to Schaeffer's concept of “registers”, pitch, intensity and duration are important factors in determining if a sound can be perceived as a genre, an instrument-like sound layer. The re-synthesized sound layer is a pitched sound,

moving in a relatively clearly defined, pitched spectral space that is close to the timpani spectral space. Concerning duration, the re-synthesized sound layer exhibits a behaviour that aural sonology terms "large note", which matches also that of the timpani.[6] The cymbal sounds belong to a different sound layer which functions as a connection with the next section of the piece. It is a layer coming from the following section, where it functions as a genre for cymbal sounds, thus it is not directly connected to the timpani sound. The cloth sound, though it is very clear that it is a different sound, does not establish a separate layer because of its short duration and close spectral and behavioural relationship to both the cymbal sounds and the timpani sounds. Because the cloth sound is actually a rubbing sound and that it is mostly established through its temporal behaviour, it relates to the rubbing (through superball) timpani sounds; because its noisy spectral content is closer to the complex, noisy cymbal sound, while its scraping sonic behaviour matches the rubbing timpani behaviour, it acts as a sound which both connects with the timpani and morphs with the cymbal.

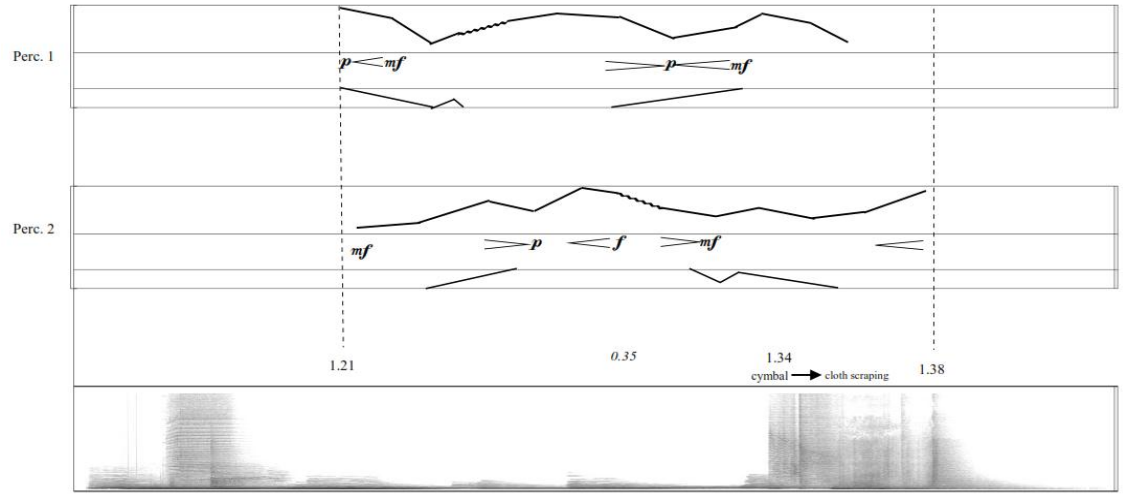

Figure 11. End of section six of *Liquid Glass,* timpani, timpani genre, cymbal transforming into cloth sound.

2.3. Relations of temporal behaviour

2.3.1. Irregularity and regularity

Sound analysis has shown that there are some basic types of waveforms; these include sine waves, square waves, triangle waves, various inharmonic waves, noise waves, etc.

6 '...an object in slow gesture time with a slowly and predictably evolving spectrum.' (Thoresen, 2007, p. 135)

Waves categorized according to their temporal shape fall into two extreme categories, with multiple variations in between: waves with a repetitive amplitude pattern, such as the sine wave and waves which continually change in amplitude, such as noise waves. Of course, in musical practice and nature we rarely find those extremes. Those types of time varying oscillations define sound or timbre in the first listening level but I propose that they may offer some general conceptions about time varying signals that are also related to the organization of sound patterns at the second listening level. Repetitive/regular and irregular/random patterns are equally important in middle level structures as they are in lower level structures. If in lower level structures of the musical work these patterns are perceived as sound and timbre, in middle levels they are perceived as gestures, textures, shapes or phrases. Those waveform patterns may also be applied to different parameters of sound in middle level structures, such as volume, pitch, filter bandwidths, density of textures, etc. and thus a connection between different levels of organization and different sound layers may be established.

Stockhausen's 1957 essay ''...how time passes...'' first popularized the notion that rhythmic particles may turn into pitched tones and vice versa, or that rhythm and pitch are two sides of the same phenomenon (Stockhausen, 1957). Pitch slowed down becomes rhythm, while rhythm sped up becomes pitch. Sound in general, may be approached as a dual, wave-like and particle-like phenomenon depending on our point of view (Roads, 2001, p.55). Digital sampling uses extremely short ''bits'' of data organized in various forms in order to reproduce sounds and air which transmits sound waves is also composed by particles. The *waveform* should be understood as a structure which organizes particles in time. The waveform may also be approached as a general structural and conceptual model, which not only defines timbre in the micro-temporal scale of the first listening level but also types of behaviours generated by the play between regularity and irregularity or randomness and repetition in the middle temporal scale.

If repetition is completely predictable would then randomness be completely unpredictable? Continuous and coherent random temporal behaviour creates a very concrete and definable temporal space; randomness then, is almost as predictable as repetition. Noise

and sine waveforms are quite similar in their predictability. It is then the relation and play between the two extremes, randomness and repetition, that creates unpredictability and a sense of forward impetus, which is not much different to the sense of forward impetus produced through traditional tonal harmonic functions; both repetitive and coherent random temporal behaviours are stable states and may function similar to the tonic in tonal music. Through my practice, I have realized that I am more interested in the dialectical relationship between unpredictable and predictable temporal behaviour, or stability and instability. Considering that a compositional goal is the generation of forward impetus in the middle level structure of the musical work, I will describe various techniques of temporal organization (organization of patterns or shapes) that attempt to connect or integrate acousmatic and instrumental compositional practices.

2.3.2. Perception of morphological shapes

Middle level patterns or shapes are collection of sounds that are perceived as a unity or a gestalt inside the musical texture. These may be either horizontal or vertical collections of sounds. Of course, music being a temporal art rather than spatial, we can argue that motion is what produces the musical shapes. Motion has morphological functions because it shapes the sound object in time and it creates expectations. It generates grammatical or even syntactical functions depending on the structural levels on which it is applied.

The notion of motion is related to rhythm. Smalley asserts that 'traditional concepts of rhythm are inadequate to describe the often dramatic contours of electroacoustic gesture and the internal motion of texture...quite often listeners are reminded of motion and growth processes outside music...' (Smalley, 1997, p. 115). These observations are of course applicable to instrumental music, if we consider the textural motions in many compositions by Ligeti and Xenakis. Smalley identifies types of unidirectional, reciprocal, and cyclic/centric motions and various types of bi/multidirectional growth processes. Another level of categorization of these types of motions would be according to their chaotic-random or repetitive-regular temporal behaviour. Complex sound masses which are composed by sound particles can also be approached as waves instead of collections of sounds. Recognition of

levels of regularity and irregularity or waveform types in musical shapes, would help us also define their functionality. For example, a regular cyclic motion in a limited space could be perceived as more stable than a random multidirectional growth process. Lasse Thoresen terms the phenomena of regularity/irregularity ''pulse categories'' and categorizes them into regular, irregular, and oblique pulses.[7]

In the first 5 seconds of my acousmatic piece *Panorama 2*, I employ a sound object which consists of a textural layer of *distorted glass bottles* and another layer which consists of *bird sounds* and *synthesized sounds.*. Although the bottle-layer is textural, comprised of multiple grains of bottle sounds, it can be perceived as a single gesture due to its united internal structure and its unidirectional motion. The bottle-layer has a unidirectional descending motion while the bird/synthesized layer in the beginning is descending, amplifying thus the bottle-layer's descending motion; it then exhibits a reciprocal undulating motion and ends with a short ascending motion. The motion that generates the specific shapes was created through MIDI sliders controlling the pitch of a virtual software sampler/synthesizer either loaded with a complex, long sample of bottle sounds and in the case of the bird-layer, a recording of bird tweeting sounds mixed together with an FM synthesis oscillator. The mixing of parts of the two different layers that creates the specific shape with its clear motion and identity was carefully done in the mixing stage of the piece, after I had already created the individual sound layers. My decisions concerning the combination of the sound layers in time were mostly based on the relations of regularity and irregularity in both sound layers. I decided to begin with a more irregular temporal behaviour, where we can perceive mostly a fast growth process of the bottle-layer and then move to a more regular (or probably oblique, because of a perceptible poly-rhythm in the bottle-layer) pulse category in the middle of the shape, which is also supported by a lowering of the pitch in both layers. A short abrupt return to a more chaotic probabilistic behaviour which is also supported by change in spectral density, just before the end of the shape, acts as an upbeat for the final two bottle-layer attacks. Of course these decisions were not predetermined but depend on the sound layers that I have at hand when I am mixing the piece.

7 Oblique pulse refers to an intermediary category between regularity and irregularity and may include duration ratios such as 3:2, 5:3, etc. (Thoreseen, 2007, p.135).

The extension of instrumental aural space offers multiple possibilities for motion and shape creation. In the first three sections of my piece for piano and electronics, *Electric Serpent,* the pianist scrapes the bass strings inside the piano with a plectrum. Pitch remains fixed most of the time, permitting a clear perception of shapes in other sound domains. Reciprocal scraping motion along the strings with the plectrum creates a wave-like repetitive granular texture produced by friction on the corrugated surface of the bass strings. When the scraping is fast, we perceive a continuous sound, but when the scraping slows down we perceive a series of repetitive metallic sound particles. While the scraping gesture generates relatively stable, sustained tones which prevail in the first two sections of the piece, changes in speed and pressure which affect the regularity of the granular metallic waveform create a more unstable micro-level texture comprised of sound particles; this more irregular micro-level texture will gradually shift in middle level texture, in the following sections of the piece, through shortening the scraping gestures and adding short impulse gestures produced by hitting the strings with a metallic bolt. The mostly irregular temporal disposition of bolt hits later on (section four) is perceived as a continuation and transformation of the temporal aspect of the lower level granular texture in the temporal scale of middle level shapes.

2.3.3. Gesture and shape in the acousmatic medium

Composer Steven Kazuo Takasugi argues that the electroacoustic medium is a problematic one, and one of the reasons for that is because of the 'problem of a new medium attempting to express the sentiments born and bred in one that is older and vastly more practised. This gives rise to the falsity when something tries to be something that it is not' (Takasugi, 2004, pp.184-85). It is true that the electroacoustic medium has no centuries of tradition in conceptualization of musical shapes and instrumental practice. It is common for the acousmatic composer to search for identity, meaning and context in the older and more familiar medium of instrumental music by mapping gestures-figures to new acousmatic materials.

Acousmatic gesture may have a dual meaning. On the one hand it may refer to the perception by the listener of gestures of pre-recorded or synthesized sounds (for example a

gesture of a pre-recorded instrumental or machine sound), or in other words the motion that is source-bonded, and on the other hand to the gestures and motions that a performer may apply to any sensors such as MIDI keyboards, sliders, etc. We could say that these are virtual gestures in the sense that are just general motions which control assignable parameters rather than real physical activity on materials which produce sound. According to Philippe Lalitte: '...even if the electronic gesture is not an instrumental gesture in the narrow sense of the term, the instrumentality of the electronics appear at a virtual level...The physical cause dissapears in favour of the moving causality' (Lalitte, 2006, pp. 95-6). We could also imagine that automated motion in various software parameters may still be considered as a virtual gesture even though no human gesture is involved.

Acousmatic gesture as virtual gesture may be perceived as musical motion inside a relatively stable musical space, which is the way instrumental motion is perceived, or it may be perceived as transformation of a familiar sound source. We can create chains of sound spaces which are activated or modulated by gestural motion. We can name the gestural activity on an aural space as *modulation*.[8] The concept of *modulation chains* is something that I have used in my work in order to transform sounds or sound layers, create complex, unstable timbrally and ambiguous sound objects, connect different sounds or sound layers through gestural motion and connect instrumental and acousmatic gestures.

In section seven of my piece *Liquid Glass* for two percussionists and electronics, I employ two upturned cymbals on timpani, mostly scraped with wire brush and metallic objects. For the creation of the electronic part I have recorded cymbals scraped either with a wire brush or the head of a bolt. I have then transformed these recorded sounds through multiple modulation chains. I have applied varying amounts of reverb on the pre-recorded sounds controlled by MIDI sliders on the audio effect module. I have then used the modulated audio file and applied a resonant filter with parameters modulated again through physical MIDI controllers. I have used several other types of audio effect modules and created in that way a series of audio files which I then used as different sound layers in the piece. The order of modulation, of course, is of great importance in determining the resulting transformation. Not

8 This term is actually borrowed from the similar concept in the instrumental medium, which Ferneyhough names "parametric modulation" (Ferneyhough, 1995, p.387).

all of the modulated audio files produced in that way have found their way in the piece; some of them were retained for use in other pieces at a later time, while some of them were discarded.

In the instrumental medium, modulation of sound spaces is also operational (simple pitch movement is already a modulation of a sound space, e.g. the modulation of the strings by left hand fingers which changes string length in the violin), but multiple modulation chains are not possible because of physical limitations of space and gesture (e.g. I can modulate the violin string through left hand pitch movement and bow pressure, or I can combine different gestures that modulate the string, but I cannot modulate the resulting aural space which was created by the interaction of gestures with physical material, except with live electronics). Various generative and indeterminate processes play an important role on how I create and take advantage of these modulation chains.

2.3.4. Indeterminacy, processes and fields

Umberto Eco, in his article 'The Poetics of the Open Work', states that the ways that artistic forms are structured reflect the way in which contemporary culture or science views reality, and he parallels discoveries in quantum physics to some indeterminate aspects of musical formal structures (Eco, 1989). Composer Chris Mercer argues that:

> 'One can draw a strong parallel between the machine-like structures of total serialism and the Darwinian reduction of plants and animals to industrial mechanistic conceptions...artists have an implicit responsibility to question the organization of society itself, they should also question the tools and attendant discursive conventions that spring from (and often insidiously serve the needs of) that same mode of organization' (Mercer, 2004, p.169).

Mercer refers to a model of algorithmic processes which he calls the Ferneyhough model, in which '...the use of determinism is engineered in the first place to provide objectification and critical distance, to place a ''sieve'' between the composer and the materials. The output may be rejected, edited in some way, or incorporated into a composition

in a state of extreme fragmentation; it may in some cases be robbed entirely of its deterministic identity' (Mercer, 2004, p.169). Ferneyhough himself states that:

> '...I tend to lose track of what I am doing, which means that, if I can't manage to reconstruct what the generational principles were, I am forced to invent new ones, grafting them onto the extant stem in such a way as to make it seem that the previous principles were still in fact operative. That implies a rather striking reversal of the principle of variation: whereas, previously, 'variation' was a term applied to compositions in which one basic principle or material was shown in many different lights, in my practice we see the surface remaining very much the same while the background generative procedures are transformed or sequentially superseded' (Ferneyhough, 1995, p.229).

Algorithmic and generative procedures in both media can be approached through a similar compositional and perceptional ''openness''. Eco refers to the notion of the *field of possibilities* that was employed by Henri Pousseur to describe a function of the open work in his electronic piece *Scambi* (Eco, 1989). According to Eco, the term borrows revealing technical terms of contemporary culture:

> 'The notion of ''field'' is provided by physics and implies a revised vision of the classic relationship posited between cause and effect as a rigid one-directional system: now a complex interplay of motive forces is envisaged, a configuration of possible events, a complete dynamism of structure. The notion of ''possibility'' is a philosophical canon which reflects a widespread tendency in contemporary science: the discarding of a static, syllogistic view of order, a corresponding devolution of intellectual authority to personal decision, choice, and social context' (Eco, 1989, p. 14).

I will employ the notion of the *field of possibilities* or the notion of the *field of information* in order to refer to how I perceive generated or indeterminate information or *networks* of interrelated data that are approached through a certain compositional (and perceptual)

"openness". In my work I usually generate complex information fields or networks (either real or imaginary), categorize them and mix them. Choices concerning middle level structures are always in a dialectic relationship with the generated material and are based on a combination of:

1. personal taste
2. chance or indeterminate processes
3. a context which is defined by a complex network of interrelated information, often related to higher level schemas and gestalts, and
4. a conceptualization of sound material based on metaphorical thinking**,** which I will explain in chapter three.

I will give specific examples here from both media that will make clear how I approach generational processes and why.

2.3.5. *Electric Currents*: an example of acousmatic fields

When working in the studio, a sound or a set of sounds is usually the starting point of the composition. I will create a sound layer out of a sound or set of sounds, in order to extend the temporal scale of the sound and explore potential sound textures. That permits me the choice, in the editing or montage phase of the composition, to use the sound in different temporal scales and in different possible roles in the musical texture of the composition (that is a result of the "openness" of the sound layer: a more concrete or pre-defined sound material would not permit multiple uses and roles in the final musical texture). I thus generate multiple sound layers through modulation chains which transform aural spaces. Transformation of aural spaces may or may not be followed by a transformation of temporal behaviour. I will usually categorize the processed sound layers according to their aural space and temporal behaviour and their use will be decided at the mixing stage of the composition.

More specifically, in the second part, titled *Electric Currents,* of my piece for piano and electronics *Electric Serpent*, I have used a layer of synthesized sounds together with a layer of pre-recorded piano sounds. The basis for the synthesized sound layer was a series of synthesized sounds (created mostly in "Reaktor" software). First of all, I improvised a dense

MIDI file, which defines time related information. The MIDI file defines mostly the attacks, or entries of sounds and durations. I did not care much about pitch at that stage because I knew that I would alter it later.

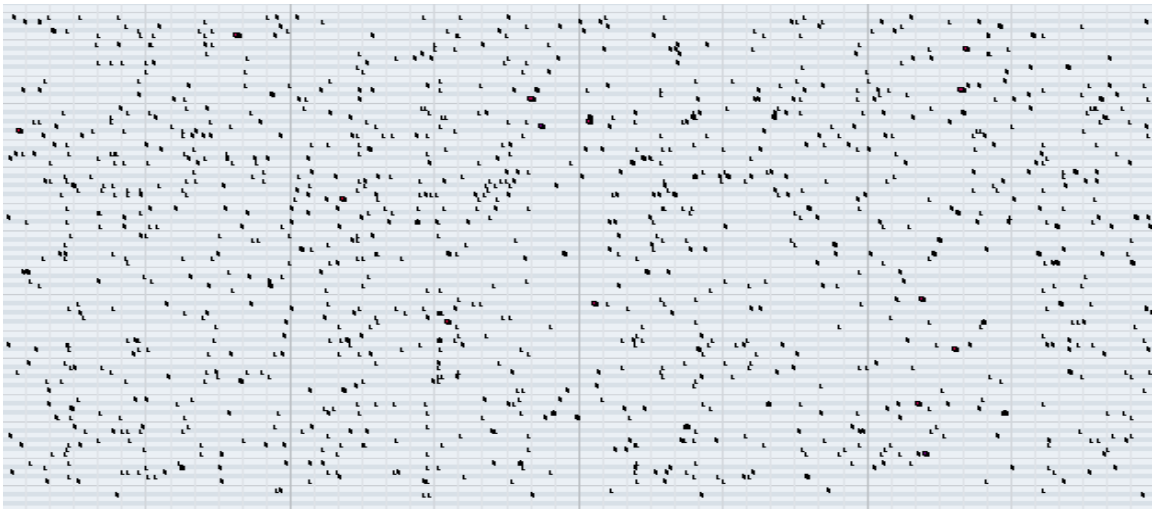

Figure 12. Original MIDI file from *Electric Currents* synthesized layer (first four minutes). Vertical position indicates pitches, ranging from about c-1 to c6) and horizontal time.

I have then modulated the tempo envelope in the software, so that it may change during the playback of the MIDI file. Here, the modulation was done manually and it took a random shape that resembles a noise waveform. I have also used another tempo envelope in other versions of the same process, which is more stable and repetitive and it resembles an inharmonic waveform as seen in figure 13. I have thus modulated the temporal behaviour of the original MIDI file through the tempo tracks in order to create more unstable temporal spaces, distort human made patterns of the MIDI file (the tempo sometimes creates extremely fast patterns not related to human gestural motion and which are sometimes perceived as new gestures with internal textural activity) and create new unpredictable shapes.

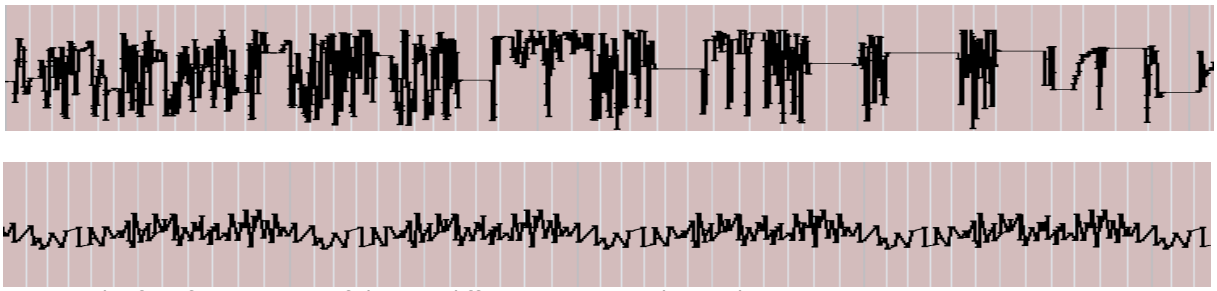

Figure 13. The first four minutes of the two different tempo tracks used.

This dense MIDI file was then dispersed in eight different, more sparse, layers. I have assigned eight different sounds to each of the MIDI tracks (sometimes I did not use all

eight tracks) and I randomized pitch, sometimes in a different way in each layer (basically separating registral boundaries). The reason I have used a single MIDI track and then dissolved it into different tracks is because I wanted the different sounds to be perceived as a single layer dispersed over different sounds and not as a polyphony of different layers. The single, almost monophonic, MIDI file (with its internal logic coming from an improvisation modulated by a tempo envelope) connects the different sounds and makes them sound as if they are transforming rapidly from one to the other. This also contributes to the spectral similarity of most of the sounds used. With this process I have managed to create motion in a complex multi-dimensional timbral space instead of a two-dimensional pitch space or a polyphonic motion in several timbral layers. The shape of the tempo envelopes, the shape of the various envelops/waveforms applied to the change of various software parameters and the pitch randomization defines a compound (but perceived as gestalt) layer which has an almost unpredictable shape and moves in multiple dimensions. The layer seems to be transforming in almost the whole area of timbral space, with its limits being the sine wave and white noise. Its temporal shape is connected to its spatial/timbral shape because the spatial/timbral identity is the result of the interaction of various temporal envelops/waveforms.

Figure 14. Eight sparse MIDI layers originated from the original MIDI track.

Having created the attacks and entries of the sounds, I then manipulated the individual sounds by changing parameters in the sound producing software. I did that in order to modulate and destabilize the individual established sound spaces or timbres. Destabilization of individual timbres resolves their boundaries, hinders the perception of clear gestural vectors

and sometimes creates new, unpredictable timbres and gestural vectors. I manipulated parameters such as attack or decay time, filter frequencies, rate of low frequency oscillators, FM synthesis modulating frequencies, reverb time, and many others specific for the software parameters, mostly through physical MIDI controllers. I created short patterns of parametric modulation with different durations, and then repeated them multiple times. When this is done in multiple parameters for one sound, a complex polyphony of different parameters is produced. This polyphony not only distorts the sounds, but also brings them to life, giving them an instrumental or physical quality. The synthesized-digital sound is perceived not only as a sound source but as a receiver of gestural energy even if the gestures are virtual. As a receiver of gestural energy, synthesized, digital sounds, even though without clear source-bonding, may sometimes simulate extrinsic physical sound sources that are also receivers of gestural energy, such as machine sources, animal sources, instrumental or vocal sources, etc., which in a way make them more real (their temporal behaviour implies a link to sound sources or signalling sounds with the same or similar behaviour).[9]

The resulting audio file of all the above processes is a complex sound layer comprising eight different sounds (when all of them are used) modulated by various parameters, specific for the individual sounds. Though I used parts of the resulting audio file in that stage, in the first section of the piece, I decided to continue processing it because I wanted to move to another level of distortion and transformation of the original synthesized sound so that I could not recognize their original sources and articulations (this is dictated by the large scale formal structure of the piece which aims to a continuous and gradually heavier destabilization of timbre and sound source perception).

In order to achieve that, I inserted the whole audio file into a simple custom made Max/MSP patch. The Max patch is a loop player that changes the pitch of the sample or reads it backwards. Additionally, I can select which part of the sample will be looped in real time. I should also note that when the looped selection is very short, or when it changes rapidly, we perceive a single tone or a series of grains instead of clear sampled sounds. To summarize, through the Max patch I shifted the pitch of the sample, sometimes very dramatically,

9 I consider this approach to digital sound as both a continuation and a critique of the sometimes machine-like “post digital” glitch music of the 90s (Cascone, 2000).

reversed the playback of the sound and moved the selection of the sample part to be looped (sometimes very short parts were looped and sometimes the change of the looped selection along the duration of the whole sample was done extremely quickly). All these actions are controlled in real time by simple gestures realized through MIDI sliders and are applied to the sample concurrently in order to achieve a level of transformation of the original sound spectrum and articulations but without completely distorting the main sound qualities of the original sound layer.

We may note here that in the case of the Max/MSP processing, the temporal experience of the sound transforms into a spatial one. The whole sample is traversed by a short or longer selection that activates it. Temporal behaviour of the original sample serves mostly in defining the sound colour of the new sample. The temporal behaviour of the new sample generated by this process is mostly defined by a gestural selection of looped audio and pitch shifting. The original sample is approached as a physical surface that is played by the looped selection, not much differently than a physical surface of a cymbal or a bass drum that is activated by the gestural activity of the percussionist.

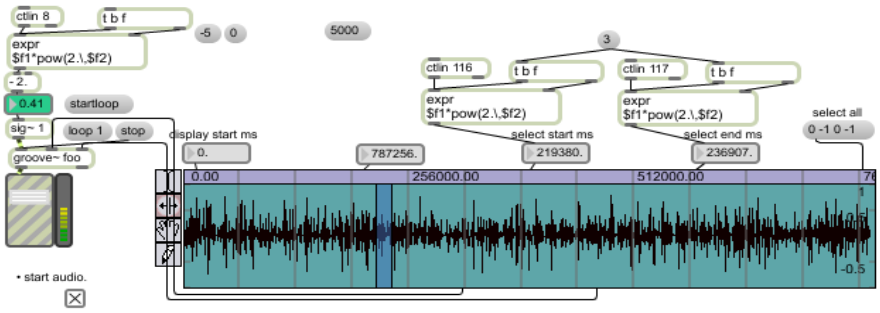

Figure 15. Main screen of Max/MSP patch used for final processing. Graphical selection of sample through MIDI controllers can be seen inside the waveform display and pitch shifting in green box.

I have created a series of samples through the same processes by varying some of the parameters in the chain of the processes (for example, varying the original MIDI file or altering the original synthesized sounds). Only selected parts of the samples that resulted from those processes were used in the piece. The final sample was approached more as an ecological field recording rather than a deterministic result of calculated intentions.

After the description of the whole process, the question that arises is whether a different choice in any of the parameters used in the various processes (without changing the processes themselves) would alter the final result. From a compositional point of view the

answer is no, except in some extreme cases (for example if I would have used very long sounds or noise sounds in the original sample). Even if I would have used animal sounds instead of synthesized sounds the final result would have been quite similar. In the case though that I would have stopped the process before the Max/MSP patch processing, the aural difference would have been clear. If we consider that the processes are additions of new data over existing ones, then we could say that the influence of the individual decisions over the final result is directly related to the amount of information used.

The information field that resulted from these processes is viewed as an ecological "real-life" environment -operating in multiple listening modes - instead of an artificial artistic result which represents one-dimensional, clearly defined musical intentions. Fransisco López argues about the representation of reality in recordings of natural sound environments: 'Whereas the "microphone interface" transfigures the spatial and material characteristics of sound, editing affects its temporality. This process has already begun to take place during the act of recording in that there is always a start and end in the recording...not only different people listen differently, but the very temporality of our presence in a place is a form of editing' (López, 1998, p.84-5). If natural soundscapes are representations of natural, animal or human sources with a behaviour that, to an extent, is beyond our control, and if even the act of recording results in a form of editing, then these natural soundscapes in an acousmatic context may be approached not much differently from a texture of synthesized sounds or from instrumental textures that sprang through indeterminate or algorithmic processes. I would argue that although there is a kind of natural neutrality in many generated textures, a form of editing is always present, even from the start of the process, and cannot be avoided except in extreme cases. Personal taste, human intervention or "error" are not eliminated or avoided in these processes and information fields and actually information fields without these "aberrations" would appear to me somewhat less interesting.

2.3.6. *Calcination, Beck:* examples *of instrumental fields*

In my piece *Calcination* for solo cymbal we can see a simple instrumental approach to indeterminate processes which generates middle level temporal patterns or shapes through

a type of modulation of the aural space of the instrument similar to the acousmatic processes I have already described. The piece explores the sound qualities of the very simple physical space of the cymbal's surface. The horizontal texture of the piece is created by repetition of physical gestures which excite the surface of the cymbal. The basic types of gestures used are *impulses,* which are generated by hitting the cymbal, either with a brush, a wooden object or a metallic object, *sustained* gestures*,* which are generated by scraping the cymbal (again with brush, wooden object and metallic object) and *iterated* gestures which are variations of the sustained gestures and are created by oscillated scraping of the cymbal or tremolo. Muting of the cymbal with the hand is also employed, affecting the dryness of the overall sound.

These gestures are placed in a predetermined four bar rhythmic structure, which is created by a division of each measure in a number of impulses. In each part of the piece, this rhythmic grid remains constant and repeats itself, providing a unity in the temporal evolution of parameters and acting as a type of rhythmic space. The rhythmic grid was constructed intuitively and its four bars are permutated in each part of the piece. The grid being a repetitive structure, the placement of gestures on it would create a repetitive rhythm. I then placed the gestures on different impulses of the grid because I wanted to give forward impetus to the temporal evolution of texture, and that is achieved mostly through shifting the rhythmic density of particles on the grid. The muting gesture which determines the dryness of the sound is again placed on the rhythmic grid, though it follows its own separate rhythmic line.

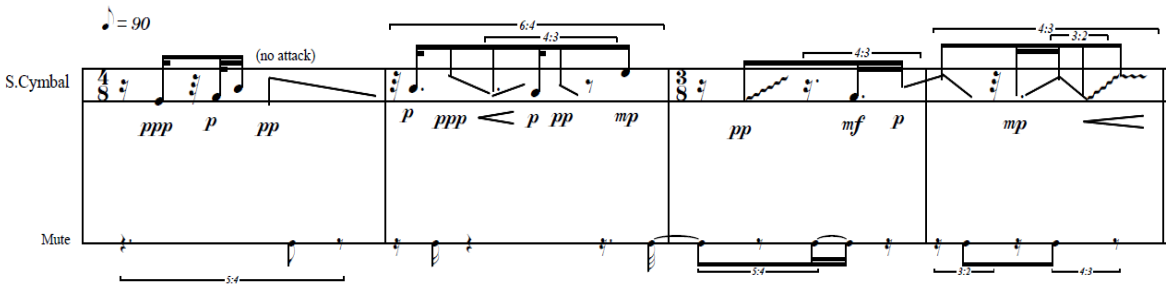

Figure 16. *Calcination*, bars 1-4. Notation of impulse (notated as ordinary noteheads), sustained (notated as straight lines) and iterated (notated as wavy lines) gestures and muting of the cymbal on a separate staff.

A texture is generated by the three different types of gestures (impulse-sustained-iterated) placed on the rhythmic grid and interacting with the muting of the cymbal. The first part of the piece may be perceived as a three-part texture, with a line of resonating impulse gestures, a line with resonating sustained gestures, and a line with dry sounds, either impulses

or sustained. My approach to the temporal evolution of the instrumental texture as a series of disconnected temporal forces interacting with each other and imposed on the aural spaces of the instrument distorting and modulating them, or maybe giving them a temporal ''personality'', is an approach heavily influenced by my experience of parametric modulation chains, transformation techniques and processes in the electronic studio.

Although the rhythmic grids employed in *Calcination, Horus* and *Beck* exhibit a certain notational complexity (partly as an intended homage to the "New Complexity" school of composers) they were intuitively derived. The grid is not a result of strict mathematical procedures, but rather a device that alters any preconceived shapes and gestures and thus adds a level of indeterminacy in many compositional decisions. The musical indeterminacy provided by the grid is a notational "modulation chain", similar to the ones I have employed in acousmatic works (see chapter 2.3.3). The grid provides me with unpredictable modulated shapes and gestures that fuel compositional imagination and influence the evolution of texture. The grid is also usually a loop and thus it is a repetitive, wave-like rhythmic structure that may provide rhythmic stability (or instability if the musical shapes are forced against it). Furthermore, the grid allows me to easily control the density of events and the rhythmic momentum of the texture. Its use was inspired by my electronic studio experience of utilizing MIDI rhythmic loops in various sound parameters for generating and controlling dense and unpredictable modulated sound layers (as I have previously illustrated on chapter 2.3.5). Furthermore, the notational complexity of the grid provides a tension between the performer and the physicality of sound material, functioning as a type of intellectual sieve between the performer's activities and the sounds produced. Especially in *Calcination* it provides tension and momentum to a texture consisting of extremely simple instrumental gestures and shapes (the rubbing or hitting gestures are mapped on a one-dimensional physical space of the cymbal's surface).

In my piece *Beck,* for saxophone, piano and percussion I have approached generational processes differently because of the nature of the instruments and the chamber music context. I have decided to use a specific set of instrumental aural spaces; in the piano, I have approached single notes, chords, dyads and clusters as different aural spaces (or we can

approach it as a single space modulated by addition of notes). In the saxophone I had one aural space modulated mainly by teeth on reed, position of mouth on the embouchure, flutter-tongue and slap-tongue. In the percussion, I had skin, wood and metallic (unpitched and/or pitched) aural spaces. All of these sound spaces are approached as a single instrumental layer composed of different but closely related sounds (most sounds are pitched, with attacked onsets and short release envelope).

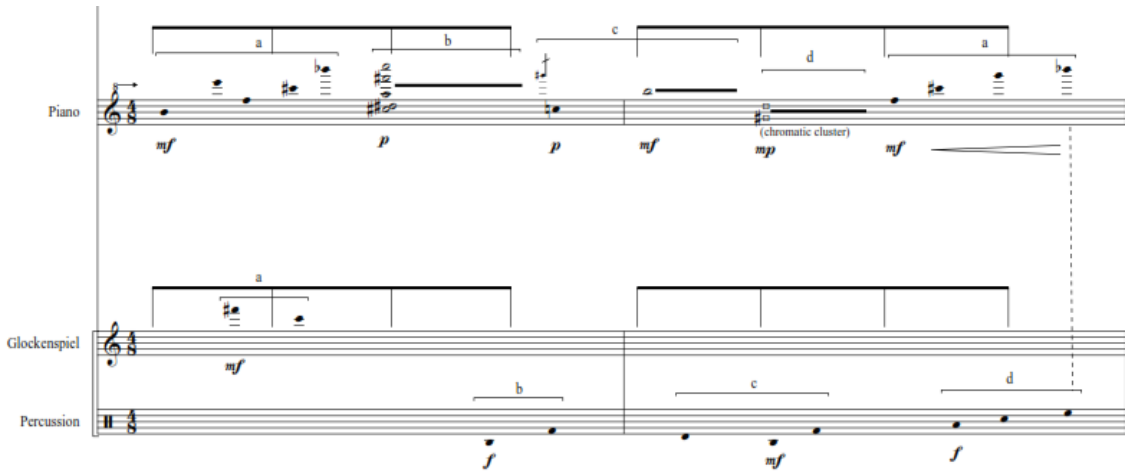

Figure 17. Beginning of *Beck* (bars 1-2), basic shapes in piano and percussion.

In the extract from the beginning of the piece in Figure 17, we can observe a set of basic shapes in the piano and percussion. In the piano, shape 'a' is comprised of single notes, shape 'b' is a chord, shape 'c' is an *appoggiatura* followed by a sustained note and shape 'd' is a cluster. In the percussion, shape a is comprised of two single glockenspiel pitches, shape 'b' is a skin shape comprised of a bass skin sound followed by a higher one, shape 'c' is the same as shape 'b' with the addition of a middle skin sound, and shape 'd' is a shape with an upward direction, comprised of wood and metallic sounds. We can observe that the shapes are extremely short, sometimes consisting only of a single sound. In the shapes with a pitch content, the pitch relationship and the direction of the shape can be retained throughout the piece or slightly altered.

I had then a set of sound shapes that I had to deploy through the five predetermined sections of the piece in order to create a compound sound layer.[10] I did not use a predetermined rhythmic structure (as I did with *Calcination*) for the deployment of shapes

10 The duration of all sections (as well as some shorter sub-sections) were based on the Fibonacci series and the golden ratio. The sound events though inside the sections are intuitively combined although the materials between sections differ significantly (basically changes in instrumentation and duration of shapes and gestures).

except for sections 3 and 4. In all other sections I freely combined the given instrumental shapes, cut them, distort them and sometimes create new ones out of them intuitively, in a way directly inspired from micro-montage in graphical sound editing software in the studio.

The shapes sometimes can be clearly perceived as units and sometimes, when they are combined with others, cannot be perceived as distinct shapes but as members of a larger gestalt. Because of the spatial notation that I decided to use, I can distort temporal behaviour of shapes very easily (I can expand them or contract them in time, repeat them, cut them, etc.). Spatial notation also permits a free and more organic approach to musical shapes and gestures by the performers, which also leads to a clearer perception of temporal shapes and musical units by the listener. Manipulation of temporal behaviour of shapes was done in an improvisational manner, although I was aware of a general imaginary tempo modulation envelope which "distorts" shapes and affects the density of events. Manipulation of shapes may be seen as a modulation of the temporal space, even though the original temporal space never existed, because the shapes never had an original form. What we perceive as an original form of temporal disposition of shapes is a repetitive state (notes when repeated are equal and thus are perceived as not being in constant motion but relatively stable) in an average tempo, where the shapes seem to have the least "kinetic energy". An information field still exists, even though there is no real rhythmic grid or real generated data. When the shapes are combined, they create an already modulated field instead of a generated field which is modulated and edited afterwards.

Because of the limited aural spaces of the instruments in *Beck*, which is basically pitch space, I decided to move the structural interest to the temporal behaviour of the sound layers and the interaction between instrumental colours. Combinations and manipulation of shapes and timbres are the main agents of the musical discourse. The generational process makes gestures and shapes, as well as larger units, sound as if "floating" in space and modulated by a random waveform which determines their temporal behaviour. A listener may perceive the musical discourse as instrumental gestures with different sound colours, resembling material grains floating in space, propelled by an unknown force and passing through a conduit which defines their shape. This image of the form of the piece, as moving

swarms of grains having a usually random but at times repetitive wave shape.

I should note here that the temporal organization of texture based on rhythmic grids is a structural device borrowed from the electronic studio and has been employed in different ways in various pieces. In *Horus*, for trombone and cello, the grid is four bar structure that is repeated, permutated and modulated through expansion and contraction of bar durations -though the rhythmic values inside each bar are usually retained. In *Calcination* the grid repeats itself steadily and provides a limited number of possible position of gestures on the textural surface. In *Scratch* the grid offers a basic waveform structure where modulating instrumental gestures are mapped and in *Beck* the grid provides a kind of quantization of the previously rhythmically free shapes. In all cases the grid functions as a sieve that determines the degree of quantization - or maybe ''bit depth'' - of usually short gestures and it is usually a wave-like structure with a period that the listener cannot recognize on the musical surface.[11] In the studio, grid-like structures are also an important tool for modulating audio or MIDI events. [12]

In the instrumental examples (*Calcination* and *Beck*), the indeterminate processes are much simpler than the process I have described in relation to the electronic layers of *Electric Currents.* That is partly due to the fact of the limited aural space of the instruments. In the case of the electronic layer, I could manipulate a great amount of different parameters in order to create modulation chains that affect both the aural space (timbre) and the temporal behaviour of the sound layer. I could then take a sound object and I could apply on it virtual gestures that distort it and I could go on until I would create a sound space and temporal behaviour that would satisfy me. In the case of the instrumental pieces, I am limited in the manipulation of sound producing gestures. The real, physical gestures can only generate specific aural spaces and may be further modulated in a limited way (saxophone is modulated by embouchure techniques, cymbal by muting, etc.). Furthermore, the ability of the modulating parameters to move in time is limited due to human gesture and interaction with other physical gestures. When a generational process is applied, it affects the temporal space

11 In *Beck* and *Horus*, division of various sections and sometimes grid periods are based on the golden ratio.
12 See also the role of the tempo track in *Electric Currents* on chapter 2.3.5. and the role of contraction and expansion of looped audio segments in *Dreamscape Part 2: Black Moon* on chapter 4.5.

and behaviour of the instruments rather than the actual aural space of the instruments, which is defined by gesture and physical material. Concerning the temporal behaviour, the instrumental sound shapes can only be combined in certain limited ways and the ability of superimposition is also limited - due to physical performance limitations (i.e. in *Beck*, the saxophone is approached as a monophonic instrument and even at times where complex sounds are generated – i.e. through modulation of teeth on reed pressure – they function as simple modulations of single tones) – except, of course, in an orchestral context.

Now I would like to make some general observations about my use of indeterminate transformational or generational processes in both media:

1. Indeterminate processes usually serve as tools that generate large amounts of information, so that afterwards I can select the part of the generated information that suits my needs

2. The abstract conceptual model of the *waveform,* approached as regular and irregular parametric motion*,* connects lower level timbre and middle level gestures and shapes in both media

3. There is no conscious intention to (re)create through these processes a neutral, natural or ambient soundscape with no references to history, tradition, etc., though these sometimes may be generated

4. The results of processes may sometimes be achieved equally, or more effectively, through improvisation and actually sometimes generational processes and improvisation coincide

5. Directionality, determinism or causality in a piece is not usually related to directionality, determinism or causality in the generational processes

6. Generational processes and modulation chains in the instrumental medium are limited by physical space and gesture

7. Generational processes and modulation chains usually affect both aural space and temporal behaviour of the sound object. Timbral transformation is perceived as motion from one aural space to another and thus it is linked to temporal behaviour.

2.3.7. Techniques borrowed from surrealistic art

In order to make clear my compositional intentions in middle level structures, I would like now to trace some connections between some of the techniques that I employ and surrealistic art and painting. A composed sound object, with temporal evolution defined by the motion of a number of gestural vectors (parametric motions that define aural dimensions), or envelopes, which alter a number of sound parameters, may be perceived as a specific space-time system of coordinates. When this sound object is further altered though the imposition of new gestural vectors upon some parameters, the original system of coordinates is no longer operational. A new system of coordinates may be perceived when the previously established aural space is modulated or transformed. The listener then is continually re-evaluating the system of coordinates on which the modulating motion of gestural vectors are operating.

Chilean painter Roberto Matta, one of the main painters of the Surrealist movement, called his works of the 1940s 'psychological morphologies' and offered new concepts of space related to inner psychological space (McNay, 2002). Matta states about his 1940 painting *The Vertigo of Eros:* 'The reference I was making once again, was to non-Euclidean space, where all the ordinates and co-ordinates are moving in themselves, because the references to the 'wall', shall we say, of the space, are constantly changing' (Kozloff, 1965, p. 26, cited by Parkinson, 2008).

Matta's sense of space and depth is connected to my work not only through the continuous re-evaluation of co-ordinates established by gestural vectors, but also as a more real sense of depth in acousmatic music which is the result of different reverb times or other reverb parameters applied on the same sound objects which then seem to move in perspectival space. For example, in *Electric Currents*, or in the second part of *Liquid Glass* for two percussionists and electronics, I have dispersed one sound layer into different tracks, armed with different types of reverb, which creates the illusion that the object changes in depth. The sound object, then, seems as if it is actually moving or stretching in space. Abrupt panning effects also enhance this effect. In instrumental music, volume changes, and filtering gestures applied onto shapes lead to similar results.

Figure 18. Roberto Matta, *The Vertigo of Eros* (1944).

Another characteristic of Matta's paintings that is related to techniques that I employ in my acousmatic and mixed works is the concept of *biomorphic forms*. These are forms that, while abstract, refer to or evoke living forms such as plants and/or the human body. Biomorphism has to do with transformation and hybridization and is a concept explored by many surrealist artists before and after Matta.[13]

Figure 19. Roberto Matta, *Elle loge la folie* (1970), an example of biomorphic art.

I tend to categorize sounds according to their references to the extrinsic matrix (the sounding world outside the musical work) in natural sounds and human made sounds. Furthermore, I tend to categorize human made sounds in mechanical, electronic-digital and instrumental sounds. Forms with a biomorphic resemblance can be created when sounds that

13 I should note that my first exposure on the concept was through the popular "biomechanical art" of Swiss surrealist artist H. R. Giger.

have a clear human or human-made source-bonding are mixed together with either natural sounds or mechanical/electronic sounds. Morphing of sounds can be easily achieved by mixing sounds with similar temporal behaviour (see also chapter 1.2.2.). In *Electric Currents,* I have used two clearly separated sound layers; one is comprised of piano sounds and the other of synthesized sounds. The live piano part is a layer that morphs with the pre-recorded piano. I have then one layer of piano sounds (which are made more human and real by the presence of the live pianist) and one layer of synthesized sounds. Many abrupt pauses are employed in this section, which fragment the shapes created by the sound layers. The listener may find it difficult to perceive a horizontal evolution of the layers; he would perceive instead a compound sound object that is comprised of piano and synthesized sounds (that sometimes simulate natural sounds), which starts and stops. In my view, the listeners, being denied a clear perception of layers (because of the extreme fragmentation of texture), attempt to perceive the nature of the various sound objects unfolding in time, and it is my intention, by blurring the boundaries between different types of sounds, to excite their imagination so that they may start thinking in terms of new sound sources, shapes and forms that may resemble the surrealistic biomorphs.

Another surrealistic technique, employed by Matta, is automatic drawing. *Surrealist automatism* can take the form of spontaneous drawing or writing. Andre Masson was one of the first artists who employed the technique, but it found its way in the work of most surrealist artists. Surrealists believed that automatism could express the creative forces of the unconscious. Mary Ann Caws states that: 'Surrealism should not be “treated” like any other literary movement, which had its period of influence...It considers itself to be on a different level from ordinary traditional concerns, no matter how metaphysical they may be. It's the hand pointing away from all we already know' (Caws, 1996, p.21). Andre Breton defines surrealism in his first manifesto as 'pure psychic automatism by means of which it hopes to express...the real functioning of thought. Dictation of thought, in the absence of any control exerted by reason, outside all esthetic and moral preoccupation' (Caws, 1996, p.23). Surrealist automatism was probably the most radical surrealistic technique in that by claiming to abolish control by reason and traditional esthetic concerns it opened the gates to new approaches

towards the notion of historical time in Western art, in a way that it may be seen as a precursor of postmodern ideas about history and tradition. If we consider the unconscious mind to be a repository of images, sounds, words, signs, etc., that we have experienced in the past, then are our present thoughts just a recombination and rearrangement of older information, in the same way that we access stored information in the world wide web through a computer, or can we continually create or access new information? In other words does new information really exist? If for example a person was locked in a prison for the rest of his life, would his imagination create new information or rearrange and re-access information already stored in memory? These questions are rather philosophical and an objective answer may not be offered, but I think that they point to the ideas that interest me in relation to surrealist automatism. It is also interesting to observe the relation to similar techniques employed by spiritualists around the same time, such as mediumistic automatism (although Breton denies a connection with these techniques) and also with 'Arthur Rimbaud's formula for the experience of otherness within the self "Je est un autre" ' (Conley, 2006, pp. 130-1).[14]

In my work I have employed a kind of automatism in my approach to improvisation and generational processes. In the acousmatic medium I have used virtual gestures (MIDI controllers) in a way similar to the surrealistic use of the pen in automatic drawing. I usually select one, two, or more parameters of a software and assign to them MIDI controllers (the software could be either a sound production software such as a virtual synthesizer or a sampler, or an audio effect which transforms the sounds "fed"). Having established the aural space in which I move, I then create virtual gestures therein which are usually very free, uncontrollable, and intrinsically linked to physical gestural activity. It should be noted though that before starting drawing shapes in the aural space I am usually aware of the kind of gestures that will produce certain types of sounds. Additionally, I may interact with the sounds that I am producing and accordingly decide to change my gestures, in a way similar to traditional improvisation. In the image below we can see the shape produced by controlling reverb time in a reverb virtual audio effect. That shape was applied to several synthesized and pre-recorded sound layers in the first part of my piece *Electric Serpent.*

14 "I is another" or "I am another".

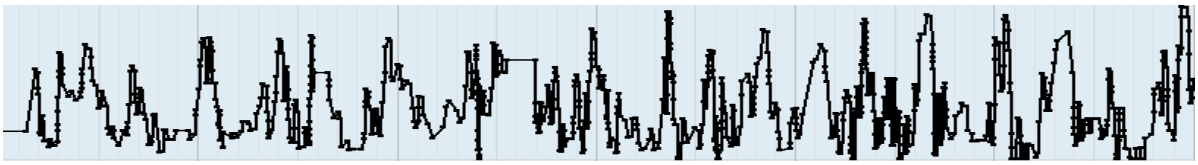

Figure 20. Shape produced through MIDI controllers.

At other times automatic drawing in my work is exactly that. In the instrumental medium, automatic drawing can be directly mapped onto instrumental gesture.[15] In section 8 of my piece *Liquid Glass* for two percussionists and electronics, for example, I have employed a notation of free shapes in the bass drums. I have drawn a series of shapes in the staves that are to be translated by the percussionists as shapes drawn on the surface of their instrument with a wire brush. Although I was aware of the general spectromorphologies that these shapes would produce when drawn on the surface of the instruments, the particular details of most of the shapes were drawn in a spontaneous fashion that aimed to emphasize curved lines, unity of shape and connection with the electronic sounds. Some of the electronic sounds used in this part (pre-recorded bass drum sounds and synthesized noise sounds) were also transformed by similar visual shapes or virtual MIDI gestures, which controlled software parameters.

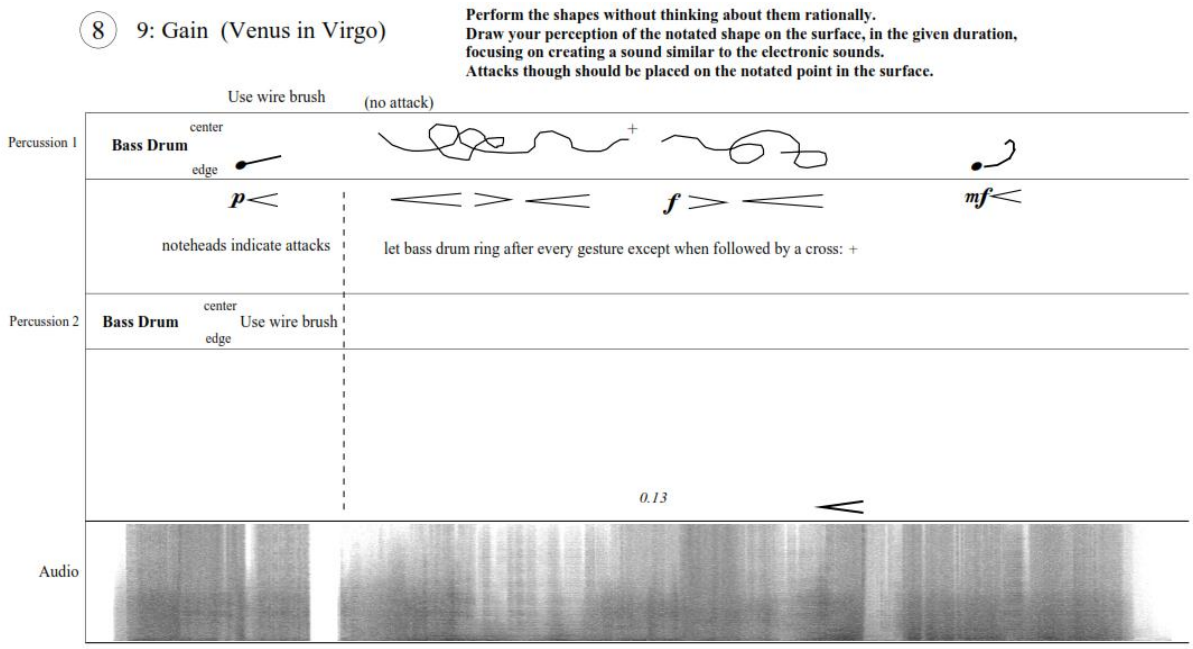

Figure 21. *Liquid Glass*, section 8, shapes drawn on bass drums with wire brushes.

In conclusion, although there are some important differences with the traditional

15 I also approach rhythmic grids as predefined structures that add another level of distortion (or modulation) and unpredictability to the often "automatic" gestures that are mapped on them (i.e. in *Calcination*, *Horus*, *Scratch*).

notion of automatic drawing (mainly the fact that I did not consider the result of the spontaneous drawing to be the final artistic work in its entirety), there are some significant similarities. My approach to automatism, similarly to my approach to other indeterminate generational processes, aims to the generation of large amounts of information (information fields or networks), to the extent that the final result becomes chaotic and unpredictable either in its low level structures that affect sound/timbre, or in its middle level temporal behaviour that affects sound patterns and shapes, or both. Spontaneity and unpredictability of results boosts my imagination and keeps the compositional process fresh and exciting in the same way that a recording of a lush natural soundscape excites the acoustic imagination. The results also usually exhibit a kind of natural/physical or human behaviour, which stems from the fact that they are the products of spontaneous (human made) gestures inside limited aural spaces. Electronic sound is not presented in a "polished" state resulting from the perfection of the digital software but is rather presented as a "used", somewhat "dirty" sound which is the result of human interaction and gesture. This type of sound exhibits similar morphological characteristics to instrumental sound and thus I have employed them in order to simulate instrumental sound qualities.

Figure 22. Andre Masson, *Automatic Drawing* (1924).

3. Approaches to higher level structures

3.1 Conceptualization and cognitive image schemas

3.1.1. Conceptualization

If we approach middle level structures of a musical work as indeterminate information fields that resemble real acoustic environments, then the question arises of how the composer and listener perceive and conceptualize acoustic information and communicate meanings and musical narratives. In order to approach large scale structures in instrumental and acousmatic music, we need to think about conceptualization and functionality of musical structures in the context of a musical narrative. The notion of conceptualization has to do with recognition and apprehension of patterns, which is the foundation of the creative process. In a musical texture that is concerned with hybridity and ambiguity of sound sources and time scales, there is the danger that identity of discourse and connection to a human temporal scale may be lost, resulting in confusion. For me this is indeed a common problem in acousmatic and instrumental music today. The abstract properties of the acousmatic medium in general (e.g. the absence of a common source-cause texture connected to human gestures and temporal scales) calls into question the nature and object of the musical discourse and how we approach, as composers and listeners, middle and large scale structures of a musical work.

Greek philosopher Plotinus commented on the abstract qualities of art and the much misunderstood concept of Platonic *mimesis* in art:

> 'Still the arts are not to be slighted on the ground that they create by imitation of natural objects; for, to begin with, these natural objects are themselves imitations; then, we must recognize that they give no bare reproduction of the thing seen but go back to the Reason-Principles from which Nature itself derives, and, furthermore, that much of their work is all their own; they are holders of beauty and add where nature is lacking. Thus Pheidias wrought the Zeus upon no model among things of sense but by apprehending what form Zeus must take if he chose to

become manifest to sight' (Plotinus, 1987, p.59).

Metaphorical thought seems to be vital to understanding art, especially an art as abstract and ambiguous as acousmatic music. According to Lakoff and Johnson, 'the essence of metaphor is understanding and experiencing one kind of thing in terms of another' (Lakoff and Johnson, 1980, p. 5). Conceptual metaphors also influence compositional methods and techniques. Xenakis compared sets of sounds to clouds, gases and liquids, and Cage the position of sounds in time to the position of stars in space. Traditional tonal functions were conceived in terms of tension and relaxation, even if those terms are actually metaphors coming from the domain of bodily experience. Mark Johnson observes that '...virtually all of our conceptualizations and descriptions of music uses metaphors whose source domains are drawn from sensorimotor experience' (Johnson, 2007, p. 243).

Candace Brower, in her article ''A Cognitive Theory of Musical Meaning'', draws upon the cognitive sciences in order to explain how we perceive traditional tonal functions by matching patterns we experience to patterns stored in memory. She describes three types of patterns: '1) *intra opus patterns* – patterns specific to the work itself; 2) *musical schemas* – patterns abstracted from musical convention; and 3) *image schemas* – patterns abstracted from bodily experience' (Brower, 2000, p. 324). She also proposes that the *image schemas* play the most important role in our embodied understanding of tonal music and how we perceive the metaphorical concepts of musical space, musical time, musical force and musical motion. Those image schemas are: *container, cycle/wave, verticality, balance, center-periphery* and *source-path-goal*. Those image schemas are applied principally onto a two dimensional space, defined by time and pitch. Now, what happens if we attempt to apply the image schemas to multi-dimensional aural spaces defined by multiple sound parameters?

Taking into account the complexity and variety of multi-dimensional spaces, especially in acousmatic music, and the aural compositional approaches to musical material, an attempt to connect the image schemas to specific parameters and dimensions would not be of much practical use. Trevor Wishart suggests that:

> 'In this new space of possibilities, reason (or rationalisation), must come to terms with intuition. With precise sound-compositional control of the

multi-dimensional space, we can move from what were (or appeared to be) all – or – nothing shifts in sound – type to a subtly articulated and possibly progressively time-varying ''playing'' of the sound space...we are already familiar with such subtle articulations of a multi-dimensional sound space within our everyday experience. Consider the many affective ways to deliver a text, even where we specify no significant change in tempo or rhythm. The range of human intent...which can be conveyed by multi-dimensional articulation of the sound space, is something we take for granted in everyday social interactions and in theatre contexts' (Wishart, 1994, p.104).

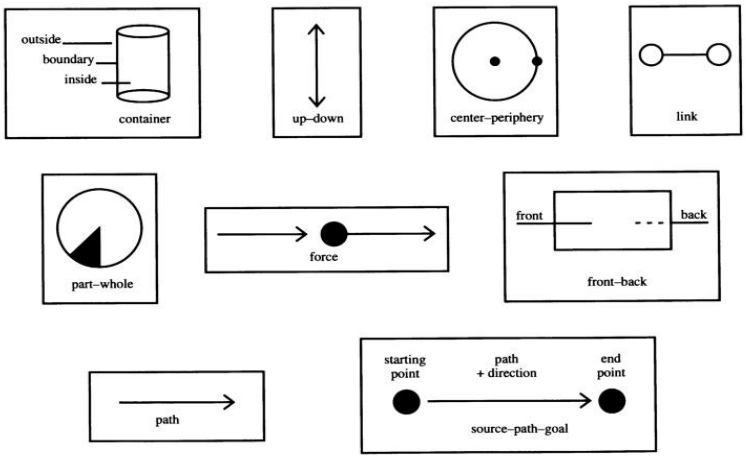

Figure 23. Diagrams of some common image schemas (Saslaw, 1996, p.219)

I believe that multi-dimensional spaces in middle level structures should be approached intuitively if we want to exploit their expressive possibilities, but we can still benefit from applying the image schemas to large scale formal structures or to middle level basic concepts which affect the organization of the large scale form, in order to define functions and connect compositional methods in both acousmatic and instrumental media. It should be noted that the image schemas are conceptual models that may change or evolve and not objective acoustic models.

Image schemas are extremely significant in the exploration of the notion of hybridity between acousmatic and instrumental structural strategies. Cognitive image schemas are linked to a bodily perception of musical discourse and are operational on pitch space or

spectral space in general but source-bonded sounds are also intrinsically linked to various image schemas because they are the result of physical gesture, force and motion. A connection then between various types of sounds may be achieved when common images schemas are employed in middle or even higher level structures. For example, in my piece *Panorama 4* the sound of a drop of water that opens the piece is linked to a periodic wave-like or bouncing image schema. Throughout the piece I have employed this wave-like image schema in order to modulate the synthesized layers that dominate through the end of the piece. Furthermore, a directionality is given to the synthesized sound layers by overlaying a source-path-goal image schema either through motion in pitch space or through varying the period of the wave-like schema. In my piece *Fissure B*, for cello and electronics (as well as in the first part of *Electric Serpent* and the second part of *Liquid Glass*) the starting point for the creation of the electronic sounds were certain articulations linked to specific image schemas that are generated by the physical gesture of the instrumentalists. Thus, instrumental bouncing sounds such as *jeté* sounds on the cello led me to create electronic sounds with a wave-like schema, rubbing sounds and longer sounds have a wave-like and/or source-path-goal schema (stemming from bow motion articulations) which led me to create sounds with similar behaviour, while the speed and rate of change between various sounds (the product of a freely permutated grid that defines mainly the density of texture) directed me on how to combine the different sounds in order to create the electronic texture. The result is a texture that combines a wave-like schema together with a source-path-goal schema and exhibits certain instrumental qualities. This instrumental qualities are not so much the result of spectral similarity between the synthesized and cello sounds but rather the result of the combination of image schemas derived from the gestural instrumental writing. I would say that the apprehension of the type of image schemas present on the instrumental sound and texture direct me as to what type of texture I want to create and even to what type of larger scale formal structure may even be appropriate. In my acousmatic works a similar methodology is followed by apprehending the image schemas present on the source bonded sounds or the generated sound layers that constitute my musical material.

3.1.2. Containers and physicality

An aural space may have one or more stable dimensions. When we perceive a sound layer as an autonomous entity in the musical texture, we are automatically perceiving a relatively stable aural space where motion can be perceived as such. A very simple two dimensional aural space would be defined by the pitch versus time co-ordinates. A simple three dimensional space could be defined by pitch versus time, plus spectral bandwidth. When spectral bandwidth changes, pitch motion would also be affected. The more dimensions we add to an aural space the more complex and uncontrollable the space becomes, mainly because motion in one dimension affects other interconnected dimensions. A complex multi-dimensional aural space is usually perceived as a sound layer with unstable timbre. How can we then recognize a sound layer in the midst of a texture comprised of multiple layers with unstable timbre? Fred Lerdahl proposes that sound layers which appear to be in a more stable or psychologically archetypical or ''default'' state timbrally are perceived as being prototypical (Lerhahl, 1987, p.144-5). Even though multi-dimensional spaces do not necessarily have a reference state or a “default” state, a sound layer establishes its timbral presence and identity in time through some timbral characteristics which the listener recognizes as being prominent and relatively stable. Pierre Schaeffer's notion of sound characters, which denote the stable qualities of aural spaces or aural dimensions, expresses the same idea. In cases of extreme timbral fragmentation the sound layer cannot be perceived as a single entity but as a combination of various timbral entities. A sound layer as a stable aural space - or a Schaefferian sound character - can be perceived as a timbral container; it contains various sound parameters or dimensions, which may be perceived as varied sound colours.

The metaphor of musical colour, useful as it may be, cannot express the dynamic qualities of the sound layer moving in multi-dimensional space and evolving in time. Space is a metaphor borrowed from our bodily experience of physical reality. The sound layer, especially in acousmatic music, can be easily endowed with almost tactile properties of physical materials and bodily sensations. Smalley talks about various types of motions and growth processes and uses metaphors such as “floating”, “drifting”, “coiling”, “flocking”, etc. in order to describe particular types of motions (Smalley, 1997, p.117). Similarly, Xenakis, with his sound masses

and his application of stochastic principles in types of motion and textural organization, is particularly important in conceptualizing instrumental sound layers as physical materials or objects.

When we listen to an abstract acousmatic texture, even through reduced listening, we perceive one or more sound layers that are linked to certain image schemas and may remind us of tactile physical materials and objects. Our familiarization with the instrumental way of perceiving sound layers - as instrumental bodies excited by certain types of gestures - enhances that conceptualization of sound layers as material bodies or objects. Spectral bandwidth and density or amplitude intensity are usually the qualities of sound that most remind us of thickness. The sound layer can be approached as a container which can get thick, covering a large part of the sound spectrum (extending to noise) or reduced to a very small frequency band (a pitched tone), though retaining its own identity in the musical texture. A container may also comprise of other nested containers inside its aural space. The sound layer as a container moves also in spectral space, interacts with other containers or may morph and become part of a larger container or sets of containers.

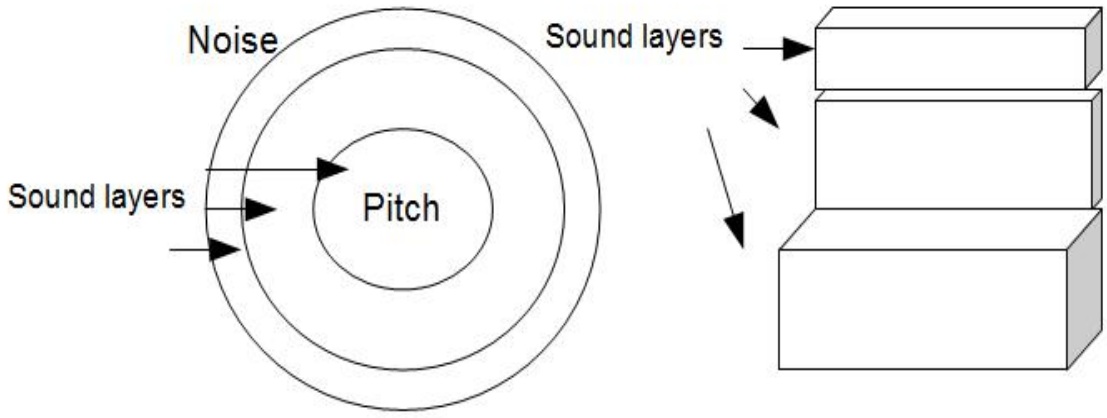

Figure 24. Sound layer as spectral nested containers and as external objects positioned in spectral space.

In my piece *Liquid Glass,* for two percussionists and electronics, we can see an example of musical discourse where electronic and instrumental sound layers may be conceptualized as both timbral containers and material bodies or objects. Throughout the piece I mostly employ instruments which can generate continuous sounds through rubbing and scraping gestures. Particularly in section seven, I employ two cymbals placed upside-down on top of two timpani; the first cymbal is scraped with a metallic object (head of a bolt or coin)

and the second cymbal is scraped with wire brush. In order to notate the piece, I had to prioritize the properties of the physical space of the instruments that change mostly when excited through gestural activity. I notated the vertical movement from the bell to the edge of the cymbal's surface as shown below, while horizontal movement is left to the discretion of the performer.

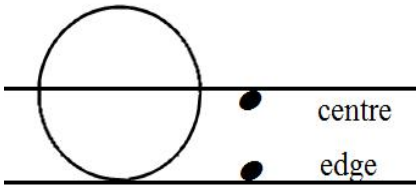

Figure 25. Notation of vertical gestures on the cymbal's surface.

The vertical gestural movement on the surface of the cymbal mostly affects the brightness of the sound spectrum rather than the pitch content. The pitch content of the sound spectrum and the metallic timbre of the cymbal remain relatively stable throughout the section, providing a stable background where the changes in the brightness generated through vertical physical motion can be easily perceived.

Having to work with changes in one sound parameter controlled by basically one gestural vector, I tried in a way to transfer the string instrument technique of lateral bow movement on the strings in order to create continuous sounds. The wire brush and the coin or bolt which excite the surface of the cymbal affect the sound colour and thus the aural space of the instrument. The physical, instrumental space then may be mapped to a different aural space depending on the material of the object by which it is excited. Two additional parameters modulate the sound properties of the physical space. The first is the muting of the cymbal's surface by the performer, which affects the cymbal's resonance. The muting is approached as a parameter that modifies the aural space of the instrument because of its importance in affecting the dryness of the overall sound (its role is similar to the function of reverb in acousmatic music). It is notated on a separate line, with a thick black line which indicates the duration of the muting. The second parameter which modulates the instrumental aural spaces is the glissando of the timpani through its pedal. The timpani acts as a resonator which modifies the frequency of the cymbal's resonance.

To summarize, the aural spaces in that section of the piece in the instrumental part consist of the two sound spaces created by the two different objects which excite the surface of the cymbal and a modulation of those spaces through the muting of the cymbal and the pedal motion of the timpani. The aural spaces - which in this case are also physical spaces - can be easily conceptualized as timbral containers because of the stability of the aural space, defined by physical material and gesture. Both containers have a relatively stable position in spectral space mostly because of the metallic surface of the cymbals. Thus, despite the difference between the objects that excite the surfaces of the cymbals, the two layers can be aurally perceived as one layer, comprised of two closely related internal layers.

Concerning the electronic part, I have employed 3 layers of pre-recorded cymbals and a layer of synthesized sounds. I have recorded cymbals placed upside-down on top of timpani and excited through scraping by wire brushes, coin or the head of a bolt. The recorded sounds are then electronically modulated through various processes and several sound layers are generated. Each layer is characterized by a different level and type of transformation, ranging from filtered layers with a thinner cymbal sound, which sometimes is perceived as pitched, to a completely noisy layer which was created by reducing the quality (bit and sample rate) of the original recording. The synthesized layer is comprised of sounds with a noise and inharmonic sound spectrum, created mostly through FM synthesis. Both the sound spectrum and the articulation of the synthesized sounds, with a strong attack followed by a relatively short decay, match the spectrum and articulations of the cymbal when excited with wire brush.

Similarly to the live instrumental layers, these four layers can be conceptualized as timbral containers because of their relatively stable aural spaces. Additionally, their aural spaces, defined mainly by one or two dimensions, permit reciprocal and sometimes cyclic motions, which resemble the physical vertical or cyclic gestural motion on the surface of the cymbals. The similar qualities of instrumental and electronic aural spaces, in that case, makes them able to be perceived as variations of one common aural space. I should note also that the usage of the same or similar image schemas on different aural spaces facilitates the connection between them and a blurring of their boundaries. The listener cannot easily distinguish the over imposed layers but can identify live or recorded sound sources, and the

general aural differences between the layers. In the specific example, the listener is able to recognize the difference between noise sounds and filtered cymbal sounds with a clearer sound spectrum. Instead of layered sounds, the listener perceives a kind of timbral motion, or motion between aural spaces, perceived also as transformation from one to another. Although there is no actual motion, or transformation, because of their spatial and temporal similarities, the transition from one layer to another is usually smooth. Furthermore, the live instrumental spaces endow the electronic layers with the qualities of their physical spaces. The electronic aural spaces can be conceptualized as imaginary surfaces in a state of continuous transformation.

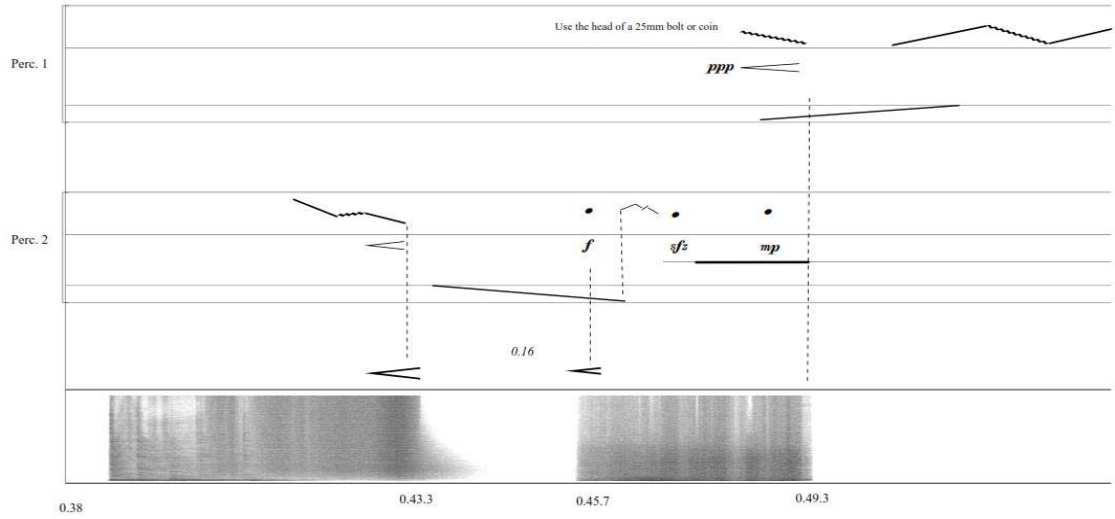

Figure 26. *Liquid Glass*, section 7, cymbal 1 excited with bolt or coin, cymbal 2 excited with wire brush, timpani pedal, muting of the cymbal and electronic sounds.

In conclusion, the four electronic layers and the two cymbal layers can be conceptualized as spectral containers, containers moving in spectral space and as imaginary physical surfaces with varying qualities. Larger structural units can be approached through the same conceptual models; even whole sections of a piece may be conceptualized as containers. It is interesting also to note that the transformational function of containers is similar to the transformational function of tonal modulation as motion or morphing of tonal spaces in traditional tonal pitch space (Saslaw, 1996).

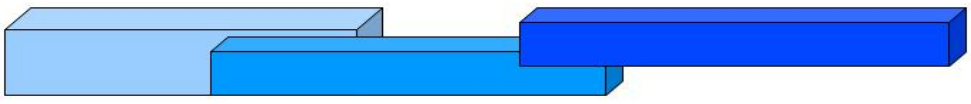

Figure 27. Graphical presentation of sound layers or containers with similar aural spaces overlapping in spectral space, creating the illusion of timbral motion.

3.1.3. Cycles, waves, paths and gravitational forces

In the domain of spectral space there are two basic polarities: clear pitch sound with repetitive waveform and noise sound with random waveform. Even though innumerable variations may exist, these are the two boundaries of the sound spectrum. Composers of acousmatic music often approach sound spectrum similarly to the colour of the painter. Mixing of various shades of sound colours seems to be a main compositional preoccupation of the composer of acousmatic music, replacing to a large extent traditional practices of pitch/rhythm organization. I have already mentioned the practise of modulation chains, which is in large extent a technique that aims to a production of new and interesting sound colours. Sound montage techniques - that I will explain in detail later in the chapter - aim to a similar mixing of different sound colours.

The sound spectrum can be seen either as a collection of sound particles or as a variety of waveforms. If we conceptualize the sound spectrum according to the particles model, then we have the polarity of particle versus plane or mass, which is usually perceived as a pitch versus noise duality. The movement from pitch to noise is perceived as a "filling"' of sound space or an addition of particles, while the passage from noise to pitch is perceived as filtering sound space or a subtraction of particles. There is a threshold beyond which the sound will be perceived more as noise rather than pitch and vice versa.

This is a conceptualization which has influenced instrumental music during the last century, as is clearly evident in orchestral pieces such as *Atmosphéres* by Ligeti and *Metastasis* by Xenakis. Xenakis and Ligeti realized that the sound masses generated by filling the spectral space with sound particles tend to be perceived through a waveform approach of the sound textures. Xenakis even borrowed models for the description of the wave-like behaviour of liquids and gases. On the other hand, a similar approach to texture is suggested when we have repetitive textures (such as in the early works of Steve Reich that were inspired by phasing techniques) or when we "zoom into" the inner details of sounds or "textured interiors" according to Smalley (Smalley, 1997, p.114). Smalley also offers a general approach to wave-like shapes in acousmatic music that can easily be transferred to instrumental music (Smalley, 1997). In my work I have employed a waveform approach to textures in the creation and

manipulation of generated data (employment of repetitive grids in instrumental music and similar generative procedures in acousmatic music) and in my use of physical or virtual gestures in the process of modulation chains .

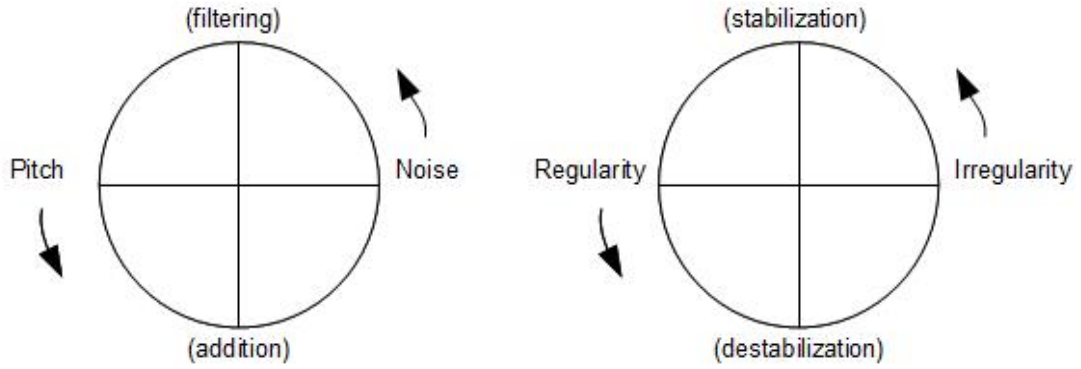

Figure 28. Cycle/waveform models for sound spectrum and temporal behaviour.

If we approach the sound spectrum through the waveform model, then we approach the sound spectrum as a continuous temporal structure and we have the polarity of regular versus irregular waveforms. Moving from regularity to irregularity can be perceived as destabilization of the repetitive original structure while movement from irregularity to regularity as stabilization. Repetition - expressed either as pitch or rhythm (space or time) - is perceived as a static ground. Irregularity, or noise, can be perceived as a static ground too, when it exhibits a predictable and uniform behaviour.

We can imagine a wheel, fixed at its centre, and combine its wave-cycle schema with the verticality image schema that defines gravitational functions. We can observe that when the wheel is at a state of inertia (resistance to a change of its state), it will stay at rest unless an external force is applied to it. When the wheel moves towards one direction, it has the tendency to continue its motion towards the same direction. If the wheel comes to a rest then we will need to apply more energy to make it move again. These laws are linked to our bodily experience of motion and force, and that is why they find application in our experience of musical force and motion. Transferring the same concept to music, we can accept that when a sound layer is static, it comes to a metaphorical state of of rest and establishes a musical plane which acts as a gravitational field. This gravitational field is established, because the plane provides a static reference point in the musical texture (we identify a resting point or "anchor" in musical space). A long note, or a repetitive pattern, will usually exhibit that type of

gravitational function.

A continuous motion between regularity and irregularity is required for the texture to be perceived as having the most ''kinetic energy'', which continually pushes the body forward, avoiding the gravitational pull of possible planes. As long as one of the two polarities is established, the gravitational pull will affect the whole musical texture. On the other hand, some polarities in musical space have to be fixed so that the dialectic relationship between stasis and motion and the play with possible image schemas may be clearly perceivable.

In my experience, when the texture is stable, the listener tends to intellectualize the listening experience. He may be wondering how the instrumental sounds are produced, what kind of sounds and through what technique are manipulated, or trying to identify familiar musical schemas, etc. In other words, the listening experience tends to become information gathering. When the musical texture is unstable, or too complex, the mind tends to "short-circuit" by the information it is exposed to. The listener has no time to perceive all the information or he is unable to easily refer to a stable aural space. In that state of perceptional ambiguity, new conceptualizations of the musical texture may be formed by the listener instead of being forced on him, listening is more alert, and narrative structure is experienced rather than understood.

3.2. Narrative strategies

Mark Johnson notes that symbolic meaning in language has a corporeal basis in that we tend to combine various simple, body related, cognitive patterns in order to construct more complex meanings (Johnson, 2007, pp.135-54). In the musical work, image schemas, combined with musical schemas (schemas crystallized from musical convention (Brower, 2000, p.324)), and schemas that are specific the the musical work, construct complex meanings and narrative structures. An investigation of possible such combinations in the field of today's acousmatic and instrumental music would be a huge undertaking and with dubious results, considering the aural and intuitive approach to multi-dimensional musical spaces by the

composer, and that many of these patterns are so intertwined in our everyday experience that we usually pay attention only to patterns of a higher degree of information (we should also note that in acousmatic music we have source-bonded sounds and signalling sounds which refer to the sound world outside the musical work). Instead, I suggest that an investigation of the methods by which I combine various cognitive patterns (intuitively or not; the boundaries between intuition and construction are not always clear), in order to produce a musical narrative, would be a much more useful venture.

3.2.1. Sound and film montage as narrative

Stable aural spaces in acousmatic music have a role similar to the instrument or the ensemble in instrumental music; they provide a reference point for the listener and establish spaces which facilitate various types of motion. When I want to create more complex sounds and motion types, or transformations of sounds, I need to utilize multiple aural spaces or different versions of the same aural space. Aural spaces here should be understood as the union of the aural space and the temporal behaviour, or what Lasse Thoresen defines as *integral sound characters* (Thoresen, 1997, pp. 314-5). Generated sound layers, through algorithmic or other processes, may be approached as integral sound characters. We can imagine that an aural space and a temporal behaviour combined can be infinitely long. Repetition is obviously the simplest way to extend an aural space and a temporal behaviour. Infinitely complex processes can be employed in order to extend an aural space and a temporal behaviour. Aural spaces can be outside-time, but so can temporal structures. An algorithm or a process is such an outside-time temporal structure. In order then to create significant change and create more complex sounds, we need to use sequences of multiple such combinations of aural spaces and temporal behaviours, in the same way that a film uses sequences of static visual frames in order to create the illusion of motion. In other words, we need to think about montage and its function in instrumental and acousmatic music.

We can assume, of course, that the slightest change in the musical texture, either temporal or timbral/spatial, is a new aural space, and that every change is a montage between different layers, although that could be impractical from a compositional point of view due to

the large amount of data that the composer would have to handle. Xenakis proposed a similar idea when he suggested the concept of screens, which are graphical representations of sound particles in the audible spectrum, placed on a fixed grid, in a ''slice'' of time. Ordering of multiple screens in time may then describe the history of any given sound (Xenakis, 1992, pp.50-1). Xenakis's notion of screens answers the issue of creating complex sounds or clouds of sounds out of elementary sound grains, and Xenakis used it to describe mostly granular textures in his pieces *Analogique A,* for string orchestra, and *Analogique B,* for sinusoidal sounds. Frequency, amplitude and density of grains, as well as ordering of screens, are determined stochastically. Xenakis, when composing *Analogique A* and *B* hadn't yet conceived of inside and outside-time structures. His later distinction between inside-time and outside-time structures made the concept of inside-time stochastic ordering of screens less relevant (Di Scipio, 2005, p. 10).

We should note the similarity between the notion of sound screens and the notion of film frames. A film frame constructs the film shot either through a direct ordering of constructed temporal images or through a selection of parts or fragments of an existing space. Instead of constructing stochastically the temporal structure of the piece through screens or "sound frames", we can imagine pre-composed integral sound characters (aural spaces united with a temporal behaviour which is predictable at the macrolevel) - thus outside-time - which can be prolonged indefinitely and can be edited, cut and combined in a montage-like fashion. Integral sound characters can then be paralleled to film shots. Conceptualization of integral sound characters as film shots will reveal formal qualities and functions of the sound montage technique that are not easily recognized when we perceive the musical texture in a linear way.

Michel Chion refers to the possibility of creating a "sound shot" in the same way as a film shot:

> '...you cannot create an abstract and structural relationship between two successive sound segments (e.g. a fragment of bird calls or of music) the way you can between shots (a character looks offscreen – cut to what he is looking at; or an establishing shot – cut to a detail in the scene). If you try something like this with the soundtrack, the

> abstract relation you wish to establish gets drowned in the temporal flow. What strikes the listener instead is the dynamics of the break itself between the two fragments. The explanation of this mystery is that when we talk about a shot we are lumping together the shot's space and its duration, its spatial surface and its temporal dimension. While for sound pieces the temporal dimension seems to predominate, and the spatial dimension not to exist at all' (Chion, 1994, p.43-4).

Chion's observations explain why film montage techniques cannot be transferred directly to sound. While it is true that a real spatial connection between sounds cannot be established, at least not in the same way as in film, if we approach musical space and its temporal dimension as a conceptual container in the context of an essentially abstract musical piece, then we may observe structural relationships between "sound shots" similar to those we observe in film montage.

Cutting and splicing together of various sound segments through sound montage may be perceived as a shift in aural focus in the musical texture, but it can also lead to complex semantic functions similar to language. Montage is a technique that goes beyond simple additive and subtractive procedures; it can endow the sound and the texture with "personality traits". In his 1929 article "The Cinematographic principle and the Ideogram", Eisenstein compared the way montage functions in films to the way the hieroglyph functions in language. While some hieroglyphs depict more or less specific objects, others are combined in order to produce complex meanings. Eisenstein explains:

> 'The point is that the copulation (perhaps we had better say, the combination) of two hieroglyphs of the simplest series is to be regarded not as their sum, but as their product, i.e., as a value of another dimension, another degree; each, separately, corresponds to an *object*, to a fact, but their combination corresponds to a *concept*. By the combination of the two "depictables" is achieved the representation of something that is graphically undepictable...this is exactly what we do in the cinema, combining shots that are depictive, single in meaning,

neutral in content – into *intellectual* contexts and series' (Eisenstein, 1963, pp. 29-30).

It is obvious that the range of possible combinations between shots with different types of content is unlimited, as it is also the range of concepts and meanings that may be expressed. When a series of shots are combined together, then we have strings of meanings which can be organized into higher level units or gestalts and create a narrative. Montage can be the driving force of the narrative structure of the musical work or film. Eisenstein argues that 'if montage is to be compared with something, then a phalanx of montage pieces, of shots, should be compared to the series of explosions of an internal combustion engine, driving forward its automobile or tractor: for, similarly, the dynamics of montage serve as impulses driving forward the total film' (Eisenstein, 1969, p. 38).

Eisenstein provided an extensive theory of film montage and described various montage methods. Based partly on his ideas (considering the important differences between film and music) and partly on Lasse Thoresen's concept of *form-building patterns* (Thoresen, 2010), I will give here a general overview of sound montage techniques that can find application in both instrumental and acousmatic media.[16]

Content	**Duration**	**Rhythm**	**Position**
Spectrum	Short (object)	Primary	Separate
Source	Medium (phrase)		Joined
Space	Long (sentence)	Secondary	Overlapping
Signal	Section		Superimposed
Temporal behaviour			

Figure 29. Types of sound montage according to content, duration, rhythm and position.

I distinguish different types of montage according to: 1. the characteristic of the individual "sound shots", 2. the duration of the "sound shots", 3. the rhythm of change between "shots", and 4. the position of the "sound shots". These should be understood as different parameters that are combined with each other, or as dimensions of sound montage

16 I am simplifying Thoresen's concepts, which are aimed mainly to aural analysis of acousmatic and instrumental music and thus are more detailed. Thoresen uses the term *time fields* to identify various subdivisions of the musical work in various hierarchical levels, while he uses the term *form-building functions* to describe various tendencies and musical forces that characterize the time fields. Time fields are almost identical to sound shots.

and not as mutually exclusive, although one or two parameters will usually dominate.

3.2.2. Content

"Sound shots" can be approached as containers. The sound **spectrum** is probably the most important of its contents. Sounds with similar sound spectra blend smoothly and thus the effect of transformation from one sound to another may be achieved. Differences in the position of sound in spectral space and spectral boundaries of the sounds are important in creating compound, layered sounds and in playing with the perception of space. Pitch is also part of the sound spectrum and has to to be taken in account. When we splice together sound fragments with even a slight innuendo of pitch content, we are actually creating melodies. Pitch space has the peculiar characteristic of being spiral (we can meet the same tone in other octaves) and of having a very clear hierarchy which can easily dominate the content of the sound shot.

The aural space of the sound shot may also be connected to a specific sound source, either through a recording, in acousmatic music, or through the instrument in instrumental music. The sound source can also be inferred or imagined. A montage of an abstract sound (with no clear source-bonding) together with a concrete sound (clear source-bonded) with a similar sound spectrum will usually be perceived as a transformation of an abstract sound to a concrete one. So, for example, similarly to film, the end of a sound with a metallic sounding source can be connected to another metallic sounding, abstract sound, or to another metallic sounding sound source (instrumental or other). Gesture is also a defining parameter; we can link instrumental spaces with different sources which are excited through similar gestures (i.e. a bass drum scraped with a brush with a cello string scraped with a bow), something particularly important in connecting orchestral parts.

Spatial positioning of the sound in the performance space or the sense of distance that the acousmatic sounds may intrinsically have also affects montage. A sense of foreground and background is created when sounds with different spaces sound together. Motion between spatial planes can be achieved by splicing together sounds with different spatial content. Additionally, sounds which come from the same space may be perceived as

having the same origin.

Sounds may also be perceived as **signals** of communication, in ecological terms.[17] Human speech, animal sounds, symbolic sounds connected to a specific meaning, or sounds which have a specific history, such as bells, rings or clocks, may fit into that category. Music too, can have such a signalling function, especially music with a strong cultural significance, if it can be differentiated from the musical work. Audio montage may connect sounds with a similar symbolic meaning even if they appear unrelated concerning their other qualities.[18]

Montage through symbolic meaning is an advanced and complex way of relating sounds. In my piece *Black Moon,* I have exploited the cultural significance of Wagner's music from the Prelude in *Tristan and Isolde* in order to create a narrative. The music from T*ristan and Isolde* - more precisely, motives and themes that function as leitmotifs - is culturally connected to the expression of sensual love in Western music. I have segmented and arranged the orchestral music through a rhythmic looping in a way that it gives the impression that it is continually building towards a goal. The goal, which in the case of the Prelude is the cadence in the context of tonal harmony, is never reached. In the very last seconds of the piece, a repetition of a single chord from the Prelude, which is the chord with the most tension and just before the cadence, is joined to a white noise sound and a sound of human rhythmic breathing or moaning with clear sexual connotations. While a connection between a romantic symphonic piece, white noise and a human breathing would seem absurd in another context, the cultural significance of the orchestral piece, its rhythmic, wave-like montage, and the clear signalling functionality of the human sound permits a meaningful montage with significant narrative implications; human breathing and noise substitute the pure musical goal.

Language and the human voice in general are probably the most important carriers of signals. In my piece *Voyage* for piano and electronics, I have used a recording of the voice of Timothy Leary, reading excerpts from his book T*he Psychedelic Experience: A Manual Based on the Tibetan Book of the Dead* (1966). Some of the short pieces which comprise the work have prominent voice parts while others are for solo piano or piano and

17 Smalley coins the term 'signals space' as 'a type of behavioural space produced by the signal calls of the participants, either to communicate with each other, or to communicate their presence to other inhabitants (Smalley, 2007, p.56).
18 Musical schemas (schemas abstracted from musical tradition) may also be understood as a special case of signals.

electronics. The voice part in some pieces is approached as another electronic sound layer or sound shot with the obvious additional signalling meaning. The voice sound layer though, cannot mix with other musical layers easily without losing its signalling function (a possible solution to that problem would be a transformation of the voice to a musical sound layer while retaining its signalling role). Thus, for example in pieces one, three and seven the voice layer is joined or separated with the musical layers in a way similar to the operatic recitative, while in pieces five and eight the static, drone-like musical layers permit the perception of language, when superimposed on top of them.

I have already implied that the aural or physical space defines the **temporal behaviour** of the sound shot (configuration of various dimensions define the types of possible movements or gestures). The temporal behaviour is a very important parameter that defines sound montage. Many cognitive image schemas are at work in the temporal dimension of the sound, as are intra-opus patterns (patterns specific to the musical work). I do not need to know the exact type of image schema in question; cognitive schemas are usually part of the musical vocabulary and the composer may work with them unconsciously. For example, it is common in montage to mix the ending (goal) of a sound that appears as having a clear source-path-goal schema with another sound with a strong onset; this will create the illusion that the goal possesses a kind of physical energy that propels the onset of the new sound. Furthermore, temporal behaviour is such a strong characteristic of the sound that usually defines its identity.[19]

Montage through temporal behaviour is particularly important in instrumental music, especially in chamber music where the limited instrumental resources limit the possible aural spaces available and thus montage through sound spectrum and sound source. Transformation of instrumental textures can be approached as a montage of different types of temporal behaviours. The addition of fast figures in a previously calmer texture, or changes in textural density, may be seen as different types of behaviour of a given instrumental texture.

19 Smalley defines a number of instrumental source-cause levels, which expose the identity of the instrument in time. These source-cause levels reveal the articulation of the instrument in different registers and its unique properties which are linked to its temporal behaviour (Smalley, 1994). Acousmatic sound objects are also defined by their temporal behaviour. When the source of an abstract sound object is not perceived, its temporal behaviour is the only clue the listener has about the sounds identity.

In my piece *Beck*, for saxophone, piano and percussion, I have approached the construction of the texture as sound montage. In the middle-level, very short instrumental sound fragments are spliced together and create a texture, while changes in this texture are approached more as a montage of different "sound shots" rather than linear transformations of sounds or sound layers. Thus, changes in textural density and long notes in the saxophone part, in sections four and five, are approached compositionally as different versions - with different temporal behaviour (i.e. in measure 78) - of the same sound layers, existing outside-time. This approach is borrowed from acousmatic music, where sound montage is the main way to construct textural and timbral motion.

3.2.3. Duration

Montage can be defined by the duration of the individual sounds mixed. The sound shot, as an outside-time structure, may be indefinitely long, but its duration in the actual composition will vary. Micro-montage (montage of extremely short sound fragments) is possible, but then we delve into the level of "sound frames" rather than sound shots, which requires a great amount of data handling, best left to automatic processes run by computers. From my experience, the shorter the sound fragments, the more manual work is required in the montage phase of the composition, and that entails the danger of producing artificial results that lack vital textural elements, such as directionality of various gestural forces, clear establishment of aural dimensions, textural momentum and others. Working with short fragments would be, to a certain extent, similar to working with notes in instrumental music. We know of course that instrumental composers have always worked with larger gestalts, such as motives, themes, figures, rows, etc.

The next level of duration would be the level of **sound object,** with a perceivable aural identity. Montage on that level produces textures which either appear to transform rapidly, or textures which are relatively stable, but with a continually changing aural surface, although there is still the danger of creating confusing textures, if montage on that level is overused. I should note that we have to take into account the number of sound shots that we are combining in order to determine the aural surface. Combination of just two different sound

shots will produce a much more static surface than a combination of five different sound shots.

Sounds with **medium** duration carry more information and thus exhibit more of the characteristics of their contents. Similar results as with shorter sounds can be achieved. **Long** sounds can be more stable (though not necessarily static) if they can establish a clear aural space and temporal behaviour. They usually serve as grounding sounds which stabilize the musical texture (depending of course on their content).

Finally, whole **sections** of a piece can be approached as sound shots. In that case, the sound may have an integrating function, connecting various disparate sounds in a single, referential aural space. Of course, we can assume that the long sound itself may be constructed by shorter sounds, either through montage or not. What determines the approach of a sound as sound shot is its unity, defined by its content and the musical context. I would argue that sections of a piece can be better compared to theatrical or film scenes rather than single shots, in that they present a small, and sometimes independent, narrative.

Duration may heavily influence the functionalities of a narrative structure. In the first two sections of my electroacoustic piece *Acid Drops,* I use one sound layer consisting of bass synthesized sounds. Three different sound shots at maximum have been used in those sections in order to vary the bass sounds. The timbral motion in these sections is almost insignificant and thus the duration of sound shots is medium, but they could be much longer covering whole sections without any change. In section three the synthesized bass sounds gradually dissipate, while a new sound layer is added. This sound layer is again synthesized, primarily in the bass register and resembles string pizzicato sounds. Two sound shots have been used; the first one is in the bass register and clearly imitates pizzicato articulations, while the second is a granular transformation of the first one, moves in higher registers and comprises shorter sounds with more ambiguous articulations. Of course, the listener cannot perceive the two layers, but a kind of granular variation of the bass layer. The duration of the sound shots is medium to long so that the articulations, the resonances and rhythms that are contained in the sound shots can be revealed. In the next two sections, more layers are added (a noise layer, multiple pitched and unstable timbrally synthesized layers, and pre-recorded layers of piano and string sounds) and shorter durations have been used. The shorter

durations and the variety of layers and sound shots aims to create a kaleidoscope of sound shots, in a continual state of timbral motion, while at some points longer durations function as anchors or gravitational fields. Finally, in section six, the sound shots (granular versions of most of the previous layers) become gradually longer (almost one and a half minutes long), leading to a stabilization of the texture which enhances the sense of ending.

3.2.4. Rhythm

Rhythm in montage is the rate at which different sound shots change. Rhythm of montage is not to be understood only in terms of objective numerical durations but also in relation to the contents of the sound shot. Thus, we may have a different experience of rhythm when we combine a sound with a busy temporal behaviour and a high sound spectrum and a sound with a calmer behaviour in a lower sound spectrum than when we combine two sounds with the same temporal behaviour and spectral content, even if their durations are the same. If montage rhythm concerns rate of change of timbre, it can then be related to harmonic rhythm in tonal music.

Montage rhythm should not be confused with the individual rhythmic content of the sound shots, although this may interact with montage rhythm. The temporal behaviour of the individual sounds usually dominates the rhythmic surface of the texture because in music, contrary to film, the temporal content of the individual segments usually dominates their spatial or symbolic content, except in cases where this is deliberately sought after. Montage rhythm almost always interacts with the rhythmic content of the sound shots, thus we should consider this feature as the main attribute of rhythm montage. We have then two basic types of montage rhythm: montage rhythm that intends to direct the rhythm of the texture independently of the already existing rhythm of the sound shot, and montage rhythm that is directed by the rhythm of the sound shot. We can term the former **primary** rhythm and the later **secondary** rhythm. Primary rhythm is similar to what Eisenstein terms metric montage[20]; the individual sounds are approached as neutral elements similar to notes in

20 According to Eisenstein: 'The pieces are joined together according to their lengths, in a formula-scheme corresponding to a measure of music. Realization is in the repetition of these “measures”. Tension is obtained by the effect of mechanical acceleration by shortening the pieces while preserving the original proportions of the formula' (Eisenstein, 1969, p. 72).

instrumental music and can be arranged at will, or according to a rhythmic grid, in order to form new patterns. Secondary rhythm is directed by the rhythmic content of the sound. Thus, any type of motion (in any sound parameter) in the segment will direct the cut. In practice, secondary and primary rhythm almost always interact in the musical texture except in extreme cases.

In acousmatic music, when the sound materials are pre-constructed or generated, the implementation of primary montage rhythm becomes problematic. Complex textural sound materials cannot always be approached as objectively as instrumental notes; they have to be judged aurally, according to their contents (textural sounds may be the result of complex modulation chains which transform basic sound materials). This difference, between simple articulations and complex textural materials, is practically confronted in the studio as the difference between MIDI and audio techniques. MIDI techniques are more flexible and similar to the note approach in instrumental music. As long as we have an audio file (i.e. a recording of a soundscape or an instrument), we lose much of the flexibility that MIDI offers. In order to regain some of the flexibility, we have to deconstruct the audio file (segregate its parts) into simpler basic materials, similar to the instrumental notes. I suggest that when we intentionally segment a sound in order to regain the simple note qualities of the sound then we are avoiding the rhythmic content of the sound shot and we move towards primary montage rhythm.

3.2.5. Position

Position, in montage, concerns how the different sounds are combined. In general, the sounds may be separated, or they may sound together. When the sounds are separated they can be either clearly **separated** or **joined**. In the case of joined sounds, two or more different sounds may be connected and form strings of sounds. In that case, the overlapping of sounds is usually unavoidable.

Simultaneous sounds can either be **overlapping** or **superimposed**. Now, superimposed (or overlapping) sounds may be perceived as different layers, in a traditional

counterpoint sense, or they may be perceived as varying an already established sound layer (i.e. as changes in spectral density, thickness, spatial position, etc.). While in music we can have multiple simultaneous sound layers, in film this is a technique known as double or multiple exposure and is not commonly used in mainstream films. Instead of multiple film shots one on top of another, the director can take advantage of the spatial and narrative properties of the medium. For example, two or more clearly identified events, or narrative lines, may be happening together in the same scene, or even in the same shot, as part of the reality of the scene. The multiple events may also have contradictory emotional content (i.e. two persons arguing and another person dancing in the same space). This is a technique that the Serbian director Emir Kusturica has employed repeatedly and effectively, in order to create multi-layered, complex and emotionally ambiguous scenes (e.g. in *Time of the Gypsies* (1988), *Arizona Dream* (1993) and others). The equivalent in music, would be simultaneous sound shots, that have some common elements which bind them together, but also some different and probably contradicting contents (i.e. different source and temporal behaviour but similar sound spectrum or similar temporal behaviour but different sound source and sound spectrum). In my modular piece *Magical Theatre,* this technique is exhaustively exploited through multiple superimposed and overlapping instrumental and acousmatic sound layers belonging to whole sections of different pieces.

Another example can be observed in my piece *Beck*. In measure 170, in the last part of the piece, three instrumental interconnected layers are combined (saxophone, piano and percussion). In measure 171, the piano plays C major figures which reminds the listener of a specific musical schema from the tonal musical tradition. Although it is so unrelated to the established texture that it may be even perceived as a mistake, it acts as a "commentary" to the tension between regularity and irregularity of the musical texture and as a passing gravitational field. The saxophone and percussion layers have not changed their behaviour. The piano is connected to the saxophone and percussion layers mostly through sound spectrum relationship (they are all in the same high register) and articulation. The C major figures involve a change in the signal and the temporal content of the piano layer (musical schema and regularity) while retaining the sound spectrum and articulation, which connects it

to the two other simultaneous instrumental layers.

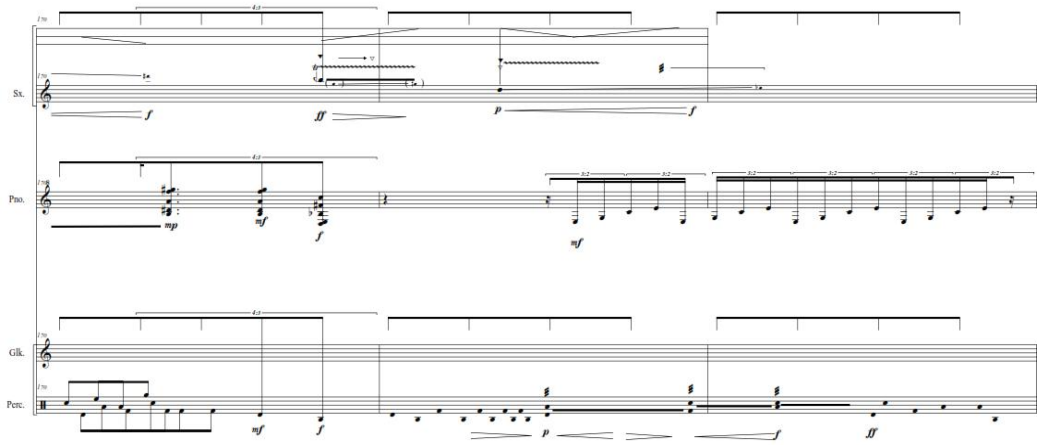

Figure 30. End of *Beck,* C major figures in piano superimposed with saxophone and percussion layers.

3.2.6. Narrativity and "openness"

Montage is basically a way of telling a story or constructing a narrative. Of course in the case of music, the narrative is much more abstract than in a conventional film narrative. Jean Mitry argues that 'the most abstract film showing a moving geometric shape is a narration since it describes the moving interplay of lines and shapes, their transformation. To refer to a non-narrative cinema is nonsensical; as is a film with no movement in it' (Mitry, 2000, p.171).

An aural, empiric and intuitive approach to middle level sound fields with large amount of indeterminate and chaotic information in acousmatic and instrumental music, though, entails a certain level of indeterminacy in higher level structures. Is it then possible to reconcile the narrative and the indeterminate aspects of musical structure?

Earle Brown is one of the composers most known for his commitment to producing an open or "mobile" form, influenced largely by the mobile sculptures of Alexander Calder. Brown summarizes his aesthetic of "openness":

> 'The general movement in all the arts, is toward the presentation of an "actual" event rather than a remembered or "representational" event. The materials become progressively more freed from subservience to the "history" of their usage and less dependent upon the inherited semantic function (a function based on the commonly understood and accepted habits of the past). The presentation of an "actual" event

> attempts to bring the "audience" and the work together in/at the same time – to close the gap between art (reflection) and life (being...in the moment and not somewhere else)' (Brown, 1998, p. 193).

What Brown terms "actual" is an artistic "openness" that offers the listener a kind of interaction with its information or at least a certain amount of interpretations. We may argue that this "openness" is a characteristic of life, as it is an interaction with reality and information rather than a passive reception of an artificial construction.

The "actual" event in film is the reality of the film shot. A montage of film shots creates a relatively close form. Television, especially broadcasting of live events, offers a more open approach to "actual" events. Eco parallels TV montage to techniques used in jazz jam sessions and *Commedia dell' Arte* (Eco, 1989, p.109).[21] Another common example of open structure that is part of our everyday experience today is the experience of montage of disparate information when "surfing" the internet. The "actual" event on the web would be a combination (montage) of closed "film-like" information, stored online, and open "TV-like" information, unfolding live; in other words, information which exists outside-time and information unfolding in real time. An important difference with the previous types of "openness" is the fact that the receiver of the information may also interact with it and shape the montage (a most common way the computer user is remixing the music live is through computer games, where specific actions trigger sounds or music), although that is also true for TV to a certain extent, through the selection of different channels (zapping).

All the above examples refer to degrees of "openness" of form, familiar through our everyday experience. In music, similarly, we can have a detailed pre-composed piece, which can exhibit "openness" in the treatment of its materials, as is the case with works composed with algorithmic or stochastic materials or works connected to the "New Complexity" movement.[22] We can also have improvisational pieces, where the composer/performer creates the form live, based on either live generation of materials or real-time montage of live or pre-

21 The kind of live aspect involved in DJing is probably a better example. Paul D. Miller considers the 'mixes created by a DJ to be mood sculptures operating in a recombinant fashion' (Miller, 2004, p. 351).

22 Richard Barrett's *Opening of the mouth* (1992-97) and Claus-Steffen Mahnkopf's "poly-works" are examples of works that consist of separate, autonomous pieces, or that consist of "parts which, through a variety of overlapping techniques, can be partly, sometimes even wholly played simultaneously" (Hoban, 2004, p.86).

existing materials, similar to the TV model of montage (e.g. Boulez's *Third Sonata* for piano, Earle Brown's *Available Forms 1* and *2,* many of John Cage's works and also Henri Pousseur's live remix of his electronic *Eight Parabolic Studies*). Finally, we can have a live interaction with the material by either the composer/performer (e.g. Xenakis's *Duel* (1959), or Richard Barrett's *Codex* series) (and in some cases the listener/performer, for example in interactive music existing as software, as in the case of Morton Subotnick's piece *Gestures (*1999-2001) or in instrumental music, Jani Christou's *Epicycle* (1968)).

I have used various degrees of "openness" in both instrumental and electroacoustic works. In all of my pieces there is a compositional "openness" of material that can be compared to the film approach to "openness". My piece *Panorama* exists in a dual form: as a set of seven autonomous pieces, comprised of two or more sound layers each, and as live mixes which are real time montages of sound layers extracted from the existing pieces, while live processing also takes place and some new materials may be added. In that case the composer is also the performer of the piece and his role is similar to that of the director in a live TV broadcast. My piece *Magical Theatre,* for instruments and electronics, permits the performers to mix their materials live, inside certain limits; *Magical Theatre* comprises six separate pieces, each divided into a number of sections or modules. The performers decide the point of entry of their sections, determining thus the horizontal and vertical texture of the piece through live montage, although their freedom is much limited by a pre-defined general structure (see figure 33, p.93).

"Openness" of higher level structures is largely the result of indeterminate lower and middle level materials that may be combined in multiple ways. Even though instrumental and acousmatic materials may be indeterminate as separate sound layers, when mixed together a certain determinism is involved. Gestalts, created through mixing or montage of materials, have their own musical logic and narrative function. To accept that everything can be combined with everything would mean to deny the narrative properties of the various musical gestalts, even if those gestalts are results of random procedures and mixing of chaotic multi-dimensional sound fields. Eco offers some insightful observations about the limits of "openness" in western culture:

> 'Our civilization is still far from accepting the unconditional abandonment to vital forces advocated by the Zen sage. He can sit and blissfully contemplate the unchecked potential of the surrounding world: the drifting clouds, the shimmer of water, cracks in the ground, sunlight in a drop of dew...but we still live in a culture in which our desire to abandon ourselves to the free pursuit of visual and imaginative associations must be artificially induced by means of an intentionally suggestive construct... A work of art can be open only insofar as it remains a work; beyond a certain boundary, it becomes mere noise. To define this threshold is not a function of aesthetics, for only a critical act can determine whether and to what extent the "openness" of a particular work to various readings is the result of an intentional organization of its fields of possibilities. Only then can the message be considered an act of communication and not just an absurd dialogue between a signal that is, in fact, mere noise, and a reception that is nothing more than solipsistic ranting' (Eco, 1989, p.100).

We should note that in a sense, all art is open - information with a completely clear meaning is perceived as a communication sign rather than art – and on the other hand, information with no intentional meaning can be perceived as "noise".

I propose that a narrative "openness" operates when we perceive a musical text in a multi-dimensional aural space and through multiple listening modes. This "openness" has to do with apprehension of patterns in highly complex and sometimes chaotic fields of information (fields of information may also perceived as being extremely simple on certain perceptual levels). Sound montage is approached as a navigation of information fields and as an act of "closing" of possible conceptualization of the musical discourse. The composer's conceptualizations are "imposed" on the information fields and they may direct the listening experience (may offer new conceptualizations or limit possible ones). When we listen to the musical discourse through a combination of listening modes we can imagine a hybrid *hyper-layer* with a strong semantic function due to the combination of all listening modes. Listeners,

although they should still surrender to the composer's/performer's narrative authority, they may experience this hybrid hyper-layer, or parts of it, differently and thus perceive different functionalities of higher level structures. This listening experience of hybrid hyper-layers is an experience that I could describe as “sound poetization” - the creation of poetic meaning out of sounds - and bears resemblance to the concept of “profound listening” coined by Francisco López (López, 1998).

My piece *Dreamscape* starts with a machine sound source with a bouncing gesture (an image schema) followed by a typical tutti orchestral chord (a sound signal or a musical schema). The bouncing gesture can be perceived as both a sound source with a mechanical origin and as an abstract musical layer with a very dynamic wave-like image schema. The montage aims to imply a casual relationship between the two different sounds by ending the machine image schema with the very familiar signalling orchestral chord. After the orchestral chord follows a texture that consists of human voices, animal sounds, and wind-like layers. Again, montage aims to imply a casual relationship between the orchestral chord and the new “windy” texture (because of its position). A hypothetical listener then may perceive the orchestral chord functioning as the ending of the bouncing gesture, the beginning of the new “windy” texture or as an accent between the two sounds. The montage facilitates all three perceptual options. By combining image schemas with reference to the instrumental experience of gesture together with sound shots perceived in multiple listening modes I aim to generate a controlled ambiguity and a play with expectations that gives momentum to the musical discourse. I will offer more insight on those concepts and techniques in regard to higher level structures, mainly through my piece *Magical Theatre* for ensemble and electronics, in the following chapter.

4. Case study

4.1. Concept and large scale form of *Magical Theatre*

Magical Theatre is a modular piece for ensemble and 8-channel electronics consisting of six pieces: *Electric Serpent* for piano and 4-channel electronics, *Waterfall* stereo electroacoustic music, *Fissure* for solo cello, *Spider Web* for string quartet, *Acid Drops* 8-channel electroacoustic music and *Liquid Glass* for two percussionists and 4-channel electronics. All of the pieces are divided into shorter sections or modules, which are assembled together (mixed in real time) through the decisions of the performers limited by a pre-defined formal framework, in order to form the piece. I had previously worked with mixing a large amount of disparate electroacoustic sound layers in *Panorama* in the context of a partially improvised, live electronic work*,* which was for me the musical starting point in relation to the construction of the large scale form and the conception of the modular aspect of the piece. I was interested in superimposing multiple sound layers in a way that a new, complex, compound, unpredictable and ambiguous sound layer would result. Furthermore, I wanted to explore the possibility of organizing the sound layers through an abstract symbolic system in order to achieve more meaningful conceptualizations of the sound material and a sound montage that is controlled/composed in its general direction throughout the piece. Below, I will explain the extra-musical foundation of the modular design of the large scale form.

Montage is intrinsically connected to symbolic thought in a way similarly to language. The connection between symbolic thought, myth and musical narrative structure is not something new. In the medium of acousmatic or mixed music, Trevor Wishart (i.e. in his piece *Red Bird* (1977)), Francis Dhomont, Murray Schafer (i.e. in his series of pieces *Patria* (1966 -)) and of course Stockhausen in his opera *Licht* (1977-2003) have been extensively investigating the possibilities of the acousmatic medium to evoke a great multiplicity of sound images and symbols. Wishart, who devised an elaborate system of sound symbolism in his piece *Red Bird,* argues:

'Using sound-images in the virtual space of the loudspeakers, we can

> create a world somewhere in between the concreteness of the opera staging and the world of musical relationships. We do not need to associate a musical object with, for example, a bird and thence with a metaphorical meaning, we may use the sound of a bird directly. And the concreteness of theatrical staging is replaced by a dreamlike landscape hovering between musical articulation and 'real-world' events' (Wishart, 1996, p. 165).

While an attempt to give symbolic meaning to musical materials may provide solutions to the problem of conceptualization and identity of sound layers and shapes in both media, there is a danger lying in the fact that the composer may endow his materials and processes with symbolic meaning that is not easily perceivable by the listener, either because of a different symbolic code or because of an unclear practical presentation of the symbols in the musical texture. In the case of clear source-bonded sounds, care has to be given to the montage between different sounds, or sound-images - as Wishart names them - in order to avoid 'film-like' representations of symbols, which may rob the musical texture of its musical /abstract properties and its momentum.

Partially in order to avoid those problems and in order to have a systematic but not limiting sound montage method applicable to multiple temporal scales, I resorted to a very abstract symbolic system connected to the four astrological elements: fire, water, air and earth. These should not be seen as symbols of the physical elements (which of course can be related to source-bonded sounds), but as general behaviours and descriptions of the world and human experience through a symbolic mandala with various levels of abstraction.

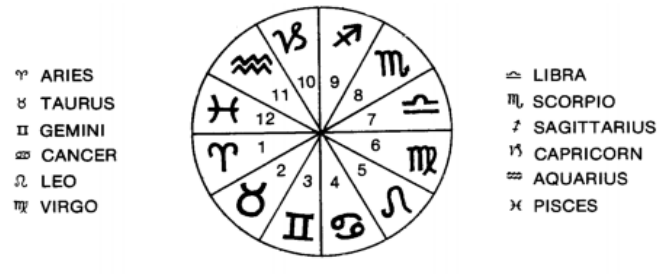

Figure 31. The zodiac (Wang, 1987, p. 48).

The concept of the mandala is a notion that can be found both in the West and the

East. Carl Jung, defined the mandalas as '...figures fixed by tradition; they may be drawn or painted or in certain special ceremonies represented plastically.... Unless everything deceives us, they signify nothing less than a psychic centre of the personality not to be identified with the ego' (Jung, 1980, pp.95-96, 99). By analysing a series of dreams by many individuals, Jung traces connections between symbols found in dreams and symbolic images found in western alchemical and esoteric literature. Probably the best known of these images is the zodiac circle .

The zodiac is divided into twelve sections or houses. The four astrological and alchemical elements - fire, earth, air and water - are represented in the zodiac as symbolic signs. Thus, fire is represented by Aries, Leo and Sagittarius; earth by Taurus, Virgo and Capricorn; air by Gemini, Libra and Aquarius and water by Cancer, Scorpio and Pisces (Wang, 1987).

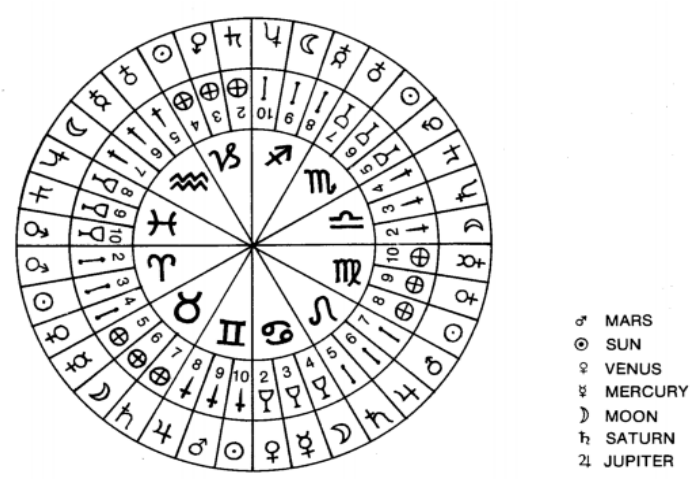

Figure 32. Attribution of the Tarot numbered cards and planets to the decans of the zodiac (Wang, 1987, p. 49).

English writer, occultist and poet Aleister Crowley, together with the painter Lady Frieda Harris, designed a Tarot deck between 1938 - 1943, which is known as the Thoth Tarot deck (Wang, 1987 p.14-5). The Thoth Tarot deck incorporated the symbolism of the zodiac, but it is also influenced by many other symbolic systems, art deco, cubism and surrealism. The Thoth Tarot is a pack of 78 cards which are divided in the major arcana which is a series of 22 cards and the minor arcana, which is a series of 56 cards. The minor arcana is further divided into four suits. Each of these suits are comprised of cards numbered from ace to ten and four face cards. The four suits are represented as clubs or wands, disks, swords and cups

corresponding to the astrological elements of fire, air, water and earth (Wang, 1987).

Magical Theatre is based on the minor arcana of the Thoth Tarot deck and specifically on the numbered cards of the four suits. Each numbered card becomes a musical module in the piece. Each zodiac sign is divided into three decans and thus each element contains nine decans while the whole zodiac contains thirty six decans. The numbered cards from 2 to 9 are then attributed to the zodiac signs. The aces, representing unity and the root of each element, are latent and thus are not attributed to any sign. The traditional old seven planets (including the moon) are '...attributed to the Decans in a sequence repeated five times: 1) Mars 2) The Sun 3) Venus 4) Mercury 5) The Moon 6) Saturn 7) Jupiter' (Wang, 1987 p.48). All seven planets are repeated five times except Mars, which is repeated one more time in the end of the circle in order to complete the 36 decans. This is explained as the extra energy that is required for the return of spring (Wang, 1987, p.48). There are then four interlocked wheels of the four elements and their corresponding zodiac signs, consisted of nine decans each and the wheel of the seven planets.

In my understanding, this symbolic system (as is true for most mandalas) is better realized as a system in motion rather than a static one. Music then, is an ideal way to represent it. Furthermore, because of the interlocking wheels of the four elements, a "poly-work" with interlocking, superimposed pieces seems a fitting way to represent it. *Magical Theatre* is then designed as a subjective representation of the zodiac based on the system used for the numbered cards of the Thoth Tarot deck. Each individual piece represents one element and its corresponding Tarot suit. *Electric Serpent* for piano and electronics represents the fire signs and the wands suit, *Waterfall* stereo electroacoustic music represents the first three cards of the water signs and the cups suit (in the mandala of the zodiac), *Acid Drops,* 8-channels electroacoustic music the remaining six cards of the water signs and cups suit, *Fissure* for solo cello represents the first three cards of the air signs and swords suit (in the mandala of the zodiac these are the cards 8, 9 and 10), *Spider Web* for string quartet the remaining six cards of the air signs and the swords suit and *Liquid Glass* for two percussionists and electronics represents earth signs and the disks suit (part one, titled *Glass Flowers* represents the first three cards of the earth signs while part two, titled *Liquid Drums*

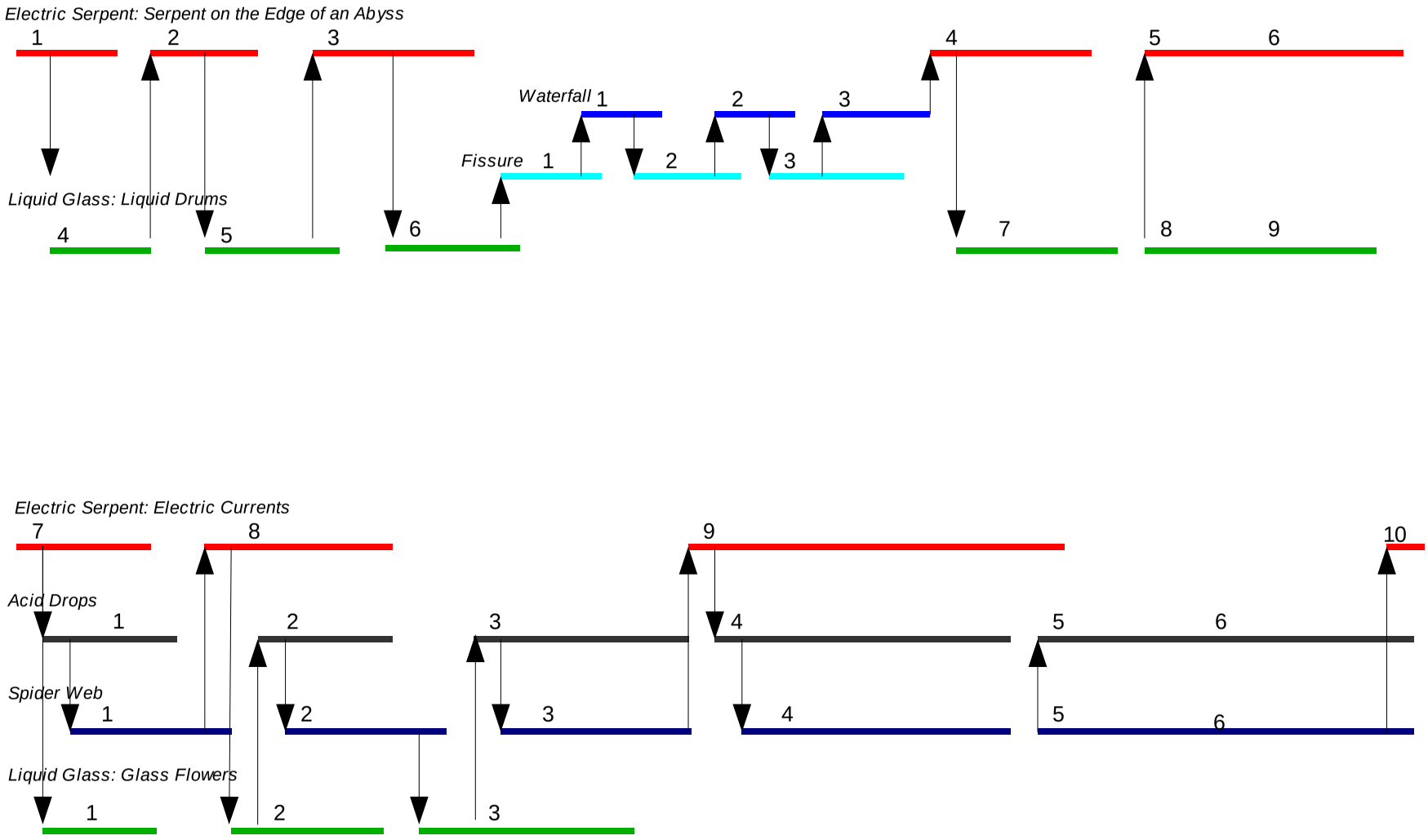

Figure 33. General structure of *Magical Theatre*. Numbers indicate sections. Colours indicate pieces. Red:*Electric Serpent*, Blue: *Waterfall*, Cyan: *Fissure*, Green: *Liquid Glass*, Grey: *Acid Drops*, Purple: *Spider Web*. Arrows indicate triggering of a piece by the performers.

represents the remaining six cards. The reason for dividing the air and water signs in two different pieces is because I wanted to emphasize the difference between the two semi-circles of the zodiac, something that is already evident in the separation of the two other pieces in two contrasting parts.

Each piece comprises six, nine or ten modules or sections, which represent the numbered cards. The symbolic system is not only represented by the clear separation of sections (mostly through changes and transformations of aural spaces and temporal behaviours), parts or series of sections, but also by acoustic representations of the symbols and images. For example, *Liquid Glass*, which represents earth signs, mostly comprises sounds coming from earth, such as rubbing sounds, metallic sounds, rustling sounds, hitting sounds, etc. Also, as this piece is related to the disk suit, its stage layout with the two timpani, bass drums and cymbals is a collection of disk shaped instruments. The symbolic system, then, should be better understood as a tool that allows me to connect in my imagination different materials, ideas, sounds, images, behaviours, etc., and still retain the unity of its narrative. Sometimes I have promoted an interpretation of the system that suited the dramatic evolution of the musical texture rather than an objective interpretation of a card, and sometimes I have promoted a certain idea or symbol and ignored another one. I approached the system as a kind of open system or map that allows navigation of imagination and information stored in memory rather than a rigid system ruled by objective laws.

The decision to follow a subjective system of extra-musical references (painting, symbols, myth) also allows to me to build in my imagination a framework of interrelating possibilities. Before starting mixing each piece I had a certain amount of processed material (comprising synthesized and pre-recorded sounds). In order to decide how I would deploy the already composed sound fields in time, I followed a subjective imaginary narrative that is primarily based on a combination of the following:

1. the descriptive titles of the cards
2. the astrological correspondence of each card (again evident on the titles)
3. texts that offer interpretations of the cards which may sometimes include even complex mythological scenarios or ideas

4. the images painted on the cards, which may include colours, symbols and relations between different objects represented

5. the position of one card in relation to the general scheme of the zodiac, the epochs and the two semicircles

6. the position of a card in relation to its neighbour cards.

I should note that while composing the piece I had in mind how different sound layers in each piece could relate to sound layers in other pieces considering how close they were in the general structure of the zodiac, which determine the sections of the different pieces that would be superimposed. In conclusion, the system is not just a representation of ideas through painting, symbols and myth, but also a geometrical and dynamic system of information, with multiple levels of interpretation. Approached as an open system, according to Eco's definition of "openness", a piece on its own may have a different meaning than when seen as part of a larger narrative framework (Eco, 1989 p. 19). Furthermore, individual sections (representing Tarot cards) may acquire a different meaning when they are connected together through montage (separated, joined, overlapping, superimposed).

There is also a relationship between this system and the concept of transformation and hybridization between instrumental and acousmatic sound layers. The elements, which are represented as individual pieces or parts of pieces, are represented by a particular aural space or a selection of related aural spaces (or sound shots if approached through montage theory). These basic *reference aural spaces* are usually the aural spaces of the live instruments or families of instruments in each piece. The main reference space of the piece is then divided into a number of secondary reference spaces (representing the zodiac signs, which are realized as collections of short sections). In that way, each zodiac sign is based on a different secondary reference space so that the listener may perceive a large scale motion of aural spaces. In order to perceive motion a fixed space is required and that is provided through the general reference space of the whole piece, which is usually the instrumental aural space. When this main "elemental" reference space is transformed through the zodiac signs, the listener perceives the transformations as such, because they are all related to the main fixed instrumental aural space.

A sense of forward motion is achieved through a nested series of referential aural spaces[23]. These aural spaces act as the centre of an imaginary wheel. Transformation in one or another direction is then perceived as movement towards or away from a reference space, but still integrated into a larger framework defined by another aural space.[24] This technique is employed in most of the pieces of *Magical Theatre* (in *Waterfall* and *Fissure* the technique is not clear, mainly because of their short duration). An example from *Electric Serpent* will be given in the next section.

<table>
<tr><td colspan="9">Reference aural space (instrument)-Element</td></tr>
<tr><td colspan="3">Secondary reference space-sign</td><td colspan="3">Secondary reference space-sign</td><td colspan="3">Secondary reference space-sign</td></tr>
<tr><td>Tertiary reference space - card</td><td>Tertiary reference space - card</td><td>Tertiary reference space - card</td><td>Tertiary reference space - card</td><td>Tertiary reference space - card</td><td>Tertiary reference space - card</td><td>Tertiary reference space - card</td><td>Tertiary reference space - card</td><td>Tertiary reference space - card</td></tr>
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Figure 34. Reference spaces, element-signs-cards. Integration of multiple aural spaces (or sound shots) into an abstract referential aural space.

4.2. *Electric Serpent:* aural spaces and montage structure

I will describe here the structure of *Electric Serpent*, focusing on its aural spaces (defined mainly by sound spectrum and sound source), in order to show how the abstract narrative schema governs its structure and hence the structure of *Magical Theatre*. In *Electric Serpent,* the main reference aural space is the piano (extended through extended techniques and pre-recorded electronics). The first aural space (representing the first sign) is the aural space created by scraping the bass piano strings with a plectrum, the second is the aural space created by scraping and hitting the strings with more coarse objects such as a metallic bolt and a coarse plastic rectangular object, mixed with a synthesized noise layer, while the third is the normal hammered piano space mixed with mainly pitched synthesized sounds. The electronic layers are extending the aural space of the instrument (see also chapter 2.2.2.) however radical this extension may be. We could use the image schema of the wheel and we could say

23. When reference aural spaces are transformed (usually through modulation chains) their temporal behaviour also changes and thus middle level shapes are also affected.
24 Thoresen also refers to a similar structural strategy. He uses the term centric to describe a formal structure in which a main sound character acts an a background which facilitates the integration of a more active foreground, and he argues that it is a formal model for 'creating and integrating differential sound-characters into an organic whole' (Thoresen, 2009, p.318).

that the reference space resembles the centre of the wheel, while the transformations are individual beams revolving around it. Additionally, the individual cards are realized as sections of pieces and they represent the minimum division of the large scale formal design. The basic aural space of the signs (which is a transformation of the main reference space of the instrument) acts as a new reference space and a new fixed centre of a new wheel. The sections are perceived as transformations of the main aural space of the signs. These aural spaces can also be approached as sound shots or as "sound scenes" connected through montage. For example, in the first part of *Electric Serpent,* the reference space of the sign is the scraping of the strings with a plectrum. In the first section, the scraping is the only aural space. In the second section, the scraping of the strings remains the main instrumental sound of the section, while the added electronic pre-recorded layer is closely connected to the instrumental sound. In the third section of the piece, scraping is still the main instrumental aural space, while the electronic layers sometimes have a more remote gestural-surrogacy in relation to the piano (the recorded scraping sound in the electronic layers sometimes becomes disconnected to the actual gesture) and are also mixed with pre-recorded and synthesized sounds not directly related to the piano. In the fourth section, the zodiac sign changes (Leo replaces Aries) and the aural space of the piano is more radically transformed by using a metallic bolt to hit and scrape the strings, while the electronic layers are comprised of pre-recorded piano sounds and synthesized noise sounds, which gradually become more dominant. In the fifth section of the piece, the strings are scraped with a rectangular plastic object and the electronic sound layers become more noisy, gradually covering larger parts of spectral space. Section six, which is connected to section five, consists entirely of synthesized noise which covers almost the whole range of the audible spectrum.

The second part of the piece, titled *Electric Currents*, represents the zodiac sign of Sagittarius. The secondary reference space is normal hammered piano, extended with multiple, mostly pitched, electronic layers (functioning as electronic *genres*), exhibiting similar morphological characteristics as the hammered piano sounds (a detailed explanation of the construction of the electronic layers can be found in chapter 2.3.5.). In contrast to the first part of *Electric Serpent*, the instrumental and electronic aural spaces are not gradually

transformed in each successive section. Instead, large scale motion is achieved mainly by varying the density of the texture. Thus, the first section consists of short sound fragments with long pauses between them. In the second section the pauses become shorter and the sound fragments longer. In the third section the pauses are almost eliminated and the texture becomes gradually denser, although it dissipates at the very end of the piece. We can see that the second part of *Electric Serpent* is not directly related to the first part in terms of sound or gesture, but it is related in terms of the general formal schema, as both pieces begin from a confined spectral space in the low register and gradually fill the whole sound spectrum. In the first part this happens mainly through gradual transformation and evolution of simple, clearly defined aural spaces, while in the second part it happens through temporal manipulations (through micro-montage) of highly diverse, statistical sound layers.

If we approach the structure of the whole piece through montage theory, the main instrumental reference space can be seen as a general narrative plot which is realized in a series of large sound scenes expressed by the zodiac signs. The zodiac signs are comprised of three shorter sound scenes each, coinciding with the sections of the piece. The first sound scene is just a long scraping of the strings with a plectrum and it is a continuous single instrumental sound shot. The second section (and sound scene) is a montage of the instrumental scraping of the strings with a pre-recorded and resynthesized layer of scraping piano sounds. Those two layers have long durations and are superimposed, while they are connected mainly through a similar sound spectrum and temporal behaviour. In section three, the durations of the sound shots become shorter, while motion in spectral space is more varied and connected to the the motion of the live sound layer. The montage in this case is more precise and reveals an interaction between live and electronic layers. A sound of a snake hiss is mixed at 1.21'' of the third section and that is the only natural pre-recorded sound used throughout the whole piece.

Short sound shots and micro montage between live and electronic sound layers characterizes section four. The noisy, synthesized sound shots become disconnected from the piano scraping and hitting sounds. The synthesized sounds for the first time can be perceived as having an autonomous existence, generated through separating the piano and synthesized

sounds in montage (piano and synthesized sounds in the electronic layers are rarely overlapping). The title of this section is "Strife" or "Saturn in Leo" (the zodiac sign also changes from Aries to Leo) and that is expressed through violent gestures of hitting and scraping the strings of the piano with a metallic bolt. Furthermore, the gestures are short and the general rate of change between different sounds is much faster than in previous sections.

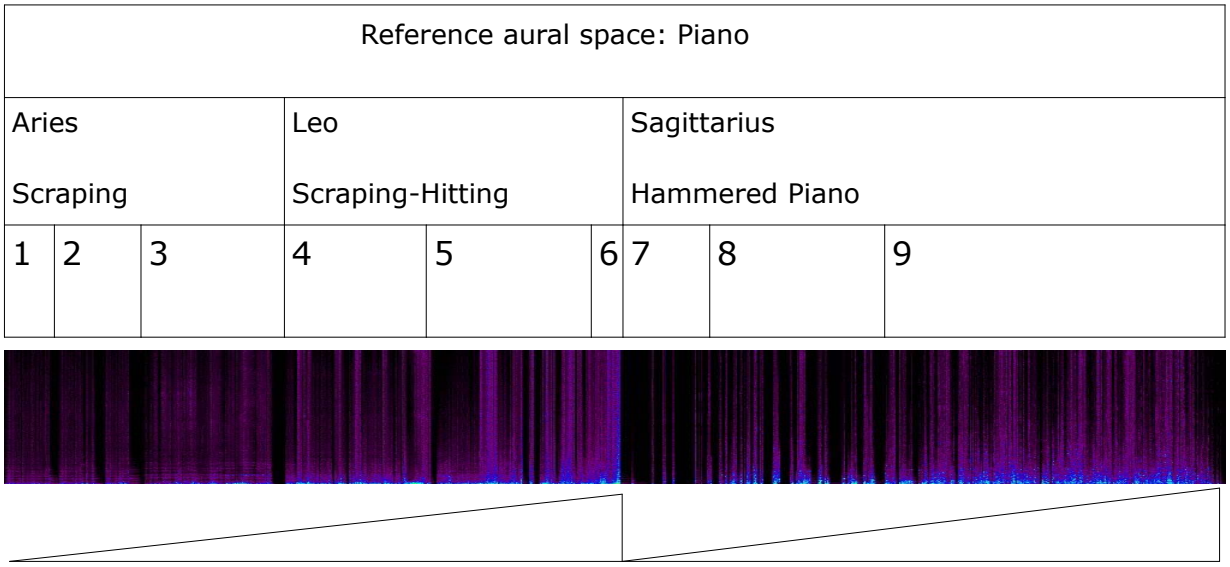

Figure 35. The morphological schema that defines the sections of *Electric Serpent* and the cycle or wave schema (Brower, 2000, pp.329-30) that defines the large scale direction of each part. Spectrograph of the piece shows the relative durations of each section.

Section five begins with a long sound shot of string scraping (with a long rectangular plastic object). Although this may be seen as a slowing down of the rhythm, it is not quite true because of the complexity of the scraping gesture, which generates a grainy texture with multiple micro changes in timbre and rhythm. Similarly to section two, the synthesized and piano sounds appear as two separated layers, while the synthesized layer gradually dominates. Finally, section six (connected to section five) consists of several layers of white noise distributed in all four channels and changing in amplitude. Thus, the piece started with a single piano sound shot in the bass register and ends with also a single, synthesized sound shot covering the whole audible spectral space. The astrological title of the first section is "Mars in Aries", while the astrological title of the sixth section is also "Mars in Leo". Part two also follows a similar large scale morphological schema although build-up is achieved through

textural density rather than timbral transformation. The narrative plot that is the basis of the montage structure is present not just in the micro or middle level structure of the piece but also on the macro level as an abstract but clear musical narrative based on a familiar large scale image-schema.

When the piece is performed as part of *Magical Theatre,* the individual sections of the piece are mixed together with sections of other pieces and are perceived as parts of another sound layer with a different narrative (I should also remark that when part of *Magical Theatre,* the second part of *Electric Serpent* is played as a solo piano piece, without electronics). In order to achieve a functional mix of sections of different pieces, I had to retain the identity of the aural space of the different sections, use very simple and easily identifiable sound materials and also confine the spectral space of each section or employ a clear direction of motion in spectral space, that could be perceived, to an extent, even when mixed with contrasting sound layers coming from other pieces. The various sound shots used in the piece are usually created through indeterminate generational and/or improvisational processes. Although the details are not predetermined, the general spectral content, dynamic shape and temporal behaviour of each sound shot are largely defined by the context of the piece where these sounds would be used (in the cases that this was known beforehand).

The general narrative plot of *Magical Theatre* is very similar to that of *Electric Serpent* (*Electric Serpent* was the first piece to be composed and all other pieces in the cycle are partially based on it) and functions as a general formal structure which "closes" the more "open", indeterminate middle and lower level structures. Both parts of *Magical Theatre* start in a confined spectral space in the low register of the piano and gradually fill the whole spectrum. A combination of the general morphological schema of figure 33 (the linear trajectories coming from the Tarot numbered cards), which indicates how the different sections or modules are interconnected, together with the cyclic or wave schema in the lower part of figure 35 (coming from the mapping of the Tarot cards on the zodiac), which shows the gradual filling of spectral space in the two parts of the piece, give a good idea of how the abstract narrative schema (the Tarot cards of figure 33, p.93) shapes the general structure of the piece.

4.3. *Magical Theater* and multi-dimensionality

In *Magical Theatre*, electronic and instrumental sounds may be perceived through multiple listening modes, which are related to time scales. As I have already laid out in previous chapters, sounds or sound layers can be perceived as sound sources, as abstract sounds (independent of their cause), and as signs (Chion, 1994, pp.25-30). I have included this notion in sound montage theory (see chapter 3.2.1.). Sounds or sound shots can be connected through their spectral content, sound source, signalling function, spatial properties and temporal behaviour. All these sound characteristics require a slightly different perception of sound. Montage of sounds with different contents requires, in my view, the ability to navigate through different modes of perception.[25] In *Magical Theatre* I have intentionally tried to play with the perceptional boundaries between different acousmatic and instrumental sound shots coming from different pieces. Sections/modules and sound shots should also be understood as sound characters (Thoresen, 2009, p.310) (see also chapter 1.2.2), with their static/stable content perceived as outside-time space.

The first part of *Magical Theatre* is a montage structure of sections of four different pieces. In figure 36 we can see the contents of each section (or sound shot) in the montage structure of part one. The columns indicate the sound source, sound spectrum, space and temporal behaviour of each section. The rows indicate the sections of the pieces. Signal content of the sound shots is not indicated in the diagram because of its limited importance in the higher level structures and its connection to sound source content. I should note here that I consider the signalling function as a complex process that can always be present, when sound sources are perceived as references to sounds outside the musical work.[26]

The diagram does not indicate the position of the different sections in the montage structure and the type of connection between them. Although montage between different sections is controlled, to an extent, by the performers, through triggering of sections (see figure 33), the blocks that are mostly superimposed are:

25 The listener is actively engaged in the conceptualization of the hyper-layer's information, based on the composer's/performer's direction. Furthermore different listeners have different experiences of sound information (e.g. signalling sounds may have different meaning for different listeners).

26 This is very common in *Magical Theatre*, where I have intentionally employed instrumental gestures that refer to the experience of gestural activity in everyday world (i.e. scraping gestures in the piano and rubbing gestures on the timpani).

-1 E.S.-4 L.G.

-2 E.S.-5 L.G.

-3 E.S.-6 L.G.

-1,2,3 W.-1,2,3 F.

-4 E.S.-7 L.G.

-5 E.S.-8 L.G.

-6 E.S.-9 L.G.

(Sections of *Electric Serpent* are indicated as E.S., sections of *Liquid Glass* as L.G. and sections of *Waterfall* and *Fissure* as W. and F.)

Sections	Spectrum	Source	Space	Temporal behaviour
1 E.S.	Pitched/grainy-Low register	Scraping	Loudspeakers 1-2	Sustained/iterated
4 L.G.	Pitched-Low register	Timpani rubbing	Loudspeaker 4-7	Sustained
2 E.S.	Pitched/grainy-Low register	Scraping-Synthesized	Loudspeakers 1-2	Sustained/iterated
5 L.G.	Pitched-Low register	Timpani rubbing-Synthesized	Loudspeakers 4-(5-6-)7	Sustained
3 E.S.	Pitched/grainy/noise-Low/middle register	Scraping-Synthesized	Loudspeakers 1-2-3-8	Sustained/iterated
6 L.G.	Pitched/noise-Low/middle register	Timpani rubbing-Synthesized	Loudspeakers 4-5-6-7	Sustained
1-3 W.	Noise-all registers	Synthesized	Loudspeakers 4-6	Sustained/impulses/ iterated
1-3 F.	Pitched/noise-all registers	Cello	Loudspeakers 5	Sustained/impulses/ iterated
4 E.S.	Pitched/grainy/noise-all registers	Hitting/scraping-synthesized	Loudspeakers 1-2-3-8	Sustained/impulses/ iterated
7 L.G.	Noise (middle register)	Cymbals/rubbing/ hitting-Synthesized	Loudspeakers 4-5-6-7	Sustained/impulses/ iterated
5 E.S.	Noise /grainy	Hitting/scraping-Synthesized	Loudspeakers 1-2-3-8	Sustained/impulses/ iterated
8 L.G.	Noise (grainy)	Bass drums/rubbing/hitting-Synthesized	Loudspeakers 4-5-6-7	Sustained/impulses/ iterated
6 E.S.	Noise	Synthesized	Loudspeakers 1-2-3-8	Sustained
9 L.G.	Noise	Synthesized	Loudspeakers 4-5-6-7	Sustained

Figure 36. Contents of all sections in part one of Magical Theatre. Sections of Electric Serpent are indicated as E.S., sections of Liquid Glass as L.G. and sections of Waterfall and Fissure as W. and F.

If we observe the changes in the sound spectrum in successive sections, we can see a common direction of the musical texture. The piece starts from the low register and gradually covers the whole spectral space, while pitched sounds (with a grainy colouration) give place to noise sounds. At the same time, the instrumental sound sources in the beginning of the piece are extended with synthesized sounds (functioning as genres), which gradually dominate the texture and prevail in the end. The sound spectrum transformation (from pitch to noise) is achieved in a different way in each piece. In *Electric Serpent* it is achieved through different types of gestures and materials on the strings of the piano (scraping and hitting with a plectrum, bolt and large plastic object) and gradual mixing of noise sounds. In *Liquid Glass* it is achieved through mapping the same rubbing and hitting gestures on different instruments, with a more complex sound spectrum (from timpani to cymbals and bass drums). *Waterfall* and *Fissure* are short pieces with basically uniform content. The temporal behaviour of the texture is mostly characterized by sustained and iterated gestures, although impulses are gradually added when the texture becomes more dense and noisy. Finally, the sounds are coming from four loudspeakers (instruments are also positioned closely to the loudspeakers so that the spatial image is not altered by the live sound) at the beginning of the piece (loudspeakers 1-2-4-7) and at the end are coming from all eight loudspeakers (see figure 41, p.114 for a diagram of the spatial position of the loudspeakers). *Waterfall* and *Fissure* are short pieces with basically uniform content. They limit the spatial image for a short duration at the middle of the piece and also connect the pitched sound spectrum of the first sections to the noisy one of the later sections.

We can see that sound spectrum, source, spatial image and temporal behaviour are interconnected and a coordination of all contents is required for the articulation of the narrative structure. The points where changes happen (usually coinciding with entrances of new sections) are crucial for the perception of the of the texture (and are also indicating entrances of new outside-time spaces or sound characters (Thoresen, 2009, p.310)). I have approached the different sound layers, coming from different pieces, as parts of a single hyper-layer, which gains its identity from the contents of its individual layers (mixed together through montage techniques). The contents that are in the foreground though, are in a continuous state of flux

throughout the piece. In the beginning, the identity of the hyper-layer comes from the characteristic piano and timpani scraping and rubbing gestures. Gradually, the attention of the listener moves to the entrance of the electronic sounds (genres, which extend the instrumental sound sources. When the synthesized sounds have been established, the attention moves to changes in temporal behaviour and articulation. *Waterfall* and *Fissure*, with their basically uniform sound spectrum and source, take the recognizable synthesized sounds of *Electric Serpent* and *Liquid Glass* and turn them into a fast moving texture, full of different articulations. When *Electric Serpent* and *Liquid Glass* enter the hyper-layer again, they exhibit the textural characteristics of *Waterfall* and *Fissure*, though articulated with quite different sounds (rubbing and hitting of cymbals with wire brushes and scraping and hitting of piano strings with a bolt). Gradually, synthesized layers, which extend the instrumental sounds, dominate the identity of the hyper-layer. Sustained, synthesized noise masks all the instrumental sounds and prevails at the end of the piece by establishing a grounding texture.[27]

Part two of *Magical Theatre* is, similarly to part one, a montage structure of multiple sections coming from four different pieces. *Electric Serpent* and *Liquid Glass* are still present, but *Waterfall* and *Fissure* are replaced by *Acid Drops* and *Spider Web*. In figure 37 we can see the contents of each section (or sound shot) in the montage structure. The columns indicate the sound source, sound spectrum, space and temporal behaviour of each section. The rows indicate the sections of the pieces.

The diagram does not offer information on the position of the different sections in the montage structure and the type of connection between them. The section that are mostly superimposed are:

-7 E.S-1 A.D.-1 S.W.-1 L.G.

-8 E.S-2 A.D.-2 S.W.-2 L.G.

-3 A.D.-3 S.W.-3 L.G.

-9 E.S-4 A.D.-4 S.W.

-5 A.D.-5 S.W.

27 This grounding image schema is established through the texture's duration and sound spectrum. The “thick” noisy sound spectrum, with its relatively long duration, dominates the spectral space and masks the “thinner” pitched sounds (bass textures may have a similar function because of the prominence of their overtones).

-6 A.D.-6 S.W.-(10 E.S.)

(Sections of *Acid Drops* are indicated as A.D. and sections of *Spider Web* as S.W.)

Sections	Spectrum	Source	Space	Temporal behaviour
7 E.S.	Pitched-Low register	Hammered piano	Loudspeakers 1-2	Impulses-fragmented texture
1 A.D.	Pitched-Low register	Synthesized	Loudspeakers 5-6	Sustained/impulses-fragmented texture
1 S.W.	Pitched/noise-Low register	Cello	Loudspeaker 5	Sustained/impulses-fragmented texture
1 L.G.	Pitched-Low register	Timpani hits	Loudspeakers 4-7	Impulses-fragmented texture
8 E.S.	Pitched-All registers	Hammered piano	Loudspeakers 1-2	Impulses/iterated-fragmented texture
2 A.D.	Pitched-Low register	Synthesized	Loudspeakers 5-6-7-8	Sustained/impulses/iterated-fragmented texture
2 S.W.	Pitched/noise-Low register	Cello-Viola	Loudspeakers 5-6	Sustained/impulses/iterated-fragmented texture
2 L.G.	Pitched-Low register	Timpani hits	Loudspeakers 4-7	Impulses-fragmented texture
3 A.D.	Pitched/noise-Low/middle register	Synthesized	Loudspeakers 5-6-7-8	Sustained/impulses-dense texture
3 S.W.	Pitched/noise-Low/middle register	String quartet	Loudspeakers 3-5-6-8	Sustained/impulses-dense texture
3 L.G.	Pitched-Low register	Timpani hits	Loudspeakers 4-7	Impulses-dense texture
9 E.S.	Pitched-All registers	Hammered piano	Loudspeakers 1-2	Impulses/iterated-dense texture
4 A.D.	Pitched/noise/grainy-all registers	Synthesized-pre-recorded piano and strings	Loudspeakers 1-2-3-4-5-6-7-8	Impulses/iterated-fragmented texture
4 S.W.	Pitched/noise/grainy-all registers	String quartet	Loudspeakers 3-5-6-8	Impulses/iterated-fragmented texture
5 A.D.	Pitched/noise/grainy-all registers	Synthesized-pre-recorded piano and strings	Loudspeakers 1-2-3-4-5-6-7-8	Impulses/iterated-dense texture
5 S.W.	Pitched/noise/grainy-all registers	String quartet	Loudspeakers 3-5-6-8	Impulses/iterated-dense texture
6 A.D.	Noise/grainy-high register	Synthesized-pre-recorded violin	Loudspeakers 1-2-(3-4-)5-6(-7-8)	Iterated-dense texture
6 S.W.	Noise/grainy-high register	Violin 1 and 2	Loudspeakers 3-8	Iterated-dense texture
10 E.S.	Pitch/grainy-low register	Scraping	Loudspeakers 1-2	Iterated

Figure 37. Content of section in part two of Magical Theatre. Sections of Acid Drops are indicated as A.D. And sections of Spider Web as S.W.

In part two the narrative structure is based on changes of textural density. Most layers are characterized by fragmented textures, consisting of impulses and/or short sustained sounds, followed by pauses. *Electric Serpent* (hammered piano) and *Liquid Glass* (timpani hits) retain their spectral content, sound source and spatial image throughout the second part of the piece. Textural changes thus, are found mostly in the electronics (*Acid Drops*) and the string quartet (*Spider Web*). A large amount of different timbres and articulations, that cannot be indicated in detail in the diagram of figure 37, comprise the electronic and string quartet textures.

Changes in the texture of the single hyper-layer occur much more rapidly here than in part one. Fast timbral and temporal changes though, are perceived in lower and middle level structures, while large scale textural motion is the result of a statistical perception of texture. In the beginning we perceive a fragmented texture of mostly pitched sounds in the low register (hammered piano, timpani hits, pizzicato and arco cello and short synthesized bass sounds). The listener perceives a series of limited timbres coming from different pieces. As the texture is enriched with more timbres (synthesized, string quartet and piano) the listener's attention moves between different sound layers, although none of them manages to establish a clear presence for more than a few seconds. The listener then, perceives a multi-dimensional musical space that has no clear boundaries (dimensions), as there are many common timbres and articulations between the different layers. This perceptional ambiguity peaks in sections four and five of *Acid Drops* and *Spider Web.* At the end of the piece a dense grainy and noisy texture is finally established, which morphs effectively with the grainy scraping of the bass piano string at the very end. My intention was to use this perceptional ambiguity in order to create a sense of tension (peaking in sections four and five of *Acid Drops* and *Spider Web*) and relaxation (achieved when the final noise texture is established) through the combination of wave-cycle and verticality image schema in multiple listening modes.

Spatial image contributes to the realization of this general morphological schema. Electronic sounds coming from loudspeakers 5-6 at the beginning, are gradually dispersed to all eight loudspeakers, while at the end of the piece the electronic sounds are projected only

from loudspeakers 1-2 and 5-6. In sections four and five of *Acid Drops* and *Spider Web*, when layers are rapidly changing and multiple different sources are employed, the spatial image of electronic and string sounds also rapidly moves between loudspeakers (the string sounds move because the string quartet is projected from loudspeakers 3-5-6-8 and each instrument is positioned close to and projected from a different loudspeaker).

I would also like to note here that signal montage, though limited, is also present. In section nine of *Electric Serpent* and section four of *Spider Web* (sections that are superimposed), a major chord in the middle register appears. Additionally, at 0.23'' of section five of *Acid Drops* (or at 6.40'' of the stereo version) a synthesized and iterated A flat major chord appears. This major chord, in the context of a texture with large amount of indeterminate information, evokes a musical tradition and is regarded as a musical schema, ('a pattern abstracted from musical convention' (Brower, 2000, p. 324)) with a signalling function (see also chapter 3.2.2.). Because the musical schema can be easily recognized in the midst of a dense texture, it functions as a connection between the three superimposed pieces.

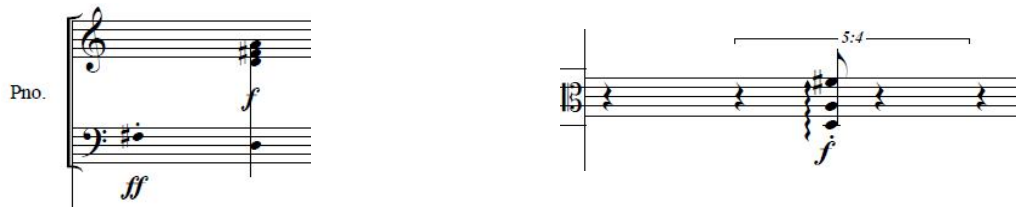

Figure 38. A musical schema (an out of context major chord) at section nine of *Electric Serpent* (left) and section four (bar 65) of *Spider Web* (right) (viola).

As micro montage is important in defining the hyper-layer's identity in part two, I will give a detailed example of micro montage at the beginning of sections four in both *Spider Web* and *Acid Drops* (both sections are superimposed) that indicates how a very similar approach to montage connects the two layers and the two media.

In the first four bars of the fourth section of *Spider Web* (bars 55-58) I have created a multi-dimensional aural space consisting of several timbres and articulations and extending throughout the whole register of the instruments by combining several different sounds[28]. The timbres, which construct the aural space, can be separated into pitched, noise

28 Although improvisation together with automated processes are for me ways of generating sound fields or sound shots in both media, a type of improvisation is also present in the montage phase of the composition, either in middle or

and intermediate sounds. Arco sounds with normal bow pressure have a clear pitch content, arco sounds with high pressure (notated with a black box on top of the four-line bow staff) have a strong noise content, pizzicato and snap pizzicato are pitched although there is a certain noise content depending also on the register, and hits on the body of the instrument (notated as x head notes on the first line above the four-line staff) are short noise sounds. Later in the section, col legno battuto sounds, which are generally similar to pizzicato sounds, have a certain noise content depending on the register. Multiple variations of these main sound types of course exist, depending on the position of the bow along the strings, the left hand fingerboard motion and the articulation. The articulations can be separated mainly into impulses (pizzicato, short arco, col legno battuto and hits on the body of the instrument), sustained (arco) and iterated (trills, tremolo, left hand oscillations and the characteristic jeté bouncing of the bow on the strings).

During the composition of the piece I had at my disposal timbres and articulations that I could combine in a permutational manner. Of course, some combinations of articulations and timbres are more possible than others because of the limitations of the instrument and the performer. My compositional decisions are largely dependent on the general morphology of the sound objects, in this case clearly separated by silences. The first sound object, in bar 55 (see figure 39), is comprised of five pizzicato sounds and two arco sounds. The first three pizzicato sounds in the viola and cello sound together as one single pizzicato sound object, and then we have two superimposed arco sounds on viola and cello. The arco sound on viola gradually morphs into a noise sound by modulation of bow pressure (high bow pressure). Immediately after the noisy arco viola sound a pizzicato enters on the first violin, followed by a wooden sound on the second violin (bow hit on the body of the instrument) and a low open string pizzicato on the cello. Because of the timbral difference between the various sounds and their separation in time, instruments cannot be perceived as having a clear, autonomous figural identity. And thus we cannot perceive a clear counterpoint of four instrumental lines. Instead,

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higher level structures, which can be related to what Umberto Eco terms “TV narrative” (live montage of materials that are also generated live) (Eco, 1989, p. 110). The sound shots in that case are either generated live or exist only as abstract, hypothetical, outside-time sound shots, and they become real (part of the composition) only when notated in the score or placed in a sequencer. The later case is true for *Spider Web* (different sounds/timbres may be approached as parts of different sound shots).

we perceive a single texture which rapidly shifts from one type of sound to another. We can assume that the sound object comprises three shorter sound objects. The first one is the first three pizzicato notes on viola and cello, the second one is the arco sounds on viola and cello morphing to noise, and the third one is the pizzicato on violin and cello and the wooden hit on second violin. We can observe a three part morphological structure (impulses, sustained, impulses) inside this very short sound object.

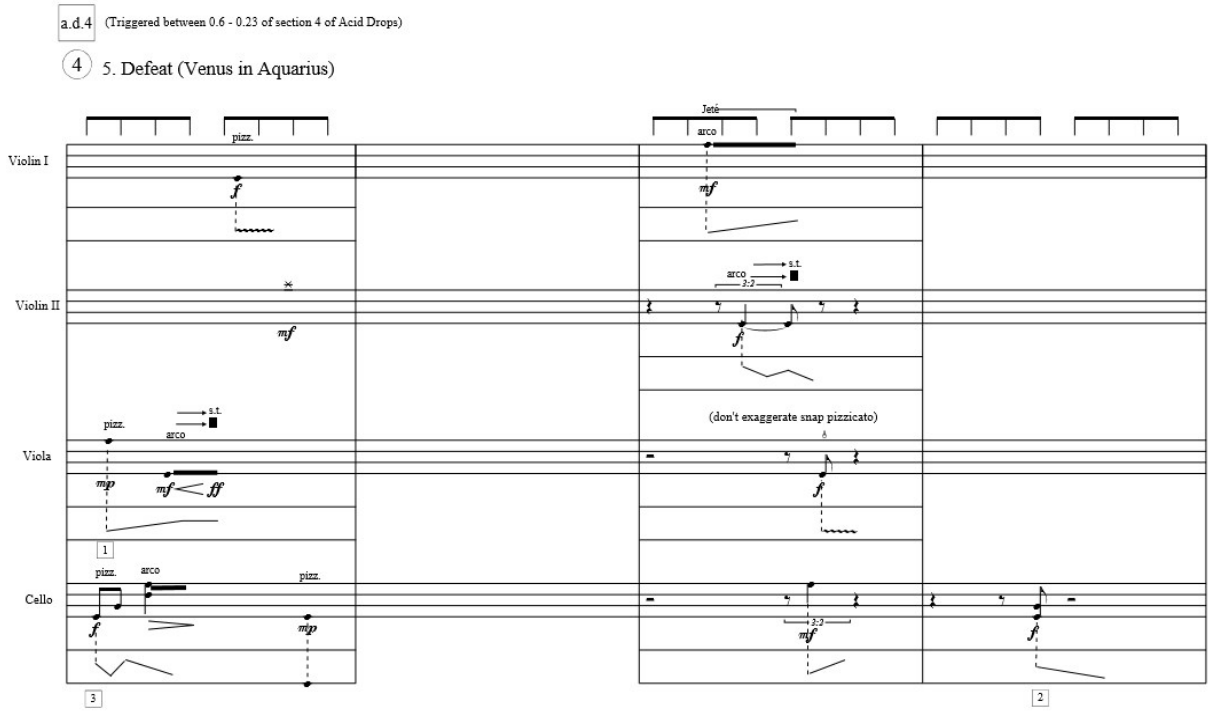

Figure 39. *Spider Web*, beginning of section 4 (bars 55-58). Four-line tablature notation of bow on the strings and two line fingerboard staff below. Black boxes denote high pressure.

The second sound object, in bars 57-58, is comprised of three pizzicato sounds and two arco sounds. The first arco sound has a jeté articulation and is followed by an arco sound that morphs into noise on the second violin. Directly after the second arco sound, which in this case is precisely notated through metric notation, a cello pizzicato sound and a snap pizzicato sound on the viola follow. Almost two seconds later comes a double stop pizzicato on the cello. In this sound object the arco sound object moves to a higher register (by moving to the violins), while its onset now becomes iterated, with the characteristic jeté, bouncing sound. The pizzicato sound object is enriched timbrally with a snap pizzicato and a double stop. Considering rhythm, the second cello pizzicato is separated from the main sound object in time so that it can be perceived as a remnant of the sound object or as an "uncertain" sound, which

may be the end of the previous sound object or the beginning of a new one. We can observe here a a two part morphological structure of the sound object (sustained/iterated and impulses) and a direct relationship to the previous sound object.

To summarize, the available sounds are categorized according to their timbre and create statistical sound objects or sound shots. These basically homogeneous sound shots are combined with each other in a montage-like manner. Thus, in the particular example, the first three pizzicato sounds are joined with the following arco sounds (although overlapping of pizzicato resonance exists). The arco sounds morph into a noise timbre and are joined with a pizzicato sound object. The duration of sound shots in this section is short, leaning to micro-montage time. Thus, although there is no great difference between various timbres (because of the same instrumental family), the texture appears largely unstable, continuously oscillating between impulse sounds (pizzicato, arco, hits, col legno), sustained sounds (arco), pitch and noise. Additionally, the spatial image is rapidly changing due to the position of the instruments in space and the fragmented nature of the texture. A perceptual ambiguity, that is the result of fast and unpredictable (random) change of the contents of the sound shots creates tension that is resolved only if either change is eliminated or if change becomes predictable (i.e. periodic)[29].

Section four of *Acid Drop*s can be played simultaneously with the fourth section of *Spider Web*, either as part of *Magical Theatre* (see figure 33, p.93) or as a separate piece for string quartet and electronics (*Spider Web B*). The beginning of section four is constructed by several sound shots, ranging from clear pitched to noise or highly unstable timbrally sounds. The sound shots are combined together and create compound sound objects, which, similarly to *Spider W*eb, are separated by silences. The different sound shots can be distinguished according to their content, mainly into:

1. pitched, bass synthesized sounds
2. granular transformation of the previous synthesized bass sounds (moving to a higher register)

29 For a better understanding of this model, see also my explanation of the cycle/wave image schema in figure 28 (in chapter 3.1.3.) in spectrum and temporal behaviour. Later in the piece change is minimized with the establishment of the noise, grainy texture produced through high bow pressure.

3. clear pitched synthesized sounds (moving through the whole audible spectral space)

4. synthesized, unstable timbrally sounds (ranging from noise to clear pitch)

5. synthesized sounds with short resonance which resembles pizzicato sounds (mostly in the low register)

6. pre-recorded and processed piano and cello sounds

7. iterated, granular synthesized noise.

Colour code:

1. Blue: synthesized bass
2. Purple: synthesized granular bass
3. Green: pitched synthesized (processed or not)
4. Gray: unstable synthesized (heavily processed)
5. Yellow: synthesized pizzicato
6. Pink: pre-recorded piano and cello (heavily processed)
7. Black: iterated noise

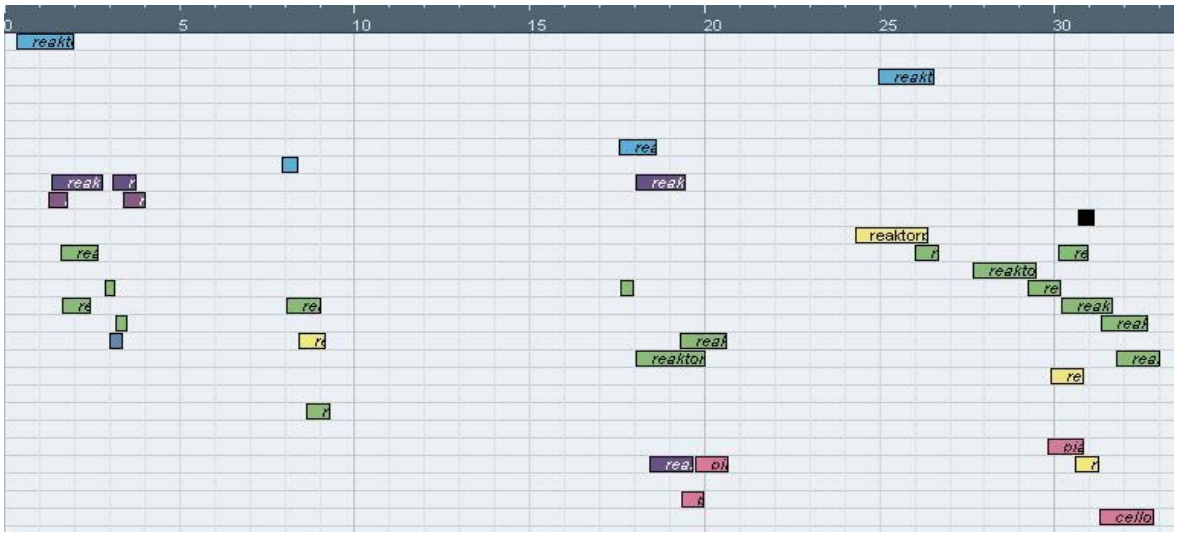

Figure 40. First 33 seconds of section four of *Acid Drops* in montage form.

Now, each of these sound shots or sound fields exist in multiple different versions (created through improvisation and automated processes). The selection and montage of the different sound shots in the editing and sequencing software resembles the mixing of the painter's colours. Similarly to *Spider Web,* the montage of the sounds depends upon the general morphology of the texture that I intend to create. As we can observe in figure 40, the

four different sound objects, separated by silences, are basically comprised of the same sound shots, although their configuration in time and their duration changes. I should note that if the sound shots have similar content and are joined or overlapping, they may be heard as a single sound shot rather than as multiple sound shots.

The silences between the sounds fragment the texture and hinder a clear perception of the contents of the sound shots. The listener cannot establish a clearly defined spectral space because its dimensions are continually expanding or contracting. Synthesized sounds are mixed together with instrumental pre-recorded sound sources (violin, cello and piano) with similar spectral and morphological characteristics so that perception of sound source becomes ambiguous. The montage rhythm as well as internal temporal behaviour of the sound shots is usually very fast, thus preventing the stability that could offer the establishment of a single sound shot. This perceptional ambiguity in spectrum, sound source, space and temporal behaviour of the sound shots (aided by the silences), besides the tension that is generated, aims to engage the listener in the process of actively conceptualizing the musical texture through multiple listening modes.[30] The listener may focus on the perception of timbre, sound source, gesture and shape or signal if all those different types of aural information are present in the texture. He may thus construct his own narrative guided by the general narrative structure of the piece.

If we compare the *Acid Drop*s textures with the ones in *Spider Web,* that I described previously, we observe that all the synthesized sound shots with clear pitch content simulate to an extent the arco sounds of the strings with normal bow pressure (functioning as Schaefferian genres). The synthesized noise sound shot, with its granular character, simulates the arco sounds with a high bow pressure. The synthesized pizzicato sound of course simulates the string pizzicato, while the pre-recorded piano and cello sounds refer to their original sound sources. Additionally, the textures of both *Spider Web* and *Acid Drops* are fragmented, with sounds followed by silences. The *Magical Theatre* hyper-layer, which consists of the

30 Eco refers to the same notion when he describes the concept of the open work as perceived by romantic poets: 'The important thing is to prevent a single sense from imposing itself at the very outset of the receptive process. Blank space surrounding a word, typographical adjustments, and spatial composition in the page setting of the poetic text – all contribute to create a halo of indefiniteness and to make the text pregnant with infinite suggestive possibilities' (Eco, 1989, pp.8-9).

superimposed *Spider Web* and *Acid Drops* layers, can then be perceived as having an additional layer of information that concerns the usually ambiguous alternations between instrumental and acousmatic sound.

4.4. Issues regarding live performance

Live presentation of mixed works or works involving both instrumental and acousmatic media presents several issues.[31] I will describe here some possible solutions in problems that I have encountered in the presentation of mixed works, using *Magical Theatre* as illustration.

The first problem is the loss of the stereo image in most concert halls, where the loudspeakers are placed in front of the audience. The spatial image can be easily lost when the loudspeakers are not close to the listener and peripherally deployed. This results in distortion of the stereo image as perceived by the composer in the studio.[32] This problem, which is also common in acousmatic works, can be solved in cases of concert halls specialized in acousmatic music, which are equipped with multiple loudspeakers and a diffusion system. A more general issue, of course, involves the spatialization and diffusion of acousmatic sound (and to a certain extent the instrumental sounds) in the particular performance space. In the case of mixed works spatialization is more challenging because the instrumental sound, amplified or not, functions as an immobile sound source. In *Magical Theatre,* I have attempted to solve this problem with the distribution of the instruments in space together with the 8-channel electroacoustic part.

In figure 41 we can see the position of the loudspeakers through which an 8-channel electroacoustic part is projected (two 4-channel pieces and one stereo piece in the first part of the piece and a single 8-channel piece in the second part). The instruments are also amplified and mixed with the electroacoustic sounds: the piano is projected through

31 A detailed presentation of issues and possible solutions can be found in the paper: 'Thinking Inside the Box: A New Integrated Approach to Mixed Music Composition and Performance' (Tremblay and McLaughlin, 2009).

32 This is something I have solved differently in my next piece *Dreamscape* (and in later pieces), through approaching the loudspeakers as two separated sound emission spots rather than one stereo channel. The second part of *Dreamscape: Black Moon* is “binaural” (the two channels have a different content although the sounds are very similar). In that case, the two loudspeakers should be placed peripherally to the listener and preferably multiple loudspeakers should be employed in order to cover peripherally all the listeners in the concert hall.

loudspeakers one and two, percussion through loudspeakers four and seven, violin 1 and 2 through loudspeakers eight and three respectively, and viola and cello through loudspeakers six and five. Of course, a position of the instruments near the appropriate loudspeakers would enhance their spatial sound image. In cases of small concert halls, amplification may not be necessary if a balanced mix can be achieved. It should be noted that such an arrangement of sound sources (loudspeakers and instruments) in a concert hall will limit the spots where the audience experiences a balanced sound image. In my view, although a balanced sound image exists, the audience in an ideal situation should experience many views of the sound image by moving around the concert hall. There is no default front and back in the stage arrangement of the piece and ideally the listeners should face whatever point they wish to, or even better, move around, if possible, so that the piece may exhibit a spatial "openness". My intention while composing *Magical Theatre* was to create a series of layers that would engulf the listener and would continually defy a single interpretation (interpretation of timbre, source, spatial position, etc.).

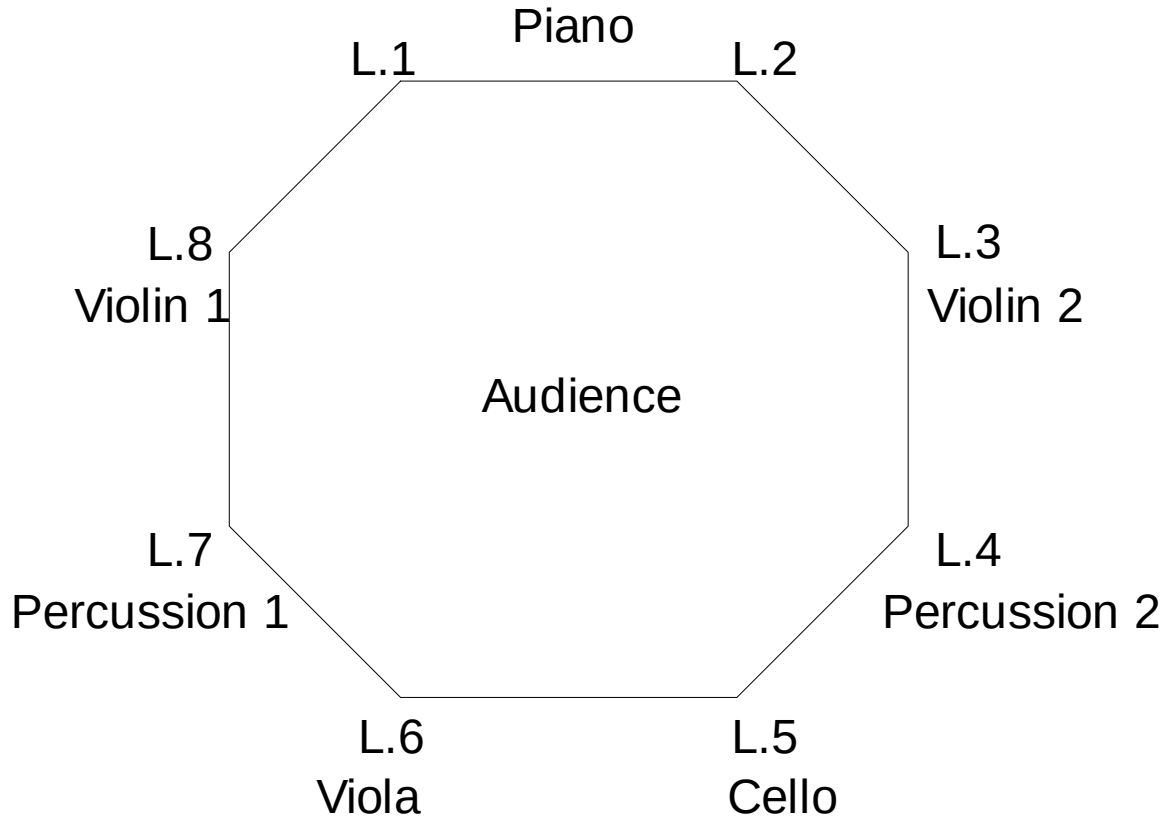

Figure 41. Distribution of instruments and loudspeakers in *Magical Theatre*. Loudspeaker=L.

Concerning synchronization and spatial projection of the electronic sounds of the various pieces, I have used a Max/MSP patch designed by the composer and software designer Adrian Gierakowski. The patch is an 8-channel cue player, which is triggered by the performer through a pedal, MIDI or computer keyboard and permits distribution of stereo audio files on an 8-channel audio interface. The patch also functions as a stopwatch synchronised with the triggered audio files helping the performer to navigate through the score (notated mostly in spatial notation and using time indicators for each system).

Another important issue in the live performance of mixed works is the visual incongruence between the sounds heard and the performers' gestural activity. When the composer works in the studio, the sound may appear to be almost immaterial and this is in fact an important characteristic of the acousmatic sound. Of course, live and acousmatic sounds have important differences but approaching them in a similar basis offers interesting compositional possibilities, which are part of the mixed music musical vocabulary. When the performer is on stage though the audience will be automatically visually fixed on his activities. Even the tiniest gesture (even if it is irrelevant to the sound) will be interpreted as being relevant to the sound heard. The performer is thus elevated to a false status. For me that is an undesirable theatrical element because it distracts attention from the sound, interferes with the gestural elements of the acousmatic sound, dissociates the acousmatic and live part of the mixed sound and limits the acoustic imagination of the listener.[33]

I would propose two possible solutions to the visual incongruence described above. One is the performance of the pieces in absolute darkness so that any visual distraction may be eliminated (instruments may be hidden behind a curtain, in another room, they may be inside the room but not in the centre of attention and they may use small lighting, similarly to an opera setting). The second solution involves the use of a video. I have envisioned the use of 4 separate video screens, projecting images of the four suits of the Thoth Tarot cards, triggered by the performers together with the audio files.[34] Additionally, though not ideal, the piece can be performed in a "traditional" concert setting with the multiple speakers providing a

33 Fransisco López in his live performance of acousmatic music (López, 2004) and Georg Friedrich Haas in his third string quartet also require a completely dark stage for similar reasons.

34 For that reason, the 8-channel cue player Max/MSP patch has been upgraded so that video triggering by the performers may be possible.

separation of layers in perspectival space instead of an engulfing sound image (the spatial multiplicity and thus a degree of openness would be lost in that case). The separate pieces can also function as autonomous pieces or even as studio pieces with the addition of live instrumental recordings.

All the above observations are mainly the result of the performances of *Liquid Glass* at Lawrence Batley Theatre on 19/11/2011 by the London Sinfonietta and *Electric Serpent* at Phipps Hall on 21/11/2011 by pianist Sarah Nicolls, both as part of Huddersfield Contemporary Music Festival 2011.[35] Although the piece has not yet been performed in its entirety, I am assured, through my experimentation in the studio and through live performance, that the different pieces can retain their dual identity as separate pieces and as layers of a common hyper-layer. It should be noted though that there is a difference in the density of sound material when the piece is performed in its entirety that has implications on the narrative of the piece. *Magical Theatre* performed in its entirety would display a significant amount of openness (because of the indeterminacy of superimposing layers and material) that would be missing from the individual pieces and that is an aspect that I wanted to explore with this dual conception of the piece.

4.5. *Dreamscape*

Dreamscape is an acousmatic work in two parts in which I aimed to emphasize montage with source-bonded and signal layers instead of more abstract musical ones. This is something that I have avoided to an extent in my previous acousmatic and mixed pieces and especially in *Magical Theatre*, partially because sounds coming from the "everyday world" have a very strong identity, which could weaken the perception of the instrumental musical discourse. *Dreamscape* consists of two very different pieces; the first one is *Rainforest* and the second one is *Black Moon*. In a concert presentation *Rainforest* should be projected first, followed by *Black Moon*, and both pieces should retain a strong stereo image in the performance space (*Rainforest* can also be diffused live). Although *Black Moon* is the second piece, it was composed first. The concept arose after seeing the film *Black Moon* (1975) by

35 A complete performance of the piece has not yet taken place (2013).

Louis Malle and in particular a scene where the heroine plays on the piano a transcription of Wagner's *Tristan and Isolde* in a dream-like environment, which evokes teenage sexuality. Another influence on the piece was the idea of recreating or reproducing the emotional content of Wagner's opera that I found interesting and engaging, while avoiding large parts that have a lesser or no emotional content or that may perceived as being mundane. This idea is realized to an extent through the avoidance of the grammatical and syntactical conventions of tonal harmony (phrases, candences, sections, etc.). In actuality, the piece "zooms" into a particular section of the Prelude to *Tristan and Isolde* through a subtle repetitive montage of a recording of the piece. Because signal space in that case is stable, change comes from the rhythmic cuts of the loops. The rhythmic montage plays with the intrinsic musical rhythm of the Prelude, by gradually "revealing" more of the sound shots and shortening their duration, until the climax of the piece, which coincides with the climax in the original Prelude. Signal montage at that point connects together a rhythmic breathing sound of a woman having sex and a rising in intensity white noise sound. The rhythmic breathing is also connected to the Prelude through a common internal rhythm (both sound shots exhibit a repetitive rhythm) which intensifies the perception of the signal function of the two different sound shots.

Rainforest is composed after Black *Moon* as a piece which would explore similar ideas of appropriation and of signal montage but through a more free form and in a more conventional manner.[36] The materials used in that piece are extremely diverse, centred though around sounds coming from recordings of forest soundscapes. The sounds can be separated into:

1. animal sounds (bird tweets, forest animal sounds)
2. natural sounds (water sounds, rain sounds, wind sounds)
3. human made sounds (machine sounds, instrumental sounds, recordings of orchestral musical pieces, sounds of household objects)
4. signal sounds (recordings of people talking in Greek and English, singing, orchestral and bell sounds)
5. synthesized sounds (heavily processed synthesized materials coming from older

36 It is influenced to an extent from my participation to the World Soundscape Conference 2012 in Dieburg, Germany.

pieces).[37]

The montage between all these different types of sounds is done in an intuitive manner through generally fast sound montage, which aims to transmit to the listener a sense of confusion as different listening modes continuously compete and "cancel" each other. Considering large scale structure, after the middle of the piece the sound shots gradually get longer. Long wind and water sounds dominate the texture, and are finally dissolved into a long synthesized white noise sound. Longer and relatively stable timbrally sounds have a grounding function throughout the piece acting as grounding sounds in this highly diverse and unstable sound world.

Although *Dreamscape* has a two part structure which resembles the one I have employed in *Magical Theatre* (in that it consists of two clearly separated and antithetical sections that gradually build in tension and density), its narrative structure relies heavily on perception of signals. In *Black Moon,* the wave image schema that defines the looping montage method – operates not only in pitch space or spectral space in general, but also in signal space. Wagner's iconic piece becomes a type of signalling "aural surface" that exists in the listener's memory. This "aural surface" is traversed gradually through a wave-like looping inspired by instrumental gesture that it is already present in the musical layer of Wagner's piece. The listener cannot easily distinguish between the montage cuts and the actual harmonic/melodic textural changes in the piece while listening attention is directed to both the musical narrative of the piece and the play with memory and expectations produced by the superimposed montage (Wagner's piece is a signalling sound shot that has information beyond its musical content). The familiar orchestral piece then seems as if is slowed down and the details move to the foreground. This perceptual ambiguity between the musical narrative of Wagner's piece and the wave-like montage method aims to work in concordance with, and magnify, the already existing in the *Prelude,* tension and relaxation cognitive image schema which stems basically from harmonic suspension and gradually builds up. In the live projection of the piece listeners have testified an experience of vertigo that stems from the exhaustive

37 This list is similar to the one in Cage's score for *Williams Mix* (1952). A similarity of approach to fast sound montage with the very early tape pieces (Cage's *Williams Mix*, Brown's *Octet I* (1953) as well as Ligeti's *Artikulation* (1958)), should be noted here (probably because of the tape medium dictating certain montage types).

play with cancellation and confirmation of expectations resulting from the wave-like montage method, especially towards the end of the piece. Montage here creates repetitive intra-opus patterns (patterns specific for the musical work), superimposed on musical schemas (the Wagner piece) and image schemas operating on traditional pitch space, all of which generate their own expectations.

As a conclusion, I would state that although similar montage methods, directed by wave-cycle image schema, may operate in a similar fashion on instrumental aural spaces (such as the wave-like gestures in *Calcination* or *Liquid Drums*), the signalling function of some acousmatic aural spaces suggests a montage approach that takes in account the different functions of the sound material when it is perceived through different listening modes (musical schemas and patterns that are repeated through the musical work may also function as signals and may suggest a similar approach to instrumental materials).

Conclusion

In the previous chapters I have addressed many significant issues that relate to the combination and integration of acousmatic and instrumental structural strategies. I have also discussed common concepts and perceptual approaches that are particularly important in my compositional work.

The different listening modes, presented in detail in chapters one and two, provide the basis for the perception and construction of multi-dimensional instrumental and acousmatic aural spaces. Examination and creation of instrumental multi-dimensional aural spaces involves a mapping of instrumental physical spaces and gestures to aural spaces. *Horus*, *Scratch* and *Calcination* present different approaches to instrumental multi-dimensional spaces. Acousmatic sound may also extend instrumental aural space in mixed music through genres, sound sources and behaviours. In *Electric Serpent* and *Liquid Glass* I have displayed an extension of instrumental multi-dimensional spaces through spectral connections or through connections of sound sources and behaviours.

Musical space is approached as a general concept that may be applied on multiple different sound parameters that remain relatively stable. Multi-parametric motion inside these spaces is generated through indeterminate processes, modulation chains and improvisation in both media. Generated sound fields that contain large amounts of disparate and chaotic aural information can be approached similarly in both media. The waveform model may serve as a common model for controlling phenomena of regularity and irregularity in both media (it may be applied into physical gesture, virtual gesture, automation, parametric modulation, etc.). The second part of *Electric Serpent*, *Beck* and *Calcination* are good examples of how I generate and control indeterminate sound fields in both media. This approach, which stems from what Eco terms openness, resembles in its foundation surrealistic visual techniques such as automatism, hybridism/biomorphism, and representation of non-Euclidean spaces.

I have also attempted to portray how the listener conceptualizes hybrid textures and how higher level narrative structures function in multi-dimensional and chaotic sound fields. The cycle/wave schema, may explain forward motion in multi-dimensional textures while the container schema may offer a conceptualization of texture as a physical object or colour. Finally, sound montage (between sound shots) offers a general, systematic and quite comprehensive theory of large scale structural strategies while it is equally applicable to instrumental and acousmatic media.

In *Magical Theatre* I have used an abstract conceptual model that controls the sound montage between multiple sections or modules.[38] The connected sound layers from different pieces and different media generate a hybrid hyper-layer that is perceived through multiple perceptual modes. An intentional perceptual ambiguity aims to dissolve boundaries between different listening modes throughout the piece.

Later works, such as *Dreamscape,* are more concerned with the montage of highly diverse sound information and its integration in a larger narrative framework. If sound material is approached as a field of signalling information, narrative structure is less driven by spectral motion or by a play with sound sources but more with a multi-dimensional and highly symbolic

38 The reason for the selection of the Tarot schema should also be found in that it is a model which would resist any strict rationalization of its structure and meaning throughout the composition of the piece. Thus, the model would remain open to multiple interpretations or conceptualizations (although it is based on a highly detailed symbolic system).

narrative that is close to how a film narrative is perceived. Instrumental sound, while still important, is approached as one type of sound information among many others rather than the "opposite" of acousmatic sound.[39]

In conclusion, the research project led me to an investigation of the relationship between highly diverse musical materials and their narrative properties. I have realized the importance of the signalling and symbolic function of sound shots, especially in a context where information is abundant and chaotic. Montage can be understood as an intrinsic property of the multi-dimensional and hybrid nature of the musical material itself, rather than an enforced outside structure. In my work I have navigated this aural labyrinth formed by strings of pluralistic sound information, with the intention to form a meaningful artistic "language".

39 In *Dreamscape* I have originally intended to use very sparse layers of live contra bassoon and flute sounds as an extension of the same pre-recorded instrumental sounds in the acousmatic part but without actually approaching the instrumental part as a solo layer (e.g. as a continuous layer simultaneous to other layers).

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