Investigating the structure of acoustic and electronic noise: an analysis of 'Volumina' by Gyorgy Ligeti and 'Canaanda' by Merzbow

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Edith Cowan University

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INVESTIGATING THE STRUCTURE OF ACOUSTIC AND ELECTRONIC NOISE: AN ANALYSIS OF ‘VOLUMINA’ BY GYÖRGY LIGETI AND ‘CANAANDA’ BY MERZBOW

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ABSTRACT

The term noise as it pertains to music is a subjective one and open to interpretation. What we find is that over 20th century discourse, the term noise has been used as a broad label to encapsulate all musical sound that functions in a way that opposes what would widely be considered ‘musical’. While much of the literature covers the categorisation and political history of noise in music, there is comparatively little literature that analyses musical construction of noise music beyond that of a purely aesthetic or political reaction.

This thesis seeks to explore the world of noise music with reference to musical relationships. Here two noise works are examined, one acoustic – Ligeti’s Volumina (1962) – and one electronic – Merzbow’s Canaanda (2011) – and attempt to chart how these works function musically with respect to recognizable musical structures and relationships.
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Investigating the structure of acoustic and electronic noise: An analysis of ‘Volumina’ by György Ligeti and ‘Canaanda’ by Merzbow

1  Introduction  1

2  Definitions and Limitations  3
   Definitions  3
   Limitations  5

3  What is noise?  6
   Noise as an acoustic phenomenon  6
   The politics of noise  9
   Noise as an element of culture  11
   Summary  13

4  Methodology  15
   Identifying structure  15
   Analysis and audio recordings  17
   Roughness assessment  17
   Spectrographic analysis  21
   Activity charts and form diagrams  21

5  Analysis - Ligiti's Volumina (1962)  23
   Background  23
   Volumina as noise music  24
   Traditional structure and form  25
   Overview of Volumina  27
   Section 1 (0:00-6:15)  29
   Section 2 (6:15-9:48)  30
   Section 3 (9:48-15:15)  34
   Summary  36
6 Analysis - Merzbow's Canaanda (2011) 37
   Background 37
   Techniques 39
   Overview of Canaanda 41
   Section 1 (0:00-5:00) 42
   Section 2 (5:00-12:35) 44
   Section 3 (12:35-18:14) 48
   Section 4 (18:14-22:34) 50
   Summary 51

7 Conclusion 52

8 References 54
Figures

Chapter 4
Figure 1: Roughness chart of Introit by Pierluigi da Palestrina
Figure 2: Roughness chart of 74.5 seconds of electronically generated white noise
Figure 3: Image of the max/MSP patch used to analyse the recordings for their relative roughness values
Figure 4: Jane Piper Clendenning’s range graph of Ligeti’s Continuum (1968)

Chapter 5
Figure 5: Figure 13 demonstrating some of the extreme musical contours that must be performed in Volumina
Figure 6: Activity chart of Volumina
Figure 7: Roughness chart of Volumina
Figure 8: Volumina score excerpt (Figure 25)
Figure 9: Volumina score excerpt (Figures 30-32)
Figure 10: Volumina score excerpt (Figures 35 and 36)

Chapter 6
Figure 11: Example of filter-sweeps in Merzbow’s Canaanda (4:26-4:36)
Figure 12: Form diagram of Canaanda Section 1 (0:00-5:00)
Figure 13: Form diagram of Canaanda Section 2 (5:00-10:00)
Figure 14: Form diagram of Canaanda Sections 2 and 3 (10:00-13:00)
Figure 15: Form diagram of Canaanda Section 3 (13:00-18:00)
Figure 16: Form diagram of Canaanda Section 3 and 4 (18:00-22:34)
Tables

Chapter 4
  Table 1: Curtis Roads’ time-scales of music

Chapter 5
  Table 2: The sonata form of *Volumina*

Chapter 6
  Table 3: Form summary of *Canaanda*
1. INTRODUCTION

Wherever we are, what we hear is mostly noise. When we ignore it, it disturbs us. When we listen to it, we find it fascinating.¹

In these words, John Cage summarised the polarising power of noise in the twentieth century to both disturb and fascinate an audience. Conversations pertaining to the musical potential of noise are widespread throughout the twentieth century² and form a basis for understanding a movement away from the conventions of the common practice period’s ideas of tonality and harmony, and towards an increasing emphasis on the importance of texture and the ‘sound object’ in the music of the last 100 years³.

Despite discussion of noise and its relation to music throughout the twentieth century, comparatively little writing exists that offers a structural analysis of noise music. Some authors have suggested that this is because conventional examples of noise music actively defy the presuppositions that musical analysis is built upon⁴, namely that of a somewhat objective ordering of pitch and rhythmic structures that are quantifiable upon the grid-like resolution of western music.⁵ As Salomé Voegelin states:

Noise understood as radical sound has not place in modernist discourse. ... We do not listen to a modernist discourse not because no noisy, visceral and impure work has been produced within its time, but because the discourse surrounding and contextualising the work has not dared to listen.⁶

Nonetheless, the objective of this thesis is to propose a methodology and examine two examples of noise music in an attempt to uncover musical form and structure.

Chapter two attempts to define the terminology of noise and music used in this thesis, so as to construct a consistent lexicon with which to explore the issue, and to

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³ Arguably this is evident in the work of such varied composers as Debussy, Varèse, Stravinsky, Cage, Schaeffer, to name a few.
⁵ This includes Western music conventions such as equal temperament, metrical unity and the reducibility of form into recognisable structures.
⁶ Voegelin, 60
acknowledge the limitations of this thesis. Chapter three provides an overview of the ideas and definitions of noise over the twentieth century, highlighting three categories of noise that relate to noise music practice. A methodology for the detection of structural elements in noise music is outlined in chapter four, wherein the methods of musical analysis realised in this thesis as discussed. Chapters five and six are devoted to the analysis of Ligeti’s Volumina (1962) and Merzbow’s Canaanda (2011) respectively.
2. DEFINITIONS AND LIMITATIONS

DEFINITIONS

Some terminology must be defined in relation to the world of noise music and this thesis.

In physical terms, sound is defined as a travelling wave that is an oscillation of pressure in air, usually perceived by humans as pitch. These waves cycle a number of times per second, the frequency of which is measured in Hertz. The amplitude of such a signal is measured in decibels.⁷ Expanding upon this, we can see that sound can also refer to the physical, communicative and cultural contexts of these waves, but perhaps the most concise definition of sound in the context of noise is as a descriptor for the raw, unfiltered and uncategorised experience of listening. As Salomé Voeglin describes sound:

Sound ... is its immediacy: unordered and purposeless, always now. The opaque and ambiguous process of living manifests itself in its sounds, and appears in an engaged listening that hears the invisible murmuring at the depth of Hegel’s State. It is the unseen but heard simultaneity that develops community not as an ideal manifestation of reason between subjects, but as their coincidental meeting in affection.⁸

“Music” is at best an ambiguous term, given that much of the music written in the twentieth century actively sought to challenge accepted definitions of what music was. In “Aesthetics and Music” Andy Hamilton identifies a number of different perspectives on the definition of music – conservative universalism, avant-garde universalism and non-universalism. Conservative universalism can be characterised as the interpretation of music as the universal high art of sound, essentially created from tonal organisation. This perspective is inclusive of atonal relationships, here embraced as an element of tonality. Hamilton characterises conservative universalism as a rejection of any aural high art not essentially based on tones. Avant-garde universalism is characterised by

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⁸ Voegelin, 160-170.
Hamilton as seeking to integrate sounds that range in a continuum between a pure tone and acoustic noise into a musical code. Non-universalism by contrast seeks to liberate sound from musical conventions and is characterised by an appreciation of the sonic object.⁹

This thesis will primarily discuss the construction of music as it pertains to conservative universalism and avant-garde universalism. That is, the role of non-tonal musical sound as it relates to a conventional musical code.

The philosophical and acoustic meaning attributed to the term noise has been the source of debate for much of the twentieth century. These ideas are explored fully in chapter three. What is clear from these discussions is that the term noise functions as a label to sound that is ‘other’ to the conventions of music. This is the basis from which an idea of noise is constructed, that a noisy sound object inevitably challenges the idea of how conventional music functions.

Sound art is a term that is related to noise but for the purposes of this discussion is a separate concept. Sound art is an area of music that focuses on the liberation of sound from musical convention. While noise music seeks to engage an audience musically through non-musical sound, sound art seeks to focus an audience on the qualities of sound itself, with an emphasis on the essential quality of listening.

Certain compositional terms will also be referred to in this thesis in order to adequately describe and analyse the construction of a work. For the purposes of this discussion we can define form as all the elements that organise a work of art as meaningful in itself.¹⁰ This definition of form includes traditional models such as binary, tertiary, rondo and sonata forms. In the context of noise music however, form will be used to refer to any identifiable pattern of musical structures that creates a musical meaning for a composition.¹¹ Traditionally musical structures have consisted of identifiable musical motifs and identifiable rhythms that are arranged in such a way as to create the musical form of a work. For the purposes of this discussion this definition will be extended to include identifiable sonic qualities that are arranged to

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communicate the form of a work. The term musical development (or simply
development) in the context of this thesis refers to the gradual unfolding of or
elaboration of a musical idea, which may in turn help to identify a works component
form.
Glitch is a term related to noise music. The term glitch is commonly referred to in the
context of digital audio, the characteristic sound of digital pops and clicks brought
about by pushing sound making equipment to its limits. In the truest sense of the
term, a glitch is what occurs when the correct sequence of ones and zeros are
interrupted. This corruption of data is inherently noisy, however the key difference
between a glitch and noise is the duration, with glitches often lasting only a fraction of
a beat. While glitch is an important term and aesthetic in the larger context of noise,
it is not a term that will be explored in depth in and of itself.

LIMITATIONS
This thesis will be specifically focused on analysing two very specific examples of noise
music: noise music of an acoustic origin – Ligeti’s Volumina – and noise music of an
electronic origin – Merzbow’s Canaanda. The subject of noise music is much broader
than this, an overview of which is given in detail in the next chapter. The areas of
improvisation, sound art and glitch are all related areas to the field of noise music,
however they cannot be discussed within the restrictions of this thesis. Similarly, an
aesthetic discussion attempting to quantify and categorise the idea of ‘good’ and ‘bad’
noise music – in the sense of being perceived as having significant artistic merit – is
similarly related to this discussion, but unable to, and will not be, discussed within the
limits of this thesis.

13 White, 63.
14 Caleb Kelly, “Cracked Media: The Sound of Malfunction”, (Cambridge, Massachusetts: MIT Press,
2009), 6-8.
3. WHAT IS NOISE?

In 1913, Futurism embraced industrial and environmental noise as a means to violently overthrow the conceptions of art.\(^\text{15}\) In 1929, Henry Cowell published “The Joys of Noise” wherein he refers to noise as a physical reality, a quality inherent in all sound including commonly defined ‘musical sound’.\(^\text{16}\) In 1937, John Cage wrote “The Future of Music: Credo” wherein he champions making available for musical purposes any and all sounds that can be heard.\(^\text{17}\) In 1962, in a lecture titled “The Electronic Medium”, Edgard Varèse discusses his reinterpretation of the act of composition, highlighting the newfound importance of the musically foreign sound body in composition:

I decided to call my music “organised sound” and myself, not a musician, but “a worker in rhythms, frequencies, and intensities.” … after all, what is music but organized noises? And a composer, like all artists, is an organiser of disparate elements.\(^\text{18}\)

From these examples, and more, we can see that the idea of noise and its relation to music has been a consistent concept in twentieth Century musical thought. Through the kaleidoscope of these different interpretations of the meaning, significance and function of noise, we can see any such definition of noise pertaining to three key areas: noise as an acoustic phenomenon, political function and cultural by-product.

NOISE AS AN ACOUSTIC PHENOMENON

We shall begin by approaching the subject of noise from a purely acoustic and perceptual perspective – that of a significantly complex sound.\(^\text{19}\) Noise as an acoustic

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\(^\text{17}\) Cage, 26


\(^\text{19}\) While the idea of tonal complexity can refer to a complex range of active frequencies in the audible frequency range, it can also refer to issues relating to the perception of music. This includes complex
phenomenon is most commonly characterised by the spectral difference to that of a pure tone. This difference is an increased activity of a band of frequencies across the sound spectrum. The most common experience of this acoustic concept of noise is white noise, defined as all audible frequencies arranged equally across the sound spectrum. When this spectrum is filtered we create different colours of noise.\textsuperscript{20} John Dribus goes a step further and defines noise in the context of his paper “Characterising Noise and Harmonicity: The Structural Function of Contrasting Sonic Components in Electronic Composition” as derived from the analysis of the amount of random distribution evident in the structure of the harmonic partials in a sound.\textsuperscript{21} One method of measuring the inharmonicity of any given point in a musical composition can be made by measuring the amount of roughness exhibited. Roughness can be defined as the sensory component of musical difference,\textsuperscript{22} or degree of signal modulation in the range of 15-300 Hz that listeners typically report as being ‘unpleasant’ or ‘annoying’.\textsuperscript{23}

One of the earliest attempts to clarify the acoustic properties of noise music is offered by Torben Sanglid. In his paper “The Aesthetics of Noise”, Sanglid attempts to classify noise as sound pertaining to one of three possible definitions. While the second and third definitions will be discussed in the following section, the first definition that Sanglid outlines is that of acoustic noise, physically defined sounds that are characterised by qualities of impurity and irregularity.

Neither tones nor rhythm - roaring, pealing, blurry sounds with a lot of simultaneous frequencies, as opposed to a rounded sound with a basic frequency and its related overtones.\textsuperscript{24}

Strongly related to this scientific categorisation of noise are the concepts of consonance and dissonance. Western music history has shown a gradual acceptance of

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\textsuperscript{23} Susan Rogers, “The Influence of Sensory and Cognitive Consonance/Dissonance on Musical Signal Processing”, (PhD, McGill University Montréal, June 2010), 8.

Initially noisy harmonic dissonances into the conventional harmonic language. Stephen Gard points to Monteverdi’s use of the dominant seventh as an early example of tonal ‘noise’, a harmonic relationship functioning outside of the established harmonic language of the period. This culminates, Gard states, in the use of clusters of pitches in the early twentieth century.\textsuperscript{25} There is an essential difference then, between the conventions of a musical code at different periods in history. As such, we can perceive a structure to be noisy if it opposes the dominant musical code of the period in which it was written.

In 1929, Henry Cowell published “The Joys of Noise”, a short paper in which he proposed that noise was, not just a musical effect – Cowell points to the use of percussion without a fixed tone and rich harmonics as potential noise-making instruments in an orchestral context – but an essential part of any instruments acoustic properties.

But most shocking of all is the discovery that there is a noise element in the very tone itself of all our musical instruments. Consider the sound of the violin. Part of the vibrations producing the sound are periodic, as can be shown by a harmonic analyser. But others are not – they do not constantly re-form the same pattern, and must be considered noise.\textsuperscript{26}

Cowell’s “The Joys of Noise” is an important text for opening up discussions as to ideas of what can be considered noise, and the musical functions noise can play in music. For Cowell, noise is sound that differs from that of a pure tone, a coloration of the acoustic spectrum that gives instruments not only their unique timbre, but that can vary throughout the duration of the sound itself.

In an acoustic sense, the term noise refers to an objective state of inharmonicity. However, it is also a gradient, with sounds graded subjectively as more or less noise than not noise. As the harmonic partials of a sound move further away from the clean harmonic ratios that define an acoustically ‘clean’ sound, the noisier the sound is perceived. Similarly, the more irregular the rhythmic divisions of a sound, the noisier the sound is perceived to be, regardless of its spectral content. While the degree of


\textsuperscript{26} Cowell, “The Joys of Noise”, 23.
variation here can be measured there is also a contextual function of noise, that of
tonally and rhythmically satisfying chords used inharmonically, which the ear is
capable of identifying as external to the musical code of a composition.

THE POLITICS OF NOISE

The twentieth century has seen much discussion of the meaning and significance of
noise in music. While texts pertaining to the political ramifications of noise music raise
some important issues, it can be hard to shake the feeling that some authors are
content to write off noise music as unquantifiable in musical form and structure, while
the issue of musicality is often completely ignored. Nonetheless, these texts also help
to shape the philosophies that motivate noise music, and contextualise noise music
with relation to society and culture.

The binary relationship between noise and music is perhaps best articulated by
Jacques Attali in his 1971 text “Noise: The Political Economy of Music”. In this text,
Attali argues that music is the end result of the organization of noise into a musical
code. Thus, sounds that exist outside of these codes remain noise, the otherness of
music. 27 Attali goes further and postulates that the use of noise is violence, a
disruption, an interruption, of this code and language of music. This conceptualisation
of noise characterises noise as the otherness to music. 28

More recently, Paul Hegarty expands on the idea of noise as the binary opposite of
music in a more exaggerated form in his publication “Noise/Music: A History”. Hegarty
champions the notion of noise being all that is unwanted by music, acting to define
what music is while incorporating all forms of sound that pose a violent uprising to a
musical code.

Noise is negative: it is unwanted, other, not some thing ordered. It is negatively
defined – ie by what it is not (not acceptable sound, not music, not valid, not a
message or a meaning), but it is also a negativity. In other words, it does not
exist independently, as it exists only in relation to what it is not. In turn, it helps

27 In this case ‘music’ is characterised as consisting of characteristically acceptable sound qualities.
28 Jacques Attali, “Noise: The Political Economy of Music”, (Great Britain: Unwin Brothers, Old Woking,
1985), 25.
structure and define its opposite (the world of meaning, law, regulation, goodness, beauty, and so on). Noise is something like process, and whether it creates a result (positive in the form of avant-garde transformation, negative in the form of social restrictions) or remains process is one of the major issues in how music and noise relate.²⁹

Hegarty presents a particularly one dimensional perspective that noise is inherently an act of violence and disruption that attains its meaning through this act of violence. For Hegarty, noise taps into the primordial, a brutism that never really left our subconscious and here comes to the surface. While Hegarty captures the spirit of noise, very little sense is made beyond this idea of brutism, which Hegarty outlines as the ideological source of much of the noise music made throughout the twentieth century.

Douglas Kahn expands upon the communicative nature of noise in his text “Noise Water Meat”. For Kahn, the concept of noise takes place in the scrutiny of imperfections and the abstraction of meaning. He offers the analogy of text as potential noise. In this context, Kahn depicts our society as one that is constantly immersed in noise as the raw materials from which we create codes. Noise is a constant threatening force that is held at bay by our understanding of its codes. When we understand these codes the noise becomes meaningful and significant, when we do not, it is an illegible scribble.³⁰

Sanglid’s “The Aesthetics of Noise” was discussed previously with regard to acoustic noise. However, “The Aesthetics of Noise” offers two further definitions of noise, which deal with political interpretations. The second definition offered by Sanglid is referred to as communicative noise, a distortion of the original signal from transmitter to recipient. Noise in this case refers to the process of corruption in regards to changing a pure (or comparatively pure) sound to an impure sound. In this way a sound that confirms to a musical code, through this process of distortion can be manipulated in such a way as to no longer adhere to a conventional musical code and is consistent with a political representation of noise, the notion that noise is a process

or definition of the corruption of sound, an action that functions both physically and symbolically.  

The final definition of noise that Sanglid offers is that of subjective noise. Subjective noise refers to the colloquial idea that if a sound is experienced as unpleasant by the listener that it is regarded as noise. Sanglid provides some general suggestions as to the kinds of sounds that might be covered by this definition of noise, including examples of the unpleasant physical experiences often associated with extremes in frequency and amplitude, and yet readily acknowledges the subjective nature of this definition. This definition echoes the assessment of noise by Edgard Varése in 1962:

Subjectively, noise is any sound one doesn’t like.

Ultimately this final definition of noise as subjective accepts the effervescent nature of any political definition of noise. Since noise, as a political entity, can embody any sound object that seeks to conflict with a conventional understanding of music, any sound that the individual experiences that opposes the cultural understanding of music is functioning as noise.

NOISE AS AN ELEMENT OF CULTURE

Of equal importance to the arguments of the political significance of noise are arguments as to the cultural significance of noise, most notably environmental noise: the remnants and off cuts of cultural sound and the attribution of meaning carried via this sound. Joanna Demers introduces the term ‘Post-Schaefferian sound object’ in her book “Listening Through the Noise: The Aesthetics of Experimental Electronic Music”. In the first chapter Demers discusses the power that electro-acoustic music has in its ability to signal and refer to the world external to music. She claims that music constructed from the noise of the environment is generally approached from one of two directions, either through the utilisation of recognisable sounds that reflect a
greater meaning or organisational approach to a work, or from the desire to remove
this cultural meaning from noise, to function in a state of reduced listening.34

Hillel Schwartz explores the cultural function of noise in “Making Noise”. From the
outset, Schwartz considers the notion on noise and the cultural background of its
production as inseparable.

As a register of the intensity of relationships, noise has a fourfold history. First,
the chronicle of changing soundscapes: how each era and culture lives within its
own ambience of sounds. Next, the annuals of sounds earmarked as pleasant or
obnoxious: how each era, culture, and rank hears (or does not hear) and
welcomes or distains the sound around it. Next, the career of noise itself as
variously apprehended: how each era, culture, occupation, or discipline
reconstitutes the notion and nature of noise. Contingent upon these, finally, are
narratives of noisemaking and noise-breaking: how noise in each era, culture,
and class have been denounced or defended, defiantly produced or
determinedly deadened.35

Noise is a concept that is essentially tied to a culture, and to the cultural importance
placed on sound. The extent to which we attribute importance to a sound is essential
in our categorisation of it as significant or not. The perceived cultural importance of
sounds changes, continually being re-categorised as meaningful or noise.

The Futurists are one of the earliest groups to call for the inclusion of cultural sound
with the musical world. Following the publication of the Futurist manifesto in 1909,
Luigi Russolo published “The Art of Noise”, a manifesto for sound and music in the
proposed new Futurist age. Inspired by the sounds of the burgeoning industrial
revolution, Russolo proposed the creation of music constructed from ambient and
environmental sounds, outlining his vision of machines that would create a wide
variety of sounds – roars, whistles, whispers, screeches, found percussion, and human
and animal voices – for the creation of music36. These proposed new musical sounds
embodied the changing environmental soundscape, and reflected the newfound

(New York: Oxford University Press Inc., 2010), 26-34.
importance of such noise sounds in musical culture, channelling this progress towards the violent overthrow of the cultural norm. Ultimately these musical aspirations culminated in the creation of the Intonarumori, large machines that brought these industrialized sounds of the environment into the concert hall.  

Philosophically, John Cage sought to explore the relationships between the environment and the practice of listening, drawing the audience’s attention to the quality of sound itself. The environmental relationships between music and material are perhaps best explained by Paul Hegarty in his analysis of Cage’s infamous ‘silent’ piece 4’33’:

... everything else becomes the material. The listeners will not hear everything else, though, if they are today’s humans, but will instead have a specific sound environment for the duration of the piece. In Cage’s thoughts, as Kahn clearly shows, this meant accessing some form of the ‘music of the spheres’, the inherent musicality of the universe, even if also raising the questions of whether this would be the case without listeners. Noise is not abolished when ‘all sound’ is let in – unpredictability means a more subtle (less literal) form of noise and the interplay of noise and music persist alike.  

The environment is essential in the construction of musical material in Cage’s 4’33’ and this awareness can be seen to inform the direction of environmental and soundscape works today.

SUMMARY

In short, noise is an acoustic reality, a political agenda, and a cultural signifier. Noise music engages with some or all of these elements to create musical and ideological interest. However, in spite of increased discussion over the twentieth century, there is significantly less written regarding the structural and technical construction of the music itself. It has been pointed out that noise music is more resistant to analysis by

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traditional musical forms, however this thesis will look at two works that engage with these ideas of noise and analyse them from a distinctly musical perspective.

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4. METHODOLOGY

This chapter will propose techniques that can be used to help derive a structural analysis of noise music. It is the view that these techniques contribute to a noise-orientated analysis that might be more appropriate than a traditional score-based harmonic analysis. In the two works chosen, the “score” is either somewhat indeterminate – in the case of Ligeti’s *Volumina* – or completely absent – as in Merzbow’s work *Canaanda*. In both works the role of traditional harmony in determining formal structure is minimised. Instead, Ligeti and Merzbow arguably rely upon broader textural components to impart a sense of structure. These take the form of extreme contrasts in pitch density, register, rhythmic activity and corruption and manipulation of the source of the sound itself. It is argued that it is the variation in these textural components that provides the most pertinent structural determinant. In locating, assessing and analysing the works for these structures this thesis will utilise several tools:

1. Roughness assessment
2. Spectrographic analysis
3. Activity charts and form diagrams

IDENTIFYING STRUCTURE

There are many factors that affect our ability to detect structure in a piece of music. There are a number of different dimensions that we can perceive a musical gesture: pitch and rhythm are perhaps the most obvious, but we might also consider dynamic level, timbre, spatial position, and indeed any other factor that causes us to perceive a sound object as distinct from other elements of a similar construction. It would be natural to expect that such determinants vary in importance from work to work. The experience of form and the relationship of these musical gestures relates to key
elements of perception, including auditory grouping processes, the relationship of these gestures to our learnt knowledge structures and event structure relationships.\textsuperscript{40}

We can group perceived musical gestures in a number of different ways:

Auditory grouping processes serve to organise the acoustic surface into musical events (simultaneous grouping), to connect events into musical streams (sequential grouping), and to chunk “event streams” into musical units (segmentational grouping).\textsuperscript{41}

These grouping processes are the processes from which we derive an awareness of a piece of music that enables us to derive musical form. From here we are able to compare these grouped musical gestures against our learned system of musical relationships, and the degree to which they relate to these pre-existing systems of musical understanding. The degrees to which a series of musical gestures adhere to this learnt system of musical understanding and convention ultimately shape our understanding of the event structure in a work. Finally our understanding of these musical gestures and their relationship to each other is assembled into an understanding of the work, the final event structure of a piece of music.\textsuperscript{42}

In this thesis we will be looking for distinct musical gestures that can be clearly identified by elements such as pitch, rhythm, timbre and roughness. Due to the experimental nature of noise music we would expect the resulting forms to, more than likely, not strongly adhere to traditional musical structures. However, we would suggest that elements such as repetitive sonic elements, the method of transition between two musical gestures, alterations in timbral complexity and more can provide an insight to how noise works exhibit a structure of relationships in their musical construction.

\textsuperscript{41} McAdams, “Psychological constraints...”, 182.
\textsuperscript{42} McAdams, “Psychological constraints...”, 182.
ANALYSIS OF AUDIO RECORDINGS

Central to this analysis is the analysis of audio recordings. In the case of Ligeti’s Volumina\textsuperscript{43} this is because there is a degree of flexibility in the score, with the length of sections left to the discretion of the performer and the restriction that the work should finish as close to the 16-minute mark as possible. As such, the performers realisation of the musical material is central to the music, and an analysis that pertains to the score would recognise this compositional direction. In the case of Merzbow’s Canaan\textsuperscript{a},\textsuperscript{44} work the music exists only in recorded form and as such any other such analysis of the work would be impossible. Ultimately though, the perception of structure is an auditory function, and as such an analysis that pertains to recorded works has been decided upon with the view that such analysis is more reliable in the construction of structure in a work than other means. The analyses were conducted upon 24bit 41.1 kHz Audio Interchange File Format (AIFF) files.

ROUGHNESS ASSESSMENT

The experience of dissonance is the product of a number of different elements, the cumulative result of which can be described in regards to the degree of ‘roughness’ exhibited by a work at a given state. In “Real-Time Analysis of Sensory Dissonance”, John MacCallum and Aaron Einbound describe the relationship between dissonance and roughness thusly:

Sensory dissonance comprises of a number of psychoacoustic factors including roughness, the beating sensation produced when two frequencies are within a critical bandwidth, which is approximately one third of an octave in the middle range of human hearing. The partials of complex tones, in which several components are fused into a single percept, can also reproduce roughness when they fall within a critical bandwidth. As a result, the timbre of complex tones can affect our experience of roughness."\textsuperscript{45}

\begin{flushleft}
\textsuperscript{44} Merzbow, Lop Lop, with Masimi Akita, 2011, Rustblade, RBL033, Compact Disc.
\textsuperscript{45} John MacCallum and Aaron Einbound, “Real-Time Analysis of Sensory Dissonance” in International Computer Music Conference, (Copenhagen, Denmark: CNMAT, 2007), 203.
\end{flushleft}
We investigate the comparative roughness of a series of recordings to demonstrate the difference between music that relies on comparatively low and high levels of dissonant musical activity. For example, the following is a roughness chart of Introit by Pierluigi da Palestrina:

![Roughness chart of Introit by Pierluigi da Palestrina](image)

**Figure 1: Roughness chart of Introit by Pierluigi da Palestrina**

If we compare this chart to an analysis of electronically generated white noise, we can see the extremes present between these two analyses, and can make the generalisation that *Introit* by Palestrina is perceptually less rough than the electronically generated white noise, and that any perceptions of roughness would most likely reflect intermittent moments of harmonic dissonance as expected by the harmonic practice of the time.

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Figure 2: Roughness chart of 74.5 seconds of electronically generated white noise

Measurements of roughness in this paper were derived by using the roughness object in max/MSP, programmed by John MacCallum. This object generates an estimate of an audio files roughness in real time, using an algorithm derived by Richard Parnscutt.

Figure 3: Image of the max/MSP patch used to analyse the recordings for their relative roughness values
The patch for collecting the roughness values of a recording, samples the roughness value every 250 milliseconds, (four times a second). The interval of 250 milliseconds was chosen according to Curtis Roads’ description of timescales in musical perception. As indicated below, the measurement of 250 milliseconds falls within the sound object or micro scale of musicality, ensuring we are sampling the level of roughness at distinct intervals that construct conceptions of the meso and macro time-scales.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infinite</td>
<td>Ideal time span of mathematical durations such as the infinite sine waves of classical Fourier analysis</td>
<td>Theoretical</td>
</tr>
<tr>
<td>Supra</td>
<td>Time-scale beyond that of a composition</td>
<td>Months to years to decades, etc...</td>
</tr>
<tr>
<td>Macro</td>
<td>Time scale of overall musical architecture or form</td>
<td>Minutes to hours, occasionally days.</td>
</tr>
<tr>
<td>Meso</td>
<td>Divisions of form</td>
<td>Seconds to minutes</td>
</tr>
<tr>
<td>Sound Object</td>
<td>Unit of musical structure</td>
<td>Fraction of a second to seconds</td>
</tr>
<tr>
<td>Micro</td>
<td>Sound particles that extend down to the threshold of perception</td>
<td>Milliseconds</td>
</tr>
<tr>
<td>Sample</td>
<td>Atomic level of digital audio systems</td>
<td>Microseconds</td>
</tr>
<tr>
<td>Subsample</td>
<td>Fluctuations on a time scale too brief to be properly recorded or perceived</td>
<td>Nanoseconds or less</td>
</tr>
<tr>
<td>Infinitesimal</td>
<td>The ideal time span of mathematical durations such as the infinitely brief delta functions</td>
<td>Theoretical</td>
</tr>
</tbody>
</table>

Table 1: Curtis Roads’ time-scales of music47

These roughness values are then collected and charted using Microsoft Excel to generate graphs of the evolution of roughness (Y-axis) over time (X-axis). This method has some shortcomings. The roughness~ object is particularly useful for deriving timbral roughness, however since it relies on the analysis of sinusoidal components measured at the same time it is less effective in measuring the amount of roughness presented in passages that utilise very short bursts of sound that would create a perceptually chaotic, jarring and dissonant phrase for the listener. Nonetheless,

analysing the various states of roughness in a work is useful to chart the difference in the roughness of texture over the course of the work.

SPECTROGRAPHIC ANALYSIS

Spectrographic analysis will be used to chart relationships between sound frequencies over time, making it a reliable tool for constructing analytical relationships between sound objects in relation to register, rhythm, timbre and melody.

[spectrographic analysis objectifies] much that has previously been most elusive, even mystifying, about sounds and the ways they create the design of musical structures. In so doing, they illuminate the very nature of musical structure and expression. 48

Spectrographic analysis is particularly useful in the world of noise music, a genre that relies on changes in timbre and dissonance as much as discrete sound objects in the creation of structure in the music. From spectrographic analysis we can derive the boundaries of frequency activity. Perhaps most importantly however, is that the spectrograph allows us to assess and analyse the physicality of sound resulting from a performance of a work. This is in contrast to conventional score analysis which requires the academic to extrapolate from the score what the resulting sound would be. The spectrograph gives us the finished product, the resulting sound, which arguably gives us the most reliable material from which to draw relationships between musical events.

ACTIVITY CHARTS AND FORM DIAGRAMS

Analysing music that exhibits complex timbral relationships can be difficult to achieve purely through the use of spectrographic analysis or more conventional analytical tools. 49 The issue of having too much information present, especially in noise music,
that the form becomes clouded with detail can be overcome by the creation of diagrams that clearly outline identifiable structures. One such example of such form diagrams is Jane Piper Clendenning’s range graph of the Ligeti work *Continuum* (1968). Here, Clendenning is able to chart changes in register over the duration of the work, highlighting the structure of the work with respect to this development.

![Range Graph of Continuum by Ligeti](image)

**Figure 4: Jane Piper Clendenning’s range graph of Ligeti’s *Continuum* (1968)**

This thesis will utilise diagrams to chart changes in activity and changes in the form of the work in order to simplify more complex data and to easily outline key structures and relationships identified by the author.

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5. ANALYSIS – LIGETI’S VOLUMINA (1962)

BACKGROUND

György Ligeti is best known for his pioneering work in the field of sound mass. His work is characterised by dense clusters of notes and an intricate tonal and rhythmic language, which came from his rejection of the practice of serialism, a dominant musical code of the time.\(^{51}\) His innovation in sound mass composition can be evidenced in his works *Apparitions* (1959), *Atmospheres* (1961) and *Volumina*. Sound mass can be defined as:

... blocks of sound of such density and complexity that individual elements, such as pitch and rhythm, are meaningless as individual events and are subordinate to the total aural effect.\(^{52}\)

*Volumina* for organ is the only work by Ligeti to utilise graphic notation exclusively. In it, intervals, melodies and harmonics are discarded in favour of shifting tone colours brought about in part by the manipulation of the manuals, pedals and stops of the organ. Precise notations are not given; rather the graphic notation defines the limits of tone clusters. These tone clusters are defined by their tone content – either consisting of only white or black notes, or both resulting in chromatic tone sets – and their function as either static or moving clusters.\(^{53}\)

*Volumina* has been thought to be the most concise reflection of the influence of electronic music and production on Ligeti’s compositional practice. While Ligeti produced barely any works purely for the electronic medium, the influence of Stockhausen’s statistical form ideas can be felt in the sound masses constructed in *Volumina*.

These examples [of sound mass construction] from *Atmosphères*, *Aventures* and *Volumina* correspond exactly with Stockhausen’s beech-tree metaphor: The ordering and perception of the individual events does not matter within the

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\(^{52}\) Hoogewind, “Compositional Techniques...”, 34.

\(^{53}\) Hoogewind, “Compositional Techniques...”, 74-79.
boundaries of the sound mass, as long as the overall shape of the structure is recognizably complete.54

VOLUMINA AS NOISE MUSIC

Volumina can be considered to be a work of noise music and as such analysed with regard paid to the noise-related structures at play. Volumina is focused on the idea of exploring volumes (Volumina literally translates as ‘volumes’ from the original German) of sound, using a combination of different types of tone sets and structures that result in an overall dissonant harmonic structure and a high degree of fluctuation in the roughness of the sound throughout the work. We can also see an acoustic approximation of acoustic noise – an equal distribution of audible frequencies – through the huge range of the organ being implemented with equal weight in several important sections. For these reasons we can perceive Volumina as engaging with the ideas of acoustic noise.

There is an element of political noise at play in Volumina as well. The physicality of the score and the demands of it placed upon on the performer are oppressive, with portions of the score unable to be performed accurately without the use of additional implements such as sandbags, or through the intervention of a second performer to operate the organ stops. The performer must utilise their body to accurately translate the graphical ebb and flow of the score into the physicality of the keyboard, a theatricality that cannot be ignored when appreciating the piece.
The structures created by Ligeti in *Volumina* to shape identifiable sections in the work are numerous. These include his use of different kinds of tone clusters or the use of the manipulation of non-tonal ideas in the development of different sections (the gradual removal of stops in section 14 is notable for this). Ultimately these structures can be seen to reinforce Ligeti’s engagement with a language outside of a traditional musical code of the time, a code best characterised by the serialist explorations of Schoenberg, Berg and Stockhausen. These factors can be seen to reflect the ideas put forward by many writers of the political undercurrents of noise music, many of which *Volumina* predates. For these reasons, *Volumina* can be discussed as an example of noise music in an acoustic form.

TRADITIONAL STRUCTURE AND FORM

Glenda Whitman Collins claims that *Volumina* adheres to sonata form, with distinguishable cluster constructions characterising the A and B sections. Glenda Whitman Collins’s analysis of *Volumina* has been summarised here.\(^\text{56}\)

\(^{56}\) The lengths of each section were calculated by myself, not Glenda Whitman Collins. These calculations are based on Ligeti’s direction that each page of the score should last 45 seconds. However,
<table>
<thead>
<tr>
<th>Section</th>
<th>Part</th>
<th>Sections</th>
<th>Length</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposition</td>
<td>A</td>
<td>1-11</td>
<td>4m15s</td>
<td>Stationary clusters</td>
</tr>
<tr>
<td>B</td>
<td>12-13</td>
<td>1m00s</td>
<td>Moving clusters, increasing pitch set, drawing manuals and increasing volume</td>
<td></td>
</tr>
<tr>
<td>A'</td>
<td>14-15</td>
<td>1m00s</td>
<td>Stationary clusters, slowly cancelling stops</td>
<td></td>
</tr>
<tr>
<td>B'</td>
<td>16-19</td>
<td>0m45s</td>
<td>Moving clusters, increasing pitch, jumping between keyboards</td>
<td></td>
</tr>
<tr>
<td>Transition</td>
<td>20-22</td>
<td>0m30s</td>
<td>Internal movement cluster, dense band, labyrinthine movement, transitions to trill</td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td>B</td>
<td>23-25</td>
<td>0m45s</td>
<td>Rapid internal movement, aperiodic changes of manual and effected different strokes</td>
</tr>
<tr>
<td></td>
<td>26-30</td>
<td>1m00s</td>
<td>Staccato clusters, at first with stationary cluster and then performed on all manuals/pedals</td>
<td></td>
</tr>
<tr>
<td>Transition</td>
<td>31-32</td>
<td>0m30s</td>
<td>Staccato clusters but stops slowly cancelled, causing a decrescendo</td>
<td></td>
</tr>
<tr>
<td>Recapitulation</td>
<td>A</td>
<td>33-34</td>
<td>0m45s</td>
<td>Static clusters</td>
</tr>
<tr>
<td>B</td>
<td>35-39</td>
<td>2m30s</td>
<td>Rapid increase in volume/manuals, dense labyrinthine movement, cuts, build from narrow cluster to thick static cluster</td>
<td></td>
</tr>
<tr>
<td>Coda</td>
<td>A</td>
<td>40</td>
<td>2m15s</td>
<td>Organ blower cut off, keys remain depressed until the air stops blowing through the organ</td>
</tr>
<tr>
<td>Silence</td>
<td></td>
<td>41</td>
<td>0m30s</td>
<td>Silence, with keys depressed</td>
</tr>
</tbody>
</table>

Table 2: The sonata form of *Volumina*\textsuperscript{57, 58} 

That Ligeti’s work can be seen to embrace a kind of sonata form is of no surprise when we consider that much of his work directly engages with the music of the past (the ternary structure of the second movement of his *Cello Concerto* (1966)\textsuperscript{59}, the micropolyphonic cannons of *Atmosphères* (1961)\textsuperscript{60}) in regards to creating form for micro- and meta- musical structures. However, it might not be accurate to contend that sonata form is the most accurate way to describe the structure of *Volumina*. 

\textsuperscript{57} Glenda Whitman Collins, “Avant-garde Techniques in the Organ Works of György Ligeti, a lecture recital, together with three recitals of selected works of J. Alain, J.S. Bach, W.A. Mozart, M. Reger, and others.” (PhD, North Texas State University, December 1980), 30.

\textsuperscript{58} A section material is generally characterised as consisting of static tone clusters, of diatonic, pentatonic or chromatic qualities. B section material is described as consisting of moving tone clusters with either static or labyrinthine internal movement.


\textsuperscript{60} Mykaayo Synytisn, “Foggy Sounds for Large Ensemble: A Study of how Timbre Affects Structure”, (Masters of Music, January 2012), 5.
Sonata form is constructed of several distinguishing characteristics, not all of which are evident in *Volumina*.

Fundamentally, sonata form has traditionally been shaped by strict tonal relationships, tonic/dominant movements and key changes. *Volumina* has no such relationships, utilising a harmony defined by tone clusters. Authors such as Glenda Whitman Collins that characterise *Volumina* as utilising sonata form, or a similar classically-informed structure, do so through equating similar and dissimilar cluster consistencies to classical harmonic relationships of the past, implying that one static tone cluster functions the same as any other, and therefore concluding that such clusters can be compared to the kinds of harmonic relationship at play in classical sonata form. This is an inaccurate application of sonata form, and in doing so we are limiting the understanding of the work through an outdated model of musical structure.\(^6\)

**OVERVIEW OF VOLUMINA**

Two key elements that help to define structure and development in *Volumina* are the level of activity in a section and the degree of roughness as a reflection of dissonance. By charting and comparing these two elements we can gain an insight into how *Volumina* functions as a piece of noise music.

The musical activity at any given point in *Volumina* can be simplified to one of eight states. From least to most active these are: static tone clusters, slowly removing notes from clusters, slowly changing a tone cluster, slow cluster movement, fast cluster movement, labyrinthine cluster movement, sparse bursts of tone clusters and frequent bursts of tone clusters. These states can be charted graphically like so:

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\(^6\) Similarly, inherent to sonata form are clearly defined sections and thematic motifs, usually reinforced by the harmonic movement mentioned earlier. Such conventions are not the focus of the musical material at play in *Volumina*, a work that centres on the idea of occupying acoustic space with, and exploring the relationships between, volumes of sound. Sections are not clearly defined to the listener, with Collins’ clearly defined sections bleeding into one another, as evidenced by the two 30 second long transitional phrases that bracket the so-called developmental section, that bleed from one structure to another. In short, while *Volumina* might display some characteristics of tertiary or sonata form, the audience does not necessarily hear it as such, nor are they intended to. For this reason, *Volumina* will be analysed without reference to such prior constructions of form.
Figure 6: Activity chart of *Volumina*\textsuperscript{62,63}

From this diagram we can see that the general level of activity in *Volumina* develops according to an arch form, with gradual changes to the shapes of the tone cluster resulting in a relatively low level of activity in the first third of the work, which is interrupted first by slow then fast cluster movements, foreshadowing the characteristics of the next section. The second third of *Volumina* is dominated by fast and labyrinthine cluster movement, while the final third is characterised by a gradual build in activity before sharply cutting to musical structures that are characterised by comparatively low levels of activity.

Using the methodology outlined earlier, we can chart the roughness in *Volumina* with relation to these changes in activity as such:

\textsuperscript{62} The black lines chart the development of activity according to the score. The red lines chart the development of activity according to the 1962 recording released on the WERGO label in 1998. Activity is charted so the seven states of activity are indicated on the y-axis while time is indicated on the x-axis (mm:ss).

\textsuperscript{63} György Ligeti, *Continuum / 10 Stücke für Bläser / Artikulation / Glissandi / Orgel Etuden / Volumina*, with Antoinette Vischer, Gerd Zacher and Karl-Erik Welin, 1998, WERGO, WER 60161-50, Compact Disc
From the roughness plot of *Volumina* we can see that three sections can be derived from this information, characterised by a gradual increase in the level of roughness before transitioning into a period of very low roughness, which signals the start of the next section. The first section lasts from 0:00 to 6:15 (figures 0-14), the second section runs from 6:15 to 9:48 (figures 15-32) and the final section runs from 9:48 to 15:15 (figures 33-41).

SECTION 1 (0:00-6:15)

The first section consists of two distinct sub-sections that are perceptually differentiated by the listener. Both subsections are characterised by gradual changes to the tone cluster and an emphasis is placed on altering the stops of the organ over static tone clusters to increase and decrease the roughness and dissonance of the sound mass. The first subsection is from 0:00 to 3:45 and consists of figures 1 to 8. The initial explosion of sound that opens the work, wherein the performer holds down every key and pedal on the organ before switching the organ on, gradually fades away and transitions into a central cluster in the middle of the organ’s manuals, utilising

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64 The blue line charts the changes in roughness, sampled every 250ms over the course of the piece. The red line indicates the average roughness over a section of activity, as illustrated in Figure 6.
slow changes in the cluster to shift the cluster construction from diatonic to chromatic. The first subsection then transitions to the second subsection with a short period of slow cluster movement.

The second subsection starts suddenly and is characterised by block-like changes to the stops that increase the register of the organ in excess of the range achieved by the manuals. This sudden increase in register causes this subsection to be clearly differentiated from the previous subsection. The amount of roughness in the sound then increases over the remainder of this subsection, peaking at the beginning of figure 14, at approx. 5:15, where the most extreme period of roughness is exhibited and slowly transitions to become less rough over the remainder of this section as a number of different stops are cancelled on the organ, creating a gradually ascending tone cluster that climbs into the upper register of the organ before being cut off abruptly.

SECTION 2 (6:15-9:48)

The transition between section one and section two is abrupt, and utilises the notable Ligeti technique of suddenly jumping from an increasing progression of higher pitches at greater volume to the same motion at a softer dynamic in the bass register. The effect is to create a sudden jump, as thought a bridging section between the high and low register was torn out of the work, perceptually marking the start of the next section via this sudden shift in musical momentum.

The second section of *Volumina* is characterised by the fast motion of tone clusters, with labyrinthine movement, and sparse and frequent bursts of tone clusters dominating the musical activity for the section. The use of cluster bursts of varying intensities is only utilised in this section, while labyrinthine movement is returned to briefly in the third section. This gives section two a distinct perceptual quality that sets it aside from the first and third sections of *Volumina*.

The transition between different musical ideas in section two is gradual, blending different musical activities together to create transitions that sound related to one another. As a result, there are no subsections evident in section two. Cluster movement in the pedals is occasionally interrupted by an approximation of the
movement on the manuals, before a stable chromatic cluster gradually transitions into a labyrinthine movement section of the same limitations. This labyrinthine movement expands and contracts in register before forming distinct gestures in Figure 25 that move between the manuals and pedals. This labyrinthine movement gradually transitions from clusters with internal movement to musical gestures that gradually increase the rate of movement and the distance between the notes that construct the internal movement of the cluster, performance instructions that transition figure 25 to figure 26, a figure that introduces the use of busts of tone clusters.

Figure 8: *Volumina* score excerpt (Figure 25)\(^\text{65}\)

Figures 26 and 27 utilise very sparse staccato tone clusters that are imposed on top of a tone cluster (initially a cluster with internal movement, then a static tone cluster, a change that occurs without a break in performance). This use of a maintained tone clusters juxtaposed with loud, sparse interjections of cluster bursts helps to soften the introduction of tone cluster bursts into the piece, the musical structure that has the possibility of being the most disruptive to the feeling of gradual development in the section. Figures 28 and 29 mark a sudden drop in register from very, very loud (fff) in

\(^{65}\) György Ligeti, “Volumina”, 15.
figure 27 to very, very soft (ppp) in figure 28. However, this change is perceived as a
continuation of this section due to the similarities between the transformed
labyrinthine movement in figure 25 and the staccato clusters of varying length in figure
28. The dynamic volume increases in figure 29 to very soft (pp) with a reduction in the
degree of staccato exhibited in the clusters, and the introduction of rapid internal
movement, including trills, tremolo and other irregularities. Figure 30 is played
similarly to figure 29, however now at the greater dynamic volume of very loud (ff),
and without internal movement. Nonetheless, due to the similarity between figure 29
and figure 30, we do not perceive this to be the start of a new section, rather the
continued development of the existing section. The short staccato cluster bursts
gradually increase in intensity, covering the entire dynamic range of the manuals and
pedals before gradually slowing down and reducing the dynamic intensity by gradually
cancelling the stops over the duration of figure 31. Figure 32 ends the section,
returning to the cluster bursts and held cluster combination from section 27, now
gradually winding down to a dynamic level of between soft and very soft (p and pp).
The held tone cluster in this section has set boundaries between the notes B and D,
the common boundaries for the tone clusters in section three, which serves to
smoothly transition between the two sections.
 Structurally, the musical activity of this section can be likened to white noise, with the activity of the organ initially creating dense bands of activity that try to occupy the space between prescribed restrictions. This activity could be seen as an approximation of a band-pass filter of white noise, before the entire range of the spectrum, such that it is achievable by the organ, is opened up for the performer. The short, frequent staccato bursts across this range seem to instruct the performer to attempt to replicate the chaos and intensity of white noise. The graphic indication itself resembles the visual ‘snow’ of white noise. Of course, inevitably the performer is unable to capture the true intensity of white noise on an acoustic instrument; the idea is only translated into an acoustic approximation. However, the sentiment appears to remain, an ideological gesture that shares similarities in the construction of music by other noise artists of the twentieth century. 

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67 It might be surprising that the degree of roughness, while reflecting an increase in perceptual dissonance in this section, does not appear to be particularly high, with the greatest amount of roughness recorded in this section still measuring below 0.05. This can be explained to be a result of the roughness“ object not accounting for the very short cluster lengths present in this section. The object compares active frequencies at a given time, while this section relies on constant changes in the clusters being performed. Inevitably there is some overlap in cluster being performed between the two manuals and the pedals which is calculated by the roughness“ object, however it stands to reason that the audience would perceive this section to be rougher than reflected here since we perceive music not just in the moment but by comparing it to the other musical gestures and languages that precede it.
SECTION 3 (9:48-15:15)

Section three comprises of four distinct subsections. The first subsection utilises the gradual addition of chromatic tone clusters between B and D, entering imperceptibly at a soft dynamic that grows softer over the duration of figure 34. This stasis is interrupted by figure 35 with the introduction of faster, more distinct chromatic tone cluster movements that utilise different stop settings on each manual, resulting in unique timbral relationships created by performing different figures at varied dynamic levels simultaneously across the manuals and pedals. Ultimately these clusters build to a loud dynamic level with the solo reeds of the organ engaged, building to a high pitched tone cluster that is suddenly replaced with a bass frequency tone cluster on the pedals: another example of Ligeti’s use of an abrupt change in register, seen earlier in *Volumina* to bridge the end of section one with the start of section two. The varied activity of figure 35 is reflected by the increase in the relative level of perceptual roughness. Figure 36 marks the start of the third subsection of the work as dense labyrinthine movement makes a return to the work, this time occupying the full range of the organ at a very, very loud dynamic (fff), creating another passage that could be considered to be the realisation of acoustic white noise.

![Figure 10: Volumina score excerpt (Figures 35 and 36)](image)

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Once again the roughness chart suggests that this subsection is less dissonant than the preceding section, a finding that can be explained by the rapid internal movement at play. The use of the entire range of the organ in this section shares similarities with the opening figure of *Volumina*, and as such it would not be unrealistic for us to project that perceived roughness of the section could be closer to between 0.15 and 0.2.

The labyrinthine movement of figure 36 grows in intensity as the performer increasingly changes between the manuals until the performer suddenly cuts to subsection four, represented by figure 37 in the score: another sustained bass cluster played with the pedals. This signifies yet another movement from a dense, noisy texture to a low stable pitch cluster.

This final subsection returns to a similar structure that marked the beginning of section two: a bass cluster in the pedals that gradually grows to a tone cluster of high pitches. The manuals join the pedals in reflecting the upward direction in pitch in figure 38, with the pedals cutting out once their reach their highest pitch content in figure 39. A tone cluster of the highest pitches on the manuals forms in the final moments of section 39, and at section 40 the organ’s blower is switched off, resulting in a gradual decrescendo as the blower slowly winds down and the wind pressure in the organ diminishes. Gradually the tone set fades away as the wind pressure dies down, adding unpredictable microtonal variation to the sound, slowly fading away to silence.

Figure 1 and figure 40 stand out as distinct musical structures in the work through their reliance on the organ as a piece of machinery in the creation of sound. Here, the resulting sound is not the result of the talents of the performer; rather the sound is necessarily a product of the organ to being switched on and off. The slow dying sound emitted from the organ that ends the work is anticlimactic, an anticlimax that is maximised through the 30 seconds of silence that ends the work. For a work that embraces excess Ligeti appears to fight against the logical expectation of a big and loud sound mass with which to end the final section and *Volumina* itself. Instead, *Volumina* finishes with a slow transition to a period of low roughness, and ultimately to no roughness at all. In keeping with our expectations of the work, one could view this to be a transition to a new section that is never realised, perhaps suggesting that the work is not over, only that it has ended.
SUMMARY

In this analysis of *Volumina*, we can see that Ligeti plays with ideas central to noise music. By analysing *Volumina* according to changes in activity and perceptual roughness we can see that *Volumina* exhibits three distinct sections that each gradually increase in perceptual roughness. Ligeti’s experiments with volumes of sound here yield noisy results, with an overall inharmonicity dominating the harmonic construction of the work, while the performer is pushed to physical extremes in the realisation of the graphic notation. Ultimately, it is the extremes of *Volumina* that help cement it as a noise work – the extremes of density, register, activity, timbre and dynamic volume – and as such the best approach to analysing *Volumina* is with respect to the relationship between these elements.
6. ANALYSIS – MERZBOW’S CANAANDA (2011)

BACKGROUND

Merzbow’s contribution to noise music is central to all other understandings of the genre. In 1982 he founded the first noise label (Lowest Music and Arts) and is credited for coining the term “Noise Composition” as a description for his music.\(^6^9\) It would be difficult to conceive of noise music without the influence of Merzbow. Due to the combination of his extensive exploration of extreme sound and his prodigious output (estimates range at between 200 and 350 individual recordings\(^7^0\)) Merzbow is the touchstone for the noise genre, wherein noise is judged in the context of being more or less like the noise of Merzbow.

Merzbow’s output has evolved over the past three decades. Merzbow’s early period (as early as 1979) is characterised by his use of analogue equipment – analogue tape loops, synthesisers, filters, delays and feedback – before embracing digital technologies in 1989\(^7^1\). This digital period ushered in a louder, harsher sound, with recordings often being mastered far above the standard.\(^7^2\) Aesthetically, Paul Hegarty summarises the differences between Merzbow’s analogue and digital music as such:

> Analogue Merzbow is mostly richer in sound and noise than the digital versions. For one thing, the liquefying stratification of the mid-1990’s goes away, as the digital stuff is more linear, and ironically, more revealing of the processes that made it. ... In Digital, Merzbow is happier for layers to stay longer, set up rhythms, even beats.\(^7^3\)

From 2000 onwards, two seemingly completely unrelated elements have defined the sound of Merzbow: the use of the laptop as his primary musical interface, and the

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\(^7^2\) Hegarty, “Noise/Music: A History”, 156.

\(^7^3\) Hegarty, “Noise/Music: A History”, 160.
thematic impact of veganism on his music. Critics have pointed to Merzbow’s incorporation of the laptop into his musical practice as a key element that has enabled him to increase the volume of his musical output, and to achieve louder and harsher sounds. From 2002, Merzbow started to become more aware of animal rights issues which prompted his involvement in organisations such as PETA and his decision to become vegan. From this period onwards, the allusion to and utilisation of field recordings of animals have started to play a role in his musical output. This ranges from his use of field recordings in albums such as *Frog* (2001) and *Animal Magnetism* (2003) to more thematic influences such *Minazo, Vol. 1* (2006) – a tribute to Minazo, an elephant seal that lived at the Tokyo Aquarium – and his *13 Japanese Birds* (2009) project – a 13 disc series recorded and released monthly over 2009, with each release named after a different Japanese bird.

The process of choosing a work to analyse from such an immense and varied discography is challenging. The track *Canaanda* was chosen from the 2011 release *Lop Lop* for a couple of reasons. Firstly, the track was released recently and as such is perhaps a fair indication as to the state of Merzbow’s recorded music now, and therefore arguably more relevant and worthy of study in the present. The second reason relates to the surrealist connotations of the title. Merzbow’s name is a manipulation of the title of Kurt Schwitters’ work ‘Merzbau’, a reflection of the role collage, surrealism and dada philosophy plays in Merzbow’s music. Loplop is the alter-ego of surrealist painter Max Ernst first realised in the 1920’s, and as such this reconnection with Merzbow’s surrealist influences – in the literary sense – made a track from the album *Lop Lop* of interest to investigate.

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TECHNIQUES

Merzbow’s work is a music of extremes: of loud volume, of spectral density and sound with a decided ‘otherness’ about it: an otherness of traditional musical forms and structure, an otherness of musical materials and an otherness of meaning, happily taunting musicologists that attempt to read too much into his sound. These factors can make an appreciation of the work difficult, as the music is inherently framed with the desire to not be understood and to give no meaning willingly. Brett Woodward comments that cultural discussion of the music of Merzbow often lacks the faculties to engage with a work beyond mere allusion.

... it is what reviewers fail to directly address, but indirectly allude to, in their work that says as much about Merzbow as about pointed reference. I believe this to be about an absence of the critical tools and language required to assess what is essentially a quantum leap forward in composition. Merzbow is incorrectly viewed as the most recent step in an avant-garde progression traceable back to the earliest decades of this century. This is flawed reasoning in the classic ‘mistaking the menu for the meal’ sense.\(^{80}\)

Woodward seems to prefer to view Merzbow’s work from a more meta-structural perspective, suggesting that the work can perhaps be best understood as a series of disconnected elements that begin to cooperate with one another as they begin to reach a critical mass.\(^{81}\) Thus, structures that emerge are fleeting and momentary, and yet inform the direction and experience of events to follow. There are some musicologists that have attempted to overcome these linguistic shortcomings in their treatment of Merzbow, and as such, recognisable features and techniques of Merzbow’s music will be summarised in this section.

One of the most recognisable elements of Merzbow’s music is the extent to which the entire audible sound spectrum is directly utilised (0 Hz-20 kHz). While acoustic instruments display audible activity in the higher frequency spectrums through the complexity of harmonics, Merzbow manufactures noise that specifically engages with higher frequencies that are more difficult to reach with acoustic instruments.

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\(^{81}\) Woodward, “Merzbook...”, 35.
Inherently this creates a majority of the ‘noisiness’ of a work as different frequencies inevitably clash with one another creating a wide-ranging dissonance, perceived by the listener as noise. The use of the entire audio spectrum is something quite unique to electronic artists, since such frequency control is difficult to achieve on an acoustic instrument. It is ultimately this increased detail of sound that makes Merzbow’s noise sound quite separate to acoustic variants.

Merzbow’s music is often characterised by interruption. Here, block-like structures come crashing in and out of the work, jarring the listening experience. This technique helps add to the ‘noise’ of the work, prohibiting the listener from growing accustomed to any repetitive element, enabling the sound to function as noise unto itself.\textsuperscript{82} Crescendos and decrescendos are almost non-existent, with structures being dropped in and out rather than building to an expected state. Similarly, tracks will often start and stop abruptly, reinforcing these block-like structures.

Repetition is an important element in understanding Merzbow’s music, with repetition and tape loops existing and often being used to create the previously mentioned block-like structures. Indeed, an economy of material has always been an element of his music, in spite of the somewhat maximalist presentation. Early works used tape loops, the physicality of such a loop ensuring a repetitive element to the material, while later works, particularly from his more recent laptop orientated works, have utilised a limited number of tones and samples.\textsuperscript{83} John Latartara makes the observation that blocks of recognisable musical material are formed by the enhancement of recognisable frequency bands.\textsuperscript{84} These block materials are an essential musical feature of the music of Merzbow and the repetition of events can point to key structural ideas that underpin the music.

Latartara observes that musical transformation is also a key compositional technique at play in the noise works of Merzbow. While Merzbow’s music is often dense it is rarely static. Aside from block-like sound objects intercutting one another, they are also superimposed upon one another, so that different frequency bands are emphasised and juxtaposed with one another throughout the work, creating new

\textsuperscript{82} Hegarty, “Noise/Music: A History”, 156.
\textsuperscript{83} Hegarty, “Noise/Music: A History”, 156.
textures from identifiable material. This notion of transformation could also be seen to extend to Merzbow’s use of filtering and pitch shifting. The use of filters throughout Merzbow’s work often seems to take the place of a lead instrument or voice, as filter sweeps (the act of moving the filter cut-off from one point in the spectrum to another) cut across a more static texture. Spectrographically we can see this technique exhibited in the following example:

![Figure 11: Example of filter-sweeps in Merzbow's Canaanda](image)

(4:26-4:36)

OVERVIEW OF CANAANOA

Canaanda begins with something rather unusual in the context of the music of Merzbow: a fade up from silence. In the Merzbow catalogue such an action is unusual, with the artist often opting to start and finish his works suddenly, dropping in and out of the abrasive sounds worlds abruptly and without a thought to continuity. The track finishes suddenly but the reverb tails of the various sounds are permitted to hang in the air, resulting in a softer take off and landing for the chaos of the track than one would otherwise expect from Merzbow.

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85 Latartara, 104.
The track itself can be divided into four sections. The first section is characterised by pitch elements that are progressively interrupted. The second section is characterised by a greater emphasis on rhythmic elements, with a sound best described as several shopping trolleys being smashed into one another acting as a percussive motif that emerges as the backbone of the entire work. The third section uses a more varied implementation of these elements, utilising percussive and pitch elements in both a free form expressive motion and through rhythmically identifiable tape loops. Finally, the fourth section is something of a coda, emphasising static filter bands and maintaining a mostly static composition for much of its duration, before exploding in the final minute.

Interruption is central to the musical development of *Canaanda*, as it is with much of Merzbow’s work, with filter bands and pitches either breaking and disrupting recognisable structures or through the superimposition of these elements onto one another to distract from a given structure. It is this variety in the approach to constructing this interruption that makes *Canaanda* worth analysing.

<table>
<thead>
<tr>
<th>Section</th>
<th>Time</th>
<th>Duration</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0:00 – 5:00</td>
<td>5m00s</td>
<td>Pitch</td>
</tr>
<tr>
<td>2</td>
<td>5:00 – 12:35</td>
<td>7m35s</td>
<td>Percussion</td>
</tr>
<tr>
<td>3</td>
<td>12:35 – 18:14</td>
<td>5m39s</td>
<td>Combination, tape loops</td>
</tr>
<tr>
<td>4</td>
<td>18:14 – 22:34</td>
<td>4m18s</td>
<td>Filter bands, little activity</td>
</tr>
</tbody>
</table>

Table 3: Form summary of *Canaanda*

SECTION 1 (0:00–5:00)

Section one begins with a slow fade up from silence over three seconds to reveal two pitch structures. A pulsing bass motif loops indefinitely at approx 53 Hz (~G#0) while a more piercing pitch attacks the listener’s critical bandwidth at approx 1868 Hz (~A#5). In the background the listener can very faintly hear the sound of the percussive hits that play a central part in the second section. The percussive bursts sit underneath the two key pitch structures and so do not act as an interruptive element; rather they can be seen to allude to the future importance this sound will play. At around the one minute mark the percussive sound is channelled through a reverb effect that causes a thick band of noise that is subsequently filtered, a technique that is used throughout
the piece to create the clearly identifiable filter-sweeps. The first band enters at around 1:31 with a central frequency of approx 2374 Hz (~D6) and drops to approx 1588 Hz (~G5) at 1:39.

![Diagram of Canaanada Section 1](image)

**Figure 12: Form diagram of Canaanada Section 1**

(0:00-5:00)  

The opening pitch structure at around 1868 Hz (~A#5) is the most stable pitch structure in the work, lasting for 2 minutes and 33 seconds without an interruption. The second pitch structure emerges at 2:38 after a five second interruption, with a pitch structure that moves between 2395 Hz and 2438 Hz (~D6 and D#6) until 4:03. In this time there are five different instances of interruption, with the tone being swept down in frequency and then back again over a duration of between one and three seconds, an instance of superimposition of pitch, with the imposition of a tone of

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86 All form diagrams are based upon spectrographic analysis of the sections in question. As such the Y-Axis represents frequency and the X-Axis represents time (mm:ss).

87 Red lines – primary pitch structures, blue lines – secondary/interrupting pitch structures, white – transitional pitch structures, grey shaded areas – filter bands, grey boxes – transitional filter bands/filter sweeps of unstable position, green shaded areas – recognizable percussive hits (green lines indicate that there is a single or identifiable percussive hit while larger shaded areas indicate that the percussive hit is manipulated to become a dense texture), yellow shaded areas/yellow boxes – recognizable spectral processing, black boxes – loud bass activity, seemingly derived from manipulating the speed and pitch of the percussive hit sample.
approx 2266 Hz (~C#6) at 3:26, and an instance of octave displacement (of sorts) with the pitch structure being shifted down to approx 1189 (D5) for four seconds at 3:54.

Another five-second interruption breaks up the second pitch structure from the third, a pitch cluster of three sequential tones of approx 678 Hz (~E4), 635 Hz (~D#4) and 565 Hz (~C#4). While the transition from one tone to another is achieved via interruption, each tone itself is interrupted only through the imposition of additional tones, with tones of approx 2481 Hz (~D#6) and 1378 Hz (~F5) imposed over the 678 Hz (~E4) tone, and a tone of approx 1555 Hz (~G5) imposed over the 565 Hz (~C#4) tone.

The interaction of these pitch elements in the first section are at the forefront of the listeners awareness of musical activity. A similarly important shift occurs at 3:23 where the pulsing bass shifts suddenly to an approx 53 Hz (~G#0) pitch to an approx 59 Hz (~A#0) pitch. This use of an A# pitch could be seen as related to the 1868 Hz (~A#5) pitch that is so prominent at the beginning of the work. As we will see in the next section this bass throb becomes an important continuity with which the listener uses to gauge the degree of activity present in the music.

Merzbow’s use of filtered noise in the first section, as in much of the work, appears to fulfil a more expressive component of the composition. The filters experience significantly more interruption than the pitch content of the first section. This constant motion suggests that the use of filtered noise acts as a kind of improvised lead-instrument. The filtered noise wraps around the pitch content, occasionally filtering sharply enough to generate clearly discernable tones, with much of the stable filtering activity occurring around approximately the 2417-2567 Hz area of the spectrum. In this way, the filtered noise creates a sense of counterpoint against the manipulation of pitch content.

SECTION 2 (5:00-12:35)

At the five-minute mark the walls of noise and the squealing pitches disappear to reveal the low bass pulse of approx 59 Hz (~A#0) that was introduced about halfway through section one. This sudden shift in mood signifies the start of section two. Narrowly filtered noise results in thick-sound pitch squeals, which act to transition us
into the first percussive hit at 5:10. From here, the musical development is generated through the intercutting of the pulsing bass with different lengths, hits and articulations of the percussive hits throughout the section. This use of these limited sound materials results in a listening experience that is repetitive in sound quality yet engaging in terms of the interaction. The amount of space between hits decreases, with larger blocks of hit material appearing as the work progresses over the next two minutes and twenty seconds. An interruption appears in the superimposition of a tone at approximately 441 Hz (~A3), the result of finely filtering the sounds of many percussive hits, until the first tape loop of the work appears (with each cycle lasting around 2.4 seconds), a high pitched fluttering of spectrally processed sound that enters at 7:20. At 7:45, a reverb effect is added to the percussive hits which creates a mess of texture that evolves as hits are triggered closer and closer together, with more interaction between each hit as important partials remain active for longer.  

![Form diagram of Canaanda Section 2](5:00-10:00)

As the percussive hits become less discernable from one another the previously easily discernable sounds become another noisy texture, which in turn is filtered. Until 10:00, the filter sweeps of section 2 are more reserved, maintaining a steady bandwidth that is changed and shaped with sudden changes and without the transitional gestures that characterised filter activity previously. Most prominent is a large filter band active
from 8:20 until 9:04, with a centre frequency of around 2050 Hz, which then shifts to a higher, more narrow band from 9:04 until 9:11 at around 2363 Hz and a lower narrow band at 9:11 until 9:19 at around 436 Hz. These blocks of filter bands continue at 9:24, with a band with a centre frequency of around 1216 Hz being subtly shaped and shifted until 9:49, after which lower and higher frequency blocks of sound are statically maintained before shifting to a new position. These static blocks of frequencies, drawn from the manipulation of the percussive hits that characterise the section, are contrasted to the more active filter manipulations of section 1, resulting in more of a block-like movement of musical material than the sharp development and motion of the earlier section.

This stasis is interrupted briefly from 10:00 until 10:24, as the active filter interruptions are reprised with sweeps of very low frequencies very quickly, after two clear pitch interruptions occur at approx 2180 Hz (~C#6) and 2158 Hz (~C#6) respectively. This activity is a burst in surface-level activity as the percussive hits fall further into the background of the work, before the static filter bands return once more with a filter band with a centre frequency of approx 1141 Hz lasting from 10:24 until 11:40. This filter band is interrupted only once by the superimposition of a tone of approx 317 Hz (~D#3) from 10:45 until 10:50.
The texture of the percussive hits promptly drops out at 11:57, once again creating a sense of space, wherein the spectral loop and pulsing bass can be heard clearly for the first time until 12:13. At this point the percussive hits enter once more, returning to their clearly articulated form.

There are two distinct sound activities occurring in the bass register in section two. The first occurs at 7:59 and lasting until 8:07 and the second at 12:21 and lasting until 12:26. The first event fills much of the bass spectrum up until approx 129 Hz, while the second fills much of the bass spectrum up until approx 183 Hz. These two events appear to be the result of slowing down the percussive hit sound and filtering up many of the upper partials, resulting in a low-pitched sound mass. These two bass events act as two separate interruptions, with the first interrupting the texture of the dense, meshed sound of the percussive hits processed through reverb, while the second interruption disrupting the return to the clearly articulated percussive hits, throwing off the listeners expectations of what will come next.
SECTION 3 (12:35-18:14)

In section three the distinguishing characteristics of the first two sections are expanded upon and processed into more complex forms. The distinguishing musical feature from 12:35 until 16:28 is the use of tape loops, with a fluttering noise motif lasting this full duration, cycling in loops of 2.4 seconds. From 12:35 until 12:53, the percussive hits are triggered in a rhythmic fashion, with a hit occurring every two seconds. At 12:53 a different percussive hit is introduced for the first time, combining with the more familiar percussive hit to form a tape loop of 2.4 seconds that is maintained until 13:29. The percussive hits are again filtered and processed creating a band of noise with a centre frequency of approx 1415 Hz, which gradually transforms into a discernable pitch of 1458 Hz (~F#5). Lasting from 13:48 until 14:04, this tone is paired with another tone of approx 192 Hz (~G#2) that lasts from 13:53 until 14:07. Ignoring the differences in register, these two pitches present the boundaries of the two following pitch structures, the tone-and-a-half range between F# and G#.

Figure 15: Form diagram of Canaanda Section 3
The next two pitch structures introduce the use of glissando pitches, with the entire range of frequencies ranging between F# and G#. The first pitch structure is a slow slide between approx 403 Hz (~G3) and 382 Hz (~G3) and lasts from 14:10 until 14:45. The second pitch structure slides from approx 780 Hz (~G#4) to 753 Hz (F#4) and back up to 764 Hz (~G4) from 14:48 until 15:26.

This second pitch structure is underpinned by the superimposition of additional pitches and filter bands occurring at lower frequencies. A frequency band with a central frequency of approx 549 Hz is interrupted by tones of approx 453 Hz (~A3) and 312 Hz (~D#3), lasting 6 and 6.8 seconds respectively. From 15:46 until 16:02 we enter a highly unstable state, with two pitches of approx 511 Hz (~C4) and 252 Hz (~B3) entering a disruptive state for 12 seconds (15:50 until 16:02), which helps to prepare the listener for the next structure beginning at 16:02.

16:02 marks the start of a long upward glissando in pitch from approx 1792 Hz (~A5) to 1878 Hz (~A#5) that lasts just over a minute and a half, one of the longer pitch structures in the work, lasting from 16:02 until 17:38. The pitch structure is bookended by filtered percussive hits with a centre frequency of approx 2029 Hz. The centre of this pitch structure, from 16:21 until 17:12, is a complex pitch-based counterpoint of sorts, with the imposition of very short tones, mostly with duration of one second or less, although some longer tones are introduced towards the end of this passage, and repetitive and recognisable frequencies. The first half of this passage utilises three discernable pitches of approx 1981 Hz (~B5), 2223 Hz (~C#6) and 2293 Hz (~D6). At 16:47 a tone of approx 1943 Hz (~B5) is introduced into the sequence, and finally at 17:08 a tone of approx 1771 Hz (~A5) is added, the only tone in the sequence that is lower than the larger pitch structure it is interrupting. This superimposed tone lasts only a second and yet due to its relationship to the start of this pitch structure, with a 21 Hz difference in tone and a comparable equal tempered pitch of A5, this tone briefly interrupts the perception two clearly discernable pitch structures, and informs the listener to listen to the degree of change that has occurred from the beginning of the glissando pitch until 17:08. At the end of this pitch structure there is another extended period of instability lasting from 17:38 until 18:10.
At around 17:12 the repetitive bass pulse of approx 59 Hz (~A#0) transforms into a wider band of rumbling bass noise, occupying much of the spectrum between approx 10 Hz and 102 Hz. The dissolution of this bass pulse, until this point a repetitive constant in the work, helps to push the other pitch and frequency band activity further into the foreground, while increasing the intensity of the sound in the bass register.

SECTION 4 (18:14-22:34)

Section four is a return to a more static feel, utilising longer passages of static texture with little interruption. A pitch structure of approx 419 Hz (~G3) becomes gradually discernable over the later half of the transition, solidifying at 18:10 and lasting for three seconds. From this point on there are comparatively few pitch structures at play, with 18:13 until 20:58 completely free of any clearly discernable pitch elements. This passage is notable for being the most prolonged passage of static texture in the work, with some initial percussive hits fading into the mid ground as a static frequency band of approx 2018 Hz, entering at 9:13 until 20:55, occupies the foreground and remains uninterrupted (aside from the occasional percussive hit) for its duration.

Figure 16: Form diagram of Canamanda Section 3 and 4
(18:00-22:34)
The final pitch structure for the piece begins at 20:58, with the sequential movement of two tones approx 516 Hz (~C4) and 1571 Hz (~G5). The lack of any transitional interruptions indicates that these pitch structures are generated from a continuous tone that is shifted sharply to from one location to another. This pitch structure is sharply interrupted by a filter band with a centre frequency of approx 1238 Hz that is performed at the same time as the 59 Hz (~A#0) bass pulse returns. From 21:35 the work returns to the chaos of earlier sections, utilising a filter band with a centre frequency of approx 2142 Hz that is sharply interrupted with full spectrum filter sweeps, resulting in a large degree of interruption to the stasis of filter band. Percussive hits processed with reverb make another appearance from 22:04 until 22:18 before the bass pulse fades out at 22:30, the filter band is cut off sharply at 22:33, leaving a one second reverb tail.

SUMMARY

The music of Merzbow hinges around temporary structures, relationships between sound objects in space that collide and interact with one another. Interruption is central to an understanding of the music, as concepts of tension and resolution are replaced with activity and stasis. Merzbow constructs four distinct, musical sections through his use of distinct sound objects, including pitch structures, filtered noise, percussive effects, tape loops, and timbral clouds of sound, that develop over the course of the work. The relationships between these sound objects however, are often transitionary, creating activity on different perceptual levels that fold away to other states through the use of interruption and superimposition.
7. CONCLUSION

The Twentieth Century has heralded a vast amount of discussion pertaining to the definition, function and value of noise in music. Noise can be perceived as many different elements: it is a perception of dissonance, it harbors political meaning, it is a cognitive process, but ultimately noise is an otherness, it is something that a listener feels, a label for musical sound that doesn’t fit in with the conventional musical code. This discussion has opened up new possibilities of sound for composers to explore but it has also managed to derail discussion pertaining to the musicality of noise music.

This thesis has sought to investigate how two examples of noise music function musically, to analyse what it is about these pieces that make us listen to them as music, not just as sound. The examples chosen – Ligeti’s Volumina and Merzbow’s Canaanda – reflect two different kinds of noise music.

Volumina is an acoustic noise work, performed on an acoustic instrument (albeit powered by electricity). From an analysis of changes in activity and perceptual roughness, we are able to derive a formal structure consisting of three distinct sections, consisting of various subsections. We are able to view the work as not merely reflecting a vague sonata form but rather consisting of its own distinctive form, with each section exhibiting a gradual increase in perceptual roughness over time, before resolving to a lower state of roughness in the next section.

Canaanda is constructed in the digital environment with sounds produced by electronic processing and manipulation, and performed electronically using a laptop and other electronic equipment. By analysing complex spectrographs and translating this analysis into simpler form diagrams we are able to highlight the sound structures that help shape the four distinct sections of Canaanda, while simultaneously describing the temporary sound structures that help to characterise the sound and feel of the work.

However, these two works are only a small sample of the overall noise genre, and reflect only a portion of what noise music is and means. The methodology used here could, in the future, be applied to artists that engage with other ideas of noise,
particularly of a political and cultural ideology, and interest could be paid to the similarities and differences between different cultures of noise music.

Ultimately, these examples show us is that noise music is still, at its essence, music. Noise music engages with concrete ideas of musicality, albeit in a language more appropriate to the genre and in a style more open to experimentation and variation. By analysing these works with a variety of techniques – charting the levels of perceptual roughness, spectrographic analysis and graphically representing changes in the activity form of a work – these languages can be made visible, and a more musically appreciative reading of the work can take place.
8. REFERENCES


