PORTFOLIO OF COMPOSITIONS

by

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ABSTRACT

This is a portfolio of thirteen compositions composed at Maynooth University during the period of March 2015 – July 2018.

The portfolio's main focal point is to bring together two diverse strands of musical influence; spectralism and minimalism. The portfolio explores the multiple manners in which these two can be merged together in order to promote the confluence of the two compositional approaches. It is important to note that whilst this is the main focus, other salient influences are apparent in the pieces.

This thesis explains the importance of each piece and its role in the portfolio, while also illustrating the methodology that was applied in the pieces.

ACKNOWLEDGEMENTS

This would not be possible without the support of my parents Helen and John O'Kelly. Expressing gratitude does not seem to compare to the huge contribution that they have made.

I would also like to thank my supervisor Dr. Ryan Molloy for the countless hours of guidance and tuition he has offered since my research began in March 2015.

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LIST OF WORKS

Title	Instrumentation	Duration
I-V: A Series of Spectra-Minimal Miniatures	Horn , Violin, Piano	**Circa 7'40"**
Vacuum Spazio Puro	Flute, Bass Clarinet, Piano, Violin, Cello	**Circa 7'30"**
Tree of Smoke	Solo Organ	**Circa 8'30"**
Flies On Butter	Violin, Viola, Cello, Double Bass	**Circa 5'00"**
You'll Only Make Matter Worse	Soprano	**Circa 3'00"**
Bolt the Cabin Fever	Crash Ensemble (See Score for more details)	**Circa 8'00"**
Pool Pieces	Electric Guitar, Violins (2) and Cello	**Circa 3'00"**
Sous L'Eau	Electric Guitars (2) and Electric Bass	**Circa 7'50"**
South-Bound Chug	Brass Quintet and Drum Kit	**Circa 7'20"**
Freedom Tunnel Portrait	Percussion Duo	**Circa 5'10"**
The Memory Void	Piano and Tape	**Circa 5'20"**
Zonnewegel 25	Electric Guitar Duo	**Circa 4'20"**
Subharmonic Homesick Blues	Orchestra (See score for more details)	**Circa 11'00"**
	Total:	***Circa 83'40"***

Fig. 1: Table of pieces, instrumentation and duration

INTRODUCTION

Minimalism and spectralism were both reactions to the straitjacket created by serialist complexity. Minimalism rejected such complexity by focussing on a return to consonant harmony, steady pulses, drones, stasis or gradual transformation through the repetition of musical phrases. The spectral approach, on the other hand, rejected serialist complexity with what many would consider as a complexity of its own; focussing on manipulating the features identified through sonographic representations and mathematical analysis of sound spectra, as well as the mechanisms of aural perception[1]. Minimalism and spectralism are very different compositional aesthetics and the resulting works cannot be readily compared, but they do share some traits in common; one being that they both emphasize the need to return to the building blocks of music. Another common trait is that both minimalism and spectralism have greatly developed from their original forms and, with the increasingly pluralist nature of new music, their traces can be found in a huge amount of late 20th and 21st century musical art forms.

With time, minimalism and spectralism have both neutralised their materials in order to make their forms transparent[2]. The spectral composer Gérard Grisey maintained that "*Spectralism is not a system… like serial music or even tonal music. It's an attitude (…)*" Grisey insisted that the basic unit of music should be the sound, not the note on the page[3]. The spectra are only one aspect of the "*attitude*" that Grisey described and do not necessarily interest the composers who work with spectral techniques[4]. This neutrality of material is an aspect shared

[1] **Hasegawa, R.** (2009) Gérard Grisey and The 'Nature' of Harmony. *Music Analysis* (online). Vol. 28, No. 2/3 (pp. 349-371) Available at: https://onlinelibrary.wiley.com/doi/full/10.1111/j.1468-2249.2011.00294.x, first accessed on 09/12/2014

[2] **Hamilton, A.** (2003) The Primer: Spectral Composition. *The Wire* (online) Issue 237, November 2003, Available at: https://www.dur.ac.uk/philosophy/staff/?mode=pdetail&id=512&pdetail=47590, first accessed on 09/12/2014.

[3] **Ibid.**

[4] **Hurel, P.** (2007-2010) Spectral music: long-term perspectives. *Philippe Hurel* (online) Available at: http://www.philippe-hurel.fr/en/musique_spectrale.html, first accessed on 09/12/2014.

by minimalist composers[5]. For composers such as Steve Reich, Terry Riley, or Philip Glass, minimalism refers to the attempt to spin out a rich, immersive web of sound through the repetitive proliferation of simple musical gestures. Though built from basic units, the resulting music is meant to be more than the sum of its parts; this act of elemental reduction made possible a new, lush sound that was, in sensual terms, anything but "minimalist"[6]. And so, with neutralisation of form, an obscurity is brought into play when considering a potential merging of minimalism and spectralism. A clear understanding of their original principles is required, as well as an acknowledgment that they both developed into something new.

There is a range of composers today still greatly influenced by minimalism and spectralism including William Basinski, Magnus Lindberg and Kaija Saariaho; however the majority of composers focus on one or the other. It is important to note that even though spectralism and minimalism have been around for a long time, there has been little research in the combination of these two approaches to the foundations of music. One of the composers to have used the joining of spectral and minimal techniques to create innovative and fresh compositions is Irish composer Donnacha Dennehy. Dennehy's pieces such as *Stainless Staining* (2007) for piano and soundtrack and *Overstrung* (2010) for violin and soundtrack are based upon the harmonic series and overtone-based harmony, the pitches of which are often pulsed and repeated in a minimalistic nature. Whilst studying under Dennehy's tutelage during my M.Phil, I was inspired to research the issue. I composed a piece entitled "*Channel 59"* based on the harmonic series with a fundamental of 'G', which was subsequently performed by Luxembourg's Lucilin Ensemble. The acoustic material, a series of long held overtones played by violin, viola, cello and B-flat clarinet, was inspired by the spectral music

[5] **Hurel, P.** (2007-2010) Spectral music: long-term perspectives. *Philippe Hurel* (online) Available at: http://www.philippe-hurel.fr/en/musique_spectrale.html, first accessed on 09/12/2014.
[6] **Patteson, T.** (2011) Less is less: The minimal music of Morton Feldman. *American Sublime Article* (online) Posted 21/09/2011, Available at: http://www.thomaspatteson.com/uploads/7/3/8/8/7388316/less_is_less_-_morton_feldmans_minimalism.pdf, first accessed on 05/12/2014.

of James Tenney. The electronic material, a perfect fifth looped on an electric guitar pedal, echoed La Monte Young's "*Composition 1960 #7*". The composition was well received and as a result I felt inspired to research other ways to marry my spectral and minimal influences in order to create original pieces.

OVERVIEW

This commentary begins with a discussion of some of the compositional practices I have applied throughout the portfolio before discussing each individual piece in chronological order.

In conjunction with an explication of the methodology behind each piece, I hope this commentary offers a clear portrayal of my research, its trajectory throughout the doctoral project, and the development of my compositional language over the past three years.

The pitch nomenclature that is used throughout the thesis is scientific pitch notation (SPN), which is also known as American standard pitch notation (ASPN).

A) COMPOSITIONAL PRACTICE

1) The Irish Composers Collective

The Irish Composers' Collective (ICC) was founded in 2003 and is a non-profit organisation dedicated to providing Irish composers with a community for information, education and the pooling of resources, all in order to put on concerts of their music with professional musicians[7].

I became a member of The Irish Composers' Collective in 2015 and my involvement since then has greatly aided my research and my development as a composer. Whenever I received the opportunity to compose a piece for a concert, I planned that the piece would be for the portfolio. The ICC concerts offered multiple workshops and followed strict score submission deadlines, which provided a schedule and a structure for my research. It also allowed for testing of material, and guarantees of performances – all important developmental opportunities for a fledgling professional composer.

It was of central importance to my research that pieces were workshopped and performed: these opportunities offered an insight into the strengths and weaknesses of my work and afforded considerable space for reflection and subsequent development. If there was one particular moment in a piece which I believed deserved more attention, I would develop on that idea in my next piece. The recycling of material (and inherent recognition of potentialities) proved to be an imperative compositional technique throughout the development of my research. The performances also offered an insight into the interesting instrumental combinations frequently offered by the ICC, which in turn often influenced my choice of instrumentation for my next composition.

[7] Irish Composers Collective (2018) *What We Do – Irish Composers Collective* (online). Available at: http://irishcomposerscollective.com/about/ (accessed August 2018).

2) Audio Software and Spectral Analysis

The software packages that I relied on for my research are Audacity, Garage Band, Pro Tools, Open Music and SPEAR.

It is important to note that whenever I used these software packages as recording applications, I used a H6 Zoom microphone to record the signal. A H6 Zoom microphone is a portable 6-track audio recorder. It allowed me to record various sounds in high definition, which I would later analyse.

The audio editing functions on Garage Band and Pro Tools were beneficial to my research. For instance, I used them to create the entire tape part for *The Memory Void* (as can be seen in Chapter V (p. 78)).

SPEAR is an application for audio analysis, editing and synthesis[8]. The analysis procedure (which is based on the traditional McAulay-Quatieri technique) attempts to represent a sound with many individual sinusoidal tracks (partials), each corresponding to a single sinusoidal wave with time varying frequency and amplitude. Hundreds of simultaneous partials can be synthesized in real-time and documents may contain thousands of individual partials dispersed in time. The majority of audio software has a fast Fourier transform (FFT) function but I decided to choose SPEAR in particular because I felt the spectrograms it produced were more readily analysed.

SPEAR provided me with the tools to carry out my own spectral analysis. The pitch material of my pieces was often informed by the sonographic representations of sound spectra, made possible by this particular software. Some composers may find Audacity and SPEAR to be limited and primitive, but they were sufficient for my requirements, being more than

[8] SPEAR (2018) *SPEAR Homepage* (online). Available at: http://www.klingbeil.com/spear/ (accessed August 2018).

powerful enough to comfortably handle the level of analysis and synthesis of complex sounds I was working with.

3) Calculators and Converters

In my compositional practice, there is a strong reliance on number games and algorithms. Since a large portion of my research is based on taking influence from spectral techniques there was always going to be the need for a frequency-to-musical-note converter. For instance, in some of the portfolio's compositions I am interested in the addition and subtraction of two frequencies to generate new ones. Frequency-to-musical-note converters are available on certain audio software but I decided that I wanted to use The University of New South Wales's converter which can be accessed for free online[9]. This converter provided me with a quick and easy way of accessing the new pitches I had created, down to the cent.

Certain parts of my research were always going to rely on calculating the harmonic and subharmonic series of certain pitches. Many of the compositions presented in this portfolio rely on the use of a 'Harmonic Calculator' spread sheet in order to quickly access the overtones and undertones of specific pitches. The calculator I used was designed by Douglas Woodrow and can also be accessed for free online through Rife Technologies[10].

[9] The University New South Wales School of Physics (2001) *Frequency to Musical Note Converter* (online). Available at: https://newt.phys.unsw.edu.au/music/note/ (accessed June 2015 – August 2018).

[10] Rife Technologies *Spread Sheet Calculators* (online). Available at: http://www.rifetechnologies.com/calcul.html (accessed June 2015 - August 2018).

B) Pieces

CHAPTER I - Initial Forays

1) 'I-V: A Series of Spectra-Minimal Miniatures'

1.1 A Starting Point

These miniatures were all composed between June 29th and July 8th, 2015, as part of the 2015 Irish Composition Summer School. During the course, the miniatures were reviewed by composers Kevin O'Connell, Nicola LeFanu and Sadie Harrison; the miniatures were also workshopped and recorded by the Clarion Horn Trio on the final day of the Summer School.

The five miniatures are all based on the harmonic series of C. In exploring my interest in spectral techniques, it made some sense for me to begin with the most basic of spectral features: the harmonic series. I had been listening to a broad range of Terry Riley's work at the time and the focus on C was in reference to his most famous work, *In C*.

1.2 The Harmonic Series

The opening miniature (*I+V*) is repeated at the end of the piece, giving the piece a chordal opening and conclusion. This chordal miniature focuses on transposing the higher partials of the series to a much lower register, and having the lower partials of the series moved up onto a higher one. The fundamental C is played as an octave in the left-hand of the piano (see b. 1 of the score) in order for every other note that follows it to be effectively interpreted in terms of that C. It is important to note that the ambition of *I-V: A Series of Spectra-Minimal Miniatures* is not to mask the fundamental, but to play with the order of the series.

The melodic material on the horn in this miniature can be perceived as being grouped into two groups of five bars. The horn's melody bb. 6-10 is almost a perfect retrograde of the

material bb. 1-5. Retrograde is a prominent technique in twelve-tone serialism, a method of composition both minimalists and spectralists were reacting against. My inaccurate portrayal of the technique in the opening stages of the portfolio is intentional and should be perceived as a form of pastiche.

The second and fourth (*II* and *IV*) miniatures are built around a jumping piano line, harmonic glissandos and fast minimal patterns. These miniatures make up the fast material of the collection, resulting in an overall structure of alternating slow and fast movements. These miniatures play an integral role in both the unravelling and entangling of the harmonic series as the partials begin to appear in (*II*) and disappear from (*IV*) their correct register. It is for that reason that miniatures *II* and *IV* can be considered as having a transitionary role.

The third miniature displays the series in its clearest form in three small sketches; *IIIabc*. *IIIa* focuses on the justly intoned nature of the series and the necessity of using microtones to accurately represent overtones in the harmonic series. The horn and violin slide in and out of equal temperament whilst the piano provides clusters in its upper register. This use of *glissandi* was recommended by Nicola LeFanu at the opening workshop as a clever way to make sure the performers would play the quarter-tones at the correct pitch. In a similar vein, the G4 on the violin at the beginning of *IIIa* works as a reference pitch from which the horn player can tune their opening B three-quarter flat.

Kevin O'Connell, my tutor for the week, mentioned that an abundant use of quarter-tones in the context of a workshop could potentially hinder the level of performance of a piece, as the performers had only a certain amount of time to prepare the material. It is for this reason I chose to avoid otherwise necessary eighth-tones. The quarter-tone equal temperament (24-tET) employed was sufficient for my purposes in this piece: the ear analyses structures based upon their frequency structure, hearing past the 24-tET to comprehend the underlying

frequency structure whenever the approximation is within tolerable limits[11]. To elaborate, quarter-tones were approximate enough for the harmonic series to be heard, or at least intimated and understood as such.

The piano material in *IIIb* is made up solely of a low, 'droning' C1, with the addition of harmonics on this note to underline the overt connection of the surrounding material to the harmonic series.

IIIc closes the central miniature with a very clear statement of the harmonic series through piano arpeggios. However, the horn line plays around with these partials via registral displacement. For instance, the long held quarter flat A4 (13^{th} overtone) is transposed down an octave. This transposition was intentionally implemented to foreshadow the inappropriate register use of the partials that follows in miniature *IV*.

1.3 Research Factor

I –V: A series of Spectra-Minimal Miniatures combines spectral and minimal influences in a simple fashion but for me the result represented a strong springboard for my research. Miniatures *II* and *IV* offer the most evident portrayal of these two influences, the rhythmic and disjunct piano line against the slower horn and violin lines creates a texture reminiscent of Steve Reich's musical language in *Eight Lines* (1979). The syncopated piano ostinato accompanied by long held violin notes which opens this work has always fascinated me.

The coupling of the harmonic series and these Reich-like textures acknowledges the works of Donnacha Dennehy, in particular *Stainless Staining* (2007) for piano and soundtrack as mentioned in the introduction of this thesis. The soundtrack of *Stainless Staining* is made up of samples of a piano (played normally and from "inside") retuned to provide a massive

[11] **Fineberg, J**. (2000) Guide to the Basic Techniques and Concepts of Spectral Music. *Contemporary Music Review*, Vol. 19, Part 2, p.84.

harmonic spectrum of 100 overtones based on a low fundamental G sharp[12]. I wished to begin my research by developing personal compositional responses to some techniques which have already been explored and so I decided to offer my own portrayal of Dennehy's approach in the first piece.

The miniature I was most content with was *III*. The droning low C of *IIIb* being played inside the piano was evocative of Grisey's words that the basic unit of music should be the sound, not the note on the page[13]. The entire passage is built from repeated Cs but the resulting soundworld intrigued me and I believe it maintains interest throughout this movement.

The microtonal language of *IIIa* is also effective as it offers an interesting harmonic contrast with the equal tempered piano chords. I felt encouraged to further explore this interesting contrast between microtonal melodies on stringed instruments alongside equal tempered piano chords in my next piece, *Vacuum Spazio Puro*.

As a collection, the miniatures offer an insight into how minimal and spectral influenced miniatures can work well alongside one another as a group. I decided to begin my research in this manner, departing on the same aesthetic pathway as the first spectralists and minimalists did, by focusing on the building blocks of music.

[12] **Dennehy, D.** (2007) Programme Note, *Stainless Staining* (online). Available at: http://www.musicsalesclassical.com/composer/work/56544, first accessed October 2018. G Schirmer Inc (Music Score)

[13] **Hamilton, A.** (2003) The Primer: Spectral Composition. The Wire (online) Issue 237, November 2003, Available at: https://www.dur.ac.uk/philosophy/staff/?mode=pdetail&id=512&pdetail=47590, first accessed on 09/12/2014.

2) Vacuum Spazio Puro

2.1 Background

Vacuum Spazio Puro is inspired by the installation of the same name by Italian artist Marco La Rosa. The work inspired me as I felt the aesthetics resonated with certain characteristics of my own music. La Rosa has stated that in his work there "*coexists the common elements that every time re-emerge in different ways in different times* (...)"[14]. I believe this quote echoes the aesthetics of minimal music. For instance, Steve Reich's music focusses largely on the use of repetitions and their gradual development over the course of time. I felt there was a mutual artistic interest between La Rosa and myself which was too strong to ignore, and it was for that reason I chose to compose a piece directly in response to one of his works.

In research terms, I felt encouraged to take on board a new spectral technique as I was content with how the use of the harmonic series turned out in *I-V: A Series of Spectra-Minimal Miniatures*. The most natural step of progression was to further explore the possibilities the harmonic series has to offer. I decided to explore the spectral technique of moving from harmonicity to inharmonicity in the context of my own research. The technique is associated with French composer Gérard Grisey and is deployed to great effect in one of his most famous pieces, *Partiels* (1975). Following on from the 'homage' approach adopted in my horn trio (in that case, to Donnacha Dennehy), I wanted to use the inharmonic spectrum arising from Jonathan Harvey's analysis of Winchester Cathedral's bell and employed in his seminal 1980 work *Mortuos Plango, Vivos Voco*, a piece I was captivated by at the time of writing *Vacuum Spazio Puro*. This audible change from harmonicity to the

[14] Dedalo Ensemble (2015) *Dedalo Ensemble – Call for Scores 2015 Marco La Rosa* (online). Available at: https://www.dedaloensemble.it/it/rassegne/call-for-scores/180-call-for-scores-2015-marco-la-rosa.html (accessed August 2018).

inharmonicity plays a significant role in describing La Rosa's work, as it in turn pays homage to the fundamental "*crossing border*" aspect of his art[15].

The piece was workshopped by the *Hard Rain Soloist Ensemble* during a visit to Maynooth University on the 30th of March 2017.

2.2 Structure

Vacuum Spazio Puro begins in a very similar nature to miniatures *II* and *IV* of *I-V: A Series of Spectra-minimal Miniatures*. Since miniatures *II* and *IV* offered the most evident portrayal of my spectral and minimal influences, I felt encouraged to explore similar figures in the context of a longer piece written for a larger ensemble. The opening 36 bars are all based on the C harmonic series and are coupled with an *Eight Lines*-inspired musical language.

The metrical structure found in bb.1-36 of *Vacuum Spazio Puro* is repeated through bb. 73-108 and directly reflects the layout of the installation, as can be seen in Figure 2 below:

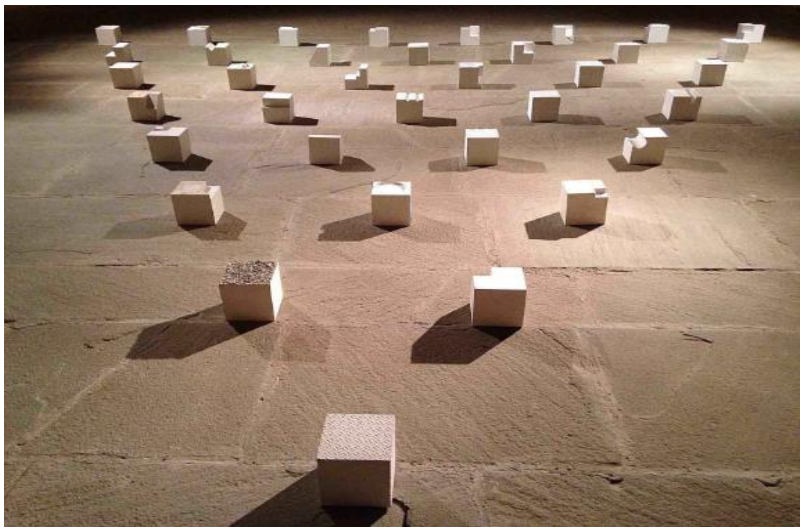

Fig. 2: Photograph of Marco LaRosa's installation *Vacuum Spazio Puro*

[15] Dedalo Ensemble (2015) *Dedalo Ensemble – Call for Scores 2015 Marco La Rosa* (online). Available at: https://www.dedaloensemble.it/it/rassegne/call-for-scores/180-call-for-scores-2015-marco-la-rosa.html (accessed August 2018).

In a direct representation of how the installation is laid out numerically, the time signatures progress from one bar of 1/4 to two bars of 2/4 to three bars of 3/4 and so on. These gradual changes in time signatures also mirror the "*different times*"[16] La Rosa speaks of. It is also important to note that these given structures occur during the moments of harmonicity in the piece. As the music progresses during these passages, our audible perception of the C harmonic series gradually changes. This is managed by slowly introducing the higher partials of the spectrum at lower registers, offering the re-emergence of common elements but once again, also taking into consideration the different ways in which they can be repeated.

2.3 From harmonicity to inharmonicity

As stated earlier on, *Vacuum Spazio Puro*'s main focus is the transition from harmonicity to inharmonicity and vice versa. In Grisey's *Partiels*, the move from harmonicity to inharmonicity happens gradually with time as he introduces some inharmonic components to unsettle the initial timbre (the attack of a low E2 on a trombone)[17]. I wanted to apply the technique in a different way to Grisey. Rather than slowly introduce the inharmonic components of the inharmonic spectrum, I decided to have a decisive moment in the score where the music moved from harmonicity to inharmonicity. In order for this decisive moment to happen convincingly and in a way that I felt suited the direction of the composition, I needed to choose an inharmonic spectrum that was similar to the chosen harmonic series. It is for that reason that I decided to use Harvey's inharmonic spectrum from *Mortuos Plango, Vivos Voco*. As can be seen from looking at Figure 3 on the next page, it is easy to see the common elements between Harvey's analysis and the C harmonic series, as C also plays an integral role in the tenor bell's sound.

[16] Dedalo Ensemble (2015) Dedalo Ensemble – Call for Scores 2015 Marco La Rosa (online). Available at: https://www.dedaloensemble.it/it/rassegne/call-for-scores/180-call-for-scores-2015-marco-la-rosa.html (accessed August 2018).

[17] **Rose, F.** (Summer, 1996) Introduction to the Pitch Organization of French Spectral Music. *Perspectives of New Music*, Vol. 34, No. 2, p. 9.

Fig. 3: Spectrum of the Winchester Cathedral tenor bell as analysed by Jonathan Harvey using FFT for his piece *Mortuos Plango, Vivos Voco* (1980)[18]

The bell's spectrum, though on C, contains F harmonic series partials which, in the words of Michael Downes, results in a "curiously thrilling and disturbing effect"[19]. The move from harmonicity to inharmonicity takes place for the first time at b. 37, at the beginning of the section marked 'Spacious', and reoccurs at b. 133.

It is important to note that I chose to play with the appropriate register of both the partials of the C harmonic series and of Harvey's analysis. The C quarter-sharps that can be perceived in Figure 3 interested me in particular as they offered a subtle change from the C harmonic series. I decided to transpose the C quarter-sharps down into the lower register to accentuate the slight change in intonation. In the opening bars of both of these inharmonic passages, the C quarter-sharp appears on the bass clarinet (b. 38 and b. 134), the violin (b. 37 and 133) and the cello (b. 38 and 134) in order to emphasize this decisive moment of transition from harmonicity to inharmonicity.

The 'Slow' section bb. 109-132 creates a sense of aural limbo as pitches from both the harmonic and inharmonic spectra are heard together for the first time. This section approaches the subject matter in a similar manner to Grisey, as there is a vertical relationship between the harmonic partials and inharmonic components. This sense of uncertainty is reinforced in *Vacuum Spazio Puro* by a revisit 'inside the piano', with harmonics upon the C1

[18] **Roads, C.** ed. (1992). Harvey Jonathan. Mortuos Plango, Vivos Voco: A Realization at IRCAM *The Music Machine*, p.92.
[19] **Downes, M.** (2009). Jonathan Harvey: Song offerings and White as jasmine, p.22. ISBN 978-0-7546-6022-4. Quotes Harvey 1986c, p.181 and Whittall 1999, p.27.

(b. 109) coupled with the inharmonic C-quarter-sharp-5 played as an artificial harmonic on the cello (b. 110).

When *Vacuum Spazio Puro* was workshopped by the Hard Rain Soloist Ensemble, the piece's movement from harmonicity and inharmonicity was effective as the slight change in intonation between C and C quarter-sharp in the lower register produced a subtle but interesting transition.

The minimalist figures bb.1-36 and 73-108 work as a strong vessel to make the journey from harmonicity to inharmonicity. This is due to the fact that the repetitious nature of certain lines accentuated the harmonic stasis. The transition from harmonicity to inharmonicity that occurs in *Vacuum Spazio Puro* explores the technique in an innovative manner as it happens suddenly with little or no warning. In contrast, Grisey's transition happens through the gradual addition of inharmonic components upon the harmonic material[20].

In all, I felt that the piece made a strong case for the combination of minimal and spectral influences and continued to develop on interesting ideas which were started in *I-V: A Series of Spectra-minimal Miniatures.*

Once I had time to reflect, I realised there were certain aspects of the piece which were questionable. The reliance on another composer's spectral analysis to generate a new sound-world seemed paradoxical. Harvey's analysis was interesting in *Mortuos Plango, Vivos Voco,* because there was a direct representation of the bell sound in the tape section of his piece. It was at this point in my research that I felt it was time to progress with carrying out my own spectral analysis, as will be shown in the 'spectral analysis' chapter of *Tree of Smoke.*

[20] **Rose, F.** (Summer, 1996) Introduction to the Pitch Organization of French Spectral Music. *Perspectives of New Music*, Vol. 34, No. 2, p. 9.

Certain sections of *Vacuum Spazio Puro* were reworked into a new composition entitled *Love Goes to Buildings on Fire*, which was workshopped by the Hard Rain Soloist Ensemble at Maynooth University on the 12th of April 2018. This piece has been included in the appendix as it offers a different approach to the moments where the harmonicity and inharmonicity meet for the first time in *Vacuum Spazio Puro* (bb. 109-132). *Love Goes to Buildings on Fire* shifts this material to the beginning of the piece, resulting in an aural limbo being present from the start. In this opening (bb. 1-24), there is an uncertainty as to how the music is going to progress. This is because the repetitive C1 is evocative of the spectral pieces which begin by repeatedly stating the fundamental; Grisey's *Partiels* being a prime example. How *Love Goes to Buildings on Fire* differs is that the repeated fundamental is answered by inharmonic components, rather than the relevant partials.

3) Tree of Smoke

3.1 A Collaborative Process

Tree of Smoke was composed for solo organ between September 2015 and March 2016 and was a collaborative process with fellow Maynooth University student James Murphy. The piece was premiered by James at a lunchtime concert on 8th March 2018 in Maynooth College Chapel. The opportunity to write for James arose through a collaborative module set up by the University's music department for postgraduate performers and composers. For months, James and I swapped influences and workshopped multiple sketches.

I had been listening to Terry Riley's *Persian Surgery Dervishes*[21] during the time I was collaborating with James, a recording of two live solo electric organ concerts, the first held in Los Angeles on 18 April 1971 and the second in Paris on 24 May 1972. The stimulating improvised material of these performances inspired me to explore the use of improvisation in the context of my own research.

Tree of Smoke takes its name from a Denis Johnson novel, which tells the story of a CIA agent named Skip Sands and his time working in Vietnam during the American involvement there. I could not help but think of my research whilst reading the novel as coincidentally the genesis of my influences came about during the time of the Vietnam War. The counterculture of the mid- to late sixties and the early seventies played an important factor in the development of contemporary music during this time. *Tree of Smoke* was initially only going to be a working title, but I eventually decided to keep the title as a tribute to Denis Johnson, who sadly passed away on May 24th 2017.

[21] **Riley, T.** (1972). *Persian Surgery Dervishes* (CD format). Mantra Records. Catalogue number Nt6715.

3.2 Spectral Analysis

Tree of Smoke is the first piece in the portfolio which relies on my own spectral analysis. Having been inspired by the compositional manipulation of data analysis in Jonathan Harvey's *Mortuos Plango, Vivos Voco*, I thought it would be an interesting idea to explore the subject myself in the context of my research. After expressing my interest in spectral analysis to my supervisor Dr Molloy, he stated that it might be worth looking into recording the organ's Zimbelstern stop in the university's chapel. The Zimbelstern (meaning "Cymbal Star" in German) is an organ stop consisting of a metal or wooden star or wheel on which several bells are mounted. When engaged, the star rotates, producing a continuous tinkling sound. At one of the very first meetings with James, I recorded the Zimbelstern using a H6 Zoom mic. The following figures and table show the analysis of this recording and how the results have been translated into the score.

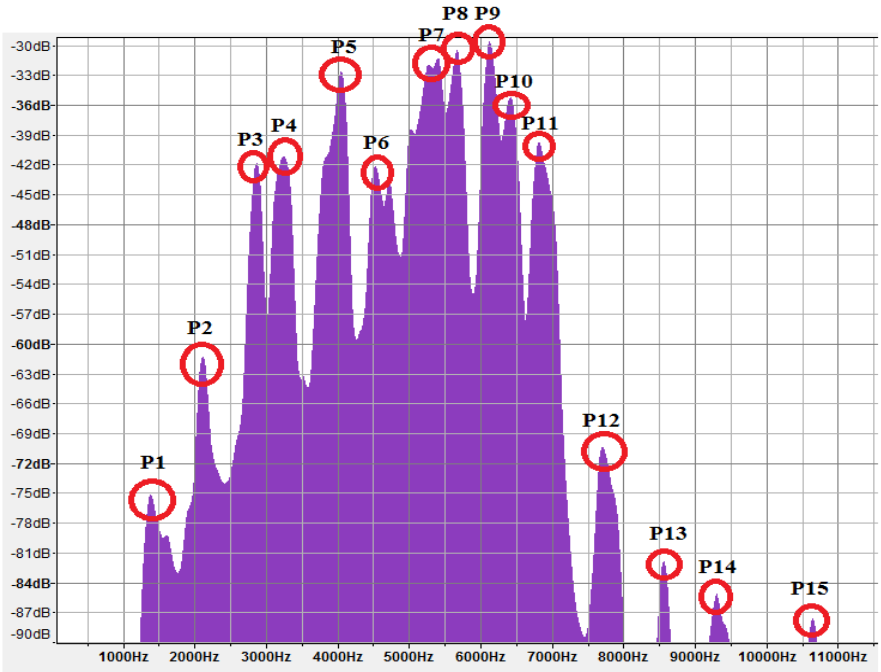

Fig. 4: A frequency analysis (using Audacity's inbuilt spectrum analysis algorithm) showing the main partials of the Zimbelstern spectrum, the peak partials are circled in red

Peak Number	Frequency	Pitch Equivalent	Score Example
P1	1384 Hz	F6 (1396.91 Hz)	RH: Bars 70, 71, 75, 76, 77, 79, 80, 82-84 91-95 *Scored as F5*
P2	2113 Hz	C7 (2093 Hz)	LH: Bar 74, 75, 82 (*Transposed down to C3*)
P3	2870 Hz	F7 (2793.83 Hz)	RH: Bar 65, 78 and 98 *Scored as F6*
P4	3262 Hz	G#7 (3322.44)	RH: Bar 65, 78 and 98 *Scored as G#6*
P5	4051 Hz	B7 (3951.07 Hz)	RH: Bar 74, 75,82-84 *Scored as B5*
P6	4526 Hz	C#8 (4434.92 Hz)	LH: Bar 78, 80, 81, 85, 86, 96-98 Scored as C#2 RH: 74, 75, 88, 89, 90, 91, 107, 108 *Scored as C#2 + C#6*
P7	5385 Hz	E8 (5274.04 Hz)	RH: Bar 74, 75, 82-84, 94, 92, 108 *Scored as E5* LH: 74, 82, 83 *Scored as E3*
P8	5664 Hz	F8 (5587.65 Hz)	RH: Bars 70, 71, 75, 76, 77, 79, 80, 82-84 91-95 *Scored as F5*
P9	6127 Hz	G8 (6271.93 Hz)	RH: Bar 74, 75, 82, 83, 84, 91, 92, 107-109: *Scored as G5*
P10	6147 Hz	G8 (6271.93 Hz)	RH: Bar 74, 75, 82, 83, 84, 91, 92, 107-109: *Scored as G5*
P11	6816 Hz	G#8 (6644.88 Hz)	RH: Bar 65, 78 and 98 *Scored as G#6*
P12	7711 Hz	B8 (7902.13 Hz)	RH: Bar 74, 75,82-84 *Scored as B5*
P13	8566 Hz	C9 (8372 Hz)	RH: Bar 74, 75, 82-84 (*Transposed down to C4*)
P 14	9292 Hz	D9 (9397.273 Hz)	RH: Bar 74, 75, 82-84, 90, 91 *Scored as D6*
P15	10644 Hz	E9 (10548.08 Hz)	RH: Bar 74, 75, 82-84, 94, 92, 108 *Scored as E5* LH: 74, 82, 83 *Scored as E3*

Fig. 5: Table showing results from analysis in *Tree of Smoke*

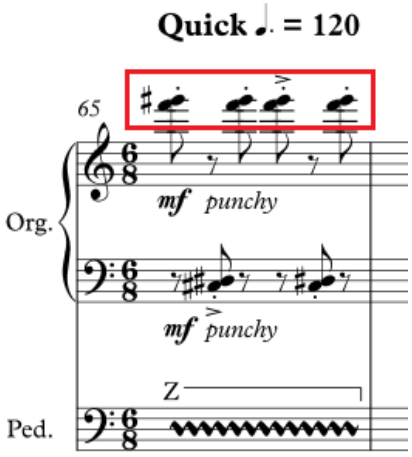

Fig. 6: b. 65 of *Tree of Smoke*, 'F6' and 'G sharp 6' are highlighted in red, the Zimbelstern line can be seen in the pedal

Figure 5 clearly shows that many of the pitches have been transposed down various amounts of octaves into a lower register, resulting in the creation of a new context for the Zimbelstern sound. Having said that, some of the pitches do appear in their appropriate register. For instance, the pitches of peak 3 appear an octave lower in the score (as illustrated by Figure 6) due to the instrument's range, but with the use of the '4' foundation stop' (indicated by a '+ Reeds' indication on page 5 of the score) these pitches sound an octave higher and are therefore heard in their appropriate register.

My decision to have the analysis's pitches appear in both the appropriate and "inappropriate" register was so I could blur the lines between what sounds were coming from the organ and what sounds were coming from the Zimbelstern. At one of the many meetings with James, we let the Zimbelstern stop ring out for a long period of time whilst we tried out various versions and combinations of the pitches alongside the stop's jingling sound. Interestingly enough, we found that having some of the Zimbelstern's higher frequencies transposed to the lower register of the organ provided a much more intriguing instrumental synthesis of the Zimbelstern. Rather than by design, however, the translation of the results of the analysis into the score is based on my own intuition.

Figure 6 also illustrates how the use of the Zimbelstern appears in the score. I stipulated very early on in the collaborative process that the bells should be heard ringing in the bars of silence naturally, and not due to the fact that the Zimbelstern stop hadn't been turned off. James and I decided to score the Zimbelstern stop as if it were a pedal, since turning the stop on and off with perfect timing in relation to left and right hand accompaniment was essential.

The piece is structured around an A-B-C-B-A form, the sections of which are characterised by the organ stops they use. So to say, I decided to structure the form of the composition around three distinctly different organ sounds. This interaction between the Zimbelstern and the organ takes place in the centre of the piece (C).

Sections A and B can be viewed as building blocks to arrive to (and leave from) this moment of instrumental synthesis of the Zimbelstern. The first section heard in the opening of the piece is a chordal passage given the tempo of 'Lento'. The organist is asked to make sure that the organ is at its loudest for this texture; '*Organ Tutti 2*'. James had informed me that this was the loudest sound on the impressive Ruffati organ of Maynooth College Chapel.

This chordal passage is heard both at the start (bb. 1-28) and at the end (bb. 147-172) of the piece and focuses on a large swelling sound created through minimal drones and long sustained chords inspired in part by Messiaen's organ writing. James and I share an interest in the works of the renowned French composer, widely acknowledged as a proto spectralist[22] and the opening of *Tree of Smoke* was influenced in particular by works such as his *Apparition de l'église éternelle* (1932)[23] and *l'Ange aux Parfums* from *Les Corps Glorieux* (1939)[24].

[22] **Moscovich, V.** (April 1997) French Spectral Music: An Introduction. *Tempo new series*, no. 200 pp. 21–27.
[23] **Messiaen, O.** (1932) *Apparition de l'église éternelle* Editions Henry Lemoine (Music Score)
[24] **Messiaen, O.** (1939) *l'Ange aux Parfums* from *Les Corps Glorieux* Editions Henry Lemoine (Music Score)

As another example of the collaborative process, Section B of *Tree of Smoke* (bb. 29-64 and 112-146) creates a space for the performer to showcase their own creative voice through improvisation. James had informed me that he was a confident improviser and we decided from early on in the collaborative process that improvisation was going to have a role to play in the piece. Composer theorist George E. Lewis states that improvisation can be defined by numerous tendencies, the most important of which for me was that "improvisation in which careful preparation, formalism, and intellectual rigor are as privileged as spontaneity and real-time decision making"[25]. Decision-making in improvisation intrigued me as it made different performances of the same composition possible, as seen in Terry Riley's *Persian Surgery Dervishes* (1972). Since James was a little unsure of the '*psychedelic*' expression stated at the start of section B, I asked him to listen to the first performance of *Persian Surgery Dervishes* in Los Angeles. The opening eight minutes of *Part 1* of this Los Angeles performance is all in the low register with spontaneous embellishments and this is the musical element I wanted James to draw from.

3.3 Towards an Original Voice?

I feel strongly that *Tree of Smoke* is an important marker in the development of my individual compositional voice. The goal of my research was to create innovative and original compositions whilst taking influence from my own spectral and minimal influences. The use of the harmonic series in the first two pieces worked as a way of contextualising this research; acknowledging Donnacha Dennehy's work built from the superimposition of the harmonic series upon Reich-like figures. However, this acknowledgement also resulted in creating sound-worlds which were still associated with other compositions of a spectral

[25] **Lewis, George E.**, quoted in Lehman, S. H. (2012) '*Liminality as a Framework for Composition: Rhythmic Thresholds, Spectral Harmonies and Afrological Improvisation*' PhD Diss., for Columbia University, p.3.

nature. This is due to the fact that the harmonic series has been used by spectral composers so extensively as to be one of the mot defining features of the style.

The use of spectral analysis in the implementation of a Grisey-esque instrumental synthesis of the Zimbelstern stop in *Tree of Smoke* helps create an innovative sound-world. Since the pitch content of the organ part relies on the spectral analysis of the Zimbelstern, both sounds share a common unity which ensures that they maintain an audible organic unity. The successful instrumental synthesis of section C encouraged me to further explore this technique, as I believed the phenomenon could be interpreted in other innovative ways.

Tree of Smoke is also the first piece in the portfolio to demonstrate the polystylism that exists in my work. As well as minimal and spectral influences, the piece borrows from a wide range of other salient influences. For instance, the improvisational line to section B not only takes inspiration from Riley's *Persian Surgery Dervishes*, but also draws inspiration from Keith Jarrett's *The Köln Concert* (1975)[26]. *The Köln Concert* is a concert recording of solo piano improvisations performed at Cologne's Opera House on January 24th, 1975. During this particular performance, Jarrett's improvisational style relied on the use of ostinato and rolling left hand rhythmic figures. The left hand line of *Tree of Smoke* bb. 29-64 is influenced by this particular playing style, as can be seen from the low-registered C sharp-to F sharp-to G sharp ostinato during this passage. *Tree of Smoke*'s reliance on other influences supports the research, as it brings a strong sense of originality to the portfolio. It is for that reason that I decided to remain open to the personal influences which had been apparent in my compositional style before the research began.

[26] **Jarrett, K** (1975) *The Köln Concert* (CD format), ECM Records. Catalogue number ECM 1064/65 ST.

CHAPTER II – Exploiting Spectral Techniques

4) Flies on Butter

4.1 Background

Flies on Butter was composed for the Robinson Panoramic Quartet during the 2016 Irish Composition Summer School, which took place between July 5th and 14th at the Dublin Institute of Technology's Conservatory of Music and Drama. Composing for the Robinson Panoramic Quartet was interesting because they do not follow the conventional string quartet formula, substituting the second violin for a double bass, extending the exploration of both tonal palette and range[27]. This grouping is not just a standard string quartet with a few extra low notes: the double-bass adds a wealth of potential textures and timbre and shifts the roles of both the viola and cello[28]. I was tutored by Dr Gráinne Mulvey of the DIT Music Conservatory for the entirety of the Summer School. Gráinne's tuition throughout the course was of great help, compositional decisions on form, dynamic balance and the development of material were all influenced by her guidance.

4.2 Extended Techniques and Ring Modulation (RM)

Flies on Butter takes its name from Saariaho's piece *Sept Papillons* (2000). *Sept Papillons* is a collection of seven miniatures composed for solo cello, first performed by Ansi Kartunnen in Helsinki in the same year. Saariaho's piece focuses on fragile and ephemeral movement, and is loaded with harmonics and extended techniques[29]. One of the building blocks for *Flies on Butter* is the spectral analysis of various extended cello techniques that Saariaho uses in *Sept Papillons*. I transcribed two of the extended techniques that appealed to me most from

[27] Robinson Panoramic Quartet Homepage. *RPQ – Malachy Robinson*. Available at: http://malachyrobinson.com/robinson-panoramic-quartet/ (accessed August 2018).
[28] **Ibid.**
[29] Kaija Saariaho Official Website**,** *Sept Papillons – Kaija Saariaho,* Available at: http://saariaho.org/works/sept-papillons/ (accessed August 2018).

the opening two miniatures; *Papillon I* and *Papillon II*. I brought these transcriptions along to the opening workshop of the Summer School so I could record them for analysis. The following figures show the spectrograms of these two extended techniques in SPEAR, with the relevant bars of the score I had transcribed above them:

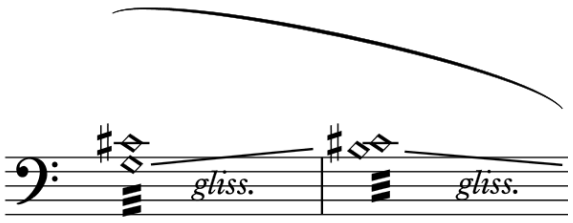

Fig. 7: Kaija Saariaho's extended technique bb. 4 and 5 of *Papillon I* from *Sept Papillons*[30]

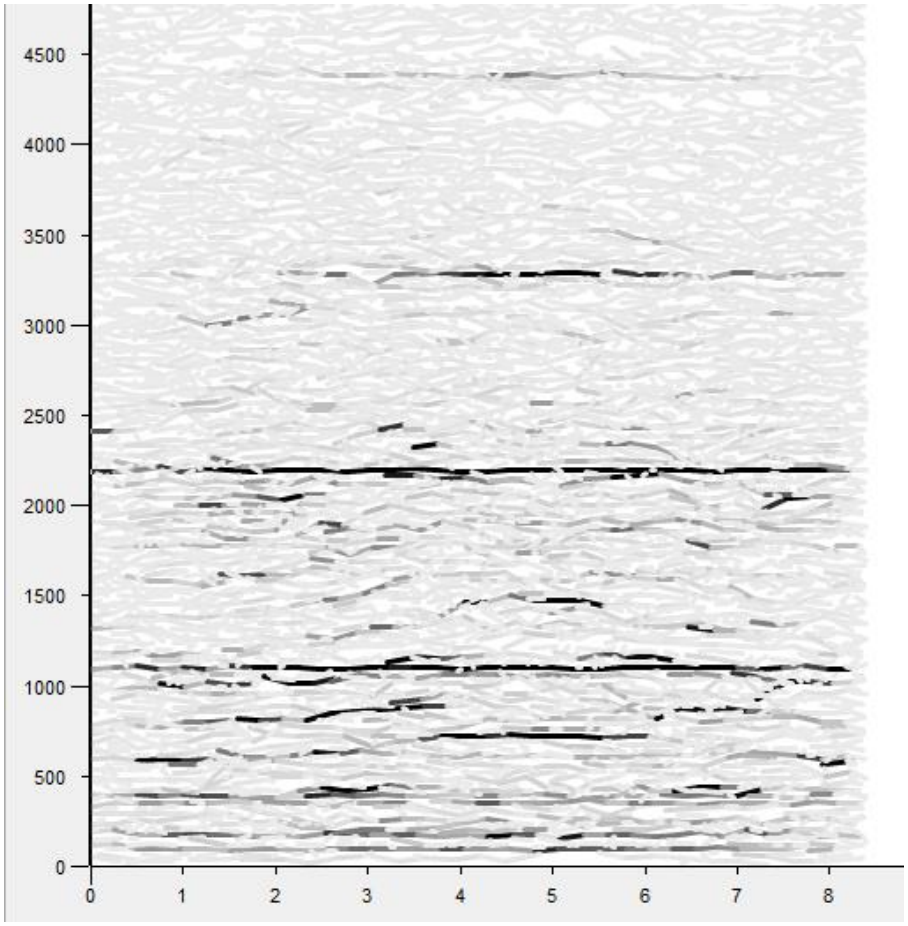

Fig. 8: Kaija Saariaho's extended technique bb. 4 and 5 on SPEAR

[30] **Saariaho, K** (2000) *Sept Papillons* for solo cello. Chester Music (Music Score).

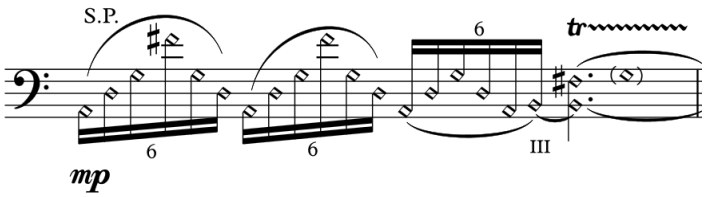

Fig. 9: Kaija Saariaho's extended technique in b. 7 of *Papillon II* from *Sept Papillons*[31]

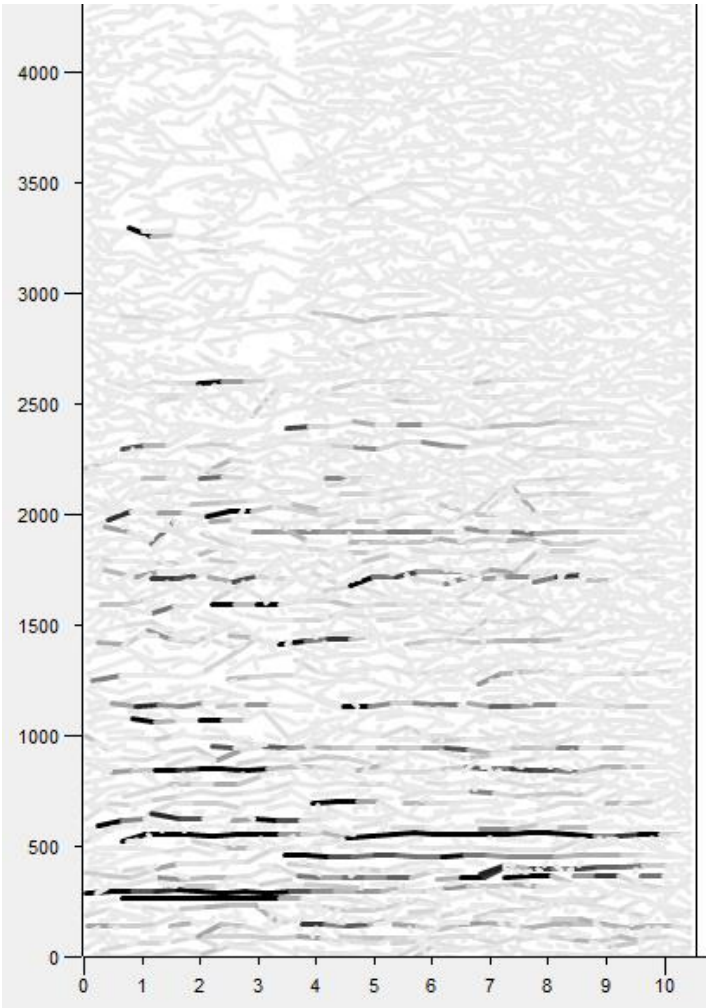

Fig. 10: Kaija Saariaho's extended technique in b. 7 of *Papillon II* from *Sept Papillons* on SPEAR

These extended techniques are sampled and quoted throughout *Flies on Butter*. Whenever these techniques are featured in the score, the other instruments play pitches unveiled in the

[31] **Saariaho, K** (2000) *Sept Papillons* for solo cello. Chester Music (Music Score).

analysis. The following table lists the pitches revealed from this analysis and where they can be found in the score.

Results from Figures 7 and 8	Results from Figures 9 and 10
Double Bass G#1 (bb. 25-28)	*Double Bass* A2 (b. 21 and 22) F#3 (b. 38)
Viola G3 (bb. 23-26 and 28-30)	*Viola* E4 (bb. 35-37) D5 (bb. 38-40)
Violin C#7 (b. 29)	*Violin* E4 (b. 21 and 22) D4 (bb. 35-37) D 1/8th # 4 (bb.38-40) G#7 (b. 36)

Fig. 11: Table illustrating the pitches from the analysis and their score position in *Flies on Butter*

As well as spectral analysis, *Flies on Butter* also investigates the use of ring modulation (RM). In his '*Guide to the Basic Concepts and Techniques of Spectral Music*', Joshua Fineberg states the importance of ring modulation and its role in the spectral world[32]. I have long been fascinated by the use of ring modulators in Karlheinz Stockhausen's compositions *Mixtur* (1964) and *Mantra* (1970) and felt that this would be a useful technique to support my initial spectral forays, maintaining the integrity of the pitch material's source while simultaneously expanding its composition potential through RM. Canadian composer and Stockhausen student Claude Vivier generated by "*les couleurs*"[33] his most famous composition '*Lonely Child*' (1980) by means of combination tones. *Combination-Tone Class Sets and Redefining the Roles of Les Couleurs in Claude Vivier's Bouchara*[34] by Bryan Christian offers a variety of insights into Vivier's approach to combination tones and their simple but convenient approximation of ring modulation applications. Vivier was thinking of

[32] **Fineberg, J**. (2000) Guide to the Basic Techniques and Concepts of Spectral Music. *Contemporary Music Review*, Vol. 19, Part 2, p.97.
[33] **Christian, B.** (2014) Combination Tone Class Sets and Redefining the Role of les Couleurs in Claude Vivier's Bouchara. Available at: http://www.mtosmt.org/issues/mto.14.20.2/mto.14.20.2.christian.html (accessed online August 2018).
[34] **Ibid.**

a vertical expansion of melody into something quasi-timbral[35] and decided to make use only of combination tones[36]. Vivier's *jeu de timbres,* a term Vivier sometimes freely exchanged with *Klangfarbenmelodie[37]*, describes this combination tone technique. Unlike harmonization of melodies in a tonal sense, the *jeu de timbres* comprises a series of complex vertical sonorities, based on the essential pitches of the principal melody, devised before actually writing the work[38].

Due to the extended lower range the double bass offers in the Robinson Panoramic Quartet, I felt encouraged to explore the typically lower 'difference' tones. Figure 12 below displays some examples of sum and difference tones that can be found in the piece. The left 'Signals' column shows the two tones that are being fed into the computer-simulated ring modulator; borrowing Vivier's term, the right-hand column shows *les couleurs*, the sum and difference tones of these two signals.

Signals	Les Couleurs
Bar 33 C4 361.63 Hz: Viola A2 110 Hz: Cello	*Bar 33* 471.63 Hz is sum: A#4 plus 20 cents = Violin 251.63 Hz is difference: B3 plus 33 cents= D. Bass
Bar 42 F4 349.23 Hz: Viola B3 246.94 Hz: Cello	*Bar 43* 596.17 Hz is sum: D5 plus 26 cents 102.29 Hz is difference G#2 minus 26 cents
Bar 46 D#4 311.13 Hz: Viola G2 98.00 Hz: Cello	*Bar 46* 409.13 Hz is sum: G#4 minus 26 cents: Violin 213.13 Hz is difference: G#3 plus 45 cents: D. Bass
Bar 54 D#4 311.13 Hz: Viola E3 164.81 Hz: Cello	*Bar 54* 475.94 Hz is sum: A#4 plus 36 cents: Violin 146.32 Hz is difference: D3 minus 6 cents: D.Bass

Fig. 12: Table displaying sum and difference calculations in *Flies on Butter*

[35] **Braes, R.** (2003) *An Investigation of the Jeux de Timbres in Claude Vivier's Orion and his Other Instrumental Works of 1979-80* PhD diss., University of British Columbia.
[36] **Christian, B.** (2014) Combination Tone Class Sets and Redefining the Role of les Couleurs in Claude Vivier's Bouchara. Available at: http://www.mtosmt.org/issues/mto.14.20.2/mto.14.20.2.christian.html (Accessed online August 2018).
[37] **Ibid.**
[38] **Braes, R.** (2003) *An Investigation of the Jeux de Timbres in Claude Vivier's Orion and his Other Instrumental Works of 1979-80* PhD diss., University of British Columbia.

The following figure illustrates the ring modulation that occurs bb. 42-43, as mentioned in Figure 12 on the previous page:

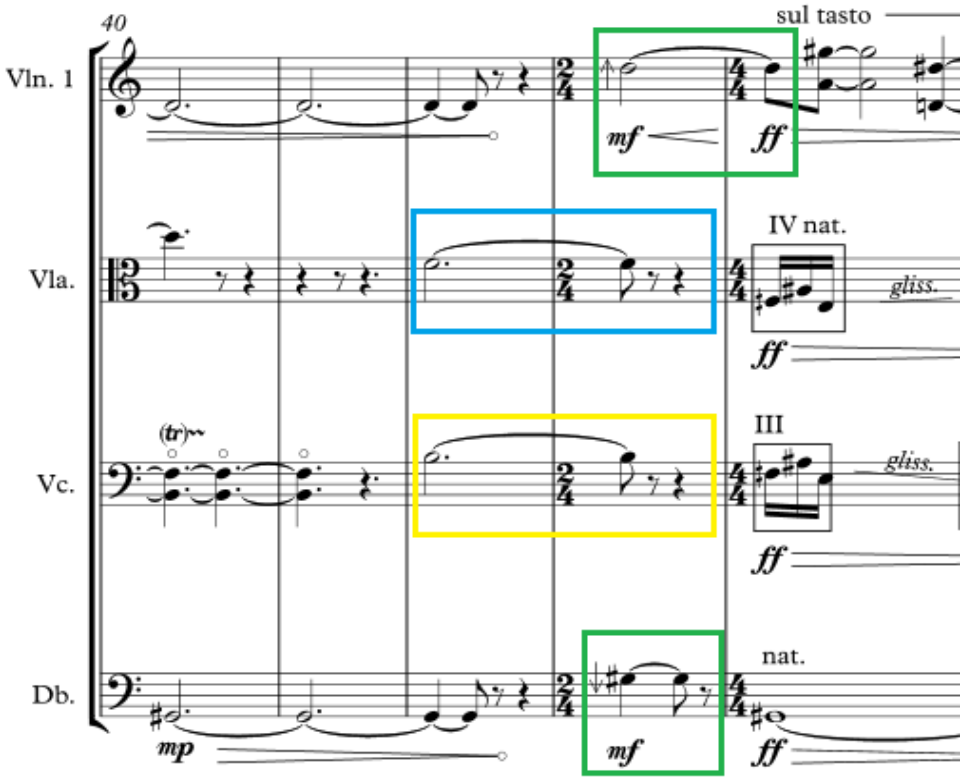

Fig. 13: Score example of ring modulation effect in *Flies on Butter*, bb. 40-44

The blue and yellow rectangles highlight the viola and cello *signals*, the green rectangles highlight *les couleurs*.

The form of the composition is based upon Grisey's consideration for sounds to be considered as living entities, and not as inanimate raw material used in the composer's work[39]. In this approach, the sound 'is born', 'lives' and finally 'dies',[40] and so is subject to constant change. Grisey's approach to a sound would very often morph and develop into something new with time. *Flies on Butter* sees the quartet move from a minimal unified

[39] **Humiçcka-Jakubowska, J.** (2009) The spectralism of Gérard Grisey: from the nature of the sound to the nature of listening. *Research Gate*. (Online). Available at: https://www.researchgate.net/publication/270282905 (accessed August 2018), p.230.
[40] **Biindler, D.** (1996) Interview with Gérard Grisey, 18 January 1996, Los Angeles. *David Biindler blog on Angelfire* (Online). Last revised 16/12/2001. Available at: www.angelfire.com/music2/davidbundler/grisey.html (accessed August 2018).

drone (bb. 1-16) to four contrasting lines superimposed upon one another in order to generate a chaotic sound (bb. 50-58). The end of the piece (bb. 70-72) finally returns to the opening's sense of stasis.

4.3 Embracing the Historical Context of Proto-Spectral Composers

With the Messiaen-inspired modal language of *Tree of Smoke* followed by the use of Stockhausen-inspired ring modulation in *Flies on Butter*, the research embraces the historical context of proto-spectral composers. In the introduction to this thesis, I mentioned that an obscurity is brought into play when considering a potential merging of minimalism and spectralism, primarily due to the fact that they both have greatly developed from their original forms. Pieces such as *Flies on Butter* and *Tree of Smoke* seek the original principles of minimalism and spectralism by also focussing on the techniques of composers who can be considered as having an influence on the founders of minimalism and spectralism.

Flies on Butter realises one of the main objectives of my research, which is to show the wide range of unique sound-worlds available when incorporating techniques from both minimalism and spectralism.

5) You'll Only Make Matters Worse

5.1 Writing for Voice

You'll Only Make Matters Worse was composed for soprano Michelle O'Rourke as part of an Irish Composers Collective[41] concert entitled 'ICC Speak'. The concert followed a call for works for solo voice without electronics of about 3-5 minutes in duration. The piece was performed three times on November 4th 2016, in the Irish Architectural Archives Building, Merrion Square, Dublin.

5.2 The Text

The words that make up the text are built from a two sentence excerpt from John Cage's *Diary: How to Improve the World (You Will Only Make Matters Worse)* and the opening minute of an interview with John Cage, taking from Miroslav Sebestik's documentary *Listen*[42]. I was inspired to use Cage's writings and quotations as a source for text through the work of minimalist composer Florent Ghys. I am a great admirer of Ghys's piece *An Open Cage* (2015), a work released as part of *Field Recordings*, an album by the Bang on a Can All-Stars in 2015[43]. Ghys's work uses excerpts from Cage's *Diary* as its basis; the *Diary* is a poetic five-hour recording made by the composer a year before his death[44]. I also chose to include two lines from the same diary as a reference to Ghys and to Cage (and in the spirit of continuing the homage approach adopted in the works presented thus far).

[41]. Chapter *A) Compositional Practice 1) Irish Composers' Collective* p. 11 of thesis

[42] **Jdavidm**. (2001) *John Cage about Silence* (YouTube video online). Available at: https://www.youtube.com/watch?v=pcHnL7aS64Y (accessed September 2016).

[43] **Bang On A Can All-Stars** (2015). Track 2 of *Field Recordings* (CD format), Cantaloupe Music.

[44] **Molloy, M.** (2015) Album Review Bang On A Can All Stars *"Field Recordings" – Second Inversion*' Second Inversion Website. https://www.secondinversion.org/2015/05/18/album-review-bang-on-a-can-all-stars-field-recordings/ (Accessed August 2018).

The chosen lines are:

-"I'm gradually learning how to take care of myself. It has taken a long time.
It seems to me that when I die, I'll be in perfect condition"[45].

I felt compelled to use these two lines in particular as they portray Cage's sense of humour. As well as this, the short phrase "it seems to me that" is spoken by Cage in the opening line of the interview's excerpt:

-"When I hear what we call music, it seems to me that someone is talking, (…)"[46].

The way Cage speaks "it seems to me that" is extremely similar in both the interview and his *Diary*. When this short phrase is stated in the score (bb. 15-16 and 28-29), the melodic line is descending and descriptive of the way Cage articulates this line.

You'll Only Make Matters Worse is a parody of the argument Cage is making in the interview. Cage's remarks, which make up the majority of the composition's text, are about the importance of silence and how everyday sounds such as traffic can be considered as sound or music. This belief was of course put into practice and took shape in Cage's seminal *4'33"* (1952). *You'll Only Make Matters Worse* uses Cage's words on silence to create a piece of music, in some measure as a humorous commentary on the work from the distance of the 21st century.

5.3 The Influence of James Tenney and Natural Formant Frequencies

When the opportunity arose to compose for Michelle, I had been researching the instrumental synthesis of human voice in James Tenney's spectral pieces. Tenney's interpretation of

[45] **Huizenga, T.** (2015) Bang On A Can Riffs on John Cage. *NPR.* Available at: https://www.npr.org/sections/deceptivecadence/2015/04/24/400119563/bang-on-a-can-riffs-on-john-cage (accessed September 2016)

[46] **Jdavidm**. (2001) *John Cage about Silence* (YouTube video online). Available at: https://www.youtube.com/watch?v=pcHnL7aS64Y (accessed September 2016).

vowels' formant frequencies in *Three Indigenous Songs* was one based on tables published in acoustical literature[47]. What I noticed when I started to research various tables offering the formant frequencies of vowels in the human voice was that the results varied and were very inconsistent. To begin with the formant frequencies between men and women obviously differ greatly as a man's voice is naturally deeper. What is less evident is the effect an accent can have. Age can also be a factor; a prepubescent boy's voice will of course sound much higher than a man's. These variations in the results prompted me to explore the use of natural formant frequencies.

I learned that the natural formant frequencies of different vowels may be accentuated by using a kind of overtone singing technique, which involves the slow movement of the mouth from one vowel shape to another whilst holding the same pitch. This is a technique explored in pieces such as Karlheinz Stockhausen's *Stimmung* (1968) and Sarah Hopkins's *Past Life Melodies* (1994). I decided to illustrate this technique in the score by using Cardinal vowels. Cardinal vowels are a set of reference vowels used by phoneticians in describing the sounds of languages[48]. For instance, the vowel of the English word "feet" can be described with reference to cardinal vowel 1, (i)[49]. Figure 14 on the following page is a schematic representation of the lip positions of cardinal vowels. This representation can also be seen in the performance directions section of the *You'll Only Make Matters Worse* score on page 2.

[47] **Wanamaker, R. A.** (in press 10/2007) North American Spectralism: The Music of James Tenney. In Reigle, R. & P. Whitehead (Eds.), Instanbul Spectral Music Conference, Nov, 18-23, 2003. Istanbul, Turkey: Pan Yayincilik.
[48] **Jones, D.** (1967). *An Outline of English Phonetics* (9th ed.). Cambridge University Press: Heffer. p. 34.
[49] **Ibid.** p. 34.

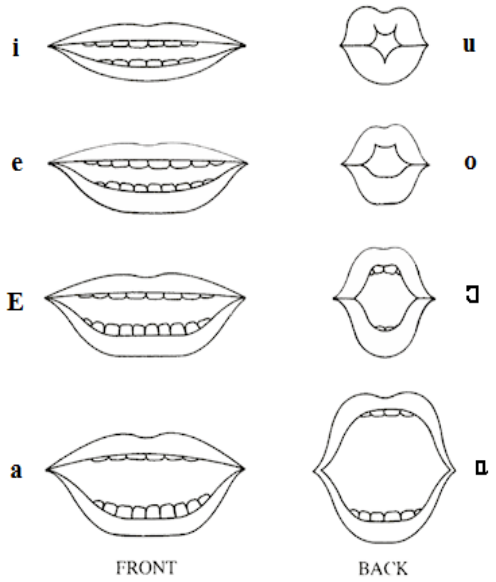

Fig. 14: Schematic representation of lip-positions of cardinal vowels[50]

In *You'll Only Make Matters Worse*, these cardinal vowels are placed above the stave of the score in order to illustrate which mouth shape to move to (see for example bb. 4-5, 18-20, 30-31, 36-37, 48-49, 57-59 and 97-98).

I wanted to unite all of the formant frequencies used in *You'll Only Make Matters Worse* further by having a clear pitch centre. To do so, I used an octatonic scale, as can be seen from looking at Figure 15 below:

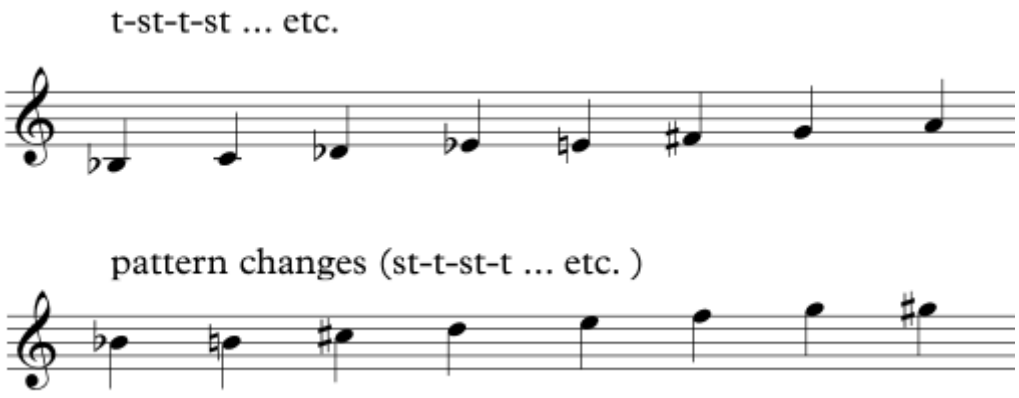

Fig. 15: Octatonic scales used in *You'll Only Make Matters Worse*

[50] Catford, J.C. (1988). A practical introduction to phonetics. New York: Oxford University Press. (Bibliographical annotation by Malone 2000.)

This scale is built from a repeated semitone-tone pattern centred on B flat, bolstered by the process restarting in the higher octave from this note. This obvious adoption and exploration of one of Messiaen's idiomatic modes of limited transposition emerged from the successful influence I felt his musical language had on *Tree of Smoke* and the interesting combination it created with my minimal and spectral influences.

Influenced by Tenney's study of formant frequencies, I decided to further investigate the techniques of his instrumental synthesis. In *Three Indigenous Songs,* consonants are articulated by the percussionists using woodblocks (for 'k', 't', and 'p'), tom-toms with sticks (for 'g', 'd', and 'b'), tom-toms with brushes (for 'th', 'f', and 'h'), and suspended cymbals (for 's' and 'sh')[51]. Tenney's division of plosives and fricatives amongst the instrumentation inspired me to elongate the fricatives of the text I had chosen. This elongation emphasised the turbulent airflow and the resulting broad band noise associated with fricatives. Broad band sound can be considered as a noise that has a continuous spectrum and which has energy over a wide range of frequencies. I view this technique as a kind of role reversal to that which Tenney was trying to achieve, instead of instrumental synthesis of the human voice, I was creating a noise from speech. This can be best understood by taking a look at Figure 16:

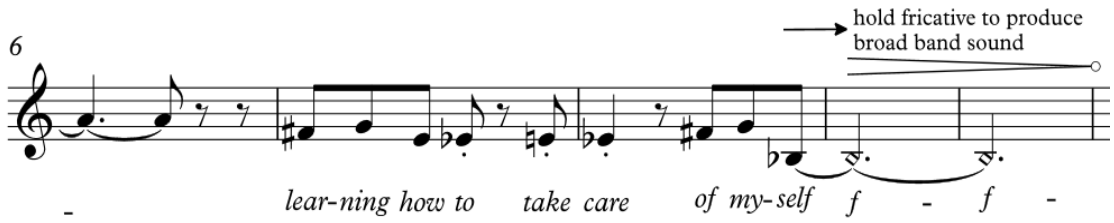

Fig. 16: Score excerpt showing elongation of fricative (bb. 8-10)

[51] **Wanamaker, R. A.** (in press 10/2007) North American Spectralism: The Music of James Tenney. In Reigle, R. & P. Whitehead (Eds.), Instanbul Spectral Music Conference, Nov, 18-23, 2003. Istanbul, Turkey: Pan Yayincilik

Figure 16 on the previous page shows the elongation of the letter 'f' in 'myself', bb. 8-10, in order to produce broad band sound. This exploration of the broad band sound is similar to the study of transients in other spectrally-minded composers' pieces. For instance, *Modulations* (1976-77), the fourth movement of Grisey's seminal work *Les Espaces Acoustiques*, uses processes of timbral transformation to essentially 'compose sound'[52]. These transformations define each of the piece's temporal structures as well as the overarching structure of the piece[53].

In acoustics, a transient is a high amplitude, short-duration sound at the beginning of a waveform that occurs in phenomena such as musical sounds, noises or speech[54]. This portion of the sound, while difficult to analyse, is extremely important to the perception of timbre[55]. Fortunately, for modelling purposes, the exact frequency content of the attack transient seems to be less important than its presence[56]. While many spectral composers have worked with the idea of attack transients and have sought to include and manipulate them in both electronic and instrumental synthesis, this modelling is rarely based on precise models emerging from analyses and is, instead, more intuitively and metaphorically based on concept[57]. The elongation of fricatives (e.g. bb. 9-10, 23, 41-43, 66-67 and 105-106) in *You'll Only Make Matters Worse* can be viewed as my own exploration of attack transients, and offers a unique portrayal of how noise can be created from speech.

You'll Only Make Matters Worse is the first piece in the portfolio to offer my own spectral-inspired compositional technique. In the portfolio's first four pieces, my approach to spectral

[52] **Leibovich, N.** (2017) Empty Spaces: Temporal Structures and Timbral Transformations in Gerard Grisey's Modulations and Release for 12 Musicians, an original composition. Doctoral Diss, University of Pittsburgh. p.79.
[53] **Ibid.**
[54] **Crocker, M. J.** (ed); Stepanishen, Peter (1998). *Handbook of Acoustics*. NY: John Wiley and Sons, Inc. p. 119.
[55] **Fineberg, J**. (2000) Guide to the Basic Techniques and Concepts of Spectral Music. *Contemporary Music Review*, Vol. 19, Part 2, p.90.
[56] **Ibid.** p.91.
[57] **Ibid.** p.91.

influences was to develop and offer my own interpretation of certain spectral techniques. Conversely, in *You'll Only Make Matters Worse*, the creation of a broad-band sound by extending certain fricatives of words in the piece was a technical development of my own. I understand this as a reaction to both Grisey's interest in attack transients and Tenney's instrumental synthesis of the human voice, rather than a mere exploration of the techniques these composers used.

6) Bolt the Cabin Fever

6.1 Background

Bolt the Cabin Fever was composed between September 2016 and March 2017 for the Crash Ensemble[58], one of Ireland's foremost contemporary music ensembles with a particular focus on postminimalist music (in a somewhat similar vein to the Bang On A Can ensemble). This work focuses on a kind of musical depiction of the development of 20th-century composition in France, highlighting the aesthetic and historic lineage of spectralism. The modal language of proto-spectralists Olivier Messiaen and Jean-Louis Florentz, the Shepard tone effect created by Jean-Claude Risset, and the Impressionism of composers such as Maurice Ravel and Claude Debussy, are all explored in order to paint a picture of French composition during this epoch.

6.2 The Techniques of the Piece

The opening section of *Bolt the Cabin Fever* is based on repetitions inspired by British composer Bryn Harrison's *Repetitions in Extended Time* (2005). Much of Harrison's work focuses on the exploration of musical time through the use of recursive musical forms which challenge the perceptions of time and space by viewing the same material from different angles and perspectives[59]. Throughout *Repetitions in Extended Time*, Harrison uses exact repetition, changing nothing in the object itself but "changing something in the mind that contemplates it"[60]. Harrison's work deals explicitly with aspects of duration and memory through which near and exact repetition operate in close proximity throughout in order to provide points of orientation and disorientation of the listener[61]. *Bolt the Cabin Fever* sets out

[58] **Crash Ensemble** (2019) *Crash Ensemble Homepage*. Available at: https://www.crashensemble.com
[59] **Bryn Harrison** (2019) *Bryn Harrison - Writings & Biography*. Bryn Harrison Official Website. Available at: http://www.brynharrison.com/writings.html (accessed October 2016).
[60] **Ibid**.
[61] **Ibid.**

in treating this subject through the use of two octatonic scales (in themselves a reference to the historical importance of these constructs in French composition from Debussy's whole-tone scales to Messiaen's modes). Figure 17 below shows these two octatonic scales:

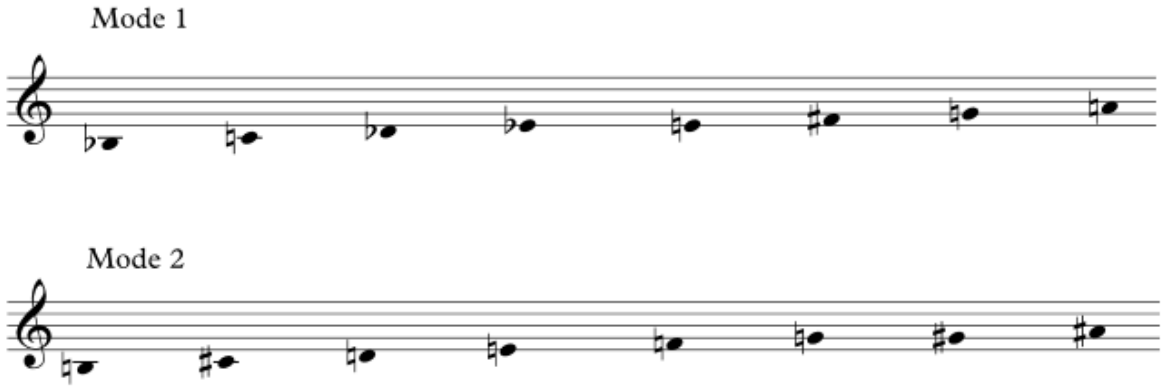

Fig. 17: Staves showing both octatonic scales used at the beginning of *Bolt the Cabin Fever*

Mode 1 has a more commanding role in the composition than **Mode 2**, as can be perceived in the opening piano line in the score bb. 1-8. **Mode 2** is slowly introduced across the instruments as a kind of 'chromatic pollution' of **Mode 1**. Figure 18 below demonstrates this:

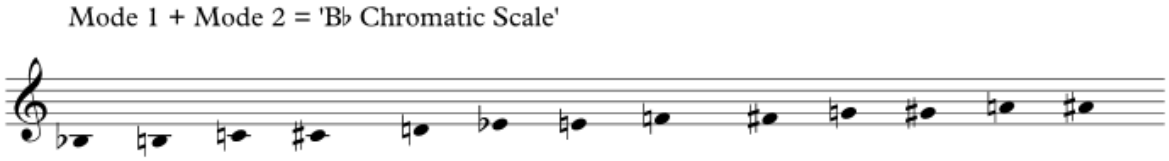

Fig. 18: Stave showing notes of both octatonic scales (Mode 1 and Mode 2) together

This 'chromatic pollution' starts to take place most notably on page 7 of the score in the string section. The violin, viola, cello and double bass play all the notes of **Mode 2** whilst the piano line continues to be fixed on **Mode 1**. This superimposition of **Mode 2** on top of **Mode 1**, which can be likened to Bartok's polymodal chromaticism, generates the chromatic language from which the Shepard tone effect is built.

The Shepard tone is named after American cognitive scientist Roger Shepard and is a sound consisting of a superposition of sine waves separated by octaves[62]. When played with the bass pitch of the tone moving upward or downward, it is referred to as the 'Shepard scale'[63]. This creates the auditory illusion of a tone that continually ascends or descends in pitch, yet which ultimately seems to get no higher or lower[64]. The repetitive nature of the never-ending descent that occurs in *Bolt the Cabin Fever* is a natural progression from the Harrison-inspired chromatic loops.

The Shepard tone effect takes place during the 7/8 'groove' between rehearsal marks '**C**' and '**E**' in the score. The stringed instruments have a principal role in creating the sense of a never-ending descent during this part of the piece; achieved by the extensive use of descending *glissandi*. The use of *glissandi* during this passage is inspired by the Shepard-Risset glissando, where the notes seamlessly glide from one to another rather than focus on discrete diatonic or chromatic steps. This Shepard tone / Shepard-Risset glissando hybrid, concludes with a solo piano passage evoking Ravel's *Une Barque sur l'Ocean* (1905). I decided to resolve the never-ending descent with a quotation as I felt it marked an interesting and timely shift in mood. I chose to quote this piece in particular as I felt the music shared the same aesthetics of the music of French composers to come. Ravel's interest in imitating ocean currents through the use of arpeggiation and sweeping melodies, seemed strikingly similar to Murail's interest in portraying Mongolia's Gobi Desert and the mountain landscapes of Tibet in *L'Esprit Des Dunes* (1993/94).

Quotations of hymns and popular music tunes in music composition have always fascinated me, especially when they are done through parody or pastiche. The quotation of the *The*

[62] **Shepard, R. N.** (December 1964) Circularity in Judgements of Relative Pitch. *Journal of the Acoustical Society of America* 36, 2346.
[63] **Ibid.**
[64] **Ibid.**

Streets of Cairo melody in *Scherzo* for String Quartet by Charles Ives is a strong example of the wit a musical quotation can fashion. Charles Ives managed to communicate his profound reverence for the American natural world by incorporating quotations into many of his musical portraits[65]. In fact, these quotations of American popular music are among the primary reasons for Ives's distinctly American sound[66]. The use of quotation to portray the American world in Ives's work inspired me to quote *Une Barque Sur L'Océan*, with the aim of evoking a French sound.

The use of quotation is not very common in minimal and spectral composition. Gérard Grisey's *Vortex Temporum I, II, III* (1994-96) grows from an arpeggio motive, derived from Maurice Ravel's *Daphnis et Chloé* (1912), but the reference is hardly noticeable. Steve Reich has admitted to having only taken direct reference from existing music twice before 2012's *Radio Rewrite*[67]. Reich's modest contributions to this genre are his 1995 vocal work, *Proverb*, which draws from the 12th-13th century composer Pérotin and *Finishing the Hat* (2011), which draws from musical writer Stephen Sondheim[68]. Today, we live in an age of remixes where musicians take audio samples of other music and remix them into audio of their own[69]. My approach to quotation in *Bolt the Cabin Fever* can be perceived as a miniature remix of *Une Barque Sur L'Océan*, as illustrated in the two figures on the following page.

[65] **Trump III, K. M.** (March 2014) *Methods of Place Portrayal in the Music of Charles E. Ives*. Thesis for the Degree of Bachelor of Arts in Music Washington and Lee University Lexington, Virginia, p. 3
[66] **Ibid.** p. 3
[67] **Steve Reich**: *Radio Rewrite* (programme note) Accessed on: https://www.boosey.com/cr/music/Steve-Reich-Radio-Rewrite/54072 (Accessed 04/11/2018).
[68] **Ibid.**
[69] **Ibid.**

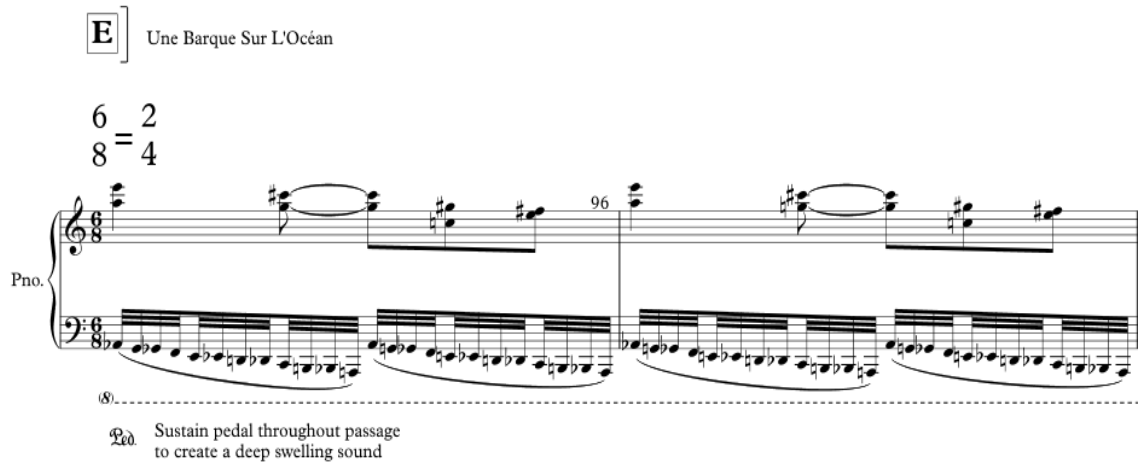

Fig. 19: Screen shot of the piano line bb. 96-97of *Bolt the Cabin Fever,* where the *Une Barque sur l'Ocean* quotation can be found

The left handed material in Figure 19 above differs to the Ravel arpeggios perceivable in Figure 20 below:

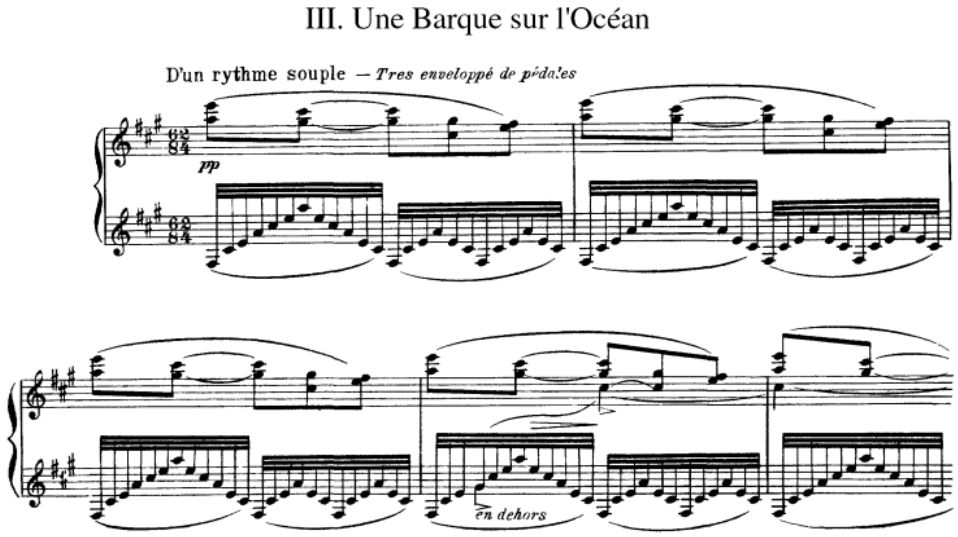

Fig. 20: Screen shot of the opening of *Une Barque sur l'Ocean* bb. 1-5

Dissimilarity between the original material and quotation is present as the Shepard tone effect dovetails into the quotation. It was my intention to draw on the melodic fragment and work it into my own language somewhat, as can be seen by the similarity of the right-hand line in

both scores. In using the opening of one of Ravel's most well-known pieces, I was striving for a more explicit approach to quotation than Reich's and Grisey's.

Another important part of *Bolt the Cabin Fever* is the move towards microtonal features in the harmonic language of the work, which are gradually introduced as the piece progresses. Between the beginning of the piece and rehearsal mark '**C**', the microtonal material is derived from the use of ring modulation. The use of ring modulation in this work differs to that in previous pieces of the portfolio in that it now acts as a call-and-response cell occuring throughout the Harrison-inspired loops. In practical terms, the loops which contain microtonal language are providing the sum and difference tones of pitches in the loops that precede them. For instance, the '**x3**' loop on page 6 (bb. 13-15) of the *Bolt the Cabin Fever* score contains 'Couleurs' of the 'Signal' pitches found in the preceding '**x4**' loop (bb. 9-12), as demonstrated in Figure 21 below:

Signals (x4 Loop bb. 9-12)	**Les Couleurs (x3 Loop bb. 13-15)**
E4 329.63 Hz (flute) B ♭ 2 116.54 Hz (cello)	Sum is 446.17 Hz (A4 plus 24 cents on viola) Difference is 213.09 Hz (G#3 plus 45 cents on cello)
F#4 369.99 Hz (flute) C3 130.81 Hz (cello)	Sum is 500.8 Hz (B4 plus 24 cents on violin) Difference is 239.18 Hz (A#3 plus 45 cents on cello)
G4 392 Hz (flute) C#3 138.59 Hz (cello)	Sum is 530.59 Hz (C5 plus 24 cents on violin) Difference is 253.41 Hz (B3 plus 45 cents on cello)
A4 440 Hz (violin) D#3 155.56 Hz (cello)	Sum is 595.56 = (D5 plus 24 cents on violin) Difference is 284.44 Hz (C#4 plus 45 cents on viola)

Fig. 21: Table displaying sum and difference calculations in *Bolt the Cabin Fever*

This process of call and response between signals and 'couleurs' repeats itself until the arrival of the Shepard tone at rehearsal mark '**C**', when the superimposition of the two modes takes full control of the musical language.

As I wanted a substantial change to occur at the conclusion of the Shepard tone effect, quartertone equal temperament returns but this time it is in the foreground of the piece for the first time, at rehearsal mark '**F**'. Gérard Grisey's music is often stated as "*crossing the thresholds of sound and space*"[70] and I feel this change in the score between '**E**' and '**F**' brings this principle to bear on the music of *Bolt the Cabin Fever*.

Rehearsal mark '**G**' on page 19 of the score marks the beginning of the culmination. The piece concludes by using fragments from the looped material between rehearsal marks '**A**' and '**C**'. For example, b. 110 is a fragment of the material in the second '**x3**' loop found on page 8. The goal here was to continue the challenging of time and space perception generated by the Harrison-inspired loops seen in the opening. In giving snippets of the previously stated loops, the listener perceives resonances of what they heard earlier on in the piece. My intentions here were to create a sense of orientation towards the end of the piece, after the listener's ears have been overwhelmed by the seemingly never-ending descent of the Shepard tone effect.

6.3 A Seamless Collage

Bolt the Cabin Fever is a seamless collage of spectral and minimal influences. The piece offers an innovative interpretation of the Shepard tone effect through minimal figures, Messiaen-inspired modes, ring modulation and Harrison-inspired loops, the combination of which I feel resulted in a unique development of my individual compositional language. *Bolt the Cabin Fever* effectively shows that a reliance on techniques from past and present composers can still result in the creation of new sound worlds, and supports the exploration of these in this research context.

[70] **Service, T.** (18/03/2013). A guide to Gérard Grisey's music. *A Guide to Contemporary Classical Music*, The Guardian Website. Available at: https://www.theguardian.com/music/tomserviceblog/2013/mar/18/gerard-grisey-contemporary-music-guide (accessed 06/10/2018).

I believe *Bolt the Cabin Fever* offers an interesting look at the use of repetition in both spectral and minimal composition. I believe Harrison's attempt to play with the listener's memory and perception of time is extremely similar to Grisey's compositional approach in *Vortex Temporum I, II, III*, which is investigated further in a piece to come: *South Bound Chug*[71].

Whilst I was putting the finishing touches to *Bolt the Cabin Fever*, I attended a conference in Oxford University entitled '**Spectralisms**', which took place between the 14th and 15th of March 2017. The conference aimed to examine a broad gamut of critical issues springing from the idea of spectral music[72]. The title '**Spectralisms**' (in the plural) reflected the conference organisers' wish to encourage discussion of the topic from the widest possible range of critical perspectives[73]. The conference took place when I was at the halfway point in my research, and the conference proved to be both extremely beneficial and an inspiring experience in my overall research pathway during the doctoral project. The keynote speech delivered by Tristan Murail placed a particular emphasis on the phenomenology of perception and the central role of hybrids in music. I believe the second half of my research was partly inspired by these words.

[71] Section B) Pieces *CHAPTER IV – Metric Modulation and Temporal Perception* p. 65 of thesis
[72] **Cross, J.** (2017) *Spectralisms: Oxford University Faculty of Music*, University of Oxford Faculty of Music. Available at: https://www.music.ox.ac.uk/spectralisms/ (accessed August 2018).
[73] **Ibid.**

CHAPTER III – The 'Underwater' Sound: Non-Harmonic Spectra

7) Pool Piece

7.1 Instrumental Synthesis of Extended Techniques

Pool Piece was composed for the first 'Ensemble ICC' concert, which took place in April 2017. Ensemble ICC is an ensemble of performers and composers made up of members from the Irish Composers' Collective. For this concert the ensemble took the shape of a string quartet of sorts: two violins, cello and electric guitar. I performed the electric guitar parts for this piece with additional effects pedals.

My aim was to carry out two types of spectral analysis in *Pool Piece*. The first spectral analysis was a further study of how the instrumental synthesis of extended techniques could be carried out, a technique which had been first touched upon in *Flies on Butter*. I was intrigued to further explore this instrumental synthesis as I wanted to create a composition whose goal was to display the instrumental synthesis of an extended technique, in the context of a miniature.

My role as a performer influenced my decision to have all of the extended techniques played on an electric guitar tuned to a scordatura. This scordatura is derived from the results of the second type of spectral analysis present in *Pool Piece*, which explores the instrumental synthesis of a natural sound. My involvement as a performer in guitar-driven bands over the last decade has influenced me to explore a wide range of scordatura and techniques, influenced by the likes of Sonic Youth and Glenn Branca.

The concert took place on the 29th of April 2017 in the IMRO Copyright House, Pembroke Row, Dublin.

7.2 Structure, Extended Techniques and Scordatura

Pool Pieces consists of four miniatures:

1. *Entrance*
2. *Lathering on the Cream*
3. *Lounging on the Sunbed*
4. *Underwater*

Throughout all four miniatures, the electric guitar's extended techniques are treated as if they were the tape line that the two violins and cello either follow or respond to. The electric guitarist is told to prepare two processes which are referred to as "sounds" in the performance directions through the use of effects pedals. **Sound 1** makes use of an unspecified distortion pedal, with the caveat that it is imperative that there is a dynamic balance with the strings when the pedal is switched on. **Sound 2** relies on the use of an unspecified delay or reverb pedal, on which the performer can manually alter the 'Delay' and 'Feedback' rate in order to create a sustained effect which does not contain any echoes. This is achieved by having the 'Delay' function turned down low and the 'Feedback' function turned up high on the pedal.

I chose to use a distortion and a reverb/delay pedal in particular as I knew from my own practice that they would accentuate the electric guitar's extended techniques in the way that I wanted. For instance in the first miniature *Entrance,* the electric guitar material plays natural harmonics on the 4^{th}, 7^{th}, 9^{th} and 12^{th} frets whilst **Sound 1** is engaged. The use of a distortion pedal helps voice the natural harmonics on the 4^{th} and 9^{th} frets in particular. This is because the pedal alters the electric guitar's sound by clipping the signal, adding both sustain and

harmonic and inharmonic overtones. Clipping is the attempt to deliver an output voltage or current beyond its maximum capability[74].

The second miniature, *Lathering on the Cream*, relies on playing before the bridge whilst shaking the vibrato bar. When a string is strummed in this position a very short and high pitched note is produced. *Lathering on the Cream* makes use of **Sound 2** in order to create a sustained droning sound out of these normally short notes. Once again, the effects pedal is used in order to accentuate the typically subtle extended technique.

The following figures and table demonstrate my compositional approach to the electric guitar's extended techniques in the first two miniatures; *Entrance* and *Lathering on the Cream.*

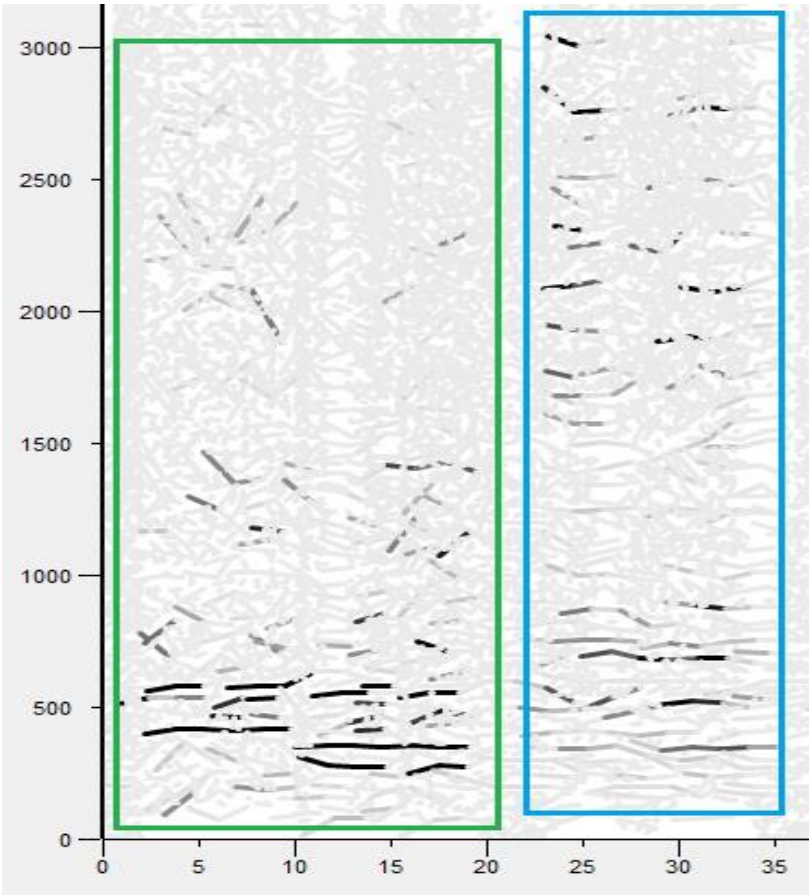

Fig. 22: This figure displays the recordings of the aforementioned extended techniques transferred onto SPEAR. The green box illustrates the recording of the distorted harmonics technique used in *Entrance*. The blue box depicts the recording of the 'before the bridge' technique used in *Lathering on the Cream*

[74] **Prof. John Gibson:** *Introduction to MIDI and Computer Music: Clipping*, Indiana University Jacobs School of Music. http://www.indiana.edu/~emusic/361/clipping.htm (Accessed on 08/10/2018).

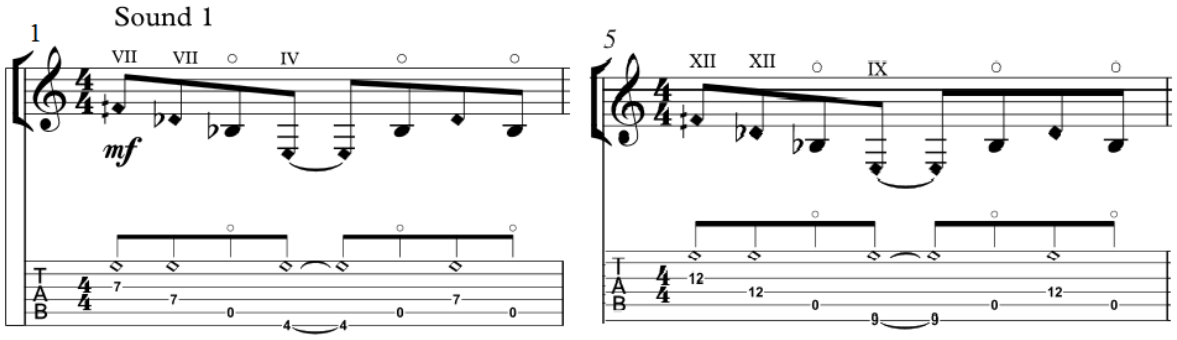

Fig. 23: Transcribed version of the distorted harmonic recording in the 'green box' of Figure 22, and its position in score (b. 1 and b. 5)

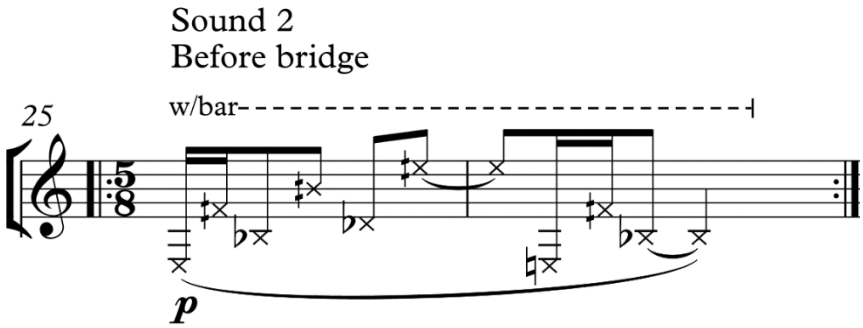

Fig. 24: Transcribed version of the 'before the bridge' recording in the 'blue box' of Figure 24, and its position in score (b. 25)

Figures 23 and Figure 24 display the transcribed versions of the recordings I had made of the extended guitar techniques. These transcriptions were later added to the score, as can be seen by the bar numbers in both of these figures. Figure 25 below shows the results of these analyses in notated form:

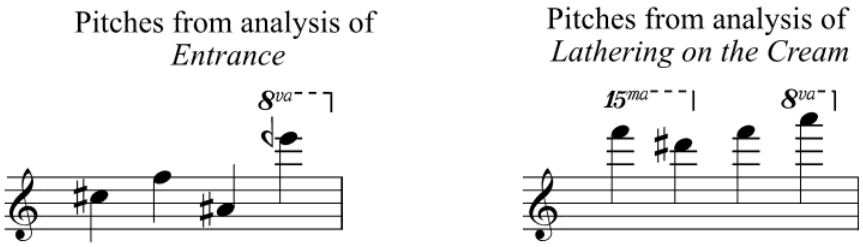

Fig. 25: Notated results of the *Entrance* and *Lathering on the Cream* analysis

It is important to note that E6-minus-41-cents, the only microtone inherent in the results of the analysis, is approximated by quarter-tone equal temperament in the score (E¼b6). The pitch is played as an artificial harmonic by the first violin bb. 13-16, by the second violin bb. 16-19 and by the cello bb. 22-24. This microtone is the only pitch from the analysis to be shared across the three stringed instruments, as illustrated by the following table:

Analysis of *Entrance* Results (Location in Score)	**Analysis of *Lathering on the Cream* Results (Location in Score)**
276 Hz: C#4 minus 7 cents (Unused)	2760 Hz: F7 minus 21 cents (Unused)
348 Hz: F4 minus 6 cents (Violin I / Bar 9)	2500 Hz: D#7 plus 8 cents (Violin II / Bar 25)
232 Hz: A#3 minus 8 cents (Violin I / Bar 5, Violin II / Bar 9)	696 Hz: F5 minus 6 cents (Unused)
1288 Hz: E6 minus 41 cents (Violin I / Bar 13, Violin II / Bar 16, Cello / Bar 22)	1765 Hz: A6 plus 5 cents (Violin I / Bar 25)

Fig. 26: Table showing where the pitches of Figure 29 are present in the score

Figure 26 above, shows the results from the analysis of the extended guitar techniques in *Entrance* and *Lathering on the Cream* and where they can be found in the score on the violins and cello. The 'unused' pitches were ignored for aesthetic reasons. For instance, the C#4 unveiled in the *Entrance* analysis was omitted due to the fact it is played by the 7th fret harmonic on the 4th string of the electric guitar part. My intention was to bring the less audible pitches of the electric guitar's extended techniques to the foreground on the other stringed instruments, meaning there was no need to double the C#4 / Db4 on the strings.

At one of the first workshops, I asked the violinists to sustain the pitches from the *Lathering on the Cream* analysis above of my own guitar playing, taking note of the pitches that I wanted to use, and those I wanted to disregard. Pitches F5-minus-6-cents and F7-minus-21-cents were omitted for the reason that I believed D#7 and A6 offered a more intriguing instrumental synthesis of the electric guitar's extended technique.

In the third miniature, *Lounging on the Sunbed*, the focus changes from the instrumental synthesis of extended techniques to a division of the quartet into two short duets, the first occurring on the violins bb. 27-32. During this passage, the first violin emphasizes the E6-minus-41-cents microtone from the *Entrance* analysis, by repetitively sliding up to the note. My aim here was to accentuate the microtone inherent in the analysis without the presence of the source material. Namely, the microtone is now heard unaccompanied by the electric guitar's extended technique.

The second duet is played by the electric guitar and cello and occurs bb. 33-38. In these bars, the instruments accentuate the sliding nature of the first duet through the use of a pick scrape on the electric guitar and a 'pick a string and *gliss*' technique on the cello. The freedom to choose any string and *glissando* emphasizes the sometimes improvisational nature of my own performance style.

As well as this, I have always been fascinated by compositions which are open to the performers' interpretation, an attribute of some of La Monte Young's compositions. *The Second Dream of the High-Tension Line Stepdown Transformer* from *The Four Dreams of China* (1962), is based on four pitches (G, C, C#, D), and limits as to which may be combined with any other[75]. Most of his pieces after this point are based on select pitches, played continuously, and a group of long held pitches to be improvised upon[76]. The La Monte Young influence on the short second duet of the third miniature can be perceived as a way of transitioning into the Young-inspired drone of the final fourth miniature.

The fourth and final '*Underwater*' miniature focuses on the instrumental synthesis of the underwater sound humans hear when submerging their heads in a pool, sea or ocean. The

[75] **Thatcher, L.** (04/04/2012) La Monte Young: The Black Record- Layer Upon Layer of Sound. *Music Reviews* Available at: https://lisathatcher.com/2012/04/04/la-monte-young-the-black-record-layer-upon-layer-of-sound/ (accessed on 08/10/2018).
[76] **Ibid.**

recording of the underwater sound was taken from a popular meditation video accessible on YouTube[77]. I chose to analyse this sound because I felt it would be interesting to carry out the synthesis of a natural sound. I chose the underwater sound as I felt there was potential in its droning nature. Interestingly enough, this final miniature was the first to be composed and is the reason for the scordatura on the electric guitar throughout all four miniatures. This is due to the fact that in order to make the pitches of the underwater sound playable, the tuning of the guitar has to be changed from standard.

The following figures and table illustrate the analysis of this underwater sound and how the results influenced the use of a scordatura on the electric guitar.

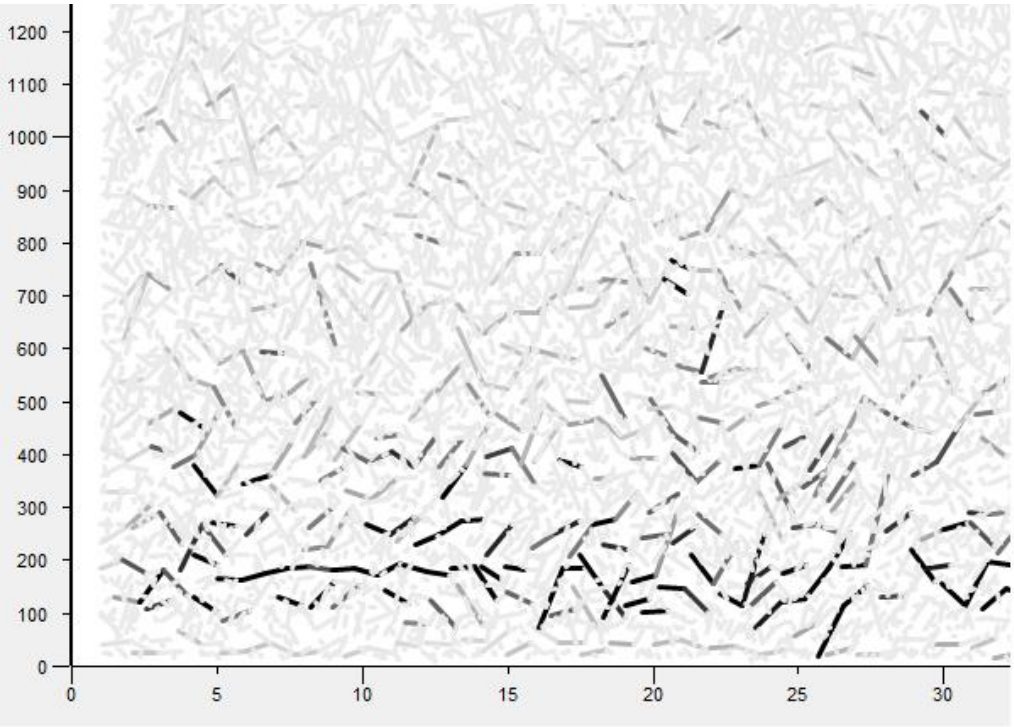

Fig. 27: A screenshot displaying the SPEAR analysis of the 'underwater' recording

[77] **BFM Digital** (2009) *Meditation from Underwater* (YouTube video online). Available at: https://www.youtube.com/watch?v=yH5swYxpWv4 (accessed January 2017).

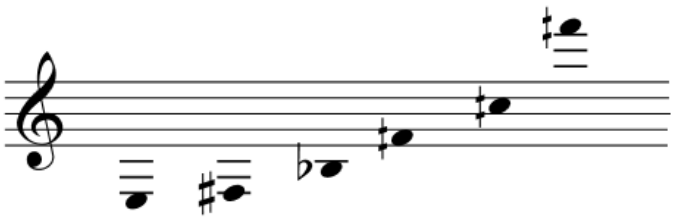

Fig. 28: Notated results of the 'underwater' recording analysis

Figure 28 above demonstrates the results of the 'underwater' recording analysis. There is a striking similarity between these results and the electric guitar's scordatura, as illustrated by the following figures 29 and 30:

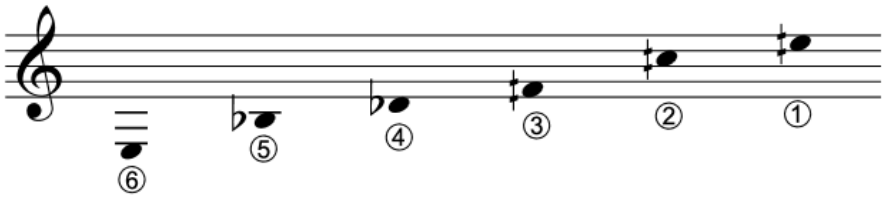

Fig. 29: Scordatura of electric guitar in *Pool Piece*

Standard Tuning	**Scordatura In *Pool Piece***
E1	E¼#1
B2	B¼#2
G3	F¼#3
D4	Db4
A5	Bb5
E6	E6

Fig. 30: Table illustrating difference with standard tuning

This planned similarity between the electric guitar's scordatura and the results of the spectral analysis in the fourth miniature meant that there was a satisfying common thread between the two types of spectral analysis across the four miniatures. The electric guitar's extended techniques in the first two miniatures are either distorted natural harmonics or 'before the

bridge' strums, meaning the extended techniques are tied in with the tuning, and therefore also tied in with the spectral analysis of the 'underwater' sound.

The table in Figure 31 below shows how the pitches from the spectral analysis of the 'underwater' recording have been translated into the score in the final miniature.

Pitch	Instrument
E2 – F#2	Electric Guitar
Bb2	Electric Guitar / Cello
F#3 minus 47 cents (180 Hz)	Open string of Electric Guitar / Violins
C4 plus 42 cents (268 Hz)	Violins
F5 plus 43 cents (716 Hz)	Violins

Fig. 31: Table showing allocated instruments for the pitches from the spectral analysis of the 'underwater' recording

The electric guitar in this final miniature plays a chord before turning up the volume dial on the body of the instrument, producing both an interesting fade-in and fade-out sound. This technique with the additional '**Sound 2**', results in a swelling sound indicative of the underwater drone.

7.3 My Role as a Performer

Pool Piece advances my research by exploring the impact my role as a performer has on my compositional practice. *Pool Piece* has a particular focus on extended techniques, which play a significant part in my own electric guitar performance style. The instrumental synthesis of extended techniques was first investigated in *Flies on Butter* but I felt that due to the composition's use of ring modulation and other techniques, the instrumental synthesis took a secondary role in the overall composition. In miniatures *Entrance, Lathering on the Cream* and *Lounging on the Sunbed* the synthesis is the primary focus, which is accentuated by their one-dimensional, minimalistic nature. As well as this, the extended techniques are derived from my own practice; in contrast to *Flies on Butter* I am not sampling techniques from

another composer. In *Pool Piece*, the extended techniques typical of my playing style created an original source from which the instrumental synthesis was born.

8) Sous l'Eau

8.1 A Different Approach to the 'Underwater' Sound

Sous L'Eau is written for two electric guitars and one electric bass. I decided to choose this instrumentation as I was intrigued to further explore my role as a performer and the potential impact it could have on my compositional process and research. I believe the use of various extended techniques on the electric guitar in *Pool Piece*, resulted in an original sound-world when coupled with my minimal and spectral influences. It was for this reason that I felt inspired to expand on some of the interesting gestures and sounds of *Pool Piece*.

Sous L'Eau is built from the same harmonic content of the final miniature of *Pool Piece.* I decided to review this material as I wanted to create a new context for the 'underwater' sound. When underwater, any sound heard exhibits elements of a drone and it is hoped that this is the sense you get from the *Underwater* sketch in *Pool Piece*. I thought it would be interesting to take this sound out of its natural state and warp it into something new, before unveiling it for what it is during the latter stages of the new piece.

The additional second electric guitar meant I could add cross rhythms and double certain pitches when I wanted to, offering more freedom. I decided to also use an electric bass as I wanted to expand on the range of the harmonic content.

I composed the piece knowing that I would eventually record all the parts myself, using a H6 Zoom microphone and my laptop. The recording took place during the course of July 2018. The score presented in this portfolio is the sounding score; I have included a 'performance' score for the piece in the appendix.

8.2 Methodology

As stated , the harmonic content of *Sous l'Eau* is based on *Underwater*; the fourth miniature of *Pool Piece*. It is for this reason that both of the electric guitars are tuned to the same scordatura as the one used in *Pool Piece*.

It is important to note that the electric bass in *Sous l'Eau* also uses scordatura:

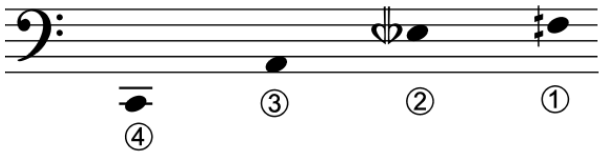

Fig. 32: The scordatura for the electric bass guitar in *Sous l'Eau*

Standard Tuning *Pitch and string number*	**Scordatura** **On Bass in Sous l'Eau**
G1	F¼#1
D2	E¾#2
A3	A3
E4	C4

Fig. 33: Table illustrating difference with standard tuning

Figures 32 and 33 above illustrate the three tuning changes to the electric bass strings in *Sous l'Eau*. The G string has been tuned down to an F quarter-sharp 3 as I wanted this particular microtone from the spectral analysis to be available on the electric bass guitar. The F quarter-sharp appears at two different octaves in the spectral analysis of the underwater sound, as illustrated in Figure 34 on the following page.

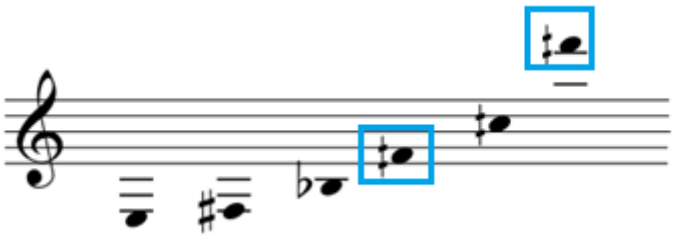

Fig. 34: Notated results of the 'underwater' recording analysis, prominence of F quarter-sharp highlighted in blue squares

This prominence of the F quarter-sharp in the analysis influenced my decision to have the pitch available to the bassist as an easily accessible open string.

The E string of the electric bass is tuned down to a C1 in order to expand the lower range of the instrument to its extremity. Even though the low E string has been tuned down a third, this intervallic distance between the E and the C is considered as moving up a sixth. Often in my compositions, I will create new material by picking a random number and finding a way to incorporate it into my compositional decision making. I decided to repeat the process of moving up a sixth across all the pitches of the spectral analysis, resulting in a faux transposition, as illustrated in the table below:

Spectral Analysis	**'Jumping up a sixth'**
E2	C3
Bb2	Gb3
F#3 minus 47 cents	D#4 minus 47 cents
C4 plus 42 cents	A4 plus 42 cents
F5 plus 43 cents	D5 plus 43 cents

Fig. 35: Table showing the jumping up 6 method applied to spectral analysis

This faux transposition influenced the tuning of the D string of the bass up to an E three-quarter flat 2 (which appears as D#4 minus 47 cents in the table). I wanted this note available on the electric bass as I wanted to be able to offer the development of the material associated

with the spectrum as time progressed. I knew that I wanted to have the harmonic content of the underwater analysis develop at some point in *Sous l'Eau*. This faux transposition of the spectral analysis can be construed as a return to Bryn Harrison's compositional technique of using recursive musical forms in order to challenge the perceptions of time and space by viewing the same material from different angles.

The decision to have all of the unveiled pitches of the 'underwater' analysis jump up a sixth is not the only example of numbers having a significant role in making compositional decisions. For instance, the opening 29 bars of the piece derive from a number game. The following lines have been transcribed from my notebook:

5/4 – 11/32 – 3/4 – 5/4 – 11/32 (x3) – 3/4

4/4 – 10/32 (5/16?) – (2/4 – 4/4= 6/4) – 10/32 (x3) – 2/4

3/4 – 9/32 – (1/4 + 3/4 = 4/4) - 9/32 (x3)-1/4

(2/4 + 4/16(1/8) =3/4) – 3/4 - 4/16 (x3)

1/4 – 7/32 – 2/4 – 7/32 (x3)

6/32 (3/16) – 1/4 – 6/32 (x3)

Fig. 36: Number game in the first 29 bars of *Sous l'Eau*

From looking at Figure 36 above, it can be seen that the pattern progresses through a subtractive algorithm in which every time signature loses one of its beats; 5/4 becomes 4/4, 4/4 becomes 3/4. The use of a number game to control the metre of a composition was inspired by similar compositional techniques used by Messiaen. In '*The Technique of My Musical Language*', written by the composer himself, Messiaen speaks of the use of rhythms with added values in his work, where a short value is added to any rhythm, whether it is a

note, rest or dot[78]. Specifically, where Messiaen was working with rhythm and addition in organ works such as *Les Anges* and *Les Bergers* from *Le Nativité du Seigneur* (1935), I was working with metre and subtraction in *Sous l'Eau*.

Messiaen's technique of 'rhythms with added value'[79] is also apparent in the *Sous l'Eau* score. For example, the first three note values of b. 30 and b. 35 in the second electric guitar line are a dotted-crotchet, quaver and crotchet, as can be seen in Figure 37 below:

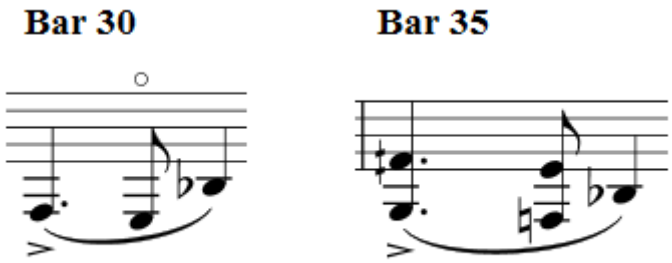

Fig. 37: b. 30 and b. 35 of the second electric guitar line in *Sous l'Eau*

Through the same added note value process Messiaen uses, the note values of figure 37 all receive an extra quaver beat and develop into a minim to crotchet to dotted-crotchet progression, as illustrated in Figure 38 below:

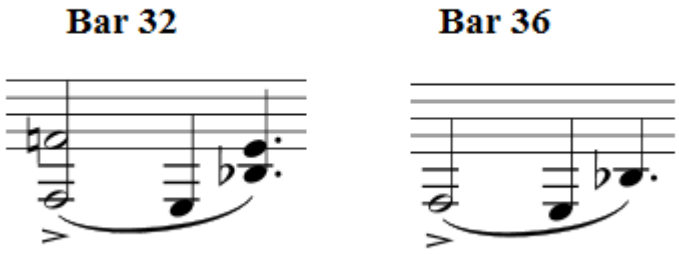

Fig. 38: b. 32 and b. 36 of the second electric guitar line in *Sous l'Eau*

[78] **Messiaen, O.** (1956) The Technique of My Musical Language, Alphonse Leduc, éditions musicales. Translated by John Satterfield, p.13.
[79] **Ibid**. p.7.

This development of the rhythmic material through adding values is used throughout the score and is not the only time *Sous l'Eau*'s musical language is inspired by the compositional techniques of Messiaen.

For instance, figures 37 and 38 are taken from the chordal texture bb. 30 to 37. This chordal passage marks the first moment in the score that there is a real exploration of notes outside of the spectral analysis of the 'underwater' sound's pitches. The purpose of these pitches (which sometimes amount to chords) is to create 'effects of resonance'[80] similar to the ones that Messiaen achieved in his use of 'chord clusters'[81]. In *Sous l'Eau*, pitches and chords outside of the 'underwater' analysis are superimposed above a droning F quarter-sharp (one of the pitches unveiled in the analysis) and its relative 'faux-transposed'[82] version; D three-quarter flat, on the electric bass guitar. This compositional decision was directly influenced by Messiaen's piano writing in *Cloches d'angoisses et larmes d'adieu* from *Préludes pour piano* (1928-29).

In *Cloches d'angoisses et larmes d'adieu*, Messiaen imitates the sound of bells through the combination of several different modes, the hum of the bell being provided by a low 'G' octave. The **B** cluster of chords in Figure 39 is written in the sixth mode of limited transpositions, the cluster of chords, **C**, in the second of these modes[83]. These two clusters of chords form a greater resonance of the chord, **A**[84]. In the case of the chordal texture of *Sous l'Eau*, the static bass figure provides a low humming sound while the electric guitars' harmonic material generates the 'effects of resonance'[85].

[80] **Messiaen, O.** (1956) The Technique of My Musical Language, Alphonse Leduc, éditions musicales. Translated by John Satterfield, p. 51.
[81] **Ibid.** p.51.
[82] See Figure 39 on p. 63 of thesis
[83] **Messiaen, O.** (1956) The Technique of My Musical Language, Alphonse Leduc, éditions musicales. Translated by John Satterfield, p. 51.
[84] **Ibid.** p.51.
[85] **Ibid.** p.51

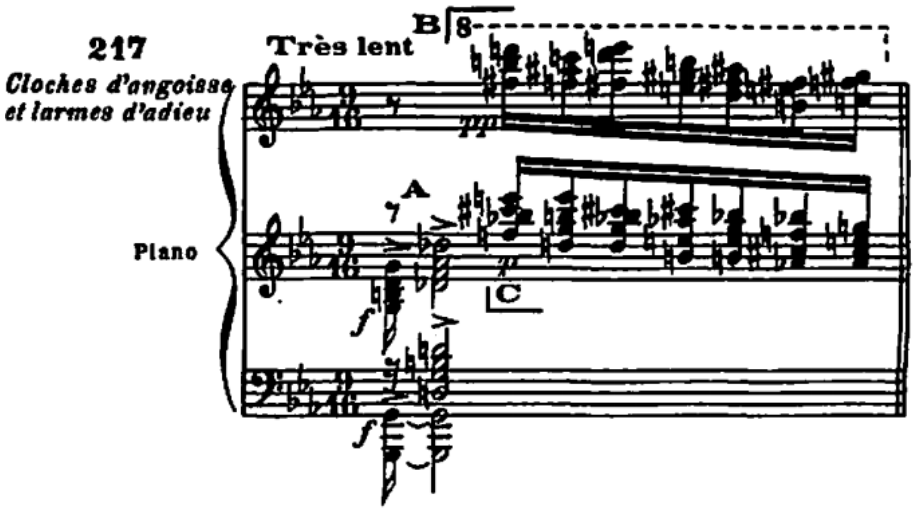

Fig. 39: Effects of resonance in *Cloches d'angoisses et larmes d'adieu*[86]

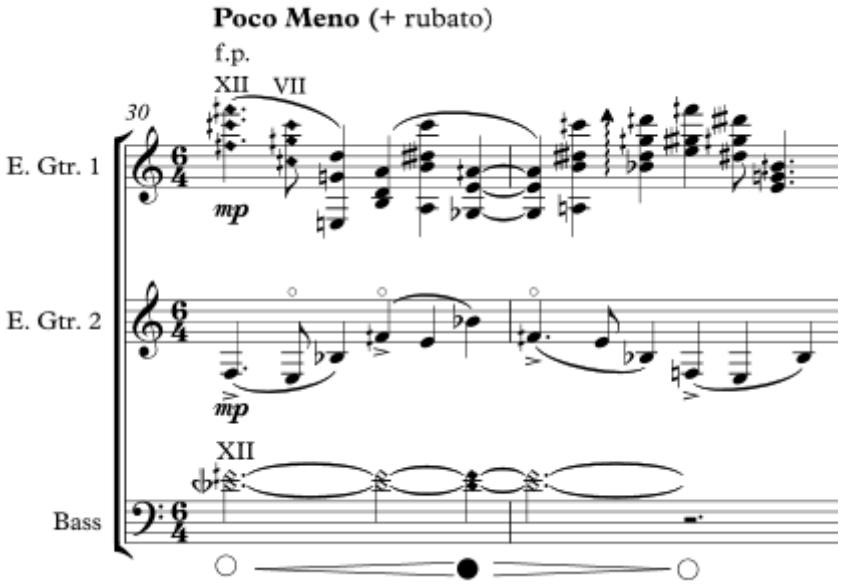

Fig. 40: Score extract from *Sous l'Eau* illustrating the 'chord of resonance' imitation on the electric bass (bb. 30-31)

The electric bass guitar's line in bb. 30-37 uses one of the many extended techniques apparent throughout the *Sous l'Eau* score. The playing of a note before turning up the volume dial on the body of the instruments produces an interesting fade-in and fade-out sound. This extended technique appears in multiple pieces of the portfolio (e.g. the electric guitar part in

[86] **Messiaen, O.** (1956) The Technique of My Musical Language, Alphonse Leduc, éditions musicales. Translated by John Satterfield, p. 38.

Bolt the Cabin Fever and the *Underwater* miniature of *Pool Piece*). I learned this technique from watching Tom Verlaine perform with 'Television' at a Vicar Street concert in Dublin. This technique is used by other electric guitarists but I could not find any use of it in minimal or spectral works. As well as this, I could not find any form of literature offering the correct way to notate this technique. It is for that reason that I decided to create my own, using an empty circle to signify for there to be no volume, and a black (or full) circle to signify full volume, as depicted in the score example below:

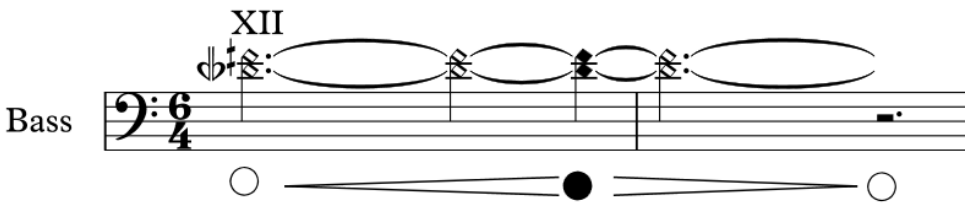

Fig. 41: b. 30 and b. 31 of *Sous l'Eau*. Score example of the 'fade-in'/ 'fade-out' technique used in multiple pieces of the portfolio

Sous l'Eau uses various electric guitar techniques inspired by the guitarists and bassists of American bands, but most importantly takes influence from the work of Glenn Branca, in particular his 1981 album *The Ascension*[87]. The album's title was chosen as a continuation of works by Olivier Messiaen and John Coltrane[88]. I believe this is quite telling as in *The Ascension*, Branca experiments with resonances generated by alternate tunings for multiple electric guitars[89]. Interestingly, the second half of the first track *Lesson No. 2*, bears a striking resemblance to the tolling of a bell.

Bars 38 to 59 are a crossover of Philip Glass's piano works and Sonic Youth's guitar sounds and is a strong example of the hybridism that exists in my work (as will be discussed further

[87] **Branca, G.** (1981) *Lesson No. 2* in *The Ascension* (Track 1, CD format) 99 Records.
[88] **Barry, R.** (2018) Rorschach Audio: Glenn Branca Discusses Reading, Writing & Volume. *The Quietus* Available at: https://thequietus.com/articles/12056-glenn-branca-interview (accessed 12/11/2018).
[89] **Foege, A.** (09/04/1995) POP MUSIC; Maestro of the Off-Key Guitars. *The New York Times*. Available at: https://www.nytimes.com/1995/04/09/arts/pop-music-maestro-of-the-off-key-guitars.html?pagewanted=all (accessed 12/11/2018).

in Chapter IV (p. 70))[90]. The triplets on the electric guitars imposed over steady quavers on the electric bass are indicative of Glass's piano writing in pieces such as *Mad Rush* (1979) and *Morning Passages* from the soundtrack of *The Hours* (2002). In these pieces the right hand predominantly uses tuplets whilst the left hand employs steady quavers. The use of scordatura on the guitar coupled by minimal figures gives rise to an interesting expression of the original 'underwater' spectrum.

8.3 Sum and Difference Tones

Sous l'Eau further investigates the use of combination and difference tones in order to ameliorate the harmonic material, with ring modulation and Vivier's c*ouleurs* once again playing an integral role.

Signals	***Les Couleurs***
Bar 13 268 Hz: C4 plus 42 cents = E.Gtr.2 716 Hz: F5 plus 43 cents = E.Gtr.1	*Bar 13* 448 Hz is difference: A4 plus 31 cents = E.Gtr.2 984 Hz is sum: B5 minus 7 cents = E.Gtr.1
Bar 16 82.41 Hz: E2 = E.Gtr.2 116.54 Hz: B flat 2 = E.Gtr.2	*Last note of Bar 16 / Bar 17* Difference tone left out 198.95 Hz is sum: G3 plus 26 cents = E.Gtr.1
Bar 13 448 Hz: A4 plus 31 cents = E.Gtr.2 984 Hz: B5 minus 7 cents = E.Gtr.1	*Bar 21* Difference tone left out 1432 Hz is sum: F6 plus 43 cents = E.Gtr.1
Bar 59 164.81 Hz: E3 = Bass 440 Hz: A4 = E.Gtr.1	*Bar 60* 275.19 Hz is difference: C#4 minus 12 cents = E. Gtr. 2 604.81 Hz s sum: D#5 minus 49 cents = E.Gtr.1
Bar 61 275.19 Hz: C#4 minus 12 cents = E.Gtr.2 604.81 Hz: D#5 minus 49 cents = E.Gtr.1	*Bar 61* 329.62 Hz is difference: E4 plus 0 cents = E.Gtr.2 Sum tone left out
Bar 88 / 89 130.81 Hz: C3 = E.Gtr.2 185.00 Hz: G flat 3 = E.Gtr.2	*Bar 91* 54.19 Hz is the difference: A1 minus 26 cents = Bass Sum tone left out

Fig. 42: Table: Mapping of *les couleurs* and ring modulation in *Sous l'Eau*

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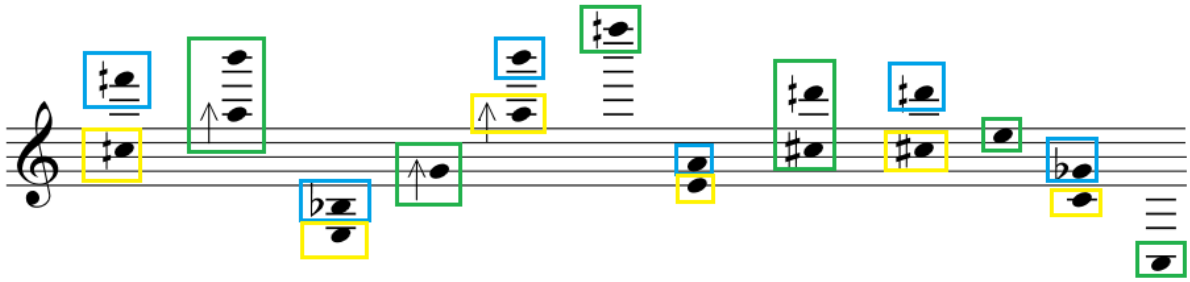

Fig. 43: The blue and yellow squares highlight the left-hand s*ignals* column, the green squares indicates *les couleurs* of the right-hand column

The *signals* column shows the two tones that are being fed into the computer simulated ring modulator, the *les couleurs* column shows the sum and difference tones of these two signals. My approach towards ring modulation in *Sous l'Eau* goes one step further than previous pieces. From looking at figures 42 and 43, it is clear to see that some of the resulting sum and difference tones (*couleurs*) are subsequently treated as signals in order to generate more harmonic material. As well as this, Bars 60–67 and 121–133 explore the use of ring modulation on gain pedals, as the pedal adds both sustain and harmonic and inharmonic overtones.

In all, *Sous l'Eau* offers a unique approach to the instrumental synthesis of an underwater sound. The piece is a collage of various ways the harmonic content of sonic 'drones' can be interpreted into new material. *Sous l'Eau* effectively shows that by continuing to explore how my own performance practice informs my compositional approach.

CHAPTER IV – Metric Modulation and Temporal Perception

9) South Bound Chug

9.1 Background

South Bound Chug was initially composed for the Earlsfort Brass Quintet as part of an ICC concert that took place on the 21st of November 2017 in Dublin's Wood Quay Venue. Following the performance of the piece, I decided to both extend the piece and to add a part for percussion, specifically a drum kit. Not content with the rhythmically loose nature of the piece, the supplementary drum kit line was added in order to create a stronger sense of beat. I made the choice of drum kit to further investigate the use of instruments typically associated with rock bands in the context of my own research. This use of a drum kit tallies with one of my overall artistic aims: to remain open to outside influences, to explore the inherent polystylism that exists in my work and to take inspiration from my experience as a performer. The title of the work is descriptive of a train or a boat, its engine's acceleration and deceleration playing an integral part in influencing the various tempi of the composition.

9.2 Temporal Perception and the Structure of the Piece

South Bound Chug's aim is to further investigate the manner in which Gérard Grisey manipulates temporal perception in *Vortex Temporum* (1994-96). This work explores three different quantitative temporal zones across three movements. In movement I, the listener is introduced to a short four note motif, taken from an arpeggio in the flute solo of Ravel's *Daphnis et Chloé* (1912). During this opening movement, the temporal perception is one of "normal time"[91]. In movement II, Grisey plays with the listener's perception of the Ravel arpeggios by slowing everything down. Grisey states that the listener's quantitative time in

[91] **Voss, E.** (2017) *Thoughts on Temporal Perception's Relativity in Grisey's Vortex Temporum and Voss's Perspectives*. Master in Music Diss., East Carolina University, p.14.

relation to the Ravel arpeggios expands; referring to the movement as being in "whale time"[92]. The third and final movement of *Vortex Temporum* is written in "insect time". Perhaps Grisey chose this name to draw parallels between the frantic movement of a flying insect and the swift changes occurring in the listener's perception of the Ravel arpeggios[93].

South Bound Chug investigates the manipulation of temporal perception by relying largely on metric modulation and a two-chord harmonic cell (bb. 1-109). Although evidently also minimalist in origin, the simple repetitive process of moving from one chord to another, over and over again, is to create a recursive musical form which plays the same role as the Ravel motif in *Vortex*. Similar to the Harrison-inspired loops in *Bolt the Cabin Fever*, the metric modulations in *South Bound Chug* are an exploration of how musical time can be manipulated through the use of recursive musical forms. Simply put, the metric modulation is used in order to manipulate the listener's temporal perception of the unfolding of the two-chord cell.

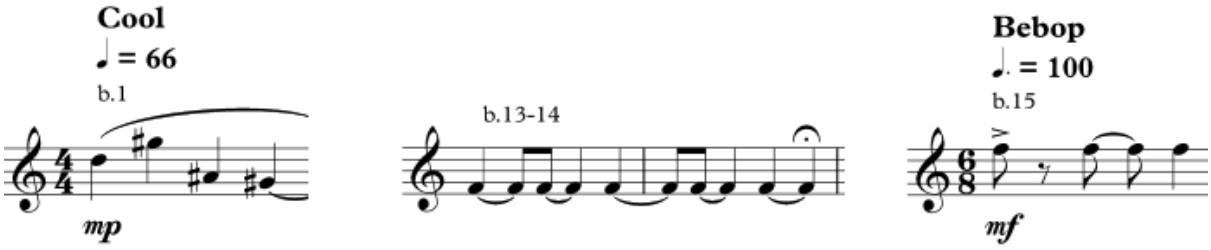

Fig. 44: Example of metric modulation in *South Bound Chug*: From left to right; the opening tempo of b.1, the pulse of the second trumpet line in bb.13-14, the new tempo of b.15

Figure 44 above demonstrates an example of the metric modulation apparent in *South Bound Chug*. The pulse in the second trumpet line bb. 13-14 anticipates the arrival of the new dotted crotchet beat in b. 15, and can be seen as a pivot or a bridge from the four crotchet beat that

[92] **Voss, E.** (2017) *Thoughts on Temporal Perception's Relativity in Grisey's Vortex Temporum and Voss's Perspectives*. Master in Music Diss., East Carolina University, p.14.
[93] **Ibid.** p.15.

has preceded it. Figure 44 illustrates one of the many tempo changes that occur within the opening 109 bars of the piece. The constant changes in tempi and the use of two repetitive chords is evocative of Grisey's frantic "insect time".

"Whale time" is implemented in a reimagined form at b.110 of *South Bound Chug*. Harmonic deceleration was not needed as this had already been achieved by the sense of movement in "insect time". In its place, the brass instruments use plunger mutes and lip bends and the compositional focus shifts from pulse to timbre. This shift in focus is indicative of the extensive use of manipulated harmonic spectra Grisey uses in *Vortex Temporum*'s "whale time"[94].

Bars 130 to 145 are essentially a jazz-influenced drum solo. Eager to further explore the use of other styles in the context of my research, the solo implements the explosive playing style of Art Blakey, taking a particular influence from the hard driving energy of his drumming in *A Night in Tunisia*[95]. Blakey's style is translated into the solo with the use of a fast tempo, heavy accentuation of the last beat of the bar and the incorporation of the hi-hat as an independent rhythmic voice[96]. The drum solo seamlessly fits into this piece of art music as it marks a crucial moment in the piece. The fact that this passage is a solo means that the listener can no longer hear the recursive musical form of the two-chord cell, shifting the focus of the piece from harmony to rhythm and timbre. The drum solo marks the moment in the piece where the listeners are offered a moment of rest from the constant manipulation of temporal perception that has preceded.

South Bound Chug finishes by superimposing elements on top of one another, reusing rhythms and figures from previous parts of the piece. The ending (bb. 146-220) deviates from

[94] **Voss, E.** (2017) *Thoughts on Temporal Perception's Relativity in Grisey's Vortex Temporum and Voss's Perspectives*. Master in Music Diss., East Carolina University, p.14.
[95] **Blakey, A.** (1960) *A Night in Tunisia* (CD Format) Blue Note.
[96] **Stern, C.** (1984) On the Cover Art Blakey. *Modern Drummer*. Vol. 8, No. 9. Available at: https://www.moderndrummer.com/article/september-1984-art-blakey (accessed 15/11/2018).

trying to convey any specific temporal perception, and instead works around the combination of elements from various parts of the piece. When the second trumpet line joins the drum solo at b.146, the piece becomes rich with flowing jazz melodies. The two trumpets play off one another in a manner reminiscent of Miles Davis and John Coltrane musical duels; the former's more melodic and lyrical trumpet lines being interrupted by the latter's unusual saxophone flourishes and rhythmic fanfares cutting through the structure of the tune[97]. The ending also includes many 'circle of fifth' chords; this quintal harmony offers a stark contrast to the static two chord focus perceived up until this point.

9.3 Hybridism

South Bound Chug is a melting pot of different influences, with the music of Bryn Harrison, Art Blakey, Gérard Grisey and Charles Ives all playing their part. This idea of hybrid music was spurred by a famous Murail quote about how both himself and Grisey sought to define the spectral movement more broadly[98]. They both viewed spectralism as a collection of ideas and attitudes about composition, placing particular emphasis on the phenomenology of perception and the central role of hybrids and thresholds in their music[99].

> "*For me, this fascination with transforming objects and creating hybrids was always there: it's almost congenital. I think retrospectively that this idea, coupled with the importance I (and others) place on working with harmony in a way that completely controls it – giving strength to the formal construction – were the basic ideas of spectral music*" - (Murail, 2000)[100].

The additional jazz influences apparent in *South Bound Chug* are an indication of the direction my research was heading in. The creation and exploration of musical hybrids was to

[97] **Kahn, A.** (2016) Miles Davis and John Coltrane – Yin and Yang. *Jazzwise Magazine*. Available at: http://www.jazzwisemagazine.com/artists/14198-miles-davis-and-john-coltrane-yin-and-yang (accessed 15/11/2018).
[98] **Lehman, S. H. (2012)** '*Liminality as a Framework for Composition: Rhythmic Thresholds, Spectral Harmonies and Afrological Improvisation*' PhD Diss., for Columbia University, p.2.
[99] **Ibid.** p.2.
[100] **Ibid.** p.2.

become a useful creative impetus for future pieces in the portfolio; as a head-on confluence of spectrominimalist concerns with other influences as diverse as jazz and brass quintets, *South Bound Chug* occupies an important position in the overall context of my research.

10) Freedom Tunnel Portrait

10.1 Linear Momentum

Freedom Tunnel Portrait was written for percussionists Brian Dungan and Alex Petcu as part of an ICC concert that took place on October 23rd 2017 in Dublin's Wood Quay venue. This particular ICC concert was part of the collective's 'In Dialogue' project, a unique series of concerts in which five premieres would be featured as a response to a central work from an established composer. For this concert, the requirements were to write a response to Steve Reich's *Nagoya Marimbas* (1994). Although this piece was performed before the brass quintet concert, it was composed after I had completed *South Bound Chug*.

Dungan and Petcu's instrumentation consisted of marimbas, aluminium pipes, pieces of wood, floor toms, trash metal cymbals, splash cymbals and bongos. Since unpitched percussion is typically used to maintain a rhythm or to provide accents, and its sounds are often unrelated to harmony, there were quite a few limitations in the context of my own spectral concerns. It is for this reason that metric modulation once again plays an integral role. However, unlike in *South Bound Chug* where the end game was to manipulate the temporal perception of the listeners, *Freedom Tunnel Portrait* deploys metric modulation in order to create a linear momentum within the minimal figures. This particular technique is a reaction to Philip Glass's words on non-linear minimalism and the different kind of listening mode he refers to in his writings about *Music in Twelve Parts* (1971-1974):

> "*The music is placed outside the usual time-scale substituting a non-narrative and extended time-sense in its place.…When it becomes apparent that nothing "happens" in the usual sense, but that, instead, the gradual accretion of musical material can and does serve as the basis of the listener's attention, then he can perhaps discover another mode of listening - one in which neither memory nor*

> *anticipation…have a place in sustaining the texture, quality or reality of the musical experience".* (Mertens, 1983, p.79)[101]

I believe the different mode of listening Glass refers to is often associated with early minimalism but is also evident at performances of Reich's *Nagoya Marimbas.* In essence, the particular focus of *Freedom Tunnel Portrait* is the creation of linear momentum to the *Nagoya Marimbas* inspired minimal figures.

The music sets the scene of night-time falling on the Amtrak tunnel under Riverside Park in Manhattan, New York City. The title is a reference to the former shantytowns built within this tunnel by homeless populations seeking shelter and the liberty to live rent-free and unsupervised by law enforcement. Since the setting is underground and hidden from any form of sunlight, the falling of night time on the shantytown is one of a different kind to the one above ground.

10.2 Methodology

Figures 45 and 46 on the following pages demonstrate the linear momentum generated through metric modulation in *Freedom Tunnel Portrait*. In Figure 45, the steady '♩= 60' beat has a dotted quaver rhythm pitted against it from bb. 6-10 in the second percussionist's part. This dotted quaver rhythm becomes the new pulse at Bar 11 '♩= *80*'. Figure 46 demonstrates what becomes of this new pulse in b. 11. A triplet rhythm is imposed on top of this pulse in bb. 16-21 in both percussionists' parts, before eventually becoming the new pulse at Bar 22 '*triplet* ♩= ♩ / '♩= *120*'. These examples of metric modulation illustrate the unique development of my individual compositional language towards minimal pulse.

[101] **Mertens, W.** quoted in Lee, R. A. (2016) Temporality as an analytical approach to minimalist music: Tom Johnson's An hour for piano. *Divergence Press*. Regis University, Colorado. Available at: http://divergencepress.net/articles/2016/10/19/temporality-as-an-analytical-approach-to-minimalist-music-tom-johnsons-an-hour-for-piano (accessed on 25/11/2018)

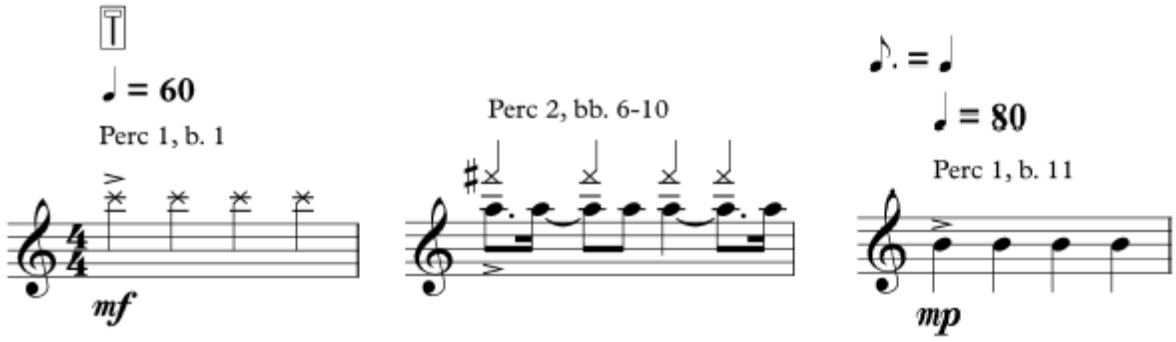

Fig. 45: First example of metric modulation in the opening of *Freedom Tunnel Portrait*. The steady '♩= 60' beat has a dotted crotchet rhythm pitted against it from bb. 6-10 in the second percussionist's part. This dotted crotchet rhythm becomes the new pulse at b. 11 '♩= *80*'

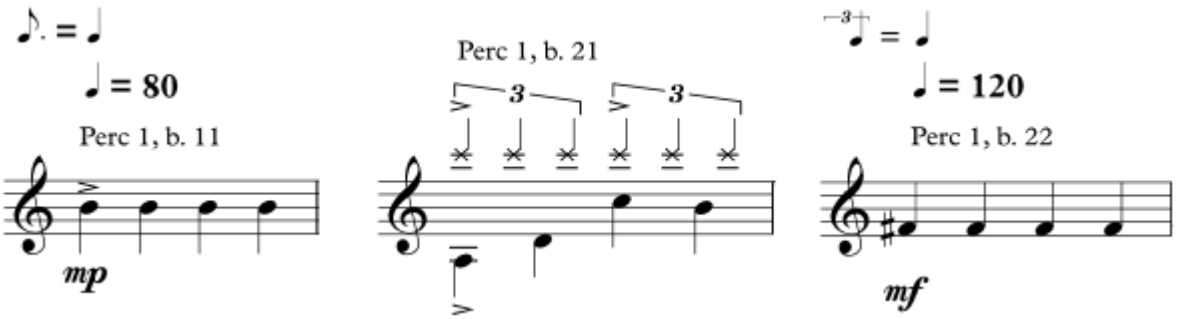

Fig. 46: Second example of metric modulation in the opening of *Freedom Tunnel Portrait*. A triplet rhythm is imposed on top of the new pulse before eventually becoming the new pulse at b. 22 '*triplet* ♩= ♩ / ♩= *120*'

These examples of metric modulation in *Freedom Tunnel Portrait* illustrate my willingness to represent both 'vertical' and undeniably linear aspects to my minimal figures, which results in a reconsideration of the nature of minimalism's idiosyncratic relation to time[102]. It

[102] **Bierns, Maarten.** (2016) Time, eternity and the problem of minimal music's alleged non-linearity in Louis Andriessen's De Tijd. *Divergence Press*. University of Amsterdam. Available at: http://divergencepress.net/articles/2016/10/19/time-eternity-and-the-problem-of-minimal-musics-alleged-non-linearity-in-louis-andriessens-de-tijd (accessed on 25/11/2018).

is for this reason that the resulting form of *Freedom Tunnel Portrait* is based on an **ABCDCDCDEB** structure, with the opening **ABCD** form providing a strong sense of progression and momentum.

The first 37 bars ('**A**') explore the combination of pulses and metric modulation as illustrated on the previous pages in figures 46 and 47. Section '**B**' can be seen bb. 38-41 and 96-107 (the end of the piece). This part of the piece plays with the relationship between the unfixed pitches of the combination of homemade percussion instruments (from aluminium pipes and pieces of wood), against the equally tempered pitches of the marimba. The particular timbre of the marimba encourages some blurring between discrete pitch material and percussive sound, due to its interesting overtones.

The composition alternates between fast bebop rhythms played on the bell of the splash cymbals ('**C**') and marimba rolls ('**D**') for a large portion of the piece. This repetitive **CDCDCD** passage explores the sense of stasis often associated with early minimalism. However, rather than generate stasis through the absence of linear progression, this passage of *Freedom Tunnel Portrait* creates linear stasis by simply moving back and forth between two sections. This works against the aforementioned **ABCD** opening where linear momentum is the primary focus. In a similar manner to *South Bound Chug*, my intentions were once again to play with the listener's expectations. My interest in the inclusion of both linear momentum (**ABCD**) and stasis (**CDCDCD**) was an attempt to manipulate the vertical time element often associated with the temporality of minimalism today. This was partly inspired by R. Andrew Lee's words on the analysis of vertical time:

> "*By analysing the creation of vertical time, and by allowing for the inclusion of some linearity, it is possible to explore the temporality of minimalism in a meaningful and specific way*" – (R. Andrew Lee, 2016) [103].

[103] **Lee, R. A.** (2016) Temporality as an analytical approach to minimalist music: Tom Johnson's An hour for piano. *Divergence Press*. Regis University, Colorado. Available at:

The fast bebop rhythms during this static **CDCDCD** passage illustrate my continued interest in the creation of hybrids. These jazz-influenced rhythms are played on the bells of the splash cymbals, and syncopate in a similar manner to the phasing process of *Nagoya Marimbas*. The marimba rolls can also be construed as a response to the musical language of *Nagoya Marimbas*, as they offer a contrasting sense of sustain.

Section '**E**' was designed as a chaotic ending to the constant alternation between the bebop cymbals and marimba roll textures, where both textures meet and the sound generated by both percussionists is at its most frantic and hectic. I adjusted some dynamic markings in the score post-performance due to certain balance issues. In particular, I had over-estimated the loudness of the *forte* dynamic in bb. 81-95.

10.3 An Exploration of Minimal Pulse

Freedom Tunnel Portrait highlights a unique development in my individual compositional style. The middle section of the piece bb. 42-78 (**CDCD**), which repeatedly transitions from Jazz-influenced rhythms and marimba rolls, demonstrates my willingness to engage with the phenomenology of perception and the central role of hybrids in music. The introduction of the jazz-like rhythms results in a departure from the piece's focus on pulse, and the resulting stagnation in the linear momentum leads to a unique sense of limbo. *Freedom Tunnel Portrait*'s form highlights another temporal structuring mechanism, one which allowed me to continue my exploration of, and fascination with, time.

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http://divergencepress.net/articles/2016/10/19/temporality-as-an-analytical-approach-to-minimalist-music-tom-johnsons-an-hour-for-piano (accessed on 25/11/2018).

CHAPTER V – Towards a Synthesis

11) The Memory Void

11.1 Background

The Memory Void was initially composed for the Robinson Panoramic Quartet (RPQ) and stereo fixed media between August and November of 2016. Following the performance of *Flies on Butter*, I felt encouraged to further explore the wide, expressive, dynamic and timbral range such a quartet setup offers and was interested in how that could be matched with electronics.

Although initial discussions with the RPQ about performance were positive, as with many contemporary musical endeavours, no definite date materialised and, as a result, I decided to rework the piece for piano and tape to coincide with a call for scores for the Dublin Sound Lab's 'Music Current 2018' festival. The piece was accepted and performed by Xenia Pestova on the 17th of April 2018 in Dublin's Smock Alley Theatre. It is this latter version that I will now discuss in more detail. The score of the Robinson Panoramic Quartet version can be found in the appendix.

'The Memory Void' can be found in Berlin's Jewish Museum. The museum was designed by architect Daniel Libeskind, who created empty spaces in several parts of the building called voids. These voids extend vertically through the entire museum and represent the absence of Jews from German Society. I revisited the museum shortly after the Irish Composition Summer School 2016, ten years after my first childhood visit. The museum installation which had remained in my memory the most during that decade was the 'The Memory Void'. 'The Memory Void' contains a work by the Israeli artist Menashe Kadishman, who calls his installation *Shalekhet*, or *Fallen Leaves*. He has dedicated over 10,000 iron faces covering the

floor to all innocent victims of war and violence. These open-mouthed faces are coarsely cut from heavy circular iron plates. Visitors are permitted to walk across this floor. Due to the size of the hall and numerous visitors stepping on iron plates of different sizes, the void has its own unique sound. I decided to make numerous recordings of myself walking up and down the floor, and to also allow me to plunder them for sonic interest at a later date. Once I had chosen my recording, the creation of a tape part could begin.

11.2 Aspects of the Fixed Media

The tape part of *The Memory Void* was constructed on various software including Audacity, Garage Band and Pro Tools. As well as using the recording I had made, the tape also synchronises a MIDI-mockup of extremely fast marimba lines that I had scored on Sibelius, alongside the tape at certain parts. This was because I felt the contrast between the live piano and a MIDI-mockup would create an interesting sound-world, but also because I did not want the live instrument to be the only source of imitation. The midi-read marimba lines provide this secondary imitation. My decision to use a marimba was also inspired by section **B** of *South Bound Chug*. I wanted to further explore the blurring between discrete pitch material and percussive sound provided by the marimba's interesting overtones.

One of the main differences between the Robinson Panoramic Quartet version and this version is that the former is a direct representation of the analysis. That is, the tape part is not equally tempered in intonation, and so the various microtones that arise in the tape can be played at the exact same frequency on a stringed instrument. However, in the case of the piano score, there is an obvious disconnect between the frequencies of the tape and their realisation on an equally tempered piano keyboard. Rather than imagining this difference as off-putting, the resulting interference in tuning added to the sound-world I was hoping to achieve.

Figure 47 below shows one of the many examples of imitation between tape and piano present in *The Memory Void*. Figure 47 shows b. 78 of the score (3'16.0" mark), where the tape becomes dark in timbre and mood. In the Spear analysis on the right of the figure, the emphasised red formant is roughly around A4 (440 Hz). Due to the fact that the formant's shape is not perfectly straight, it is easy to see that the sound slides between A4 and A#4. The movement between these two pitches is imitated two octaves lower in the left-hand of the piano, as illustrated in score excerpt of Figure 47. This process of imitation between tape and piano can be seen throughout the score.

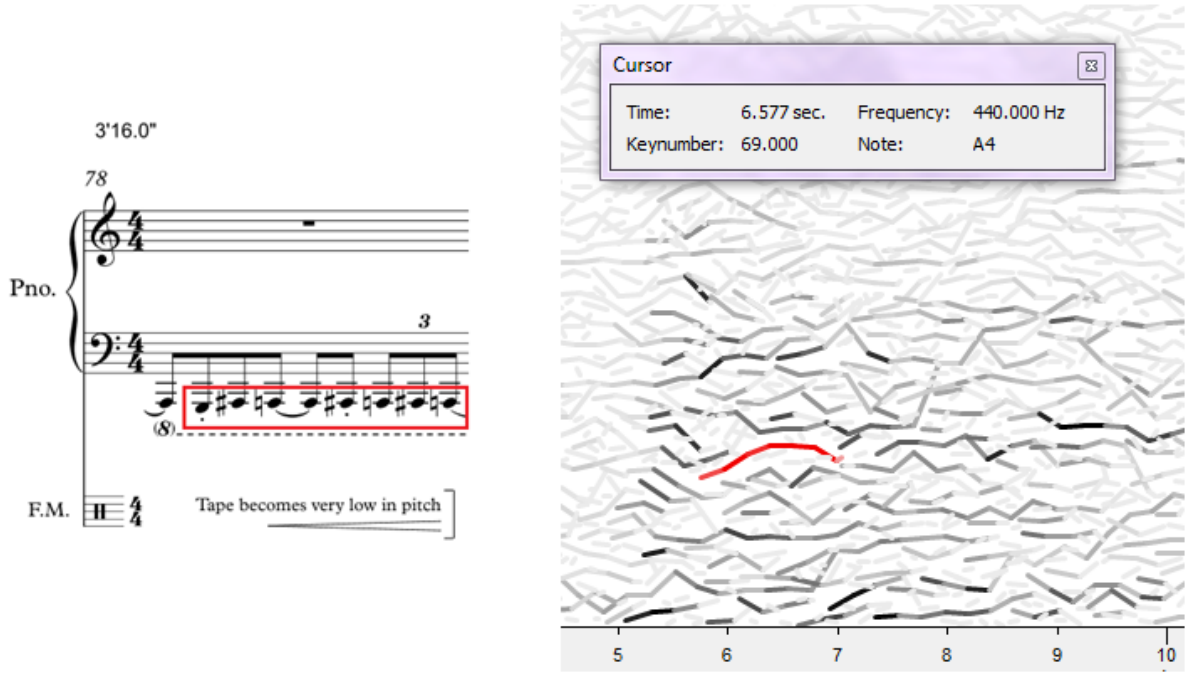

Fig. 47: Example of imitation between tape and piano in *The Memory Void*, b. 78

Figures 48-51 on the next page demonstrate the extent to which this imitation between the tape and piano has been considered. These four figures collectively illustrate how the notes of the final chord on the piano in b. 104 (5'0.00" mark), can also be heard in the tape.

Fig. 48

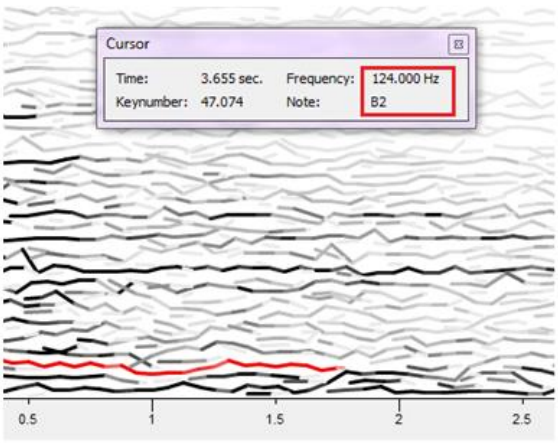

Fig. 49

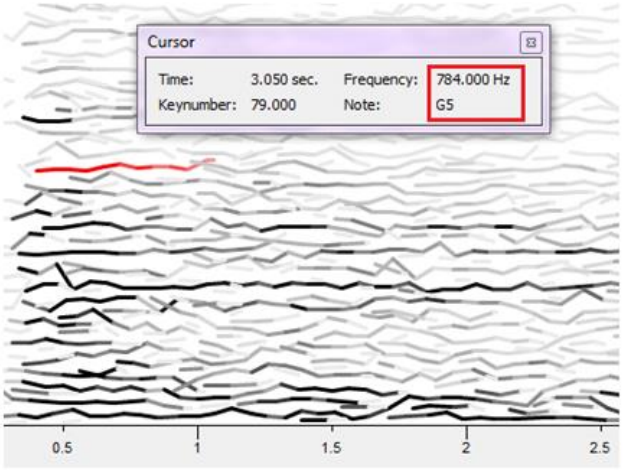

Fig. 50

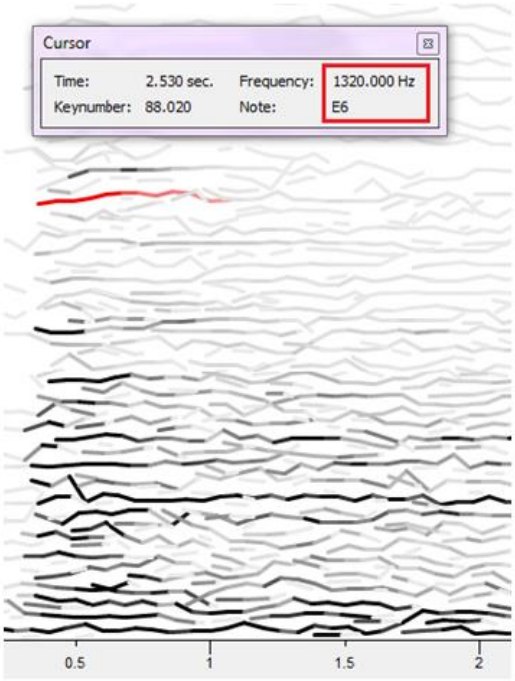

Fig. 51

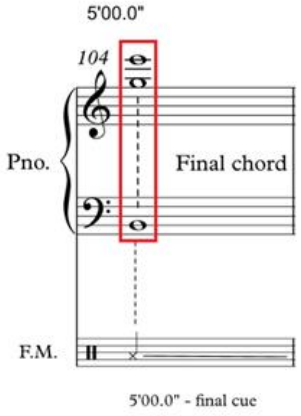

Fig. 48: SPEAR analysis of the 5'00.0" mark of tape line, 'B2' at 124 Hz unveiled

Fig. 49: SPEAR analysis of the 5'00.0" mark of tape line, 'G5' at 784 Hz unveiled

Fig. 50: SPEAR analysis of the 5'00.0" mark of tape line, 'E6' at 1320 Hz unveiled

Fig. 51: Score extract showing the pitches from figures 48-50 in the piano line, b. 104 of score

11.3 Structure and Creating a Thematic Identity

The structure of *The Memory Void* is divided into two halves, the first half portraying what the void in Berlin sounds like, the second half portraying what it feels like to be in the room. Working with a tape meant I could alter the sound of the memory void as well, and this is what gives the composition its form. The first half of the tape bb. 1-74 (0'.0"-3'09") only uses looping, reversing and splicing meaning the pitch of the original recordings is not being altered. The second half of the tape bb. 74-104 (3'09"-5'15") plays with the speed of the recordings resulting in a change in the pitch. However, as illustrated in figures 49-52, this does not mean that the piano stops imitating the tape.

The rhythmic and melodic figures of *The Memory Void* often hint at the use of motifs. This is done intentionally and can be understood as a response to the dominant role of timbre, colour and texture in spectral composers' works. *The Memory Void* is based on the spectral principle of blending the sonorities of acoustic and electronic music but rather than focus on the primary aspects, the piece often relies on short musical phrases in order to create thematic identity, as can be seen in Figure 52 below:

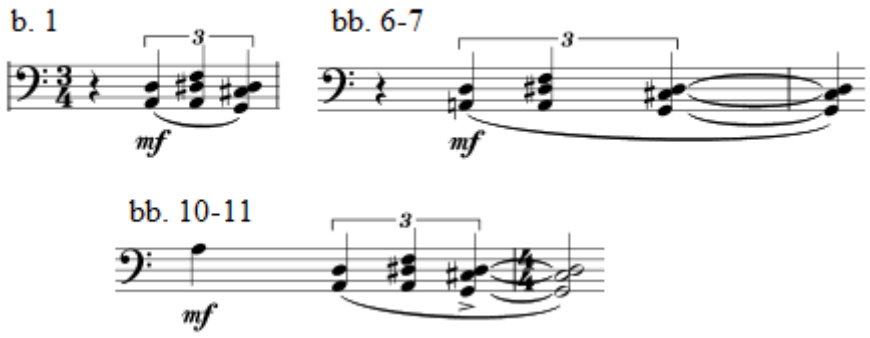

Fig. 52: Rhythmic repetition and variation in the left-hand (b. 1, bb. 6-7 and bb. 10-11)

The three-chord cell of Figure 52 is repeated and varied three times in the opening eleven bars. The repetitious nature of this cell suggests that this cell is going to be a motif, however,

it is then completely abandoned for the rest of the piece. This decision to hint at, but not exactly use, motifs through the use of repetition and variation was partly inspired by the nature of minimal figures, but also because I believed it would lead to a more original approach to spectral aesthetics. The idea of rejecting the motif as the principal constituent element of a composition and establishing timbre instead was suggested by Grisey during a presentation at the Darmstadt courses in 1978[104]:

> *"The material derives from the natural growth of sonority, from the macrostructure and not the other way round. In other words there is no basic material (no melodic cell, no complex of notes or note values)"*- (Grisey, 1978)[105].

I believe *The Memory Void*'s inclusion of recurring figures in the piano line demonstrates a different approach to the spectral principle of blending the sonorities of acoustic and electronic music. I believe this altered approach to spectral aesthetics marks progress in my research and demonstrates the benefits of going against the grain when it comes to approaching the techniques and aesthetics of a style. *The Memory Void* highlights my development as a composer during the course of my research as it offers a different compositional approach to instrumental synthesis.

[104] **Leone, F.D.** (2014) Spectral Music. *Musica Kaleidoskopea*. Available at: https://fdleone.com/2014/01/28/spectral-music (accessed on 01/12/2018).
[105] **Rose, F.** (Summer, 1996) Introduction to the Pitch Organization of French Spectral Music. *Perspectives of New Music*, Vol. 34, No. 2, p. 9.

12) Zonnewegel 25

12.1 Background

Zonnewegel 25 was composed for an ICC concert for electric guitar duo. The concert took place on the 31st of May 2018, in the Irish Georgian Society's City Assembly House on South William Street. The piece was performed by Freddy Walsh and James McDonald.

The piece is built from old recordings of 'jam sessions' between two guitars. The title takes its name from my home address in Brussels, as this is the location of where these old recordings occurred. Over the course of the last decade, my brother and I have consistently written guitar-focussed music which has recently started to demand the forces of a full band. My practice and experience as a performer has influenced the decisions behind a lot of my compositions, with the choice of instrumentation often being influenced by my participation in a rock band. For example, the use of a drum kit in *South Bound Chug* and the use of electric bass in *Sous l'Eau* were influenced by my constant interaction with these instruments at rehearsals and beyond, permeating my entire creative musical life.

12.2 The Techniques of the Piece

As well as the usual focus on spectral and minimal techniques, the piece deploys a wide range of electric guitar techniques (bb.49-69 in particular) associated with rock guitarists such as Kim Gordon, Thurston Moore and Lee Ranaldo of Sonic Youth, Tom Verlaine of Television and virtuoso Chet Atkins.

Pick-scraping whilst the gain pedal is switched on can be found in the score bb. 49-56, a technique influenced by Sonic Youth's track *Tuff Boyz*, a song composed entirely of pick scrapes[106]. I decided to contrast this distorted sound with a cleanly played descending figure

[106] **Sonic Youth (**1990). *Tuff Boyz* in *Goo* (Track 16, CD format) DGC.

on the other electric guitar; contrast having a significant role to play in a lot of the compositional decisions behind the piece.

Another technique frequently used by Sonic Youth which can be found in *Zonnewegel 25* is the use of strumming beyond the fretboard, by playing either behind the bridge or after the nut depending on the design of the instrument. The band's members most likely learned this technique from their time participating in Glenn Branca's orchestra. Playing after the nut is an extended technique which is more often associated with the classical guitar, as illustrated in the two score examples in Figure 53 below:

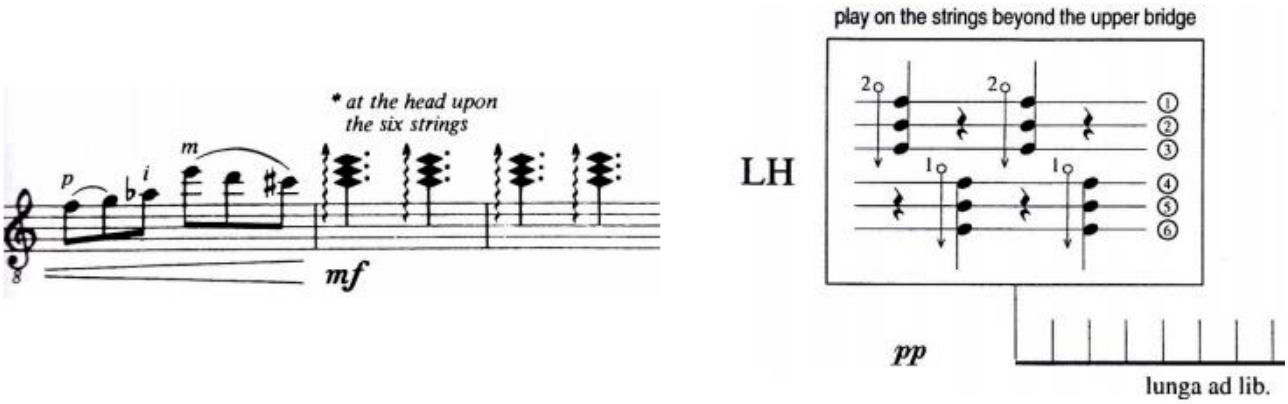

Fig. 53: *Left* - Strumming behind the nut in *Sonata* by Alberto Ginastera. 2nd Movement, "Scherzo", measures 14-16[107] *Right* - Playing above the nut in *Piece with Clocks* by Nikita Koshkin, Pg. 15 system 1[108]

In contrast, the 'playing behind the bridge' technique is often referred to as playing the 'third bridge' and is an extended technique more commonly associated with electric guitars. Fender Jazzmasters are known for having long third bridges, which by no coincidence is the style of electric guitar I own and the one predominantly used by Sonic Youth. The third bridge can be found between the standard bridge and the vibrato mechanism, as illustrated in Figure 54 on the following page.

[107] **Lunn, R. A.** (2010) *Extended Techniques for the Classical Guitar: A Guide for Composer*. PhD Diss., The Ohio State University. p.62.
[108] **Ibid** p.63.

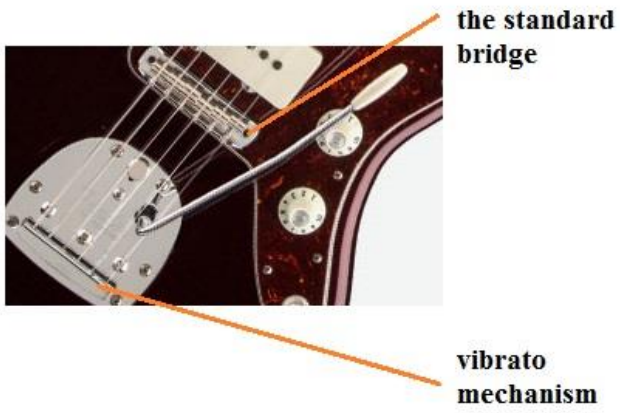

Fig. 54: Picture[109] of the body of a Fender Jazzmaster with additional information illustrating where the standard bridge and vibrato mechanism can be found on the instrument

Playing the strings on the 'third bridge' can result in the production of subharmonics, a subject which will be investigated further in the portfolio's final piece; *Subharmonic Homesick Blues*. This technique of playing the third bridge is accompanied by the use of harp harmonics bb. 66-69. Harp harmonics (also known as cascading harmonics) can be found in bb. 58-69 and are combined with pull-offs and hammer-ons in order to create a *legato* phrasing. This harp harmonic technique is a combination of the natural and tapped harmonic techniques and was once a common feature of Chet Atkins's unique playing style. These embellished *legato* harp harmonics coupled by the *staccato* 'third bridge' technique result in the creation of an interesting sound-world. It is for a similar reason that I chose to re-use the Tom Verlaine inspired 'fade-in' technique seen in *Bolt the Cabin Fever* and *Sous l'Eau*. The technique of turning up of the volume after playing a note results in the production of a sound which you would not always associate with the electric guitar, as it completely reduces the attack. I chose to re-use this technique bb. 58-68 as I felt intrigued to combine it with another sound you would not always associate with the electric guitar; the harp harmonics.

[109] **Fender** (2019) Fender Official Website. *Troy Van Leeuwen Jazzmaster* Accessed online at: https://shop.fender.com/en-IE/electric-guitars/jazzmaster/troy-van-leeuwen-jazzmaster/0140070793.html

The three-chord progressions bb. 33-40 and 70-104 are meant to portray a state of "rocking out" or "jamming". Bars 36, 40, 73, 89 and 105 of these passages all contain a staccato rundown which breaks away from the repetitive nature of the progression in order to interrupt any sense of regular rhythmic pattern.

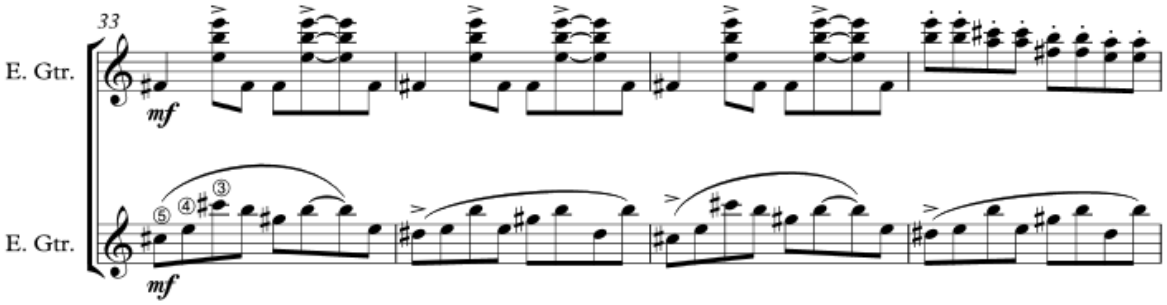

Fig. 55: Score extract from *Zonnewegel 25* bb. 33-36, b. 36 of the first E. Gtr. shows the *staccato* rundown

Figure 55 above shows the first example of this interruption at b. 36. My intentions by interrupting the sense of groove were to once again play with the expectations of the listener. Having played with the temporal perception of the listener in previous pieces *South Bound Chug* and *Freedom Tunnel Portrait*, and with my additional personal approach to minimal pulse in the latter through cross rhythms and metric modulation, it is clear to see that the manipulation of the listener's anticipation started to have a prominent role in my compositional language.

The final bar of the piece abruptly returns to the opening palm-muted drop D/D# run, once more to deliberately offset any sense of groove the guitarists might fall into. The opening palm-muted drop D/D# figuration is inspired by the guitar figures of *Spiderland*[110], the second and final studio album released by Louisville-based band Slint, which has been deemed a seminal work by music critics. The album is full of juxtapositions, with the use of dramatically alternating dynamics being a prominent feature throughout. It is for this reason

[110] **Slint**, 1991, *Spiderland* (CD format) Touch and Go. Catalogue number TG14.

the opening drop D/D# *forte* figuration is interrupted by a *mezzo-piano* descending arpeggio every other bar. In a similar manner, the alternation between punchy *forte* chords and *piano* harmonics bb. 25-29 is also influenced by the juxtaposing nature of *Spiderland*'s figures. This opposition of contrasting elements can be understood as one of the principal themes of *Zonnewegel 25*.

12.3 The Electric Guitar's Role in Contemporary Composition

When it comes to the performances of contemporary compositions, I have often felt that the sound of the electric guitar can be rather inconsistent. This could be down to the guitarists having a particular sound they rely on or perhaps because of the potentially vague performance directions the composer has provided. The electric guitar plays quite a significant role in this portfolio; with *Bolt the Cabin Fever*, *Pool Piece*, *Sous l'Eau* and *Zonnewegel 25* collectively demonstrating the instrument's potential for greater timbral control and specification on the part of the composer. It is important to note that all four of these pieces are accompanied by strict performance directions on the instrument's sound. The dominant role the electric guitar has in this portfolio is a product of the fact that my musical expression relies heavily on the summation of my personal experiences as a guitarist in a rock band. I believe the extended techniques influenced by rock guitarists superimposed above my usual spectral and minimal influences also resulted in the creation of an interesting hybrid. It became apparent as my research progressed that my own personal experiences as a guitarist were starting to play an integral role in shaping my compositional style.

13) Subharmonic Homesick Blues

13.1 Background

Subharmonic Homesick Blues is composed for Orchestra and as the title suggests, examines the subject of subharmonics in the context of my research. My decision to choose to write for a large instrumental ensemble was based on the fact that I wanted to superimpose polarising elements on top of the primary focus, the subharmonics, in order to create interesting textures and further explore hybridism. In the entire portfolio, this piece is both the longest in duration and written for the largest amount of instruments. *Subharmonic Homesick Blues* was composed between March and July 2018.

13.2 Subharmonicity

The overtone series is characterised by large intervals at the bottom which gradually become smaller and smaller in the higher register[111]. Subharmonicity is the technique of inverting the order of these intervals by beginning with the large intervals in the high register, resulting in the creation of an artificial construct called a subharmonic spectrum[112]. It is my belief that the full potential of subharmonics and subharmonicity has not been utilised by contemporary composers. Perhaps composers have neglected subharmonicity to a certain extent because they share a similar opinion to composer Paul Hindemith, who considered subharmonics and the undertone series to be a purely "intervallic reflection"[113] of the overtone series, undermining subharmonicity's true potential in *The Craft of Musical Composition*:

> *"It seems to me repugnant to good sense to assume a force capable of producing such an inversion. This force would do away with the gravitation that is expressed in the overtone series... This "undertone series" has no influence on the*

[111] **Rose, F.** (Summer, 1996) Introduction to the Pitch Organization of French Spectral Music. *Perspectives of New Music*, Vol. 34, No. 2, p.11.
[112] **Ibid.** p.11.
[113] **Hindemith, P.** (1945) The Craft of Musical Composition. Translated by Authur Mendel (revised ed.). New York: Associated Music Publishers. p.78.

> *colour of the tone, and lacks the other natural advantages of the overtone series which arise without any artificial help and are available anywhere and anytime."*- (Hindemith, 1945)[114]

However, some composers have opted to explore subharmonicity in their work. In his 1976-77 composition *Modulations,* Grisey utilised subharmonics in order to provide the "intervallic reflection" of harmonic spectra Hindemith spoke of, as illustrated in Figure 56 below:

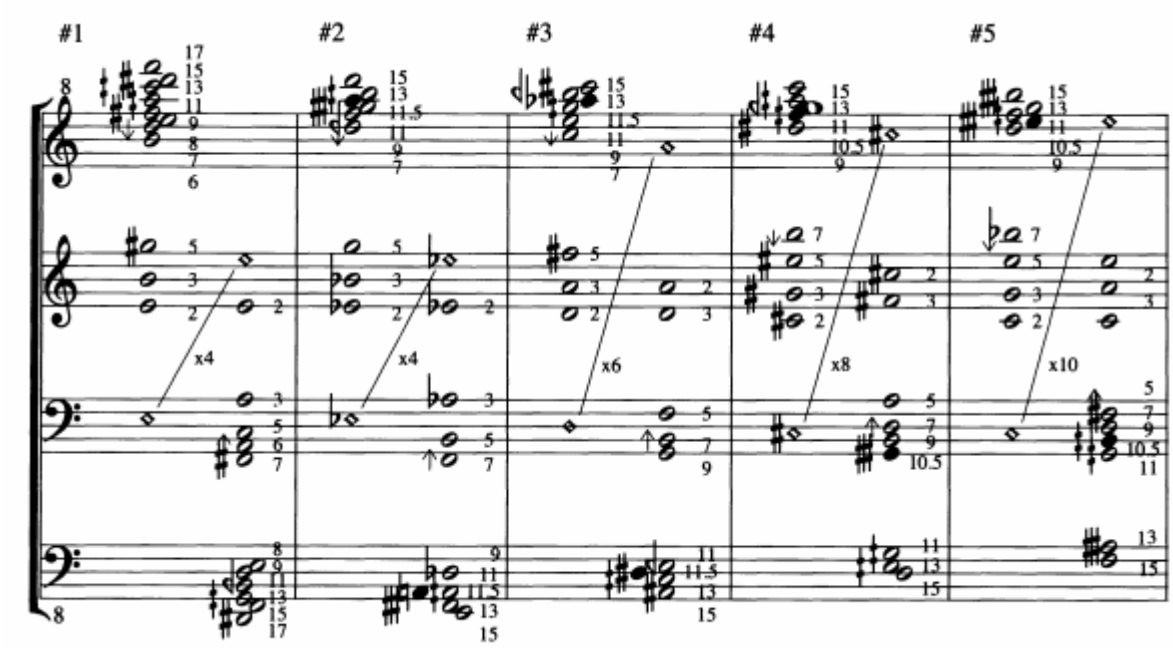

Fig. 56: Portrayal of the subharmonicity in *Modulations*[115]

Figure 56 above shows on the left of each bar in the treble clefs, a harmonic spectrum, and to its right a corresponding subharmonic spectrum in the bass clef. Across this ten spectra progression, the harmonic and subharmonic spectra are brought closer together[116]. The beginning of *Subharmonic Homesick Blues* utilises subharmonicity in a similar manner to Grisey's approach in *Modulations,* by offering subharmonic reflections of a harmonic series, in this case the harmonic series of A4 at 440 Hz. The opening passage bb. 1-10 creates the

[114] **Hindemith, P.** (1945) The Craft of Musical Composition. Translated by Authur Mendel (revised ed.). New York: Associated Music Publishers. p.78.
[115] **Rose, F.** (Summer, 1996) Introduction to the Pitch Organization of French Spectral Music. *Perspectives of New Music*, Vol. 34, No. 2, p.17.
[116] **Ibid**. p.16.

harmonic platform from which the subharmonics spring. Figure 57 below has been transcribed from my notebook and illustrates the chosen overtones for this beginning:

8^{th} overtone of A4 at 440: 3520 Hz = A7 plus 0 cents

9^{th} overtone of A4 at 440: 3960 Hz = B7 plus 4 cents

12^{th} overtone of A4 at 440: 5280 Hz = E8 plus 2 cents

Fig. 57: Transcription from my notebook illustrating the overtones of A4 at 440 Hz which can be found bb. 1-10 of *Subharmonic Homesick Blues*

The 11/8 time signature at b.11 marks the arrival of A4 (440 Hz), it can be heard on the violins, violas and on the vibraphone. I decided to begin the piece this way in order to pay tribute to Grisey, continuing my homage as demonstrated earlier in the portfolio. I wanted also to provide some context as to how subharmonics have been utilised in the past by composers who influence my own compositional language.

It is important to note that *Subharmonic Homesick Blues* relies on the use of a 'Harmonic Calculator Spread Sheet' in order to calculate the subharmonics. The calculator was designed by Douglas Woodrow and can be freely accessed online[117]. The choice of writing for a large Orchestra is influenced by my decision to focus on subharmonics. I wanted to have a large string section so the frequently microtonal language of subharmonics could be competently realised. The brass, percussion and woodwind sections of the orchestra offered the possibility to superimpose elements, in order to produce a richly layered texture of disparate elements. So to say, it is the string section's role to carry the subharmonics whilst the rest of the orchestra provides contrasting textures.

[117] **Douglas Woodrow**, '*Rife Technologies – Spread Sheet Calculators*', Rife Technologies. Avilable on: http://www.rifetechnologies.com/calcul.html (accessed March 2018).

Subharmonic Homesick Blues not only focuses on the portrayal of various pitches' subharmonics, but also in ways to combine them with previously used techniques.

Signal	Reflections	Position in Score	R.M.	Subharmonics of R.M. Results	Pitches	Position in Score
A4	*11th overtone = **4840 Hz** D#8 minus 49 cents*	*Bar 13 Vln.4, 5, 6*	*4840 + 40 = 4880 Hz*	*10th subharmonic of 4880 Hz = 488 Hz*	*B4 minus 21 cents*	*Vc. 1, 2 in Bar 16*
	*11th subharmonic = **40 Hz** D1 quarter sharp*	*Bar 13 Db. 1, 2*	*4840 – 40 = 4800 Hz*	*10th subharmonic of 4800 Hz = 480 Hz*	*B4 minus 49 cents*	*Vla. 3, 4 in Bar 16*
				9th subharmonic of 4800 Hz = 533.33 Hz	*C5 plus 33 cents*	*Vln. 4, 5, 6, in Bar 20*

Fig. 58: First table illustrating the relationship between R.M. and subharmonics in *Subharmonic Homesick Blues*

Figure 58 offers an example of the series of processes that occurs within *Subharmonic Homesick Blues*. These series of processes can be likened to chain reactions, whose main function is to generate interesting pitch content. The second column shows the *Modulations*-inspired reflections, with the 11th subharmonic of A4 mirroring its 11th overtone at b. 13 in the score. These two frequencies are then added and subtracted to generate two new frequencies, as illustrated in the third 'R.M.' column. Certain subharmonics of these R.M. results are then selected by my own compositional intuition after being unveiled using Woodrow's calculator. The chosen subharmonics are then added and subtracted with the original 'signal' frequency (A4 at 440 Hz), as illustrated in Figure 59 on the following page.

Similarly, the frequencies of these two pitches are then added to generate a *couleur*, as shown below in Figure 60.

Signal	RM	Pitches	Position in Score
A4	*533.33 + 440 = 973.33Hz*	*B5 minus 25 cents*	*Vln. 1, 2, 3 in Bar 22*
	533.33 - 440 = 93.33Hz	*F#2 plus 15 cents*	*Db. 3, 4 in Bar 22*

Fig. 59: Second table illustrating series of processes that occurs in *Subharmonic Homesick Blues*

RM	Couleur	Position in Score
973.33 Hz + 93.33 Hz = 1066.66 Hz	*C6 plus 33 cents*	*(Vc. 3, 4 in Bar 25)*

Fig. 60: Third table illustrating the series of processes that occurs in *Subharmonic Homesick Blues*

Another approach to subharmonics that *Subharmonic Homesick Blues* deploys is the numerical correlation between pulse (meter) and partial (subharmonic). The 7/8 section (bb. 32-34) and the 12/8 section (bb. 35-42) explore the 7^{th} subharmonics of frequencies across twelve violins. The figure on the following page highlights the subharmonics of this passage and their source.

Pitch	Position in Score	7th Subharmonic	Position in Score
C6 (1066.66 Hz)	*Vln. 1, 2, 3 at Bar 32*	*D#3 minus 36 cents (152.38 Hz)*	*Vc. 1, 2 at Bar 32*
B5 (973.33 Hz)	*Vln. 4, 5, 6 at Bar 32*	*C#3 plus 6 cents (139.05 Hz)*	*Vc. 3, 4 at Bar 31*
C5 (533.33 Hz)	*Vln. 7, 8, 9 at Bar 32*	*D#2 minus 36 cents (76.19 Hz)*	*Db. 1, 2 at Bar 32*
B4 (480 Hz)	*Vln. 10, 11, 12 at Bar 32*	*C#2 minus 18 cents (68.57 Hz)*	*Db 3, 4 at Bar 32*

Fig. 61: Table illustrating subharmonics in 7/8 and 12/8 passage

The numerical correspondence of exploring the seventh subharmonics of frequencies to a seven quaver beat, is a strong indicator of the prominent roles number games have in my compositional language. These types of correlations reoccur throughout the whole of *Subharmonic Homesick Blues.* For instance, the 5/8 section which begins at b. 49 explores the fifth subharmonic of every note in chords which are built from intervals of fifths. The following table demonstrates some of the subharmonic calculations that take place from the beginning of this correlation (b. 49) to b. 81. The harmonic material during the 4/4 section bb. 81 and 91 is based on combination tones, created by adding together the frequencies of the respective fifth subharmonics. The use of combination tones here is a continuation of my focus on the chain reaction of processes in regards to subharmonics. The tables overleaf exemplify the *couleurs* generated by the G2 chord's subharmonic reflection.

A2 : 110	
E3 : 164.81 Hz	*32.96 Hz = C1 plus 14 cents*
B3 : 246.94 Hz :	*49.39 Hz = G1 plus 14 cents*
F sharp 4 : 369.99 Hz	*74.00 Hz = D2 plus 14 cents*
C sharp 5 : 554.37 Hz	*110.87 Hz = A2 plus 14 cents*
G sharp 5 : 830.61 Hz	*166.12 Hz = E3 plus 14 cents*
D sharp 6 : 1244.51 Hz	*248.90 Hz = B3 plus 14 cents*
A flat 2 : 103.83	
E flat 3 : 155.56 Hz	*31.11 Hz = B0 plus 14 cents*
B flat 3 : 233.08 Hz	*46.62 Hz = F#1 plus 14 cents*
F4 : 349.23 Hz	*69.85 Hz = C#2 plus 14 cents*
C5 : 523.25 Hz	*104.65 Hz = G#2 plus 14 cents*
G5 : 783.99 Hz	*156.80 Hz = D#3 plus 14 cents*
D6 : 1174.66 Hz	*234.93 Hz = A#3 plus 14 cents*
G2 : 98	
D3 : 146.83 Hz	*29.37 Hz = A#0 plus 14 cents*
A3 : 220.00 Hz	*44.00 Hz = F1 plus 14 cents*
E4 : 329.63 Hz	*65.93 Hz = C2 plus 14 cents*
B4 : 493.88 Hz	*98.78 Hz = G2 plus 14 cents*
F sharp 5 :739.99 Hz	*148.00 Hz = D3 plus 14 cents*
C sharp 6 : 1108.73 Hz	*221.75 Hz = A3 plus 14 cents*

Fig. 62: Table showing 'subharmonic reflection' calculations for chords built on intervals of fifths. All the red pitches are out of the instruments' range and are not found in score

Combination	***Couleurs***	**Position in Score**
44 Hz + 65.93 Hz = 109.93 Hz	*A2 minus 1 cent*	*Vc. 1, 2, 3, 4 at Bar 83*
44 Hz + 98.78 Hz = 142.78 Hz	*C sharp 3 plus 52 cents*	*Vla. 1, 2 at Bar 82*
65.93 Hz + 98.78 Hz = 164.71 Hz	*E3 minus 1 cent*	*Hn. At Bar 81*
65.93 Hz + 148.00 Hz = 213.93 Hz	*A3 minus 48 cents*	*Vln. 10, 11, 12 at Bar 81*
98.78 Hz + 148.00 Hz = 246.78 Hz	*B3 minus 1 cent*	*Vln. 7, 8, 9 at Bar 81*
44 Hz + 221.75 Hz = 265.75 Hz	*C4 plus 27 cents*	*Vln. 4, 5, 6 at Bar 81*
221.75 Hz + 148.00 Hz = 369.75 Hz	*F#4 minus 1 cent*	*Cl. At Bar 81*

Fig. 63: Table illustrating the *couleurs* generated by the G2 chord's subharmonic reflection

From looking at all the tables and calculations above it is easy to see that *Subharmonic Homesick Study* is relentless in its approach towards subharmonics, offering a thorough investigation of how they interact with Vivier-esque *couleurs*, ring modulation and various

number games. The combination of traditional harmonic constructions such as quintal harmony alongside the more adventurous *couleurs* and ring modulation techniques creates an interesting stage for the subharmonics to speak in.

The interaction between subharmonics and pulses is also explored in *Subharmonic Homesick Blues*. This is partly influenced by Karlheinz Stockhausen's techniques of phase durations as used in '…..*How Time Passes*…..'[118], illustrated in Figure 64 below:

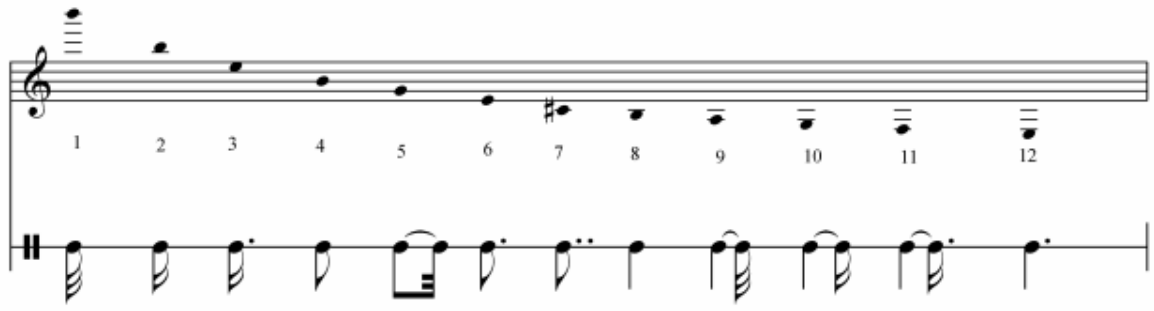

Fig. 64: Stockhausen's subharmonic series of proportions (phase durations)[119]

Stockhausen utilised the subharmonic series as a way of calculating phase durations. This relationship between subharmonics and duration reminded me of the correlation between partial and pulse in James Tenney's *Spectral Canon for Conlon Nancarrow* (1974). It seemed that one thing both composers had in common, was the need to draw an analogy between durational ratios and harmonic ones.

This inspired me to create my own proportional relationship between pulse and subharmonics. *Subharmonic Homesick Blues* equally disperses a certain number of pulses in a fixed amount of time. For instance, in bb. 129-136 on the strings, the fifteen subharmonics are equally dispersed as fifteen pulses across eight bars of 6/8. These calculated pulses can be

[118] **Stockhausen, K.** (1959) '….. How Time Passes….' English ed. of *Die Reihe musical journal*. Available at: https://www.artesonoro.net/artesonoroglobal/HOW%20TIME%20PASSES%20BY.PDF (accessed 10/12/2018).
[119] **Leibovich, N.** (2017) Empty Spaces: Temporal Structures and Timbral Transformations in Gerard Grisey's Modulations and Release for 12 Musicians, an original composition. Doctoral Diss, University of Pittsburgh, p.79

seen throughout the score and are also used in the percussion. The timpani line in bb. 138 and 142 equally disperses fifteen beats into five bars of 5/4 for instance, as illustrated in Figure 65 below:

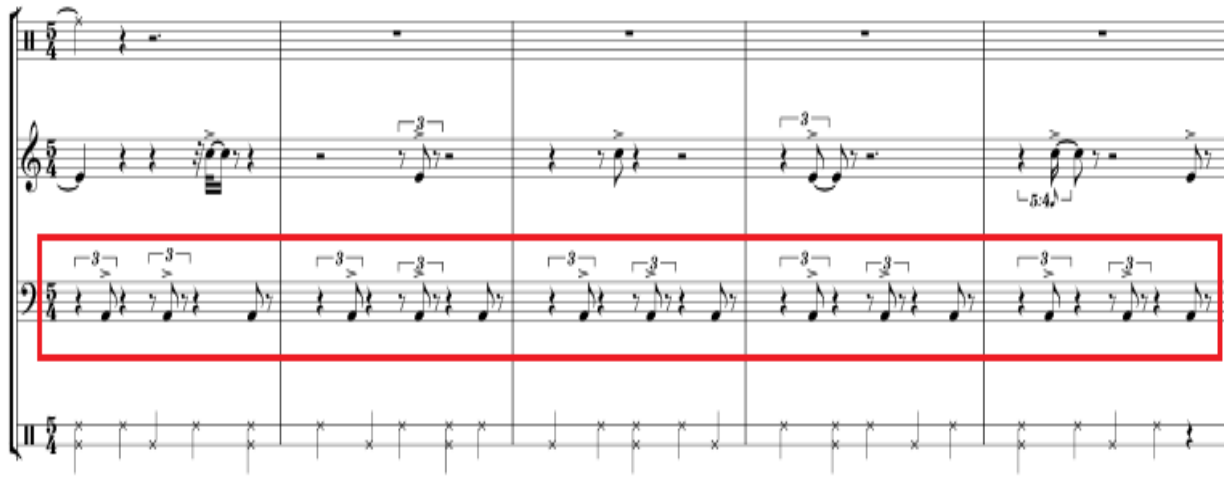

Fig. 65: Score extract of fifteen timpani beats equally dispersed across 5 bars of 5/4, bb. 138-142 of score

The use of pulse can be perceived in the majority of the portfolio's pieces, but I believe my approach towards pulse is different in *Subharmonic Homesick Blues.* This is because the beats do not occur at a mensural level; these pulses are not ones that listeners or an audience would respond by tapping their foot to. It is for this reason that the drum kit holds a significant importance in the piece. The steadiness of the drum-kit throughout the piece works as a conductor for the entire Orchestra to follow, especially since some of the graph generated pulses are rhythmically complex. The additional use of temple blocks, maracas, bongos, claves and a thunder sheet all help propel the composition along, their rhythms providing a secondary textural layer to the subharmonic study.

13.3 Relation to Portfolio

Subharmonic Homesick Blues has a unique role in the portfolio, being as it is the only piece to explore the area of subharmonics. The piece offers multiple examples of how

subharmonics can be paired with other elements, such as rhythm, ring modulation and more traditional harmonic structures in order to create interesting sound-worlds.

I believe the piece illustrates my development as a composer over the course of my research, demonstrating that as my research has progressed, so has my approach towards handling the techniques of composers who influence my musical language. For instance, rather than merely implementing Tenney's and Stockahusen's approaches towards durational ratios and harmonic ones, *Subharmonic Homesick Blues* offers its own interpretation of the matter. These *Blues* add to the diversity that exists in the portfolio and demonstrates how embracing minimal and spectral aesthetics can result in an original work.

The piece itself makes a statement for the need of a stronger consideration of subharmonics in contemporary compositions today.

CONCLUSION

Research Summary

This portfolio of compositions and accompanying commentary has explored the development of my compositional language through the study and incorporation of gestures and techniques found in spectral and minimalist music. The portfolio offers the examination of these two influences and how they can be combined in multiple ways to create new progressive compositions. I believe that the portfolio will be beneficial to other composers as it offers an in depth look at the central role of hybrids in music and how the combination of influences can still result in an innovative musical language.

The principle research question that I set out to engage with throughout this portfolio was about how the above two contrasting styles can be combined and what techniques have already been used in doing so? I believe this question has had an all-encompassing effect on my research, with every piece in the portfolio offering its own answer to this particular question. The early pieces discussed in Chapter I provide context to my research by shining a light on what has already been said and done by other composers when it comes to combining minimal and spectral influences, which is very little. Pieces such as *I-V: A Series of Spectra-Minimal Miniatures* and *Vacuum Spazio Puro* embrace the early constructs of minimalism and spectralism, focusing on the combination of harmonic and inharmonic spectra alongside repetitive figures. This is in particular a nod to the work of fellow Irish composer Donnacha Dennehy. However, it is important to note that already in the early stages of the portfolio there is a clear striving to generate unique and original music. *I-V: A Series of Spectra-Minimal Miniatures* approaches the research with an inventive form, by offering a collection of spectra-minimal miniatures which unravel the harmonic series. The sudden transition from harmonicity to inharmonicity apparent in *Vacuum Spazio Puro* reimagines one of the most

popular techniques of French spectralism. Even in the early stages of the research, where creating context seemed essential, the compositions still offered an innovative approach when treating the influences.

Another question I was eager to answer was whether or not the combination of spectral and minimal influences was a route that composers today should study? It is my belief that the performances and recordings that have taken place during my years of research audibly substantiate this language. The portfolio's scores offer a way for other composers to analyse my own compositional approach towards a subject that might interest them, but also maps out my progression. This noticeable progression in my own compositional language across the years of this research highlights the benefits of harnessing personal influences. While the compositions in this portfolio present new ideas about the use of spectral and minimal techniques, they do not advocate one specific way of approaching the matter. The stylistic developments throughout this portfolio pertain to my own compositional language; however, it is hoped that other composers will find these developments useful in extending their own techniques.

In this thesis's introduction I spoke of how minimalism and spectralism had both neutralised their materials in order to make their forms transparent. One of the questions I set out to answer in this portfolio was whether or not this neutralisation in form meant some composers and compositions were of a greater importance than others when researching this practice. My research has led me to the opinion that this is not the case. This portfolio of compositions features a wide variety of minimal and spectral techniques which range from the early days of their creation, to well after their neutralisation in form has occurred. My research promotes a confluence which is not limited by the obscurity caused by minimalism's and spectralism's evolution. For instance, pieces such as *Pool Piece* focus on the early aesthetics of minimalism such as drone and the repetition of musical phrases, whereas *Sous l'Eau* offers the rich,

immersive web of sound through repetitive proliferation of simple musical gestures common in post-neutralised minimalism. I believe one of this project's main successes, both compositionally and personally, is that it demonstrates how a clear understanding of the original principles is required, as well as an acknowledgment that both minimalism and spectralism developed into something new, and continue to develop in the increasingly pluralist trends of contemporary composition.

Future Directions

Outside of the research put forward in this portfolio, there are other current academic developments that may have future compositional applications. The second edition of the '**Spectralisms**' conference will take place at IRCAM between the 12th and 14th of June 2019. It is my hope that the second edition will be as insightful as the first one. An aspect that I hope to investigate in future compositions was briefly touched upon during the final panel of this first edition; the relationship between technology and spectralism. Since spectralism's creation, technology has progressed and developed at an extremely fast pace and the argument was made that the techniques used by spectral composers has not. It is my aim to focus on this aspect of the spectral side of research in years to come.

APPENDIX I: *Love Goes To Buildings on Fire*

APPENDIX II: *The Memory Void* - Robinson Panoramic Quartet score

APPENDIX III: *Sous l'Eau* - performance score

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DISCOGRAPHY

Disc 1 – Compositions in this Appendix

TRACK NO.	TITLE	PERFORMER(S)	DURATION
1	*I-V A series of Spectra-Minimal Miniatures*	Clarion Horn Trio	7:37
2	*Tree of Smoke*	James Murphy (organ)	8:39
3	*Flies on Butter*	Robinson Panoramic Quartet	5:03
4	*You'll Only Make Matters Worse*	Michelle O'Rourke (soprano)	3:01
5	*Pool Piece*	ICC Ensemble	2:56
6	*Sous l'Eau*	Kilian O'Kelly (myself)	7:56
7	*Freedom Tunnel Portrait*	Alex Petcu / Brian Dungan (both percussion)	5:13
8	*The Memory Void*	Xenia Pestova	5:19
9	*Zonnewegel 25*	Freddy Walsh / James McDonald (both electric guitar)	4:17

Disc 2 – Additional Audio

TRACK NO.	RECORDING
1	The 'Underwater' sound analysed for *Pool Piece* and *Sous l'Eau*
2	Recording taken inside The Memory Void
3	Workshop recording of *Love Goes to Buildings on Fire*