SPECTRALISM DECOMPOSED: AN EXPLORATION OF PROCESS AND TRANSFORMATION THROUGH THE IMPROVISATIONAL NETWORK

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A thesis submitted in fulfilment of

the requirements for the degree of

Doctor of Musical Arts

Sydney Conservatorium of Music

University of Sydney

2019

Abstract

Spectralism decomposed is a cross-disciplinary experiment connecting perspectives drawn from the first generation of French Spectralism with the art of improvisation. In *Instrumental transformations* Martin Kay discusses instrumental synthesis as a strategy for altering instruments through scordatura and preparation, creating unique sonic territories for improvisation. In *Metaphorical transformations* Kay discusses Spectral composers' rethinking of musical form through the emergent field of chaos theory, introducing Landgraf's autopoietic model for improvising networks. Grisey's ecological rethinking of form leads to compositions influenced by a rhizome metaphor. In *Psychological transformations,* Kay explores themes of expectation, the present moment, time-perception, memory, and transcendence through analysing Grisey's *Périodes* and Murail's *Territoires de l'oubli*. In *Eclectic emergences,* Kay considers the transformation of Spectralism through the improvisational voice. Throughout the paper, Kay explores continuums of order-disorder, predictability-unpredictability, known-unknown, and individual-totality, viewing composition-improvisation as poles of an interpenetrable continuum.

With Love to Mum and Dad

Table of Contents

Table of Figures

Acknowledgements

Thankyou Damien Ricketson for your wise supervision.

Thankyou Tracey Kay, for your superpower of making the complex simple.

Thankyou David Reaston, Jamie Cameron, Steve Barry, Mathew Bruce, Emily Granger, Benjamin Carey, Angela Wagstaff, Steve Weymouth, Daryll Pratt, and the Sydney Conservatorium Modern Music Ensemble for indelibly shaping my compositions.

Thankyou to my friends who shared and discussed my emergent ideas.

Thankyou to the Australian Government for the Australian Postgraduate Award and to the University of Sydney for the University of Sydney Merit Scholarship.

On Exactitude in Science

In that Empire, the Art of Cartography attained such Perfection that the map of a single Province occupied the entirety of a City, and the map of the Empire, the entirety of a Province. In time, those Unconscionable Maps no longer satisfied, and the Cartographers Guilds struck a Map of the Empire whose size was that of the Empire, and which coincided point for point with it. The following Generations, who were not so fond of the Study of Cartography as their Forebears had been, saw that that vast map was Useless, and not without some Pitilessness was it, that they delivered it up to the Inclemencies of Sun and Winters. In the Deserts of the West, still today, there are Tattered Ruins of that Map, inhabited by Animals and Beggars; in all the Land there is no other Relic of the Disciplines of Geography.

—Suarez Miranda,Viajes devarones prudentes, Libro IV,Cap. XLV, Lerida, 1658. (Rowe, 1999, p. 325)

Introduction

Spectralism decomposed is a cross-disciplinary experiment connecting perspectives drawn from the first generation of French Spectralism with the art of improvisation. Across four chapters, I mine the Spectral tradition seeking inspiration to transform sonic territories through the improvisational network. Through *Instrumental transformations* I discuss Spectral strategies for creating harmonic content. In *Metaphorical transformations* I discuss extra-musical considerations influencing the temporal evolution and interaction of Spectral compositions. In *Psychological transformations*, I focus on the experiential aspects of Spectralism. In *Eclectic emergences,* I discuss the importance of the improvisational voice to my compositional portfolio. In the following paragraphs I give a brief history of Spectralism, introducing the concepts and techniques which I adapt and transform through my own practice.

Spectralism: history and harmony

Spectralism, as a moniker, describes the body of work emerging from the collective of composers *Ensemble l'itinéraire*, founded in 1973 in Paris by Tristan Murail, Michaél Lévinas, and Roger Tessier, soon after joined by Gérard Grisey and Gustave Dufourt. Dufourt (1981) created the term *Spectralism* to describe Spectral composers' foundational techniques and attitudes. Spectral composers followed a modernist agenda developing during the late 1960s and early 1970s, identifying with the revolutionary zeitgeist occurring within society and science, seeking paradigmatic shifts within their musical agenda through a rethinking of form and experience. Murail writes of two foundational aspects of Spectralism:

> Historically, the ideas of process and continuous change came before the real *spectral* work. For me, this fascination with transforming objects and crating hybrids was always there: it's almost congenital. I think that this idea, coupled with the importance I (and other) 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. (2005a, p. 7)

Grisey (2000b) writes that 'coming into being in the mid-Seventies, curiously around the same time as fractal geometry, spectral music offered a formal organization and sonic material that came directly from the physics of sound, as discovered through science and microphonic access' (p. 1). Sounds were recorded via

the microphone then transferred into an audio image called a spectrogram.[1] The spectrogram allowed composers to see the energies comprising sound in detail, enabling them to connect with and extend a tradition exploring correspondences between the structure of sound and compositional form, stretching back through Pythagoras, to Rameau and Messiaen. Musical parameters once treated as a duality were now viewed as a continuum separated by perception. In *Spectra and Sprites* Murail writes of threshold between harmony-timbre:

> A timbre can be defined as an addition of basic elements, pure frequencies, sometimes white noise bands; a harmony is created by adding timbres together, which is to say the addition of additions of basic sonic components. In other words, there is theoretically no difference between the two concepts; it is all a question of perception, of habits of perception. (2005c, p. 138)

Grisey adapted the term liminality to describe the fuzzy boundary where perception indeterminately oscillated between two states. Dufourt (2014) observes that perceptual thresholds[2] of harmony-timbre, pitch-noise, harmonicity-inharmonicity, and timbre-saturation formed a repertoire of idioms at the heart of

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[1] McAdams describes the information shown in the spectrogram: 'Any complex signal can be decomposed into a sum of sinusoidal waves, over an infinite time frame, by specifying precisely their relative amplitudes and phases. It is thus possible to decompose a complex sound into a sum of sine tones, which are called the partials of the sound, the set of which form its spectrum (McAdams & Pressnitzer, 2000, p. 5).' Throughout this dissertation, I use the term microphonic to describe this energetic complex.

[2] The terms liminality and threshold are interchangeable in this dissertation.

Spectral music and that 'the concept of the threshold… played a considerable role in compositional practice: a threshold is found at the confrontation of conditions that permit stabilization and those that forbid it' (p. 164).

Influential articles covering the methods Spectral harmony include: Anderson (2000) *A provisional history of spectral music,* Rose (1996) *Introduction to the Pitch Organisation of French Spectral Music,* Moscovitch (1997) *French Spectral Music: an Introduction* and Hasegawa (2009) *Gerard Grisey and the 'Nature' of harmony*, and Fineberg (2000) *Spectral Music*.

Extra-musical influences

In *Metaphorical transformations*, I discuss extra-musical patterns shaping Spectral form. I propose that the paradigmatic scientific turn towards chaos theory, contributed to a fundamental shift in Spectral composers' understanding of the microphonic aspects of timbre and perception, leading to an affinity between compositional form and complex systems. I also suggest that the spectrogram represents a past ecology of sound-perceiver-present, a static and incomplete image summarising a once indeterminate complex. To revivify the energies implied by the spectrogram, Spectral composers evolved innovative compositional strategies, such as the transference of patterns from one system to another.

I consider this transference as process, inspired by the original Greek etymology, meaning 'to transfer' (*The concise Oxford dictionary of English etymology*, 1993). McAdams (1984) considers the spectrogram as a metaphor which describes

auditory organisational processes, enabling fields to cross-fertilise.[3] Lara (2013), in his thesis *Translation and the Perception of Extra-Musical Models in the Work of Tristan Murail*, frames translation as a metaphor to understand how Murail uses extra-musical models to shape temporal processes. As an example, Murail, in his program notes for his work *Attracteurs ètranges (2009),* observes that his musical form is a poetic representation of the strange attractor:

> The poetic force of these objects comes from the fact that generally simple forms, though rich and striking for the imagination, are produced by very complex, but hidden operations. However, no mathematical procedures were used to write this piece. (Murail, 1992)

Dufourt (2014), observes that cybernetic techniques of thinking catalysed formal developments within Spectralism. I discuss the foundational cybernetic technique of feedback, applied to model simulations of complex systems. Through doing so I reimagine musical processes in Murail's *Territoires de l'oubli* and Grisey's *Périodes*. I connect my work to Dufourt's observations through reimagining the improvisational network as a complex, self-evolving system. Landgraf (2011) adapts the biologists-cyberneticians Varela and Maturana's (1980) autopoietic concept,

[3] Métaphore or L. metaphora — Gr. metaphor, f. metaphérein transfer.

accounting for the self-evolution of biological cells, transforming the concept to describe the sustenance and evolution of an improvisational network. Grisey, interestingly, used a cellular analogy to understand sound:

> From now on it is impossible to think of sounds as defined objects which are mutually interchangeable. They strike me rather as force fields given direction in time. These forces – I purposely use this word and not the word form – are infinitely mobile and fluctuating; they are alive like cells, with a birth, life and death, and above all tend towards a continual transformation of their own energy. (Grisey, 1987, p. 268)

This cellular analogy reflects Grisey's interest in ecological models to rethink hierarchies and to reformulate compositional structures. Grisey (2000a) writes of the 'invention of processes, as opposed to traditional development' (p. 2) as a core achievement of Spectralism. Through engaging with Deleuze and Guattari's (1988) botanical-philosophical concept of the rhizome, I shape compositional forms connecting multiple overlapping processes and emergences, rethinking improvisational hierarchies, and inviting a decentralised web of overlapping improvisations expressing continuity, divergence, and rupture.

Psychological influences

Murail (2005d) writes that, 'my material is not a musical note, nor even a sound, but the sensation (sentiment) created by that note or sound' (p. 149). Similarly, Grisey (1987) observed that 'it seemed to me virtually impossible to reflect on structures of musical time without immediately touching on phenomenological and psychological aspects' (p. 257). Moscovitch (1997) writes that Spectral composers' material was the

'acoustic phenomenon of physical sounds, the human perception of these sounds, the psycho-physiological response to sound-stimulus, and the choice of sound sources' (p. 21). Schäfer and Kursell (2016) write that 'Grisey confronts the natural order of acoustic space with the human order of producing and perceiving sounds' (p. 192).

Improvisation and Spectralism both value the present as a space of creative and sonic emergences. Grisey (1987) includes the perceptual present in a compositional approach favouring 'the moment and the immediate memory of the sound event,' considering composition as 'an emanation, an enlargement of the moment' (p. 257). I consider Grisey's observations of the structure of the present, and the boundary with memory, to be a direct influence on his compositional form, which I discuss through an analysis of *Périodes (1974)*. I suggest that his composition of slowly unfolding forms worked on multiple levels, simultaneously allowing time for the perception of sonic effects, the overlaying of processes simulating the continuously emerging present, as well as controlling the density and rate of informational diversification, engaging the performer's memory to affect time perception. Grisey gives a clue to his structural thoughts:

> We can imagine degrees of presence of sound leading us progressively from the present (minimum period of perception, constant of time) to the very width of the present to which one's immediate memory adheres - "a sort of phosphorescence of immediate perceptions" (Moles, 1966) - then, ultimately, to the more or less immediate past where what we rightly call the memory - sometimes called cognitive memory - operates. (Grisey, 1987, p. 272)

In Grisey's observation, the perceptual present layers to become cognitive memory, a process observed in the psychological present. The acoustic researcher Michon (1978) defines the psychological present as 'the time interval in which sensory information, internal processing, and concurrent behavior appear to be integrated within the same span of attention' (p. 90). Lehman (2012) extends Grisey's work, summarising recent studies on rhythmic thresholds, concluding that the boundaries of the psychological present are elastic, 'corresponding to a qualitative shift in our perception of rhythm and musical time' (pp. 14-15).

Grisey's observation shows traces of Husserl's phenomenological account for continuous perception, which also layers degrees of sound, though is more dynamic, involving interpenetrable memory retentions and future projections (Beyer, 2018). The structural principle of recursive information flows permeates Spectralism, through judicious repetition and controlled divergences. I draw correspondences between Spectral compositional structures and the studio technique of the feedback loop, cybernetic feedback loops simulating the evolution of complex systems (Wiener, 1961), and self-evolving autopoietic improvisational networks (Landgraf, 2011).

Eco (1989), in making a case for the improvisational approach enabled by open form works, observes that through repeated contact with a stimulus, sensations become dull: perceptions layer to become memories, which rather than emerging as the 'spontaneous products of a stimulated mind,' are eventually turned by habit into 'ready-made schemes' (p. 37). Hicks observes how habits may be transformed and even

'ready-made' schemes of interpretation – memorised strategies – may be imbued with a communicative force through improvisation. He writes that,

> it is a bad idea to think of interpretation and improvisation as different things because interpretation has to have an element of improvisation as well. Improvisation can be a great communicating link and if that link isn't there in the interpretation then I think you lose something. (Bailey, 1993, p. 33)

Murail connected to the tradition of open form works, adapting aleatoric strategies to accommodate the indeterminacies of sonic emergences. In *Territoires de l'oubli*, Nonken (2014) writes of learning Murail's *Territoires de l'oubli (1978)* as quasi-improvisatory, a process leading to a heightened awareness of the moment, less reliance on memory, and consequently a greater awareness to sonic detail. For the perceiver there is an order and logic, though the indeterminacy of the work plays with the expectation of the listener.

Composition-improvisation

In *Tempus ex machina*, Grisey (1987), compares three parallel continuums mapping expectation: periodicity-silence, predictability-unpredictability, and order-disorder (figure 1). I propose a fourth column, composition-improvisation. Following Nettl (1974), I consider improvisation and composition to be two interpenetrable poles of a continuum: to varying degrees, one always contains the other. Improvisation represents unpredictability and disorder. Across multiple performances of a work I control the periodicity of the material; the more composed elements, the greater the periodicity.

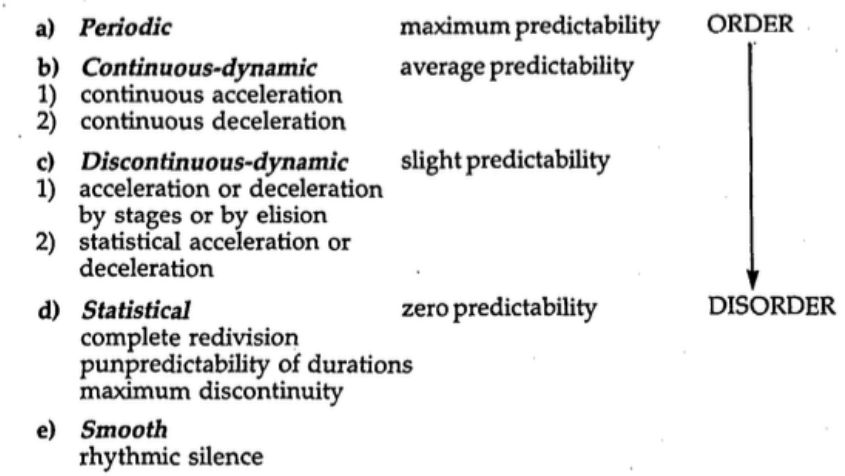

Figure 1: diagram of continuous processes

While harmonic aspects are an important aspect of my compositions, inspiring sonic territories for improvisational networks, I also foreground psychological thresholds associated with improvisation, such as the memory-present, known-unknown, virtual-manifest, order-disorder, and individual-totality. Lehman (2012) adapts Grisey's concept of liminality, writing of improvisation as 'a creative practice situated at the thresholds of structure and disorder, individuality and community, understanding and mystification, and the known and the unknown' (p. 9).

In *Eclectic emergences*, I explore Spectral concepts and the improvisational voice, a juxtaposition leading to eclectic results aligned with later generations of composers, like Lehman, who adapted aspects of Spectralism to augment their compositional practise. I am interested in how Spectral concepts may mutate and evolve through the improvisational network, which both creates and responds to

spontaneous emergences, transforming sonic territory. During this process, I relinquish compositional controls to create non-linear artistic worlds with chaotic characteristics, inviting psychological transcendence, and a heightened sonic acuity.

The composition as a world

Benson (2003) adapts Heidegger's concept of Dwelling to describe the space where performers, listeners and the composer interact. He considers that 'creating a work of art is in effect the setting up of a world' (pp. 31-32), constructing a model for this world through conflating improvisational definitions and etymologies: dwellers use 'whatever is at hand' to improve and 'cultivate' the emerging artistic space, concluding that the creation of a world is not 'simply taking up space,' that the dweller also 'transforms the space in which one dwells' and that this manner of dwelling is 'best described as improvisational.' In Benson's model, not only do the sonic materials morph and mutate, psychological processes also shift along axes of perceptual sensitivity. Through composing for improvisational networks using Spectral techniques and concepts, I hope to create such worlds.

INSTRUMENTAL TRANSFORMATIONS

1 Sound to image to sound

In *Sound to image to sound*, I explore a process beginning with a sound becoming a recording of a sound, to a spectral analysis of the sound, to the translation of the spectral analysis into compositional form, and finally, back to transformed sound through performance. Once sound is recorded, it may be analysed, and its energies recorded in a spectrogram showing frequency, time, and amplitude. Compositional challenges arise during the process of transferring the information in the spectrogram into sound. The first is that there is too much information to be rendered effectively in compositional form as there are notational limitations: information must be filtered. Secondly, the exact microtonal proportions of the spectra are impractical to realise on acoustic instruments designed to perform in equal temperament. The composer must devise strategies with this in mind. Thirdly, the image is static so strategies must be devised to recreate the flow of information.[4] Finally, the composer must take into

[4] This is a subject I explore further in the section *Metaphorical transformations*.

account that each instrument imports its own set of partials,[5] creating a fractal flow of information which Murail (2005d) calls 'spectral proliferation' (p. 165).

Figure 2 shows a spectral analysis of a cymbal I made for my work *Sine tone etude 1* (Kay, 2017b). The vertical axis represents the partials, represented as frequencies measured in hertz (vibrations per second). The horizontal axis represents time. The darker the line is, the greater the amplitude of a partial at any point in time. Darker lines are called formants. For *Sine tone etude 1,* I selected formants to make into sine tones, using the digital audio workstation *Logic 9* to capture the microphonic structure, using them as a basis to create subtle changes of amplitude and frequency.

[5] Partials are 'constituents of the pitches of the harmonic series, the main (fundamental) note being the first partial and the remainder the upper partials' (Kennedy, 2012).

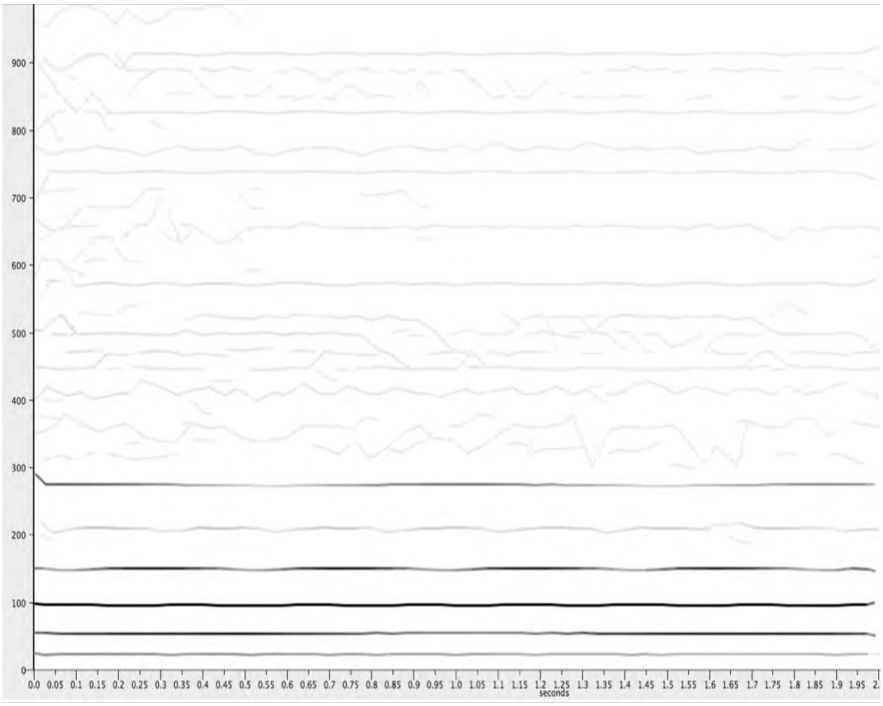

Figure 2: cymbal analysis from Sine Tone Etude 1

Instrumental synthesis in *Périodes*

Grisey's *Périodes,* composed for flute, clarinet, two violins, viola, cello and double bass, is chronologically the first work in his paradigmatic series of works *Les espaces acoustiques*. On the closing page of *Périodes,* Grisey introduces instrumental synthesis, a process of orchestrating the frequencies shown in the spectrogram, assigning them to pitches on instruments. This closing page is also the opening page of *Partiels*, which continues to develop the material.

Hasegawa observes a transition from composing harmonies based on the proportions of a theoretical overtone series[6], to one based on the microphonic proportions of real sound, writing that:

> Grisey is dealing with real sounds, not with an idealised source of overtones. Recall that Rameau's corps sonore, as formulated in the *Generation Harmonique*, conveniently stopped vibrating after the sixth partial to avoid the 'out-of-tune' natural seventh. In contrast, Grisey carries into his music the complexities of real sounds, including their often distorted and imperfect spectra. (Hasegawa, 2009, p. 351)

Instrumental synthesis was not intended to imitate the original sound, rather instruments simulated the energies shown in the spectrogram, transferring forms and patterns across perceptual dimensions. Hasegawa (2009) writes that 'The goal of instrumental synthesis is not a precise reproduction of the trombone sound – which would in any case be impossible given the complex spectra of acoustic instruments – but rather a hybrid sonority permitting us to hear both the individual instruments and

[6] Rose explains it thus: 'The overtone series is a theoretical concept which describes a set of vibrations whose frequencies are all integral multiples of one fundamental frequency (fi). Any frequency can be used as a fundamental while the other elements of its overtone series are called respectively: the second partial (f2) which is equal to 2 x f, the third partial (f3) which is equal to 3 x f, and so on (Rose, 1996, p. 7).'

their fusion into a unified timbre' (p. 351). Hasegawa (2009) shows the following trombone spectrogram[7] (p. 350):

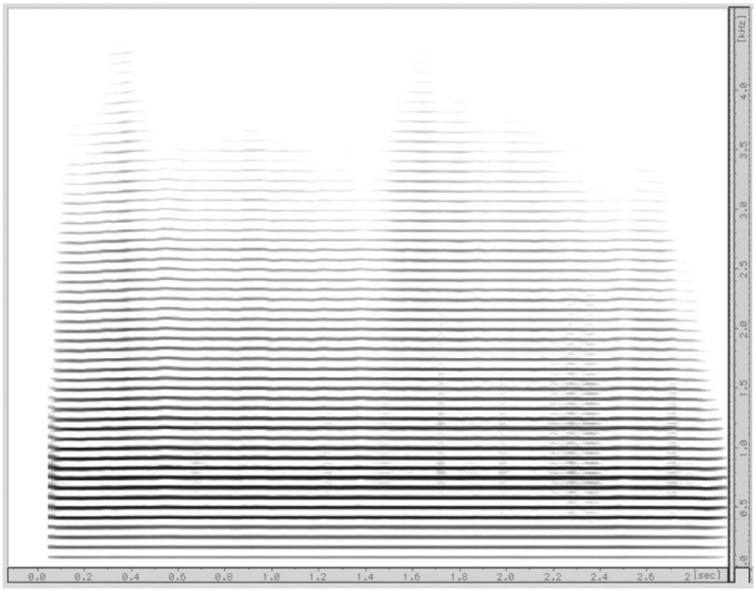

Figure 3: Trombone spectrograph

Figure 4, from the score of *Périodes*, shows instruments entering in a staggered temporality simulating the entry of partials in a trombone timbre. The trombone enters first, playing the fundamental pitch E2, doubled by the basses an octave below. The frequencies of the trombone's upper partials emerge after a delay. The clarinettist

[7] Though it is not the one Grisey used, which seems lost in time.

enters next, playing the 12th partial, followed by the violinist playing the 10th partial. The violist enters fourth, playing a double stop comprised of the 7th/9th partials. The violinists share a complex cluster of overtones including the 13th/15th/17th/19th/21st partials.

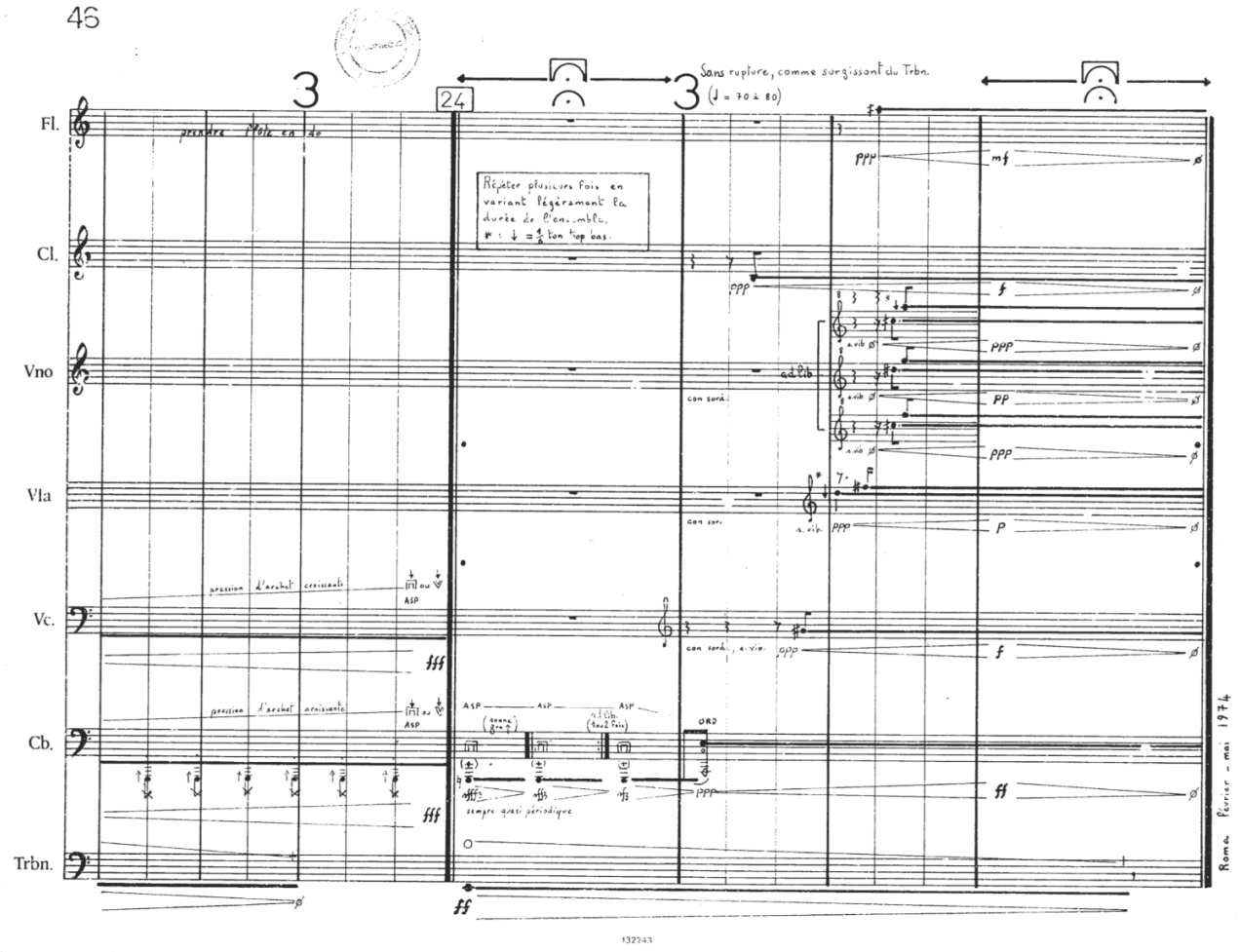

Figure 4: last page of Périodes

Pitch aggregates in *Périodes*

Féron (2011) studied Grisey's manuscripts in the Paul Sacher foundation, analysing the emergence of spectra in Grisey's oeuvre. He writes of three pitch aggregates which Grisey used as a basis for *Périodes*. The first aggregate, as described above, is represented by the harmonic prism. In optics, a prism only lets some of the light spectrum through. Grisey adapts the prism analogy to describe his filtering the overtone series, allowing only odd numbered partials up to the 21st partial through. This is called aggregate A (figure 1). To accommodate performance challenges, Grisey approximated the pitches of the overtone series by lowering the 7th and 21st partials by a sixth of a tone and the 11th partial by a quarter tone.[8] Figure 5 is a diagram of the harmonic prism (Aggregate A) shown in Grisey's score (1974).

[8] Compromises were made as a pragmatic response to instrumental design and contemporary performance practice.

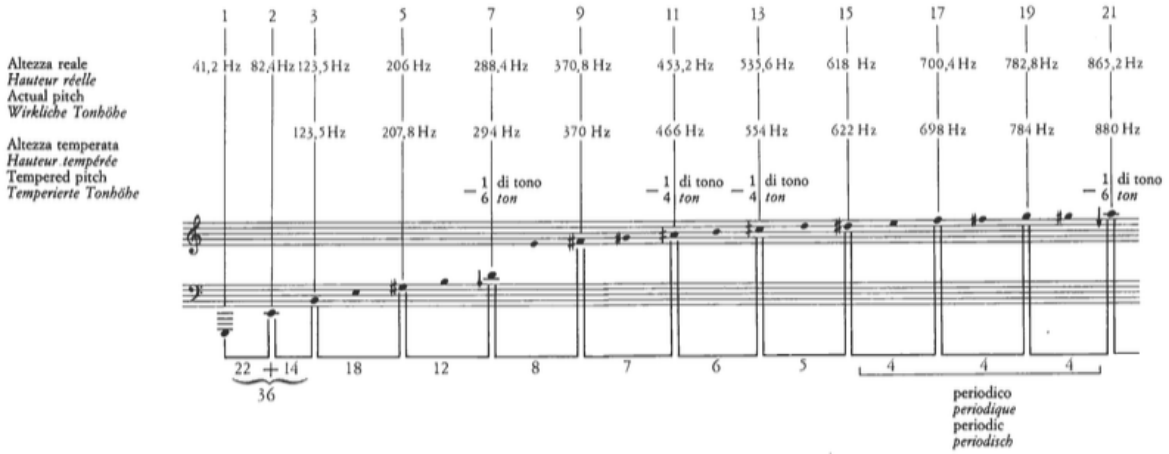

Figure 5: Harmonic prism in Périodes

Grisey creates two complementary aggregates; one comprising all the partials from the overtone series not shown in the prism (aggregate B) and one comprising all pitches outside of the overtone series (aggregate C). Grisey controls a gradual temporal unfolding of the above aggregates through a breathing metaphor. There are three phases in a cyclic motion of inhale (tension), exhale (release), and the pause between the exhale and inhale (repose). Aggregate A symbolises a repose, as the point of greatest consonance, or relaxation, with the addition of the other aggregates increasing dissonance or tension, and the subtraction of these elements moving back to the repose.

Grisey (1987) writes that 'we can construct a continuum that can be found in the classification of intervals (by their degree of dissonance) and of timbres (by the extent to which they are non-harmonic)' (p. 244). For instance, an octave which is vibrating in a ratio of 2:1, is considered more consonant than an interval of a minor

third vibrating in the ratio of 7:5.[9] For *Périodes* a move towards tension, or a greater vibrational complexity, is made by moving towards inharmonicity through gradually introducing even numbered partials (aggregate B), and then adding pitches from outside the overtone series (aggregate C): a move towards noise, a complex of (relatively) irregular, unpredictable vibrational patterns. Grisey provides a temporal homology: aggregate A, the point of greatest harmonicity, the area of repose, is characterised by openly repeated sections, temporal moments with the most predictable periodicity.

Instrumental synthesis and pitch aggregates are key strategies for the organisation of my composition *In the deep end*. In the chapter *Becoming gong*, I show how I adapt the process to change instrumental space through a harp scordatura, piano preparations and modular synthesiser samples. I establish pitch aggregates partitioning this sonic territory. Juxtapositions and continuities between these territories occur through both gradual compositional processes and improvisations responding to compositional instructions.

[9] Grisey's table of continuums in *Tempus Ex Machina* (figure 1) creates a temporal homology for consonance and dissonance. Spectral composers understood consonance and dissonance through the terms harmnonicity and aharmonicity, categorised through analysing vibrational periodicity.

2 Becoming gong

In the Deep End uses a spectral analysis of a Tibetan gong to design a territory for improvisational action, adapting the technique of instrumental synthesis to the materiality of the instruments themselves. I composed the work for Emily Granger (harp), Ben Carey (modular synthesiser), Steve Barry (prepared piano), Jamie Cameron (drums) and Martin Kay (saxophone/clarinet). The premiere performance was on October 18, 2017, at the Sydney Conservatorium of Music.

Using the software program *Spear*, I analysed a sample of a bowed Tibetan gong. The shorter the time frame, the more accurate the partial representation becomes. Figure 6 shows one view of the spectrogram I worked with. The two darker lines give two major formants as B4 andB5.

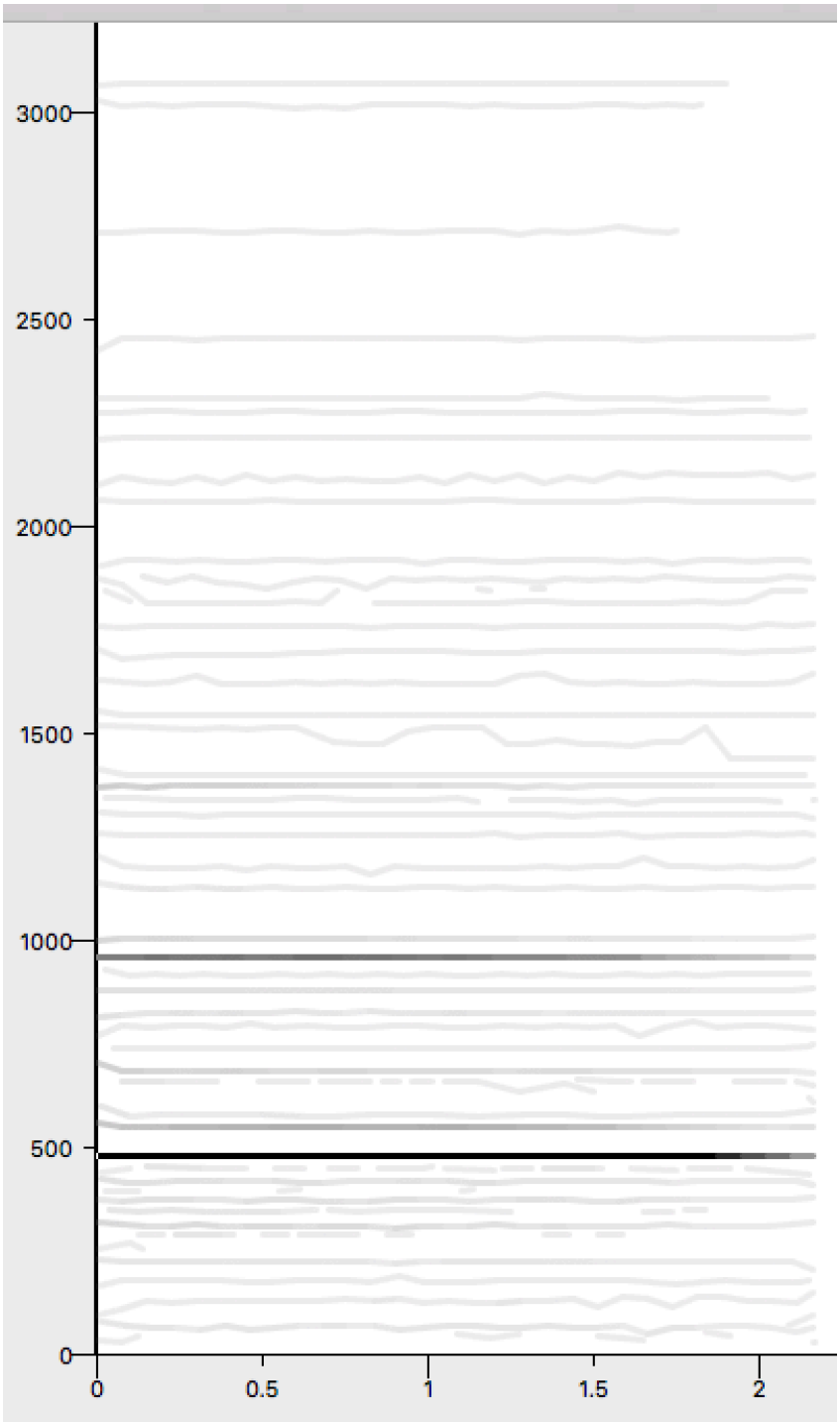

Figure 6: spectrogram of Tibetan gong

Working from the spectrogram, I translated the frequencies into a table, recording the closest equal temperament equivalent with the cent deviation, and in another column, the equivalent hertz (figure 7).

Octave	Pitch (difference from Equal temperament)	Frequency (hz)
Octave 1 (O1)	A#1 (-87)	55.4
	B1 (-24)	60.9
Octave 2 (O2)	D2 (-63)	70.8
	B2 (-24)	121.8
Octave 3 (O3)	F3 (+48)	179.4
	A#3 (-69)	224
	B3 (-24)	243.8
Octave 4 (O4)	F4 (4)	350.1
	G#4 (20)	420.22
	A#4 (-53)	452.2
	B4 (-48)	480.4
Octave 5 (O5)	C#5 (-17)	549.1
	D5 (-19)	581
	F5 (-36)	684.1
	G#5 (-16)	822.92
	A#5 (-27)	917.8
	B5 (-50)	960
Octave 6 (O6)	C#6 (26)	1005
	D6 (-74)	1125.3
	E6 (-22)	1302.2
	F6 (-30)	1372.7
	G#6 (-43)	1515
	A#6 (-46)	1700.5
	B6 (-55)	1913.8
Octave 7 (O7)	C#7 (47)	2109.3
	D7 (-53)	2278.1
	F7 (-50)	2714.4

Figure 7: Tibetan gong analysis for In the Deep End

The advantage of using a harp was the precision with which I could represent the frequencies of the gong harmonics. I selected seven-and-a-half octaves of partials, guided by the practicalities of designing the harp scordatura. I assigned these pitches across the entire range, with no repeated tunings across octaves. At the bottom of the harp range, gaps are filled by standard, equally tempered tuning. As the range reaches higher every string conforms to the harp analysis. For simplicity of performance, I made the decision to construct the scordatura so that no pedalling was required to express the full set (figure 8).

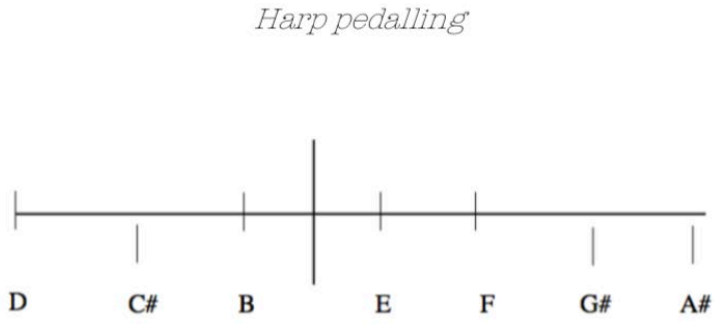

Figure 8: harp pedalling for In the Deep End

Murail writes that spectrograms 'lend themselves as easily to sine wave realizations… as to realizations in richer instrumental timbres, which produce effects of spectral multiplication' (Murail, 2005d). This observation by Murail inspired me to include a modular synthesiser into my work. The prime reason for me choosing the modular synthesiser as a part of this composition, is its ability to express the

proportions of the gong partials using sine waves, projecting a clarity contrasting with the more complex timbres occurring throughout the ensemble. The modular synthesiser is programmed with a subset of the gong set (figure 9).

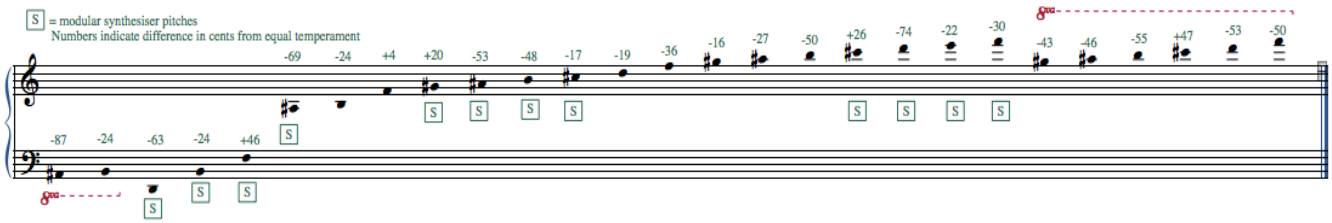

Figure 9: Modular synthesiser set (subset of harp scordatura)

I design further pitch aggregates, creating contrasting material to sustain a dramatic arc within the work. All of the pitches on the harp not altered by the gong harmonic form a contra-set, made up of pitches in equal temperament. In this way I set up a competition between two harmonic systems, as well providing a shared temperament between modular synthesiser, saxophone/clarinet, piano, and harp (figure 10). The piano equal tempered set extends beyond this range.

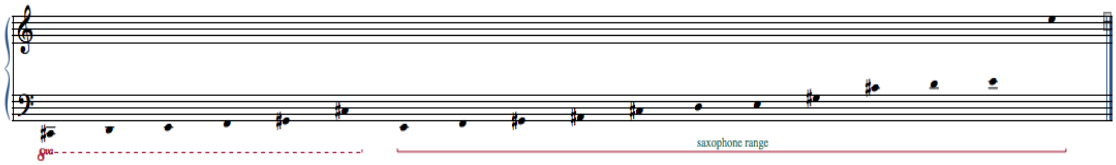

Figure 10: equally tempered aggregate

A further set radiates unpredictably from the gong scordatura. Each note of the harp scordatura governs a possible preparation, as the nearest pitch on the piano is prepared with paper, plastic or cardboard. There is no prescription on how to prepare the piano, although for the first performance I suggested creating gong-like sounds and percussive sounds connecting to the drumkit. The aim was to create a completely new set which may vary from performance, while keeping the equally tempered set intact, connecting the piano with the harp and saxophone. To summarise the three pitch aggregates:

- The gong aggregate
- The equal tempered aggregate
- The prepared piano aggregate (variable).

In figure 11, the first five pitches of the harp and the second to fifth piano pitches draw from the equal-tempered pitch set. In the lower staves the top two pitches of harp and piano and the lowest piano pitches are drawn from the scordatura set (the pianist plays prepared pitches and the harp the scordatura pitches). For the performance in my compositional portfolio, the pianist chose not to prepare the E and the A in the right hand so as to create a microtonal difference between the harp and the piano pitches. The synthesiser player performs bass tones tuned to sine waves drawn from the gong aggregate, moving gradually towards a beating pattern made through amplitude modulation. Fermatas cause the patterns to move out of phase, creating unpredictable melodic and harmonic confluences. These composed elements provide a sonic territory for the alto saxophonist's improvisation.

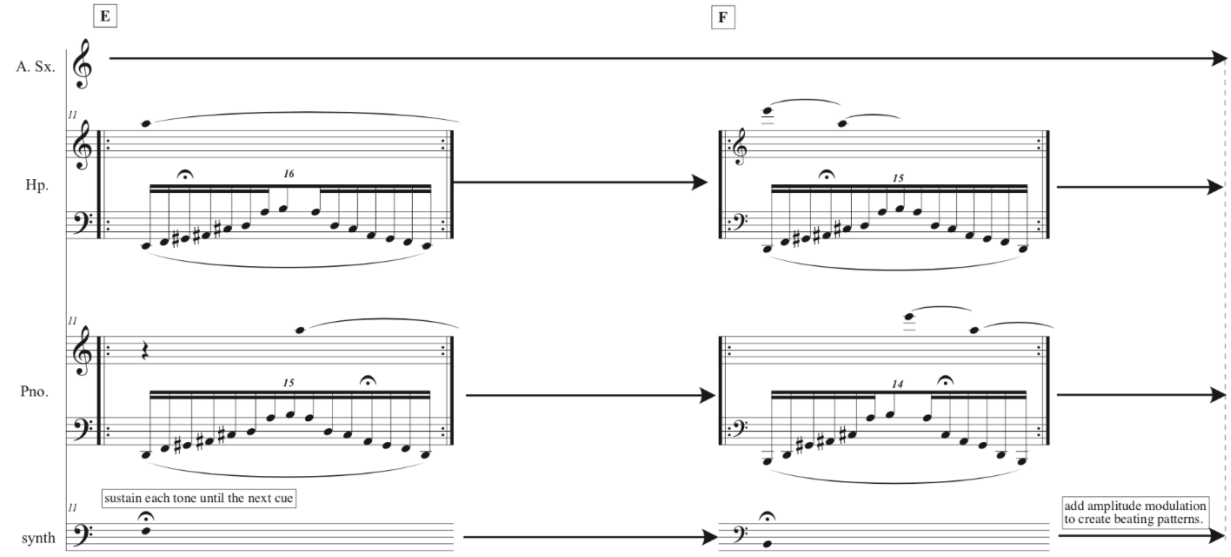

Figure 11: mixed pitch sets for In the Deep End

My compositional process for *In the Deep End* demonstrates an improvisational and experimental approach from conception to conclusion, as I experimented with a Tibetan gong, striking and scraping it with a variety of materials, spontaneously subjecting it to hammers, hands, cloth, nails and several violin bows, eventually settling on several samples to be used as a part of the work. The improvisational network was involved also from during the process as a series of free improvisations catalysed my compositional process. In a sense, I clothed the improvisational network with compositions emanating from the Spectral techniques of instrumental synthesis and pitch aggregates, and, as I will show in the section *Metaphorical transformations*, continuous and gradual processes. The performer's aesthetic is sustained through the process and emerges at each moment to shape and evolve the composition.

The newness of the temperaments leads improvisers to develop a new repertoire of sounds, harmonies and interactions.

3 Improvised approximations

ImpOsition[10] is a Spectral etude for improvising orchestra, composed for *The Sydney Conservatorium of Music modern music ensemble*, conducted by Daryll Pratt, who premiered the work at the Sydney Conservatorium of Music on October 16, 2016. The title *impOsition* suggests a playful approach. An imp is a mischievous sprite, indicating a psychological attitude which I wished each performer to convey; a playful attitude towards interpreting the score, surprising themselves, using their wiles to adapt to unexpected musical situations, which they themselves produce. *impOsition* suggests the limitations which the composer places on the improviser.

Murail (2005d) writes that structures drawn from sound analysis, 'are sufficiently pertinent and elastic to endure various treatments or tortures with their

[10] Scored for alto flute/piccolo, Bb clarinet/bass clarinet, alto sax/soprano sax, tenor sax, baritone sax, French horn, trumpet, trombone, tuba, vibraphone/crotales/ride cymbal, harp, piano, violin 1, violin 2, viola, cello, and double bass.

identities intact' (p. 151). In *impOsition* I test the bounds of this statement. Grisey's approximation of pitch in *Périodes* inspired me to exploring the harmonic consequences of improvising pitch variations up to a quartertone flat or sharp of the written pitch. Pitches drawn from the C overtone series become centres of gravity. Microtonal deviations from the central pitches are improvised, simulating variations from the theoretical overtone series characteristic of instrumental timbres.

Chords emerge as spontaneous events. The balancing of these unexpected emergences becomes a group endeavour, though a slightly treacherous one, made of a constantly shifting musical terrain. *impOsition* forms a continuum from a chordal, tonal aesthetic to a saturated, grungy aesthetic bordering on noise. I create pitch aggregates which pit many versions of a C spectrum against each other. The first variation on the C overtone series is a one-octave harp scordatura repeated across all octaves. The harpist tunes the B, F and A strings to match the deviations from equal temperament of 7th, 11th and 13th harmonics respectively (figure 12)

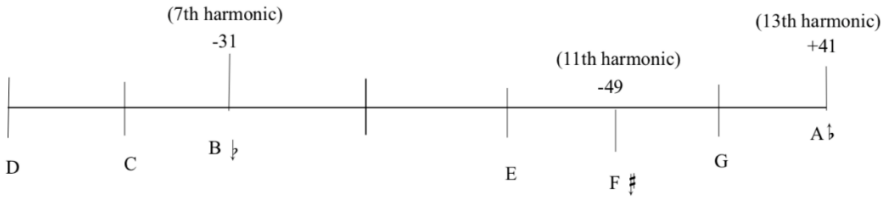

Figure 12: harp scordatura in impOsition (In C)

The violinist, violist and cellist tune one open string each to match the scordatura harp. The violinist tunes to the 7th harmonic, the violist to 13th harmonic, and the cellist to the 11th harmonic. The second violin tunes the D string anywhere up to a quartertone higher, a tuning remaining malleable during the performance (figure 13).

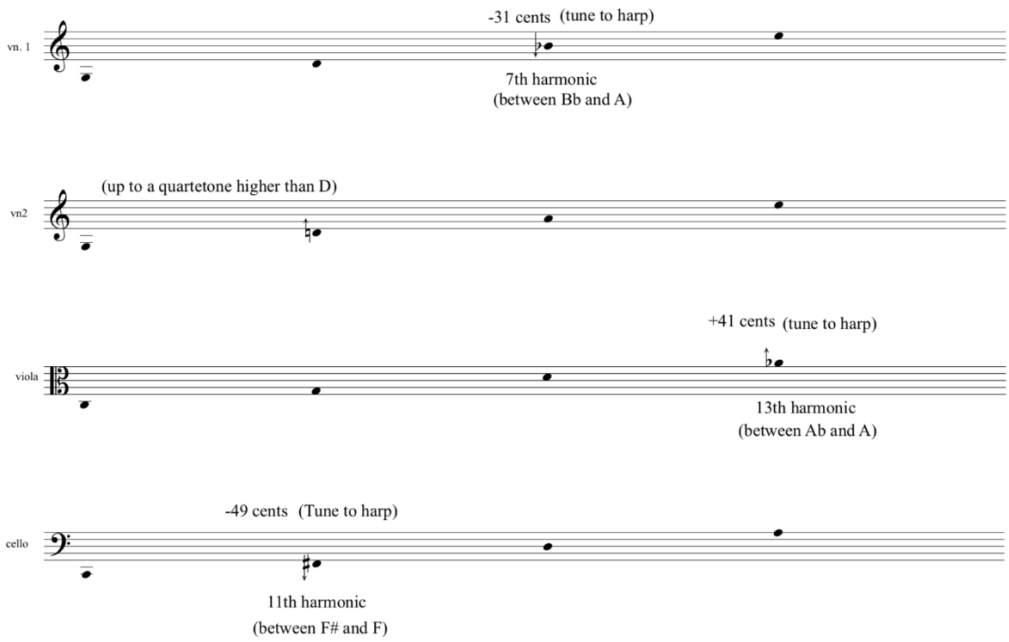

Figure 13: string scordatura for impOsition

In figure 14, the baritone saxophonist improvises on an overtone series based on low A (C concert), improvising around the cellist's harmonics, also built off of a C concert, exploiting microtonal differences through occurring through the natural design of the instruments.

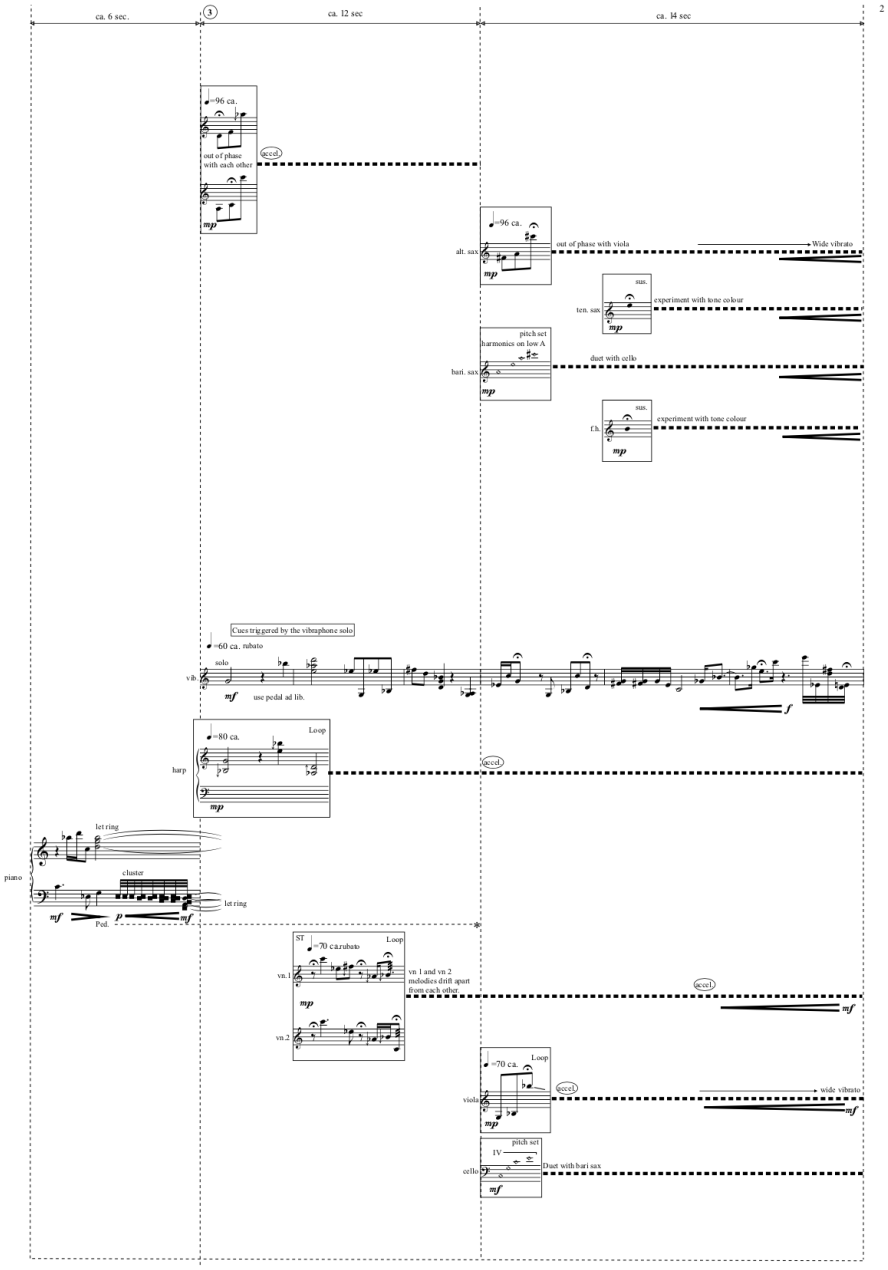

Figure 14: natural harmonics between the baritone sax and cello

I establish five microtonal accidentals (figure 15). Three, the 7th, 13th, and 11th harmonics equate to the harp scordatura, while two direct performers to improvise pitches up to a quartertone sharp or flat.

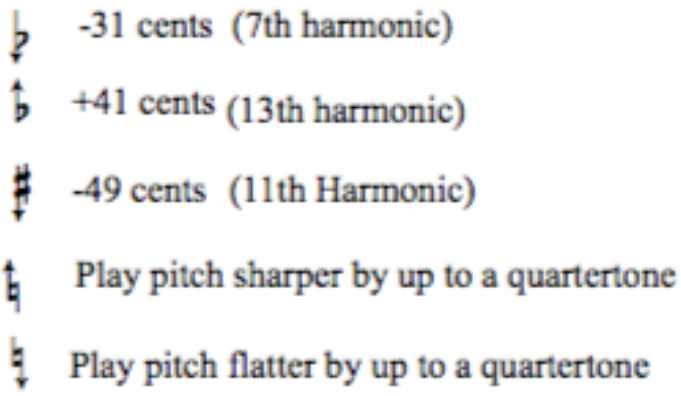

Figure 15: altered and approximated accidentals

In figure 16, the baritone sax improvises melodies using a pitch set. Three options occur for the saxophone pitch B; an equal-tempered pitch and two improvised variations up to a quartertone sharp or flat. In the score, I set up a process asking performers to constantly vary their intonation, to explore how these pitches play with the unfolding texture, challenging both improviser and ensemble to adapt.

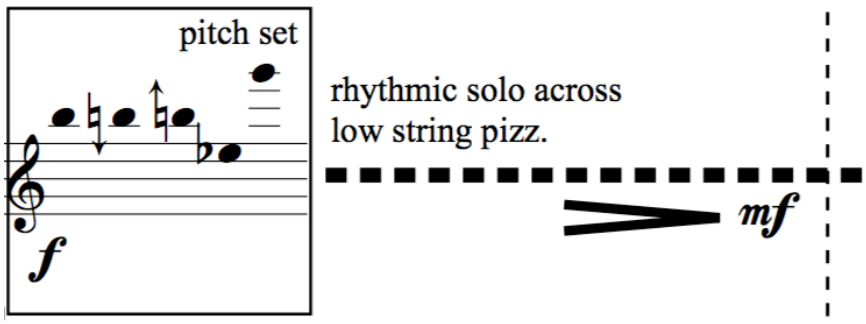

Figure 16: baritone sax improvised approximations

impOsition as a Spectral etude guides the performer to develop a repertoire of microtonal responses, as well as honing musical reflexes to respond and adjust to local circumstances. In *impOsition*, I drive processes creating asymmetry, destabilising the performer through the unexpected. The temporal disorientation of both performer and listener becomes a compositional aim. The recorded performance functions as a kind of aural Rorschach test, with each performer (and listener) finding their own pathway through a kaleidoscopic texture of sound. The improvisational ensemble, itself a complex and unpredictable entity, navigates a score with unpredictability encoded in its form. The next chapter begins to explore the influence of chaos, unpredictability and non-linear systems on Spectralism.

METAPHORICAL TRANSFORMATIONS

> We are in the position of relating different time scales when we try to link the surface pitch movements to the underlying spectral structure, or to transfer structural information from micro-time to macro-time. Music composition strategies cannot reproduce, but rather replace metaphorically, the nature of the phenomenon. (Teodorescu-Ciocanea, 2003, p. 89)

4 Virtual ensembles

Murail (2005b) writes that the spectrogram showed that 'our entire musical tradition assumes a direct correspondence between the symbol and the thing. But sound is essentially variable—in the sense, of course, that a sound can never be repeated exactly, but is variable also within its own unique lifespan' (p. 122). Imagine for a moment a series of repeated pitches; sonic analysis will show the subtle microphonic variations making each instance unique. Imagining timbre in this way, a single spectrograph represents just one possible moment with infinite possible variations, providing both a locus and a trigger for the composer's imagination.

In this view, Murail contracts all of the serial possibilities of a repeated note into a single, virtual instance. He adopts a panoptic stance, writing that 'ultimately, it is better to consider the spectrum not as a new type of grid, but as a field of possible relationships within a group of frequencies: an ensemblist conception, as a mathematician would say' (Murail, 2005d, p. 153). The mathematical ensemble was created by the mathematician Gibbs to represent an ideal complex, consisting of a large number of virtual copies, possibly infinitely many, of a system, considered all at

once, each of which represents a hypothetical state that the real system might be in: a probability distribution for the state of the system. Murail writes that:

> This conception may extend to all manifestations of the musical discourse: a spectrum is an ensemble, a sound is an ensemble, a form, a microform, an orchestral figuration, a group of durations; all of these are ensembles upon which ensemblist operations can be performed. (Murail, 2005d, p. 153)

An ensemblist conception formalises the notion that an experimenter repeating an experiment many times under the same macroscopic conditions, but unable to control the microscopic details, may expect to observe a range of different outcomes (Gibbs, 2014). I consider the improvisational network as artistic experimenters trying out all possible combinations of my scores. From this perspective my scores are sketches which improvisers colour in time and time again, outlining a network of possibilities which the improvisational network knits together. In this I follow the spirit, if not the exact meaning of Murail's observation that:

> We shall retain above all the fact that the spectrum offers at the same time material and a frame, in the form of a network of relations among which one may choose, but within which one must remain, if one wishes to respect the rules of the game and, in so doing, guarantee the necessary harmonic and discursive coherences. (Murail, 2005d, p. 153)

On considering the spectrogram as a sketch, as an incomplete image of a past ecology of timbre-perception-present, a sonic revivification presents a virtually infinite array of possibilities. There is a persistent correlation in the imagination between the memory (recorded or otherwise) of the original sound, the spectrogram which

captures an instant, and the potential variations this sound may produce. This triangulation catalyses compositional challenges.

Both Murail and Grisey encoded possibility in their works through introducing aleatoric notations. Murail's *Territoires de l'oubli* and Grisey's *Périodes* contain sketch-like elements. In *Territoire de l'oubli* the performer coaxes a finely detailed aura of harmonics from the piano, which interact in ways beyond the performer's direct control. In *Périodes*, performers temporally approximate pitches around a grid, itself in flux, simulating aperiodic fluctuations such as the heartbeat.

Each of these instances allows a range of possibilities across multiple iterations of a work. To understand the implications of an ensemblist conception for a composer, begin to imagine an array of performances. In a completely notated work, the differences will be far less than in a work with aleatoric notations, and even less when, as in my works, notation is juxtaposed with free improvisation. The essence is repetition and divergence across iterations. Sketches, or schemas, are indispensable for the improviser as a locus for contracting unmanifested possibilities. As a personal example, I have improvised variations on melodies for many years, exploring myriad versions. It seems to me that this knowledge is stored in a single image of the melody, an image providing a virtual anchor around which ideas accumulate. The composition is the locus around which all of the imagined possibilities coagulate.

Bergson's (1929) ideas on the visual image gives an inkling of an imaginative process which contracts all possibilities; remembered, imagined, unimagined and impossible, into a symbol. He observes that:

> Quasi-instantaneous views will be taken, views which this time are bound to be pictorial, and of which the more vivid colours will condense an infinity of elementary repetitions and changes. In just the same way the multitudinous successive positions of a runner are contracted into one sole symbolic attitude, which our eye perceives, which art reproduces, and which becomes for everyone the image of a man who runs (Bergson, 1929, p. 277).

A parallel may be found in the contraction of multiple repetitions into a single sonic image. The spectrogram is made in this way, through taking samples of a sound, then rendering them in a continuous image (McAdams & Pressnitzer, 2000). The overlapping phases of the vibrational patterns, displayed as frequencies, contract not only an instance of a particular sound, but also, by extension, all instances of that particular sound into a single image; an image which becomes a locus of concentration for the composer. Dufourt (2014) writes that 'The musical form is based on a singular intuition – however diverse and proliferated it might be – that is itself drawn from the same process deployed within the multitude of its phases' (p. 161).

For the both the improviser and the composer, there is a moment where the potential, the unrealised possibility crosses a threshold into manifested reality. I view the threshold of the virtual (potential) and the manifest (actualised) in two ways: first, over large spans of time, the improvised differences occurring across multiple realisations of my work may be analysed as cleaving to a central logic by the score. This is what Lewis (1996) calls a 'multilaminar perspective' (p. 108); a second view occurs continuously at during moment, as the improviser sits at the liminality of multiple possibilities and a singularity. Peters (2009), draws on the philosopher Kant,

observing that the improviser does not create freedom, freedom already exists, and it is the improviser's task to maintain this freedom at each moment, to sustain a field of possible relationships. The improviser sustains the freedom to manifest a musical direction, existing at the cusp of possibility, responsible for a work constantly in flux.

5 Chaos

Grisey (2000a) observes that Spectralism emerges from an interaction between a 'utopic desire for a musical language articulated on scientific facts' (p. 3). He places Spectralism within a scientific zeitgeist, observing that 'coming into being in the mid-Seventies, curiously around the same time as fractal geometry, spectral music offered a formal organization and sonic material that came directly from the physics of sound, as discovered through science and microphonic access' (p. 1). Perhaps he recognised synergies between fractal science and patterns within his own compositions. For instance, instrumental synthesis may be thought of in fractal terms, as a repetition of patterns across dimensions, with each instrument introducing the vibrational patterns of its own timbre upon the frequency pattern of another timbre.

Entropy

Lara (2013) considers Murail as a translator, transforming the patterns of extra-musical models into sound, using the concept of translation as a metaphor for Murail's compositional process. In Lara's (2013) translation metaphor, each 'reiteration is increasingly enriched, but simultaneously distanced from the initial source' (p. 119). The initial source becomes a transformed memory. Murail's *Mémoire/Erosion* (1976) is

a compositional metaphor for reinjection loops occurring in the recording studio, where information is re-recorded and layered. The reinjection loop causes distortions through layering repeated material which degrades, interacting with precious layers leading to distortion and noise. This continuous process leading towards sonic chaos (noise) is reimagined into musical form.

Although Murail foregrounds the re-injection loop in *Mémoire/Erosion*, I suggest that the dual title represents the both the overlaying and distortions enabled by the studio technique *and* temporal processes of cognitive memory. The paired concepts of memory and erosion are an important organising force in Spectralism, evidenced by Grisey's *(1987)* dedication of a section to this subject in his article *Tempus ex machina,* titled *Memory and erosion.* [11] Murail connects the idea of erosion to entropy, writing that:

> Positive entropy is defined as the progressive passage from order to disorder. The entire universe is subject to its law: natural erosion, one of its manifestations, destroys geological structures to create disorder, the final

[11] I discuss the relationship of memory and erosion in more detail in Part III: first through Murail's solo piano work *Territoires de l'oubli*, which I reimagine through the phenomenologist Edmund Husserl's concept for the perceptual present; and second through Grisey's thoughts on the liminality of the perceptual present and cognitive memory, which I explore through improvised processes in my Spectral etude for improvising orchestra, *impOsition*.

> stage of which is indifferentiation. Life, considered as negative entropy, constructs an ephemeral order. (Murail, 2005b, p. 124)

The improvisational network reverses the process of erosion, which works towards indifferentiation, establishing an ephemeral order through performing acts of negative entropy.[12] For my compositions I introduce a rhizome metaphor to create chaotic non-linear structures, providing a creative locus around which my imagination gathers: a strange attractor for my imagination.

The strange attractor

In *Attracteurs étranges* for solo cello, Murail uses the scientific metaphor of the strange attractor to guide formal evolution. Murail used the strange attractor as a compositional metaphor. He writes: 'I do not use any mathematical processes in the true sense. My only concern is poetic analogy' (Murail, 1992, p. 1). It is worth quoting a definition, to ascertain structural principles Murail aspired to:

> Strange attractors are an interesting mix of order and disorder. The dynamics of a system with a strange attractor is fully chaotic. It possesses the butterfly effect, and so long-term prediction is impossible. However, there is considerable order to strange attractors, too. The existence of the attractor, to which almost all initial conditions are drawn, means that the

[12] In the section *psychological transformations*, I explore the role of negative entropy, the countering of habit through constant renewal. The lighthouse in Homer's tale becomes a metaphor for heightened perception.

> system is constrained despite being chaotic. In the long term the orbit never repeats, but it also never strays from the attractor (Feldman, 2012, p. 283).

Murail (1992) describes the beautiful and elusive patterns of a pendulum, hinting at an invisible gravitational order, writing about how he translates these patterns into the cello melody, which melodically spirals, 'seeming to return to one or more identical points but in fact always follow differing, warped or diverted trajectories.' Each point of equilibrium proves to be unstable, projecting the music 'into a new cycle of oscillations.' Murail writes that 'the poetic strength of these new mathematical objects comes from the fact that by very complex, but hidden, operations, one could globally produce forms simple, but rich and stimulating to the imagination' (P. 1).

When multiple improvisers form an improvisational network, this network may be framed as a chaotic system. The composition provides an initial condition. Through multiple iterations of the work – through multiple orbits – there is a chaotic progress adhering to a compositional logic, with the improvisational network navigating a continuum of order and disorder.

6 Cybernetics

> Cybernetics studies the flow of information round a system, and the way in which this information is used by the system as a means of controlling itself: it does this for animate and inanimate systems indifferently. (François, 2011, p. 146)

Dufourt (2014) writes that Spectralism 'is indebted to cybernetics, if the discipline is conceived less as a technology of a new class of machines and more as a new technique of thinking, a technique that has given birth to numerous scientific and artistic domains by presenting them with highly original problematics and perspectives' (p. 164). In this chapter, I use this observation to draw parallels between Spectral formal concerns and the structural behaviour of the improvisational network.

Dufourt (2014) unpacks the cybernetic influence on Spectral composition with the following three points, which I adapt to the improvisational network in my works. First, there is 'an interaction between unstable elements' (p. 164). This is an apt description of the relationships within the improvisational network. Second, there are 'criteria that determine location between reference points and thresholds' (p. 164). Improvisers form a centre, a reference point for others and a threshold which may not be crossed. Third, there is 'a device comparing voltages or streams of data – or a

feedback circuit' (p. 164). Each improviser compares another improviser's stream of data, making selections then recycling the material, contributing to a feedback loop, maintaining the balance of the improvisational system.

Murail's solo piano work *Territoires de l'oubli* demonstrates all of the above characteristics. Nonken (2014) describes the work as quasi-improvisational, writing that 'as the score forgoes its instructional role, the pianist must focus on the abstract ideal that the score represents, then chart a course towards it, instead of imposing an external "meaning" or "significance" on the work' (p. 81). Nonken's language of 'charting a course,' brings to mind the founding metaphor of cybernetics. The cybernetician McCullough (2016) writes of negative entropy through the story of the oarsman in Homer's Odyssey: 'The helmsman must be so informed of the consequences of his previous acts that he corrects them – communication engineers call this 'negative feedback' — for the output of the helmsman decreases the input to the helmsman' (p. 164). [13]

Murail's score may represent the laws of nature, a system of wind, tides, and rain – indeterminate vicissitudes symbolised through aleatoric notation, manifesting sonically as a complex of resonance which the performer responds to. The pianist, the

[13] In the section *psychological transformations*, I explore the use of improvisation to effect negative entropy, countering the sedimentation of habit through constant renewal. The lighthouse in Homer's tale becomes a metaphor for heightened perception.

helmsman, recalibrates each response to tack towards the distant lighthouse (Murail's compositional instructions). Murail's ideal, the performer, the score and the acoustic environment may be viewed as a complex ecological system. Within my compositions, through exchanges of information, the improvisational network also generates negative entropy: as interactions send the performers off course, they constantly tack towards the compositional instructions.

7 Autopoietic improvisers

Wiener (1994) formulated the cybernetic principle of feedback through his work on aircraft trajectories. He charted a series of co-ordinates, at each stage creating slight differences in the co-ordinates to model continuity. After a period of morphing trajectories, the co-ordinates eventually differ entirely from the original set, although they are related through an interconnected chain of events. His work on aircraft trajectories was to do with designing anti-aircraft missiles.

Wiener was an early proponent of the theory that intelligent life was based on feedback mechanisms. He realised that he was not only mapping the machine, but the unexpected manoeuvres of the pilot. The inclusion of an unpredictable observer into the cybernetic system led to neocybernetics.[14] Landgraf (2011) extends this tradition, introducing a neocybernetic model for the improvisational network, viewing

[14] This is, as I will show, is remarkably similar to how Grisey uses slowly morphing material to structure compositional form, and how I, in turn, structure processes for improvisational networks.

improvisers as recursive actors, selecting trajectories from other improvisers, gradually altering and transforming an improvisational complex.

The autopoietic model favouring the totality over the individual, viewing an improvisational network as a self-organising system, recursive system. The ensemble becomes a machine, an emergent system evolving due to feedback between the parts. The Chilean cyberneticians and biologists Maturana and Varela created the concept of the autopoietic system to describe the development of eukaryotic cells. They write that an autopoietic system is,

> … a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components which… through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them. (Maturana & Varela, 1980, p. 78)

Landgraf writes that an autopoietic improvisational network forms a 'complex feedback process that continually responds (repeats and alters) to what it decides to recognize as worthwhile irritations,' revealing itself as 'a self-authoring, self-directing, and self-perpetuating process that does not deny repetition, but derives its inventive force from it' (pp. 38-39). Systems are not 'conceived to be stable entities or structures, but rather are thought to be sustained — and with every iteration subject to be changed — by the continued, recursive reproduction of their elements' (p. 35).

Landgraf broadens his metaphor through Luhmann's social systems theory. An improvisational system is characterised by dynamic stability evolving through

constant transformations. Interactions are shaped by a tripartite communication process synthesising utterance, information and understanding:

> For the communicational system, a single statement by a speaker is nothing until it is processed again by another speaker whose statement/response in turn must be processed, and so on.... Viewed at one level, the improviser is making choices, however, when looked at as a part of system of improvisers, the ideas occur as a part of a complex feedback loop, where ideas are selected for reproduction and reprocessing by other elements in the system. (Landgraf, 2011, pp. 35-36)

I rethink improvisational hierarchies through the autopoietic concept, linking the lightning fast perceptions of the present moment, the recursive feedback loops between improvisers with a major structural preoccupation of Spectralism: morphing forms made through repeating sonic material, gradually diverging through overlapping, independent processes. My works, like Spectral compositions, form a structural hall of mirrors, as microscopic feedback loops and macroscopic feedback loops exist simultaneously.

Drott (2017) quotes the philosopher Lyotard, to illustrate the Spectral rethinking of musical hierarchies through an emphasis on emergent processes: 'objects appear and disappear, like fins of dolphins on the surface of the sea...what is important is metamorphosis, fluidity. Not a dolphin, but a trail, an energetic trace left on the surface' (Lyotard quoted in Drott p. 53). This image, provided by Dufourt, is an excellent description of rhizomatic forms, which may intersect at any point.

8 Rhizome

The rhizome is a formative metaphor for my work *impOsition*, one I develop through an artistic reading of Deleuze and Guattari's concept of the rhizome. Their concept of the rhizome correlates with nature. They write:

> A rhizome as subterranean stem is absolutely different from roots and radicles. Bulbs and tubers are rhizomes. Plants with roots or radicles may be rhizomorphic in other respects altogether: the question is whether plant life in its specificity is not entirely rhizomatic. Even some animals are, in their pack form. Rats are rhizomes. Burrows are too, in all of their functions of shelter, supply, movement, evasion, and breakout. The rhizome itself assumes very diverse forms, from ramified surface extension in all directions to concretion into bulbs and tubers. When rats swarm over each other. The rhizome includes the best and the worst: potato and couchgrass, or the weed. Animal and plant, couchgrass is crabgrass. We get the distinct feeling that we will convince no one unless we enumerate certain approximate characteristics of the rhizome. (Deleuze & Guattari, 1988, pp. 6-7)

The rhizome metaphor extends Grisey's call for the field of ecology to become a new science for musicians, one enabling them to better understand the intricate relationships comprising timbre. Drott discusses Grisey's view:

> Consider, for instance, Grisey's invocation of ecology. More than just a call for a return to origins or to the putative nature of sound, ecology implies a reformulation of the relations between individual and totality, as well as a changed comportment towards the natural environment. (Drott, 2005, p. 4)

The emphasis on the totality is reversed with the introduction of a rhizomatic model for the improvisational network. Here, the totality is viewed as an unforeseeable emergence resulting from a tangle of improvised processes.

Multiplicity

> It is only when the multiple is treated as a substantive 'multiplicity' that it ceases to have any relation to the One as subject or object, natural or spiritual reality, image and world. (Deleuze & Guattari, 1988, p. 8)

Grisey (2000a) established the composition of processes as a definitive element of Spectralism: processes moving in different times, processes progressing independently, as well as ruptured, incomplete or implied processes. In *impOsition-superimpOsition* form emerges through the confluence of improvised processes. As in Grisey's work, the tangled and sinuous multiple overlapping processes are fundamental to the expression of continuity. Form is not considered as hierarchical (like a tree), rather it is a result of emergent temporal processes. In *impOsition* cells repeat, each time with an improvised divergence. In figure 17, processes are constrained, opening to more options during the baritone saxophonist's improvised melodies on the given pitch set.

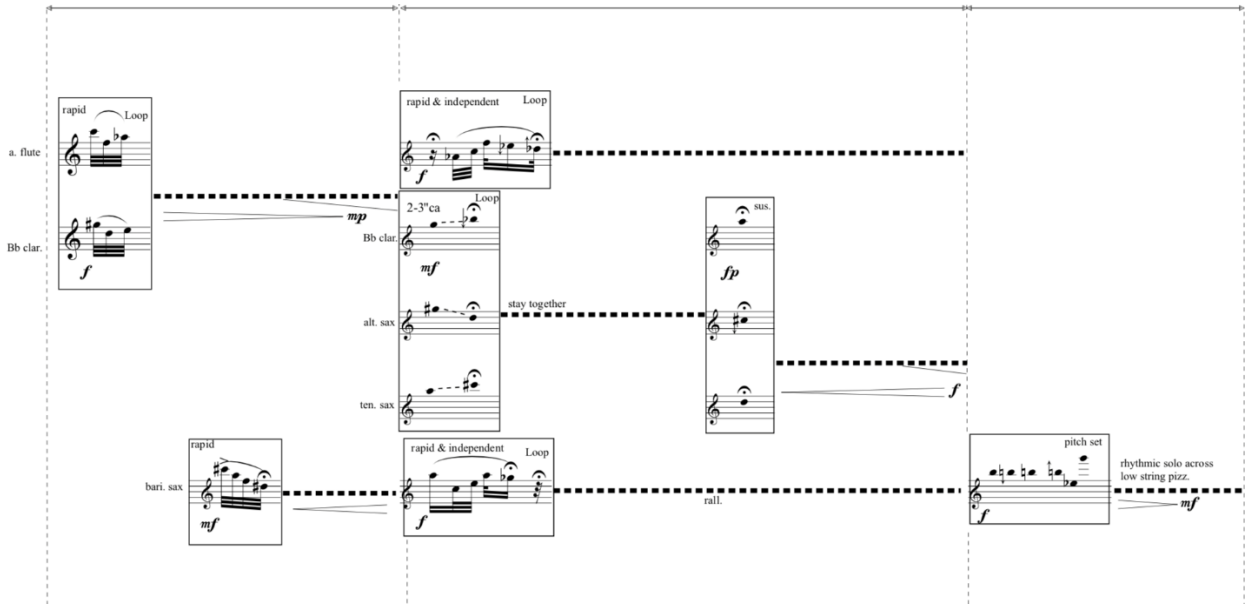

Figure 17: multiple processes in impOsition

Connection and heterogeneity

> The Principle of connection and heterogeneity: any point of a rhizome can be connected to any other and must be. (Deleuze & Guattari, 1988, p. 7)

At any time, any performer may reach out to connect with any other performer. The process is just as important as the outcome, and the interactions are as important as the content. The heterogeneous voices of performers bring different perspectives to a singular process: that of improvising divergences. The gradual retreat of my compositional specificity throughout the *impOsition-superimpOsition* cycle unfolds a distributed creativity. The performers observations and responses become less predictable, leading to an emphasis on rhizomatic transfer between the present and the performer's responses. I view notation as a counterbalance, controlling the

predictability of change however there becomes as a consequence less spontaneous connection and less change made through recursive feedback exchanges.

Rupture

> The Principle of asignifying rupture: a rupture may be broken, but it will start up again on one of its old lines, or on new lines. (Deleuze & Guattari, 1988, p. 9)

A characteristic of the rhizome is that it can be cut and will regrow. A process may rupture and change at any point. This process can be seen in the cutting of concepts across mediums, from *impOsition* to the *Rhizome* etchings, through to *superimpOsition*. In *impOsition*, vertical dashed lines indicate a rupture, causing a shift in texture or the introduction of a new cell. At each rupture, evolving processes shift together. After rupturing, the same process of improvising differences continues, renewing an improvised trajectory.

In figure 18, a passage from *impOsition*, the cellist and contrabassist play a rhythmic passage rupturing into wild overtone improvisations. Violinists one and two improvise within the range of a third above and below the given pitch, joining the violist's improvisation. All three string players create a rupture, suddenly improvising natural harmonics. The crotales player improvises rapidly with the instruction to connect aurally to the violinist's process. The process ruptures again when the ride cymbal player vigorously interrupts the proceedings, to explore sounds on different parts of the cymbal, while the double bassist and cellist improvise wild overtones and the trombone and tuba play constructions based on the interval of a third. Noise and

saturation gradually increase, breaking into the second rupture on the page as the percussionist picks up a chain and smashes the cymbal, bringing the music towards a chaotic zenith.

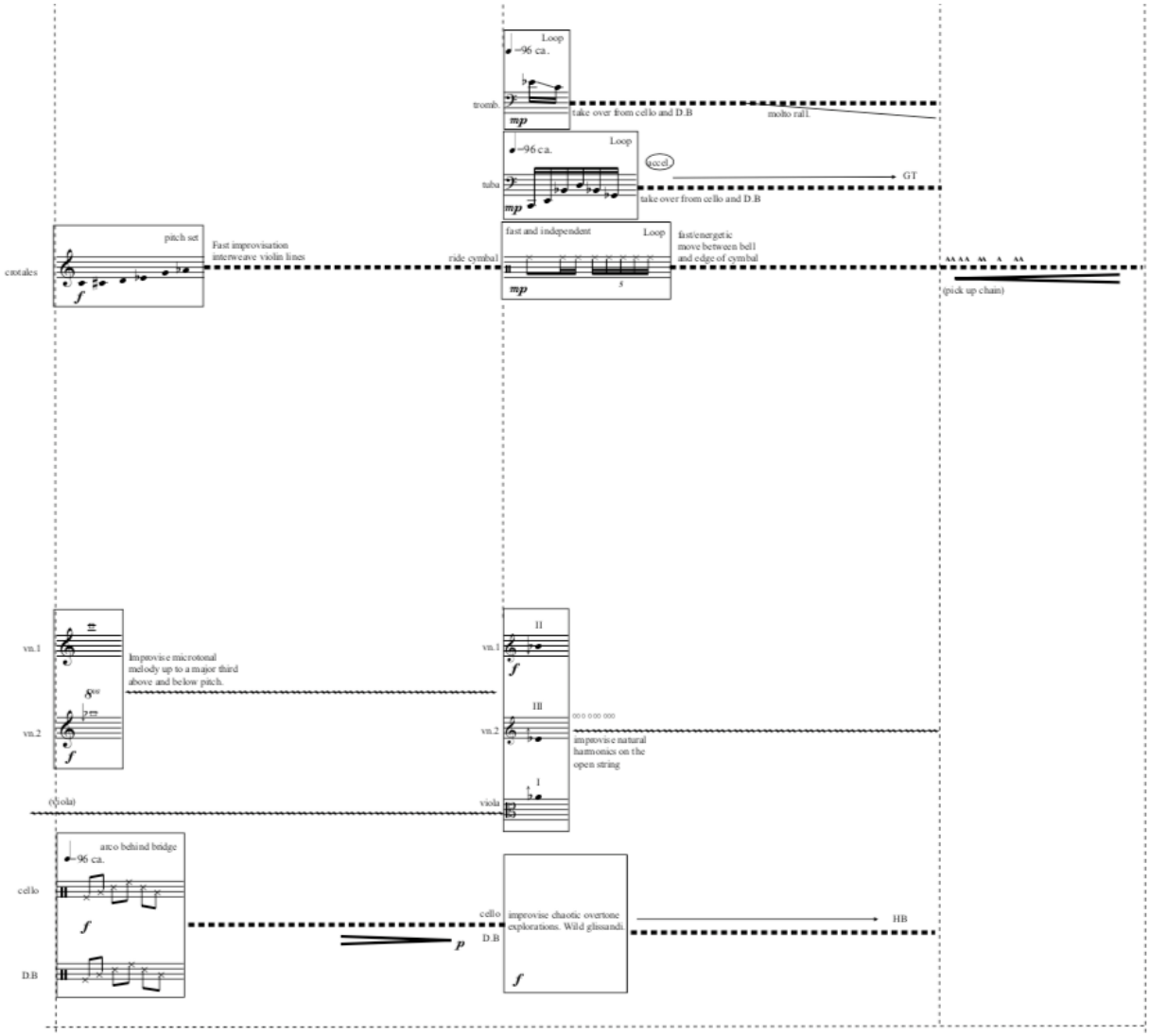

Figure 18: ruptures in impOsition

In *superimpOsition*, ruptures become a compositional category. In Rupture three, rapid improvisational interactions form a type of superorganism, like an ant colony, a beehive, or Deleuze's rhizomatic image of scurrying rats. The swarm image represents distributed creation within the network. Borgo (2005) in *Sync or Swarm,* writes that 'In the community of free improvisers it is not uncommon for musicians to speak of the importance of developing a 'group mind' during performance. This requires, at the very least, cultivating a sense of trust or empathy among group members, and, according to some, it may also involve reaching a certain egoless state in which the actions of individuals and the group perfectly harmonize' (p. 2).

Decalcomania

> The sixth Principle of the rhizome – decalcomania – forming through continuous negotiation with its context, constantly adapting by experimentation, thus performing a non-symmetrical active resistance against rigid organization and restriction (Deleuze & Guattari, 1988, p. 12).

The botanical rhizome, or rootstock is often used for grafting. Wagstaff responded to the score of *impOsition* in a rhizomatic mapping inspired by decalcomania, the decorative technique where engravings or prints are transferred to pottery, or, in the case of modern graffiti, the industrial landscape. *superimpOsition* continues processes begun in *impOsition,* opening them up further to improvisation. Improvisers create divergences, now responding to Steve Weymouth's score, an animation of visual artist Angela Wagstaff's *Rhizome* etchings (figure 19). This translation from sound to image to sound is an echo of the process of instrumental synthesis, except, rather than the

translation of partials, processes of repetition, divergence and rupture mutate across media.

Figure 19: Rhizome (etching one) by Angela Wagstaff

Wagstaff situated herself as a performer of *impOsition*, basing her performance on processes translating concepts of accumulation, repetition, divergence and rupture, as well as literally grafting images from the musical score to the etchings. Each etching results from improvised layers forming an accidental web of associations, skilfully integrated into the form of the work. There is no one way to look at *Rhizome* as the act of perceptually organising the patterns is also rhizomatic task. Steve Weymouth furthered the decalcomania, using *Rhizome* to create an animated score, knitting together each etching, adding colour and enhancing the layering.

Each etching emerged through layering multiple iterations of a process, resulting in a beautiful, otherworldly quality. Interactions between each layer in *Rhizome* are analogous to the layering of the memory of the improviser performing multiple iterations of *impOsition* - or at local level, during a single performance, the layering in the memories as improvised musical cells gradually transform. Wagstaff and I discussed a rhizomatic characteristic of memory: once events cross a threshold becoming memory, a temporal collapsing occurs, with the consequence that each memory may now connect with any other memory. The following explanatory notes are drawn from Wagstaff's personal notes (Wagstaff, 2017).

- To begin the process, I cast myself as an improviser of the score in the same way that the musicians would be when it was performed, using a visual repertoire of marks and gestures rather than an aural one.
- Unintentional marks made as part of the manipulation of materials were kept in play and woven into the image just as they would be in a musical performance where sound is created in the moment.
- Patterns of small marks are direct representations of the pitch patterns on the score with care taken to render the distances between the pitches accurately. Larger marks are improvisations using the original pattern and varying the order, the scale, the opacity, and the density of the mark.
- The music is punctuated by rupture points, so the etchings also have delineated rupture points represented by vertical lines on the etchings. The rupture points

on the etchings were dictated by the parallel timings of the etchings and the composition.

Maps

> … The rhizome pertains to a map that must be produced, constructed, a map that is always detachable, connectable, reversible, modifiable, and has multiple entryways and exits and its own lines of flight. (Deleuze & Guattari, 1988, p. 21)

A challenge in *superimpOsition* is that there are two maps: the animated score, and my interpretive guide to the animated score. My interpretive guide provides a simple framework for improvisational action, one which grafts the overlaid processes begun in *impOsition* continuing through Wagstaff's *Rhizome*.[15] For the first performance of *superimpOsition*, I asked the performers to respond to the score as it scrolled, improvising to visual gestures as they left the screen.[16] In the future I would like to

[15] As my interpretive guide was written to explore ideas in this thesis, it is really applicable just for the one ensemble I composed it for. The animated score is the actual score and new improvisational frameworks may be written. It is useful however, to take into account the underlying concepts, such as the timing of the ruptures, as well as the rhizomatic concepts of connection and the process of improvising repetitions with varying amounts of divergence. Ultimately, the improvisational network could just play entirely intuitively, responding to any element of the score. As an interesting note, I have played versions of this with saxophone orchestra. Angela Wagstaff has also transformed the score through projecting it on multiple different surfaces, adding mobility.

[16] In a future iteration, I plan to experiment with interpretations moving closer to the rhizomatic ideal, freeing the performers to respond to any image on the screen, regardless of positioning. In the final section of *superimpOsition*, the ensemble interprets a series of pulsing lights signalling the close of the work. This is an effective scaffolding strategy which, although directing the performers' attention, breaks free of linearity. During the rehearsal process, I withdrew my commentary as much as possible, as I found this counter-productive, creating another layer of cognitive constraints antithetical to the ideal I wished to achieve. As a result, the performance often transgresses the bounds of my score, as the intimacy of the moment subverts compositional organisation. At the extremes of this process the connections with Spectralism are thin, held together only through the scordatura of guitar and the temporal improvisations of continuity.

experiment with a freer approach, freeing the performer to respond to the entire screen.

Viewing Spectralism as a complex of techniques and concepts, I see a rhizomatic map which may read in multiple ways; a map still forming through the confluence of multiple processes. Through the process of decalcomania, ideas transfer from person to person and across artforms, where any point may be connected to any other point; and the transfer of information involves a rupture as concepts are uprooted, yet the processes are reassumed, continuing along the same or new lines.

PSYCHOLOGICAL TRANSFORMATIONS

9 Morphing trajectories

Predictability is in the ear of the beholder, related to expectation. Grisey addresses the listener's memory, influencing temporal perception through modelling a continuum of predictability-unpredictability. Grisey's recursive feedback loops emerged through his observation that listeners recognise differences through a comparison with memory, setting up an expectation, or a pre-audibility:

> By including not only the sound but, moreover, the differences perceived between sounds, the real material of the composer becomes the degree of predictability, or better, the degree of 'preaudibility'... it is no longer the single sound whose density will embody time, but rather the difference or lack of difference between one sound and its neighbour; in other words, the transition from the known to the unknown and the amount of information that each sound event introduces. (Grisey, 1987, p. 258)

Grisey (1987) develops compositional strategies for engaging memory, playing with expectation:

- The repetition of an event helps and sometimes forces it to be memorized.

- The degree of salience of a sound or a sequence can help it to be memorised. A violent, unexpected sound, for example, can leave a lasting trace. This is the very purpose of contrasts.
- To the contrary, in the composition of certain types of processes, the difference between one event and the next is virtually nil (the degree of pre-audibility tends towards infinity).

In *Périodes*, a continuous flow is achieved through processes occurring on the pitched and temporal planes. Each section blurs into the next, through overlapping and disguised processes. Grisey based *Périodes* on a breathing metaphor, representing processes of tension and release. Exhale one (a process of relaxation) begins with a series of upward glissandos running from G#-F# (figure 20). The minor 7th glissandos gradually lengthen in a notated rallentando, eventually refracting into a chromatic scale. The refraction into the chromatic scale introduces rapid subdivisions. Characteristically of the work in general, each instrumental entry is staggered. Each instrument enters with a progressively faster subdivision, moving up through the number scale: the flautist enters with 11 subdivisions, the contrabassist with 13, the cellist with 15, the clarinettist with 17, the violist with 19, then the violinist with 21.

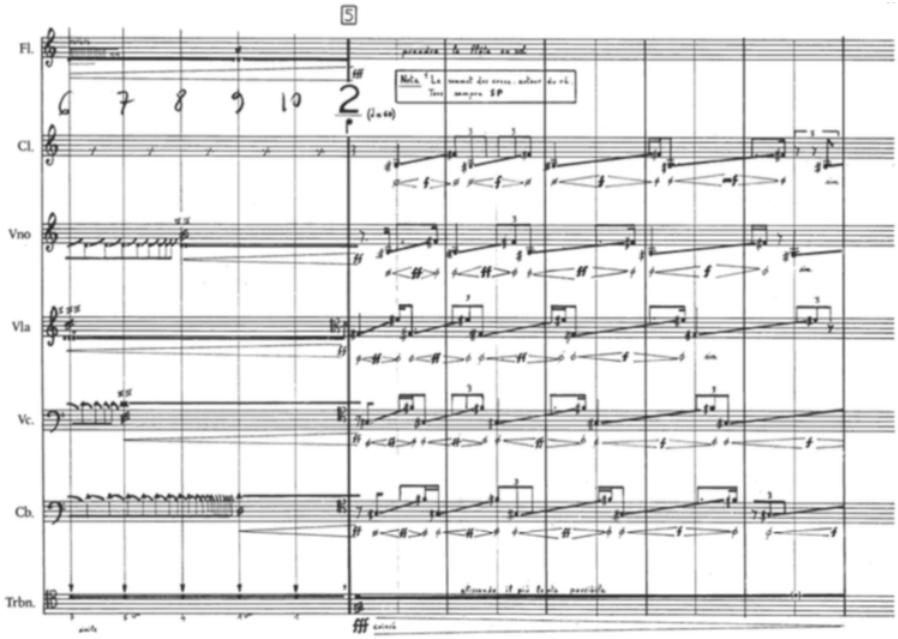

Figure 20: ascending processes in Périodes (1' per grid)

Figure 21 shows how, after the initial entry, the subdivisions of each instrument slows through a systematic reduction in notes per grid (also following the numbers from the harmonic prism). For example, the flute begins with eleven notes over 3 seconds and the clarinet begins with 17 notes per 3 seconds. Each minor 7th frame fills with upward sweeping, slurred gestures. Each slur group begins and finishes imperceptibly, with a gentle crescendo in the middle, creating waves of overlapping sound. Slurs cross the subdivisions, adding another layer of off-kilter periodicity. The bottom notes of the slur groups oscillate around an imaginary constant axis, swaying back and forth, subject to the composed grid.

A process also occurs melodically, one inseparable from the decreasing subdivisions. Each slowing of a subdivision results in a hollowing of pitch. This hollowing out of the minor 7th is an ordered process with pitches disappearing in the

following order across each instrument: A#, D#, C, F, A, C#, E, B. The minor 7th is filtered until just the 5th, 7th, and 9th partials remain, gradually reducing complexity and tension towards the repose section. Each iteration incrementally shifts the musical trajectory, until the upward portamentos are totally transformed. Thinking back to Wiener's aircraft trajectories, each musical gestalt represents a co-ordinate shifting slightly at each iteration, gradually morphing the musical direction.

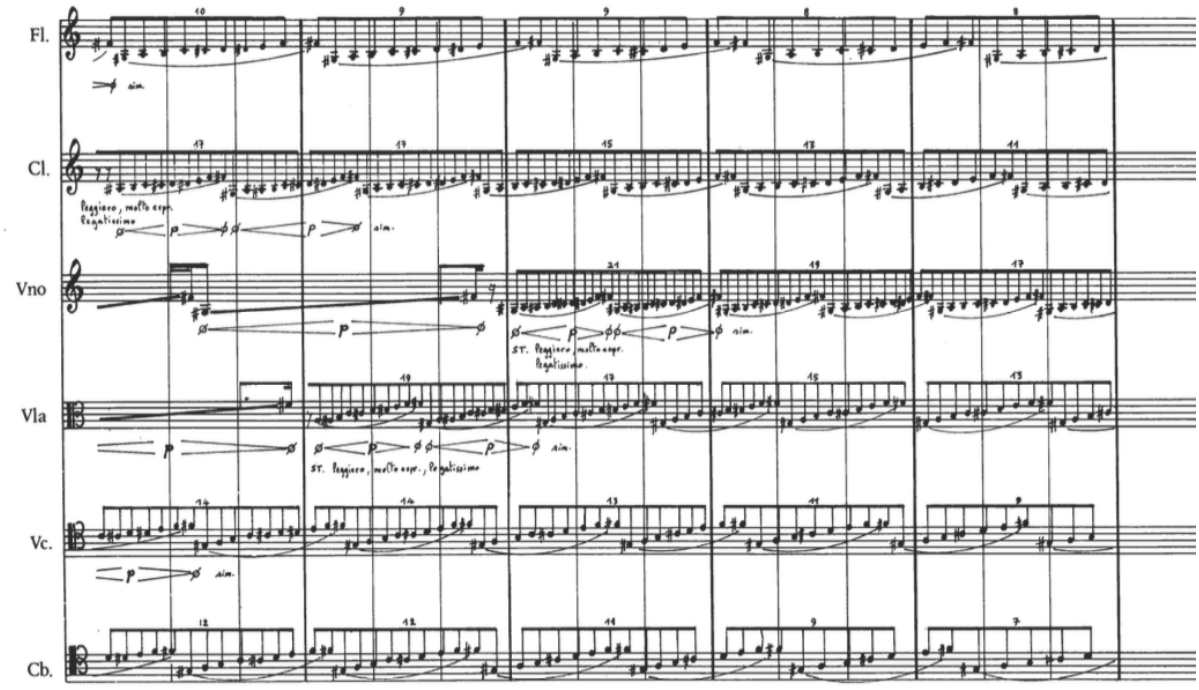

Figure 21: increasing subdivisions in Périodes

	Each column = 3”															
Flute	11	11	10	10	9	9	8	8	7	6	5	4	3	3	2	1
Clarinet				17	17	15	13	11	9	8	7	6	5	4	3	2
Violin						21	19	17	15	13	11	9	7	5	4	3
Viola					19	17	15	13	11	9	8	7	6	6	5	4
Cello			15	14	14	13	11	9	8	7	6	5	4	3	3	3
bass		13	13	12	12	11	9	7	6	5	4	3	3	2	2	1

Figure 22: decreasing subdivisions of exhale three

10 Fuzzy periodicity

Eco (1989) analyses the reintroduction of improvisation into western art music, describing an artistic work in constant evolution countering a dulling of perception through too much predictability. Although chaos is a prevailing feature, it implies 'an organizing rule' governing relations.' It is the composer who creates these rules. Indeterminacy 'offers the performer the opportunity for an oriented insertion into something which always remains the world intended by the author, completed 'by the performer at the same time as he experiences' (p. 19). According to Eco, the composer creates a system of rules which the performer responds to. The cybernetician Beer writes of creating systems of control, one which I consider aptly describes my compositional view of the improvisational network:

> Probably the first clear insight into the deep nature of control... was that it is not about pulling levers to produce intended and inexorable results. This notion of control applies only to trivial machines. It never applies to a total system that includes any kind of probabilistic element — from the weather, to people; from markets, to the political economy. No: the characteristic of a non-trivial system that is under control, is that despite dealing with variables too many to count, too uncertain to express, and too difficult even

> to understand, something can be done to generate a predictable goal. (Beer, 2002, p. 213)

Although not considered as improvisation within Spectralism literature, grid notation in *Périodes* does offer the performer a choice of where to temporally place notes, giving a limited flexibility. In the score, Grisey (1974) calls this strategy 'fuzzy periodicity' writing that 'as periods stray from strict and the automatic… periodicity is infused with a life it was previously lacking' (p. 1). He observes examples of fuzzy periodicity in the polyphonic interplay and micro-timings of jazz rhythms inextricable from bodily motions, and the deviations from the beat heard in Gagaku music, perceived as delays — a withholding of expectation.

Following the ideas of the information theorist Moles, Grisey (1987) linked rhythm to expectation. He draws an analogy between a continuum from rhythmic predictability (periodicity) to zero predictability (silence), and a continuum from order to disorder (figure 24). Fuzzy periodicity correlates with Grisey's category of statistical temporality. The grid forms a strange attractor around which pitches oscillate, sitting ahead of or behind the (conducted) grid.

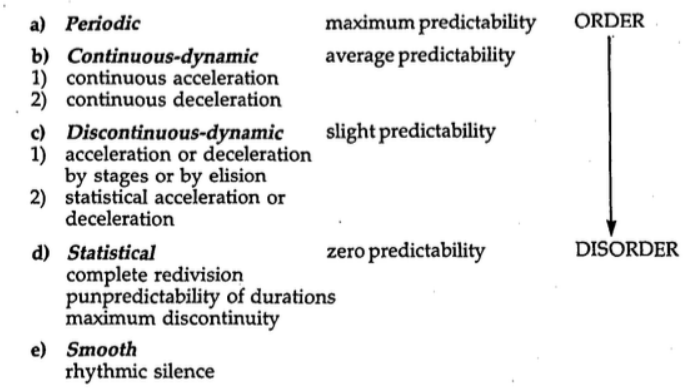

Figure 23: Diagram from Tempus Ex Machina

Grisey (1974) likens fuzzy periodicity to the heartbeat. He writes 'our heartbeats, our breathing, the rhythm of our walk and doubtless many other unknown rhythms (our nerve impulse, for example) are never as rigorously periodic as a clock; they vary around a time constant (p. 1). Rather than bind the performer to reproduce a precisely notated rhythm mirroring the rhythmic proportions of a heartbeat, Grisey uses spatial notation. He placed pitches around a grid, allowing for the performance of complex rhythms impractical, if not impossible to notate. The grid is itself often in flux, accelerating and decelerating.

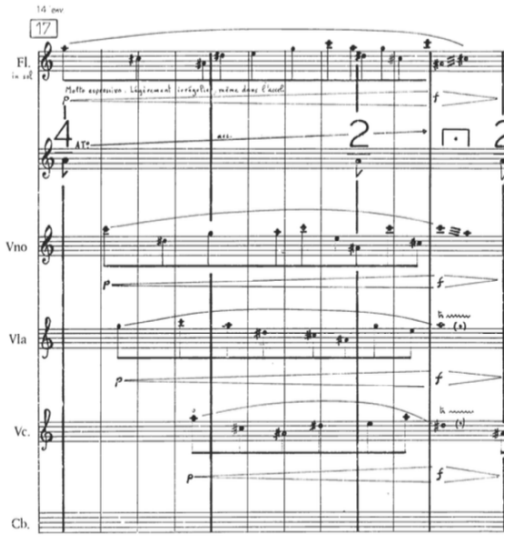

Figure 24: Périodes: fuzzy periodicity

The need to make temporal approximations means that the performer places the note not through subdivision, but through an intuitive response, unpredictably playing with temporality.[17] Grisey (1987) seems to desire a situation where the music invokes a physical movement in the listener, writing of a transfigured time 'that our "emptiness" requires, or the vertiginous vacuum to which our body, saturated with physiological rhythms, would aspire' (p. 274). This looks forward to the evolution of Spectralism through the second generation of Spectral composers, who more overtly brought rhythm into their work.

[17] This is a process I consider homologous to the pitch approximations in my work *impOsition*.

11 Territories of oblivion

Murail (2005d) writes that 'neither the score nor the performance' are the musical work, they are 'just representations of the work at different degrees of accuracy' (p. 141). He observes a temporal gap between the composer's conception and its physical representation, writing that, 'music exists only at the moment it is heard; but it is often heard symbolically, by the composer, for example, at the moment he conceives it, and then over the long chain of distortions that finally lead to its public reception' (p. 141). During this process, 'the artist does not try to write the object, but to reflect the feeling created by its impregnation of this object' (p. 149). Murail collapses the entire creative process running from the compositional ideal to the experience of sensation in the perceptual present, writing that the artist 'lives the experience of the target receiving the arrow' (p. 141).

There is something mysterious in Murail's ideal musical work, an articulation of the ungraspable. Murail (2005d) writes that 'vestiges of the ideal score can be discovered through graphic schemas of temporal relationships, lists of frequencies and

algorithms' (p. 13).[18] Figure 25 shows an indeterminately repeated cell in the right hand. Murail uses a repeated cell which both ruptures and creates a slowly moving halo of resonance, layering sustained repetitions. A chorus effect occurs as an accumulation of micro-differences creates a dense sonic complex. Heterophonic interplay happens at the microphonic, vibrational level, with small variances in hertz causing unexpected beating patterns and overtone emergences.

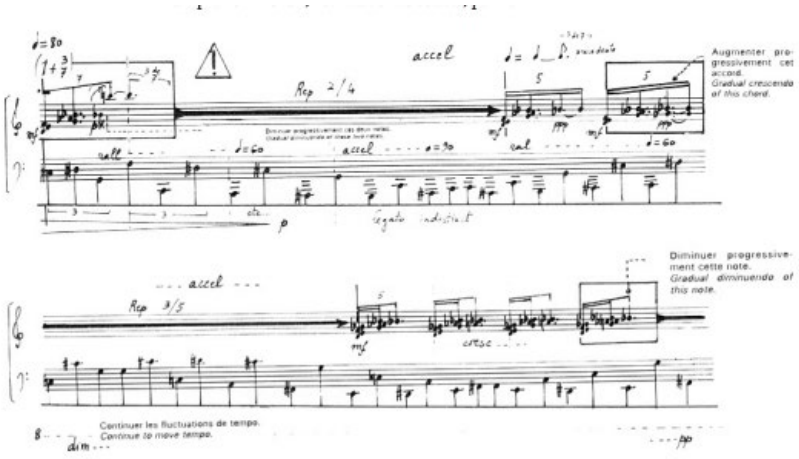

Figure 25: repeating cell structures in Territoires de l'oubli

[18] I suggest that that Murail's use of aleatoric notations in *Territoires de l'oubli*, sustain possibility, drawing closer to his ideal score. The sonic material the performer works with is inherently unstable requiring a flexible notation to accommodate this characteristic.

Flexible notation has a pragmatic foundation, framing a complex system including the acoustics of the room and the particularities of individual pianos into the fabric of the work, allowing for the performer to adjust to variable circumstances. Learning the work forms something of a puzzle for the performer, and the process of solving this puzzle forms a variety of responses, and I suggest, an improvisational repertoire of touch and temporal flexibility. Nonken draws inspiration from Murail's compositional ideal. She writes that,

> The pianist will try many unsatisfying versions. Yet the activity of working through unsuccessful versions, and diagnosing the factors responsible for their failure, sensitizes the pianist to the materials. As the score forgoes its instructional role, the pianist must focus on the abstract ideal that the score represents, then chart a course towards it, instead of imposing an external "meaning" or "significance" on the work. In this sense, the performer is reawakened to the neutrality of the material, in and of itself, and the complexities of its sheer physical realization. (Nonken, 2014, p. 81)

Through grappling with the optimum design of a compositional map, Murail expresses the dilemma of precision of performance or notation. He writes that:

> We find ourselves confronted with an apparent dilemma: precision of performance or notation? In fact, there is no precision at all. Creating and then hearing a work merely entails a parade of distortions: from the idea to the eventual form; from the form to the score; from the score to the performance; from the performance to the ear. (Murail, 2005d, p. 159)

To favour precision of notation requires a dense and complicated notation, diverting attention away from sonic sensitivity. The opposite approach, precision of performance, leaves the score open to flexible realisations. Nonken (2014) observes the limitations arising from tightly controlled scores, writing that 'the attempt to coax from live, human performers the wealth of acoustic detail inherent in the microstructure of sound was often frustrating; human frailty, elegantly excised from acousmatic music, was something of a recurring and troublesome element' (p. 83). Through coding openness into the work, inviting unpredictability and chaos, Murail creates the possibility for psychological transformation. Nonken writes that,

> When the compositional ideal is animated without ever being explicitly represented on the page, the pianist's decisions are more fully informed by and attuned to the responses of instrument and space. Heretofore untapped resources of timbral and dynamic subtlety are unleashed. (Nonken, 2014, p. 83)

Murail (2005a) felt that music processes 'had perhaps become too directional and predictable; we then had to find a way to re-introduce surprise, contrast and rupture' (p. 7). Aleatoric processes enable rupture and unpredictability. Nonken writes that,

> Murail's incorporation of chance elements into his music can be seen as one way of guiding the performer towards instability and to those moments of rupture, away from the rigorously controlled environment and into one of transcendence and liberation. By doing so, he broadened the spectrum of chaos and order, extending the extremes (Nonken, 2014, p. 83).

In *Tempus Ex Machina*, Grisey (1987) provided a maxim that 'the acuity of auditory perception is inversely proportional to that of temporal perception' (p. 259). Perhaps Murail's title – *Territories of Oblivion* – refers to the erasure of a sense of passing time; or the obliteration of memorised responses as the performer interacts with emerging chaos, reaching for sonic acuity. I suggest that Murail's compositional ideal may be approached through encounters with chaos (unpredictability), causing a psychological transformation bringing the performer closer to sound, closer to becoming sound.

12 The future past

I suggest that Grisey's interest in including phenomenology led him to adapt Husserl's model of perception into compositional form, translating the lightning fast actions of perceptual present across a threshold of awareness in *Périodes*, to form sonic material observable in the psychological present. Husserl's concept comprises three braided, interpenetrable parts, accounting for the continuous perception of reality. The *Stanford Encyclopaedia of Philosophy* summarises Husserl's tripartite model:

> This merely seemingly unconscious structure… consists, at a given time, of both retentions, i.e., acts of immediate memory of what has been perceived 'just a moment ago', original impressions, i.e., acts of awareness of what is perceived "right now", and protentions, i.e., immediate anticipations of what will be perceived 'in a moment.' It is by such momentary structures of retentions, original impressions and protentions that moments of time are continuously constituted (and reconstituted) as past, present and future, respectively, so that it looks to the experiencing subject as if time were permanently flowing off. (Beyer, 2018, p. 6)

Husserl's perceptual model enables a reimagining of form in Murail's *Territoires de l'oubli*. The pianist sustains a process which Dufourt (2014) observes, creates 'a chain of alterations created by interactions' (p. 166). Striking the keys creates

an original impression which subsides, becoming a retention. The process repeats, and a retention of a retention is formed, and so forth. Resonant layers interact, altering each other. As each new layer makes its mark, previous resonances gradually fade, becoming distant in the memory. Retentions continue to layer, with each retention decaying while simultaneously interacting with more recent retentions.

The sonic territory where the overlapping waves unfold is the resonance, a facet out of the performer's direct control. Dufourt (2014) considers *Territoires de l'oubli* to be a 'fabric-work,' a work 'without a seam or a tear, a piece that flows out in overlapping waves.' He writes that *Territoires de l'oubli* is a 'radical exploration of transformation, pushed to its very limit,' which 'found its principal obstacle and its principal inspiration in the phenomenon of the piano's resonance,' allowing for the 'diffraction and interference of harmonies and timbres' (p. 166).

The form is thus double, with the layering of protentions and retentions correlating with the layering of resonance, a multi-layered study in continuity. Merleau-Ponty enriches Husserl's model of the perceptual present, describing the implications for the temporal layering protentions and retentions from the experiencer's perspective. Merleau-Ponty writes:

> With the arrival of every moment, its predecessor undergoes a change: I still have it in hand and it is still there, but already it is sinking away below the level of presents; in order to retain it, I need to reach through a thin layer of time. It is still the preceding moment, and I have the power to rejoin it as it was just now; I am not cut off from it, but still it would not belong to the past unless something had altered, unless it were beginning to outline itself against, or project itself upon, my present, whereas a moment ago it was my

> present. When a third moment arrives, the second undergoes a new modification; from being a retention it becomes the retention of a retention, and the layer of time between it and me thickens. (Merleau-Ponty, 2013, p. 416)

A halo of resonance envelops the performer, moving in parallel to the pianist, connecting through the portal of a sustained damper pedal. The performer is pinioned between the compositional instructions and the resonance, bound to operate in the perceptual present. The limitation of the perceptual present, existing at the threshold of memory, makes the maintenance of Murail's compositional ideal a fraught adventure, as the continuity of perception is threatened by the stratifying influence of memory, just as the continuous halo of resonance is compromised by the striking of the piano keys, as the performer reaches into the halo of resonance to create a rupture, one necessary for the sustenance of the process.

13 Perceptual presence

Peters (2009) observes the role of memory in improvisation in his description of the improviser-as-angel. The inspiration is Paul Klee's painting *Angelus Novus*. In Klee's painting an angel flies backwards towards an uncertain future while watching the present, hoping to make a fragmented history whole again, but a tempestuous paradise carries him off task. Walter Benjamin, who owned the painting, observes that *Angelus Novus*:

> Shows an angel looking as though he is about to move away from something he is fixedly contemplating. His eyes are staring, his mouth is open, his wings are spread. This is how one pictures the angel of history. His face is turned toward the past. Where we perceive a chain of events, he sees one single catastrophe which keeps piling wreckage upon wreckage and hurls it in front of his feet. The angel would like to stay, awaken the dead, and make whole what has been smashed. But a storm is blowing from Paradise; it has got caught in his wings with such violence that the angel can no longer close them. The storm irresistibly propels him into the future to which his back is turned, while the pile of debris before him grows skyward. This storm is what we call progress. (Benjamin, 1969, p. 13)

Like Benjamin's angel, I look into the past, abstracting techniques and concepts to create frameworks for the improvisational network. Through creating a cohesive and structured composition, I inevitably transform these structures through my future projections. Likewise, the improvisational network transforms my compositions, seeking to make sense of my creations now solidified into notations, sustaining possibilities, flying backwards into the future.

The trumpeter Wadada Leo Smith, a prominent thinker on improvisation, writes of a continuum of memory which the improviser reaches into, drawing material to improvise the emergent present. Smith (2015) views memory and improvisation as layered and nuanced, refracting historical arcs through the present moment 'where the creative artist needs to make creative decisions while still moving forward; simultaneously utilizing the perception of a musical idea, technical skill to execute it, and the ability to release those ideas through their instrument.'[19]

Smith observes multiple temporalities at work in the improviser. The first mode, the *Reflective Memory*, is 'lightning-fast.' The performer 'journey's backwards' only to make sure 'they are moving forwards.' The musical material manifesting through the *Reflective Memory* draws on the *Known Memory*, 'acquired by the artist

[19] There are no page numbers in this book. The material from this chapter is drawn from 'The creative inspirational moment.'

who has an awareness of the compositional and improvisational forms' which 'provides contextual support for the musical material they are developing.'

To supplement the *Reflective Memory*, the improviser selects ideas from the *Active Memory,* which is 'still close in your memory and can be referenced if needed but remains part of the active past.' The improviser's selections unfold frameworks for the *Reflective Memory*, conjuring further, unbidden ideas. A feedback loop occurs as lightning fast responses to the perceptual present accumulate into memory, becoming frameworks which improvisers respond to, eliciting further responses.

Feedback loops also occur over larger timescales too. In a 'Cambrian explosion of ideas', some will flourish, developing complexity and robustness, surviving long enough to become *Epic Memory*. Smith writes that 'this memory consists of any skill that you use but have not learned from anyone. It also says something about long-term memory in cultural practice.' *Ancient Memory* is 'all of recorded history as well as the creative and reflective nature of human beings.' For Smith the present moment is informed by each phase of accumulated memory. It is from this continuum that ideas rhizomatically flow to form an emergent present. Figure 26 shows how Smith organises a temporal continuum of memory into five sections.

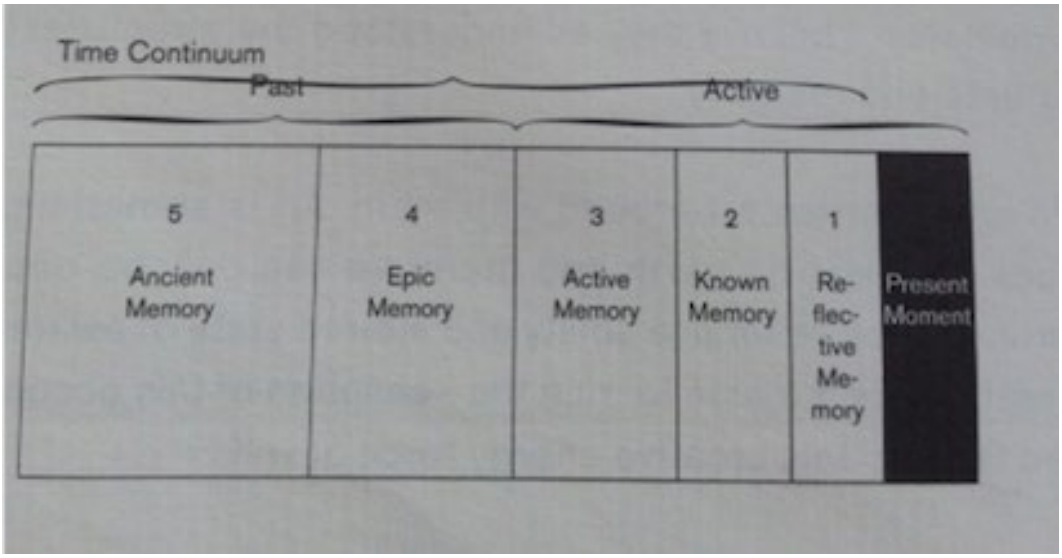

Figure 26: Wadada Leo Smith, the present moment

Smith expresses a common feeling amongst improvisers that there is a threshold beyond perception. This can be accessed by the improviser through a reflective ability, leading to a heightened awareness. Smith writes that, 'Art is something that does not exist on earth and therefore can be only obtained through their reflective ability and altered state of awareness. Great artists are able to map the sensation of this occurrence and tap into this creative energy force at will.'

The perceptual present is not simultaneous with the event perceived, although it seems to be. There is an imperceptible duration between an event and the time the light takes to travel to the eye, or the sound to stimulate the tympanum. Pressing (1987) connects improvisation to a pre-perceptual continuum, writing of intuition as 'a special kind of contact with a prime reality, a glimpse of ultimate truth unclouded by the machinations of reason or the compulsions of instinct.' He writes that, 'Bergson

saw intuition as a way to attain direct contact with a prime reality ordinarily masked from human knowledge. This prime reality is an ongoing movement, an evolving dynamic flux which proceeds along a definite but unpredictable course.' '[The intellect and senses] divide the prime reality into discrete objects, events and processes… interacting with intuition (special knowledge and experience) to develop an enriched personal perspective' (pp. 26-27). Through foregrounding the improvisational network in my compositions, I aim to access a pre-perceptual continuity, so that emergent forms may evolve alongside psychological transformations inspired by a complex of intuition.

14 The edge of continuity

In *impOsition*, I extend Grisey's observations on memory and time-perception, composing a challenge splitting the attention of the improviser between remembering and improvising. Grisey (1987) writes of a compositional approach foregrounding 'the moment and the immediate memory of the sound event' (p. 272). In *impOsition*, I compose processes transferring material from the perceptual present to memory, setting up processes where improvisations, through layered repetitions, move from the perceptual memory to what Grisey calls cognitive memory. Once an improvised gesture occurs, it becomes memory, and constant diversifications must be made (while keeping the past instances in mind). As memories accumulate, the ability of the performer to maintain a connection with the evolving flux of the ensemble occurs. Peters writes:

> It is through the dual intentional act of retaining what has just happened and recollecting what has happened before that an improvisation can get under way and be sustained—the duration, once under way, being determined by and dependent upon the ability of the improviser to hold together in a phenomenological continuum this view of the immediate and

> the mediated past and what is to come now (protention) and beyond the now (expectation). (Peters, 2016, p. 14)

Through setting up a challenge for performers to remember their improvised gestures, I explore a threshold between auditory and temporal perception. Grisey (1987) writes that: 'The acuity of auditory perception is inversely proportional to that of temporal perception' (p. 259). I hope to set up a situation where the improviser will become absorbed in the task, not noticing the passage of time. Michon writes:

> Given the limited capacity of the subjects they will, when asked to estimate time, either pay attention to the temporal information of the situation or to their main task. When absorbed by the task, no spare capacity is available to notice the passage of time, and consequently time seems to pass quickly; when the task is simple, much attention can be spent on time passing and estimates will be long. The relation between time experience and information processing in general determines the most dramatic confrontation with time that we know: the variability of the subjective speed of time. (Michon, 1978, p. 16)

McAdams and Pressnitzer (2000) write of two intervals of memory, the perceptual present, lasting several hundred milliseconds, which relates to sensation; and the working memory, lasting for approximately a few seconds, which can only store a few items (p. 55). At some point, as memories accumulate, a limitation is reached causing a psychological rupture. The perceptual present cannot be judged in the same way as memory, as the awareness of the passing time is not there. Michon writes that as the perceptual present is uninterpreted, it cannot contain errors:

> Retention should be distinguished from memory, according to Husserl. It is not open to the type of operations that we can perform on memory contents, such as rehearsing, picking out certain episodes, or "sweeping glances" with their concomitant loss of detail... the present cannot be subject to the types of errors that our memories can show; it has the quality of the uninterpreted, and proceeds as it comes, in real time. (Michon, 1978, p. 3)

Through calibrating ratios of notation and improvisation I control the complexity of the challenge. In the opening of *impOsition,* the bass clarinettist keeps an account of the lengths of the fermata and also the pitch approximations, maintaining constant variations, while also playing rubato and ensuring a drift away from the flute. Accumulations also gather along the trajectory of the horizontal line. In figure 27, dynamics, textures and verbal instructions accumulate, gradually modulating the process and layering memories in the improviser's mind.

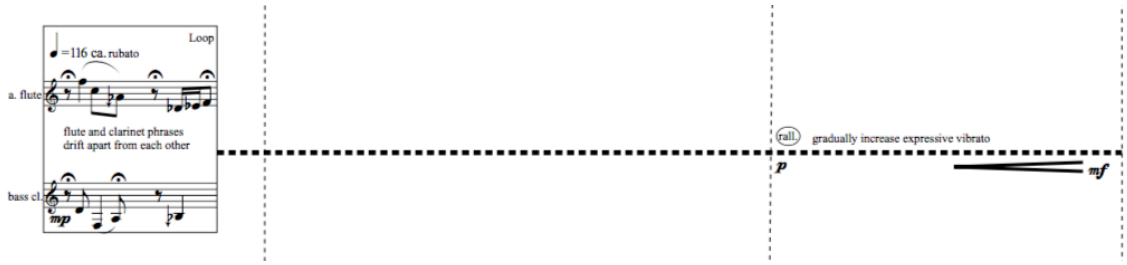

Figure 27: accumulation of memories

Dufourt (2004) observes that for Grisey, change is irreducible to stable elements. Improvisation in *impOsition* provides instability, creating diversity.

Instability becomes more pronounced in *superimpOsition*. In *Rupture Three* (figure 27) a melody, carried over from *impOsition*, is shared between the pianist and violinist.

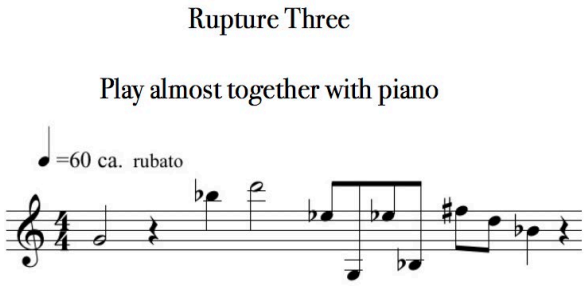

Figure 28: Rupture three from superimpOsition

Once the melody is established it is transformed through repetitions with improvised differences. At the extremes, transformations may retain nearly all of the information or just the barest hint of material. The performer chooses to carry forward whatever information they choose (though there must be shared material between adjacent phrases). As the composer, I have relinquished much control over the details of the challenge. It is of course impossible to tell how far a performer is cleaving to the spirit of the work. Many magical moments emerge which must be responded to, and the challenge of remembering is ruptured. Thinking rhizomatically, the process must renew along a new trajectory. Ultimately, I consider the work to be successful if there were moments of rapport, a shared empathy with moments of temporal oblivion, before rupturing into a consciousness of passing time.

ECLECTIC EMERGENCES

15 Lehman's liminality

As the continuum of composition-improvisation moves toward the pole of improvisation, notation recedes, allowing the voice of the performer to emerge. Lehman's work brings Afrological improvisers into contact with harmonic and temporal compositional choice and long musical associations ensure an organic continuity between his compositional and improvisational concepts. Lehman invites the voice of the performer into his work through fusing liminality with the characteristics of Afrological improvisation. Lewis (1996) created the concept of Afrological improvisation to describe an approach to improvisation foregrounding the agency and personality of the performer. Lehman (2012): summarises Lewis's key ideas

- An understanding of improvisation in which careful preparation, formalism, and intellectual rigor are as privileged as spontaneity and real-time decision making
- A collaborative model in which the internalization of alternative value systems is supported and encouraged
- A preoccupation with the articulation of personality and the assertion of individual agency through sound

- An emphasis on the social instrumentality of sound and the potential for improvisation to resist perceived restrictions on expression (p. 3).

Lehman suggests that Grisey's alternative term for Spectralism, liminality, 'points to a significant link between Spectralism and Afrological Improvisation.' He augments the Spectral concepts of perceptual liminality with the liminality experienced by Afrological improvisers.

> Both of these musical traditions are built around thresholds of transition and becoming, where the exploration of a liminal terrain between two fixed identities can lead to a transcendent musical experience. Musical boundaries are central to Spectral music: the lines between harmony and timbre, pitch and noise, electronic and acoustic, and rhythm and duration. (Lehman, 2012, p. 9)

Lehman places Afrological characteristics within the stylistic framework of his own milieu, augmenting them with the ideas of the scholar Wilson (Wilson, 1974) to describe an African American aesthetic, adapting elements existing across a range of musical genres, including, perceptually salient musical pulse encouraging a psycho-physical response to music, rhythmic contrast through polyrhythms, an off-beat displacement of accents and a dominance of percussion as an expressive element.

Lehman aligns with the eclectic second generation of French Spectral composers such as Hurel, who combined Spectral concepts with Jazz. In an essay on his website, Hurel writes that his generation 'claimed repetition for their own,' using it perceptibly to break 'the hypnosis of slowness' characterising early Spectralism, injecting 'repetitions, loops and returns into the long linear procedures….

diametrically opposed to the Spectral spirit of the time.' The second generation used explicit cultural references as opposed to the 'neutral' sonic archetypes favoured by the first generation of Spectral composers. Hurel writes that:

> The new generation takes a different way, generally using macrophonic rhythmic models that often have a recognisable cultural connotation. This model could be a rhythmic structure that has resulted from natural or 'concrete' movements of the objects that surround us... or from the world of music influenced by jazz and rock. What binds (ce qui relie) these few composers to the Spectral attitude is the reference to an acoustic model. (Hurel, 2005, p. 1)

Lehman (2012) extended the Afrological tradition of improvising over chord changes by using pitch sets from the spectrum as a basis for improvisation. As with chord changes, the pitches of the pitch set become a central reference point yet are by no means the only pitches that may be played. Rather, they are incorporated into the fabric of an improviser's artistic statement. Lehman's composition *Echoes* provides a framework of chord changes based on the E concert overtone series. He emphasises 'harmonics nine, eleven, twelve, and fourteen, in addition to incorporating pitches derived from other scales when the musical context calls for it' (p. 26).

Figure 29 shows chord symbols used as a basis for improvisation (alto saxophone transposition). Lehman writes that 'an improvised solo on *Echoes* can be built around the microtonal pitch content of the Spectral chord changes, but it is also possible to imagine an improvisation that uses the piece's rhythmic, textural, and dynamic changes as its foundation' (p. 26).

C# (H8-H16):

The chord symbol notation (H8-H16) indicates that the soloist is to improvise using those pitches, rounded to the nearest 1/4 tone, which correspond to the 8th, 9th, 10th, 11th, 12th, 13th, 14th, 15th and 16th harmonic of a given note. In the case of C# (H8-H16) this gives the following:

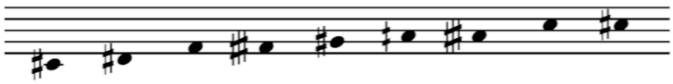

Figure 29: pitch set for improvisation in Echoes

Lehman (2014) observes that in contrast to Grisey's work with harmony, which evolved through an in-depth study of psychoacoustics, his ideas on rhythmic perception remained intuitive, mostly based on personal observation. Lehman set out to compose works using measurements from the cognitive studies. *Segregated and Sequential (2014)* features a dynamic and ambiguous rhythmic terrain with multiple aural pathways to travel upon, engaging and disorienting the listener. Lehman (2012) writes that 'Perkins and Howard… have found that when presented with multiple tempos, listeners will attend to the rhythmic structure in one way while remaining aware of alternate possibilities for entrainment, in some cases moving back and forth between two or more options', creating 'a compositional tension between 'serial and segregated modes of listening.' He adopts Jones and Jagacinski's definition of 'serial listening as a mode of attending in which two or more rhythmic textures are perceived as part of one sequential stream of information….' and that 'segregated listening, or streaming, on the other hand, occurs when a rhythmic sequence is perceived as two or more segregated streams (p. 35).'

The alto saxophonist, tenor saxophonist, and trumpeter perform a rhythmic ambiguous condensed sonic complex in the opening two bars. All three instruments enter powerfully on the second quaver, instantly blurring the opening pulse. The alto sax continues to play off beats, while the trumpet plays every three quavers. The tenor sax, beginning on its second note, plays a note every four triplets. The closeness of the instrumental timbres causes them to be perceptually grouped together, however, on concentrated listening the separate streams and tempos can be discerned. Lehman gives the bass the role of marking the measure. The bass moves unevenly, outlining a 3+3+3+3+2 (crotchet) grouping. The drums follow the bass pulse, improvising groove-oriented subdivisions, knitting the sonic complex together, in the process creating further rhythmic ambiguities. Across this the vibraphone plays a harmonic rhythm changing each seven semiquavers, moving 1.125 times as quick as the bass crotchet pulse. In bar seven, the tuba enters with an implied tempo pulsed every two tuplets. The interwoven web of implied tempos sets up an ambiguous backdrop for improvised solos (figures 30-32).

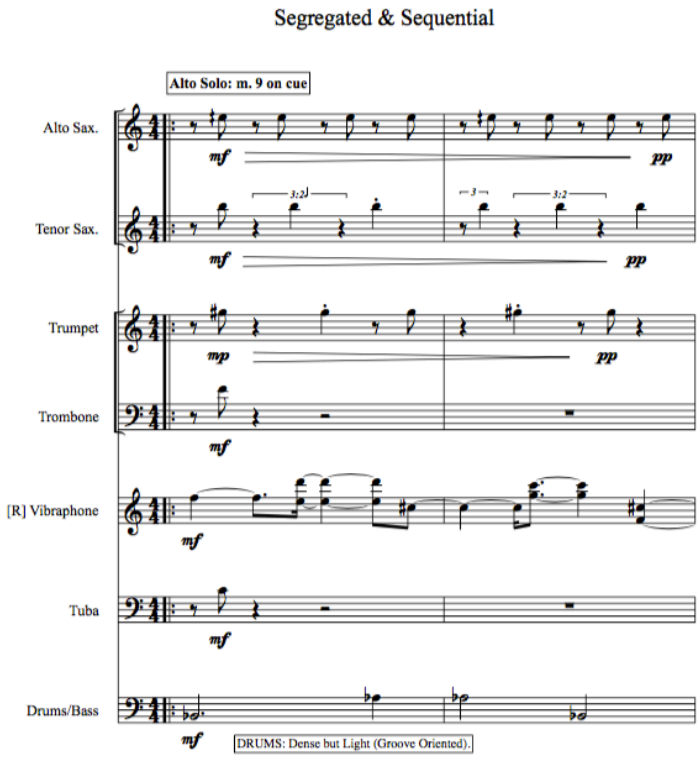

Figure 30: Segregated and Sequential page one

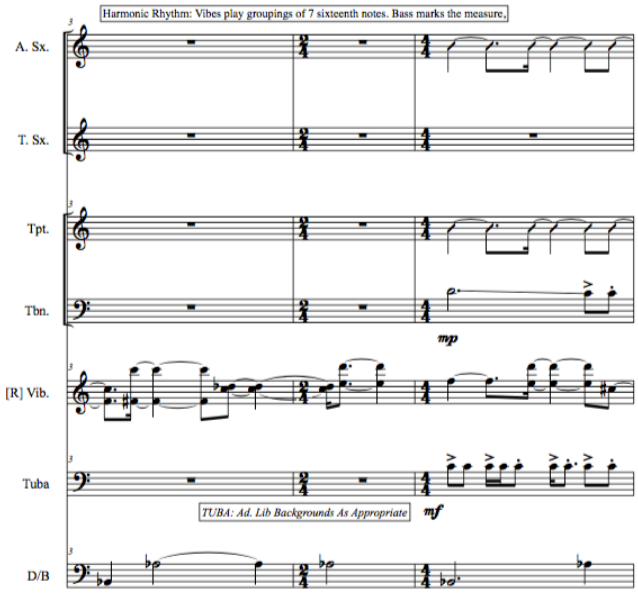

Figure 31: Segregated and Sequential page two

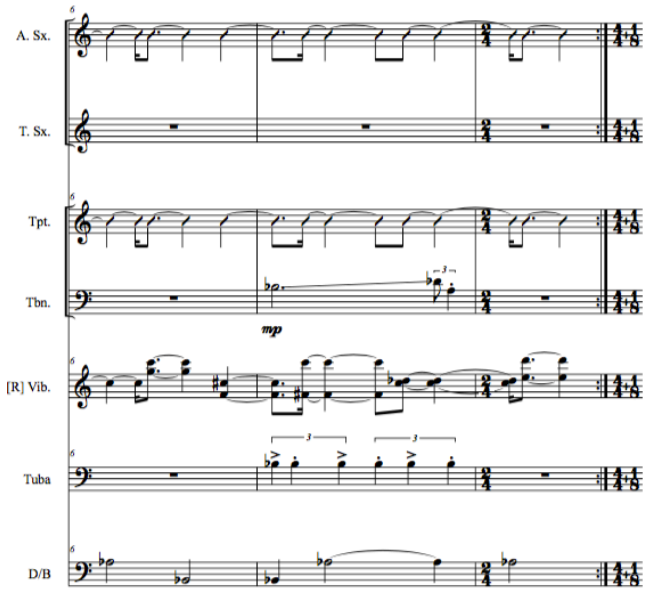

Figure 32: Segregated and Sequential page three

16 Notational recessions

In *impOsition* I worked remotely, imagining the performers I would be working with. I was aware that many of the performers, as classical performance students, may not be conversant with improvising, and therefore would not have developed an improvisational aesthetic. For this reason, I conceived *impOsition* as an etude calibrating the gradual introduction of improvised elements, introducing degrees of challenge as notation became less specific. Thus, the composition of a notation-improvisation continuum was itself an emergent response to a specific compositional challenge. As the work evolves, more elements are opened up to improvisation, a process which allows the personal aesthetic of the performer to gradually emerge.

Figure 33 shows limited scope for improvisation, as the performer improvises different lengths each time a rest is repeated. This combines with a similar process for improvising microtonal variations around a pitch centre. While many subtle variations are possible, the performer is much like a cog in a machine, sitting at a threshold of interpretation and improvisation.

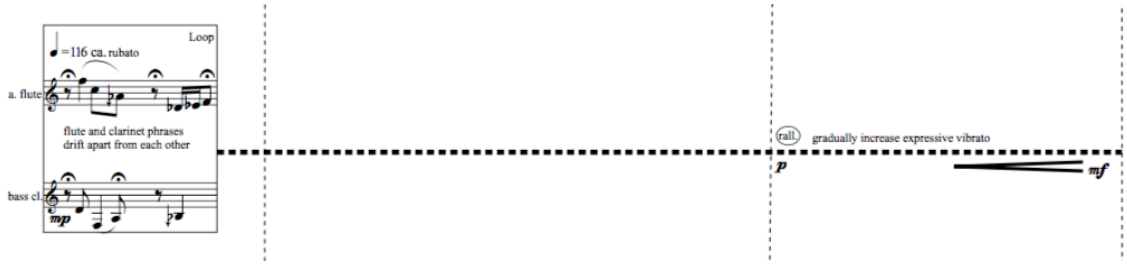

Figure 33: The constrained improvisational voice in impOsition

String improvisations in figure 34 invite the possibility for greater creative agency. The violist improvises freely within a pitch range of a third above or below the pitch, with an instruction to focus on microtones. There is no pitch set, just a range limitation and within this, there is more range for a distinctive style to emerge.

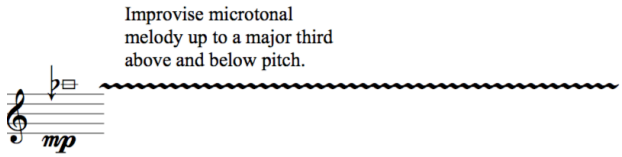

Figure 34: Viola solo, the possibility of creative agency in impOsition

For *superimpOsition,* I worked with the performers from the beginning of the process, and like Lehman, composed frameworks exploring extensions of Spectralism juxtaposed with eclectic improvisational aesthetics. At the point of most improvisation during *In the deep end*, only verbal instructions are given. At other points, free improvisations are juxtaposed starkly with the slowly evolving composed frames. I balance the freedom of the improviser with transformations of instruments through

preparations, scordatura, and sampling, translating a spectrogram of a bowed Tibetan gong.

For *In the deep end,* I included improvisation as a compositional strategy from the beginning of the work. As an example, I introduced a limitation on the improvisational network, asking members to improvise an idea then vary it through creating small differences at each iteration. After analysing the gong, I introduced instrumental transformations. Through such strategies, ideas 'organically' emerged to be incorporated into the final composition, allowing performers' musical personalities to become a part of the fabric of the composition.[20] A rapport develops within the improvisational network, informing the emergent performance, so that the recordings in my portfolio are an extension of the compositional process. In this way I connect my compositions to Lehman's work and the Afrological legacy of composers such as Duke Ellington and Charles Mingus.

[20] I never literally transcribe these ideas. They form impressions and frameworks to enhance the musical contribution of the performer.

17 In the Deep End

When composing *In the deep end,* I imagined episodes of a surfer's experience. From the calmness of a lull to the turbulence of being pitched off a wave. *In the deep end* moves gradually toward a climax representing the greatest instability and unpredictability, before calming towards the end, where the instrumental transformations are pulled apart.

Resolve

Resolve opens with a sample of the source material for the entire work, a sample of the bowed gong whose partials govern the harp scordatura.[21] The modular synthesiser player activates two identical samples, beginning at different times. At section B, across the texture created by the samples, the modular synthesiser player and the

[21] See figures 6 and 7 (pages 27-28)

harpist perform a microtonal unison melody tuned in a temperament corresponding to the frequencies of the gong sample (figure 35).[22]

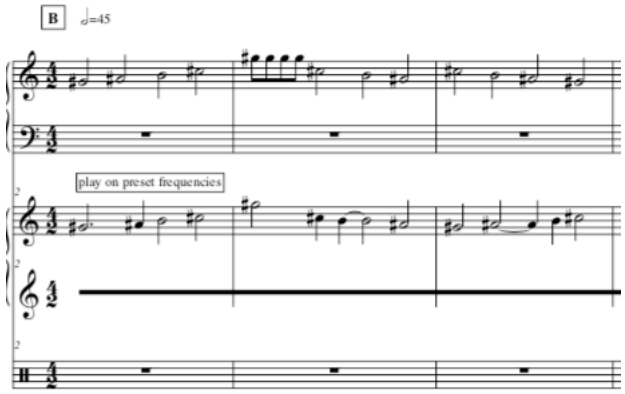

Figure 35: wave-like melody in Resolve (Harp and synth)

Figure 36 introduces the beginning of a process gaining rhythmic complexity, to build tension. A momentary metric shift occurs in the third bar of section C, played by the whole ensemble.

[22] The harmonic basis for this piece is outlined in detail in the earlier chapter *Becoming Gong.*

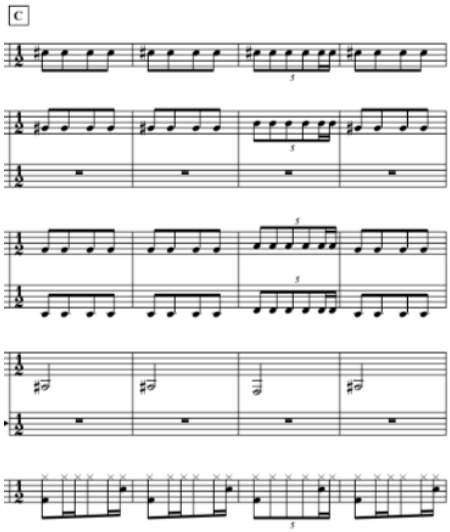

Figure 36: implied tempo shift in Resolve (from top: clarinet/piano/harp/ synth/drums)

This rhythmic process continues during section D. The drummer repeats the fragment, while the clarinet gradually transforms the idea one note at a time. The pianist introduces a new ascending figure, performing a gradual retardation. A remnant from the opening melody also remains, developed with spontaneous harmonies, improvised according to the aesthetic decisions made by the harpist and pianist (figure 37).

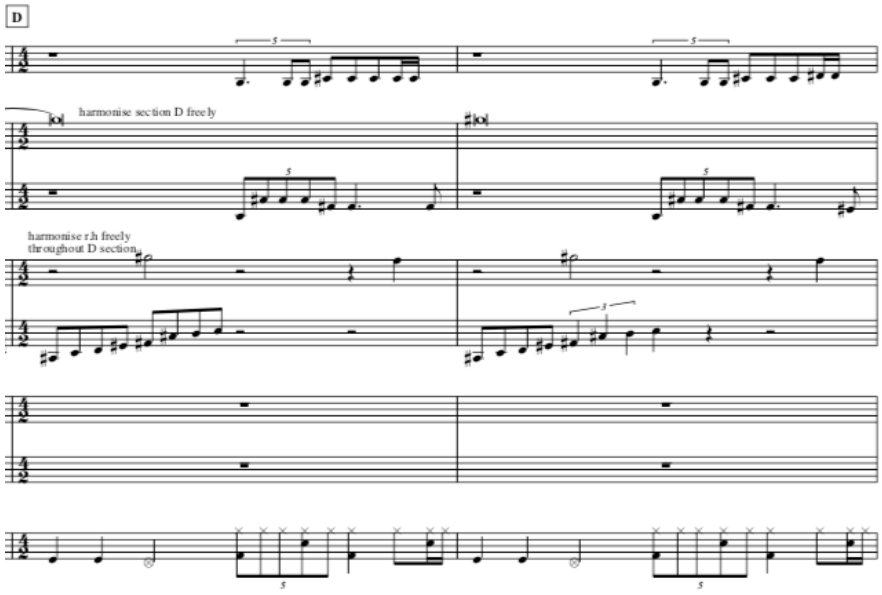

Figure 37: ascending process in Resolve (clarinet, harp, piano, synth, drums)

An ascending line played by the pianist and harpist creates the sonic territory for the clarinettist's improvisation. A truncating rhythmic process occurs, with a semiquaver being discarded at each repeat. The last note of each ascent is displaced up an octave, creating a secondary musical line which descends slowly throughout the section, creating a counterpoint (figure 38). The clarinettist improvises responding intuitively, weaving the improvised responses into the texture of the work.

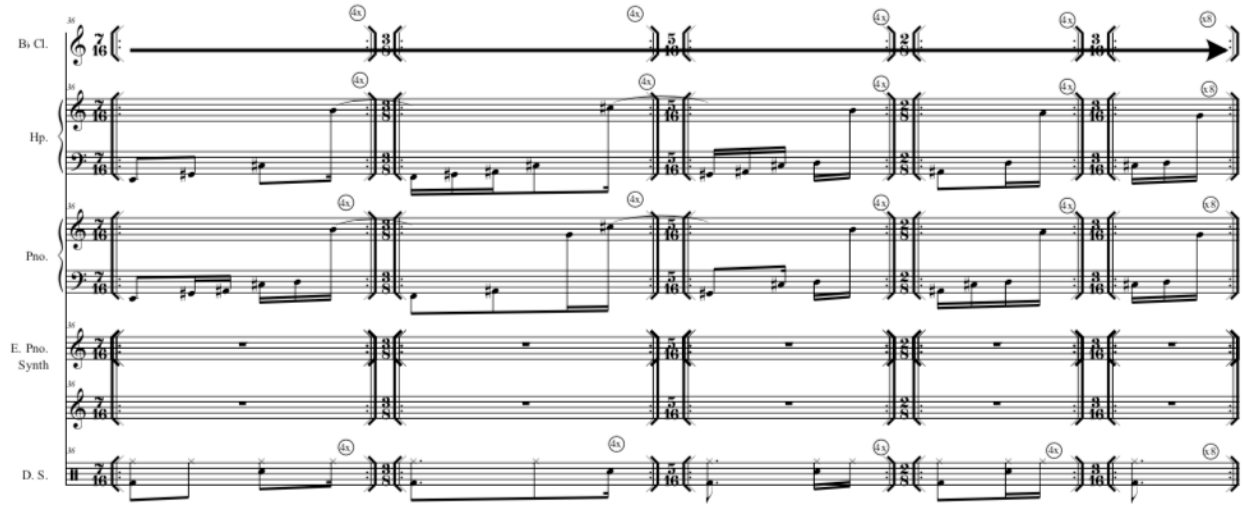

Figure 38: clarinet solo over truncating process in Resolve

At section F, a rupture occurs (figure 39). The clarinettist and pianist suddenly shift to slowly improvised counterpoint, imitating the electronic technique of the splice, creating a glitch. At section B, a repeated pattern, which I call a holding pattern[23], provides stasis, enabling the ensemble to realign. This idea adapts the repose sections in *Périodes* (symbolising the pause between breaths). Holding patterns allow me to acoustically recreate the recording studio technique of crossfading, allowing one idea to fade out while another is gradually introduced, creating an overlapping of processes influenced by Grisey's ideas of modelling continuity.

[23] A reference to Wiener's foundational cybernetic technique of modelling predictions of aircraft trajectories.

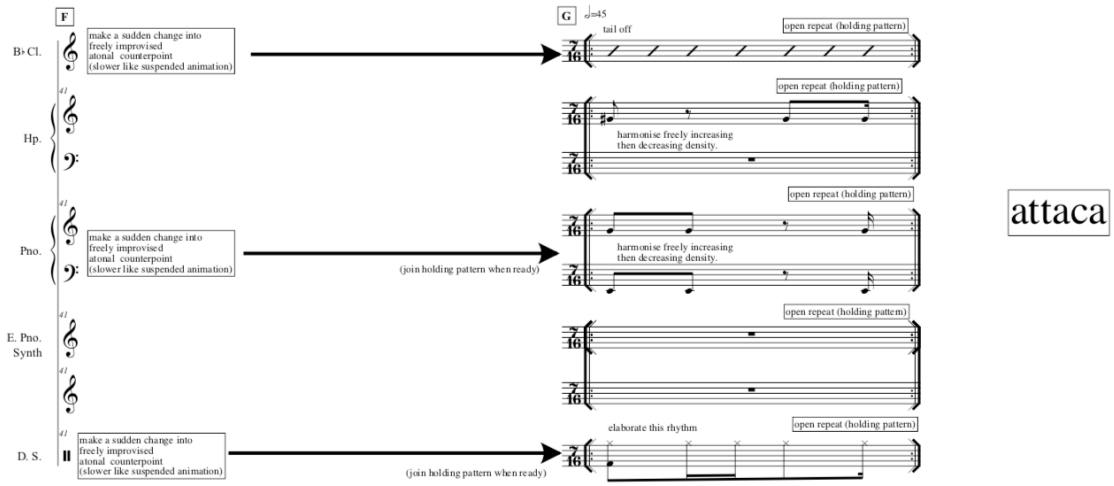

Figure 39: sudden rupture in Resolve

As Spectralism evolved, the early obsession with continuity gradually gave way to more abrupt shifts in mood. Murail noted that the algorithms he used to design processes became too predictable, and as an artist he intervened to create ruptures and imperfections in the system. *Resolve* ruptures attacca into *Glare*. This contrasts the technique of crossfading happening in figure 40.

Glare

Figure 39 features an improvised duet between the clarinettist and the modular synthesiser player. As with Lehman's compositions, the pitch-sets are guides only, a central point of departure for improvisation. At section C the texture changes as the harpist improvises microtonal variations on the B string. The pianist improvises chord clusters, and the drummer accumulates ambience, striking the Tibetan gong.

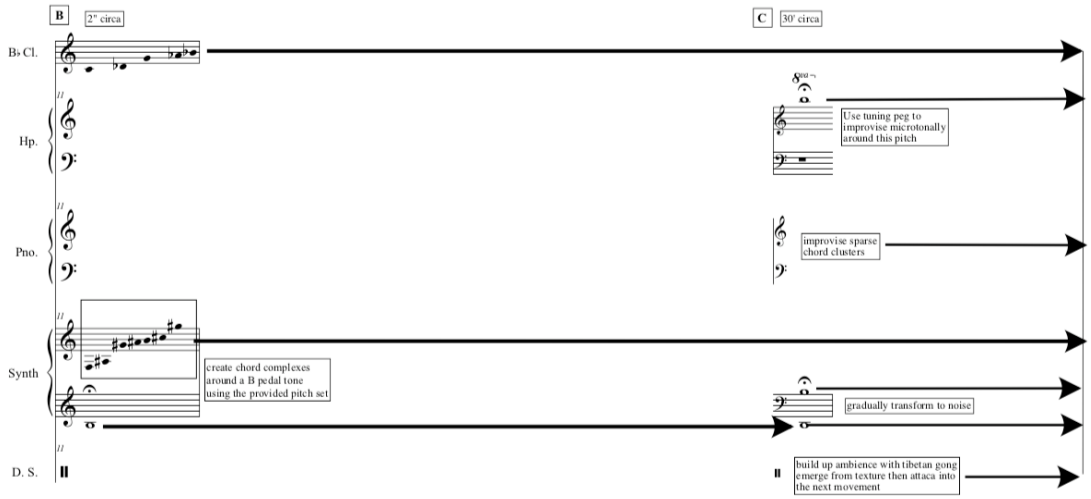

Figure 40: pitch sets in Glare

Drift

The movement *Drift* reintroduces wave-like motion from the opening movement, mixing the scordatura set with the equal-tempered set. The rhythm truncates, dropping notes each time the cell changes, inspired by gradual process in Grisey's *Périodes*. The pause ensures that the waves overlap, creating a natural phasing effect, creating a seamless, continuous form. The alto sax improvises microtonally throughout this section (figure 41).

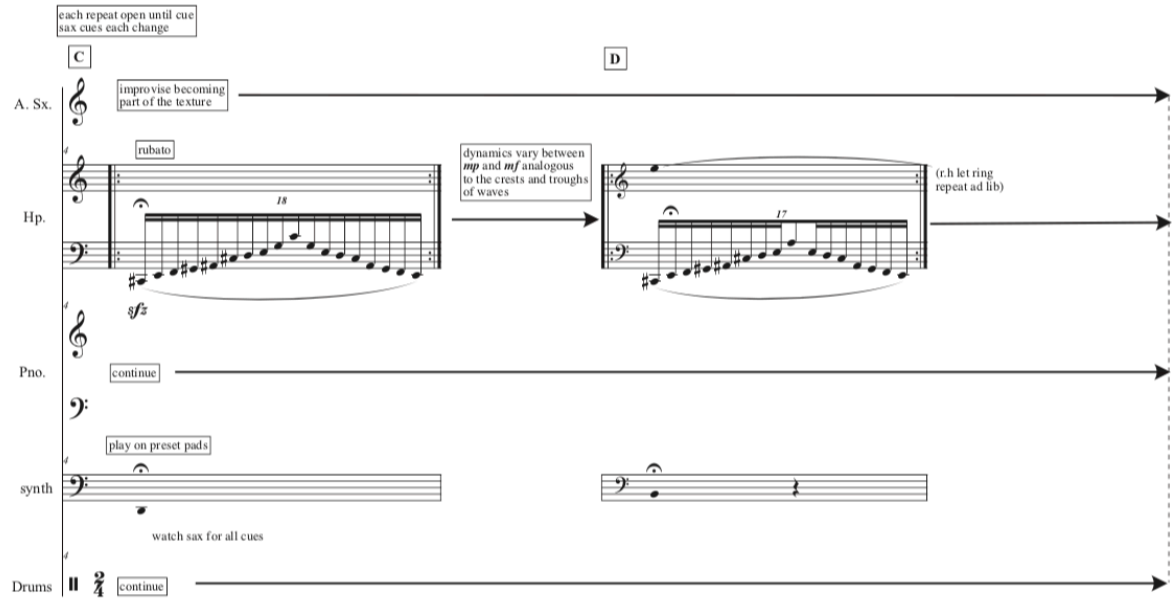

Figure 41: waves of sound in Drift

Limber

In *Limber,* there is a strong reference to the rhythmic ideas of contemporary jazz I am interested in how Spectral concepts may mutate and evolve through different genres. This was a preoccupation of the second generation of Spectral composers, who rethought the first generations' achievements, introducing rhythmic elements from jazz. Lehman continued this tradition, exploring Spectral techniques within what Lewis frames as the Afrological tradition. My compositional palette for *In the Deep End* emerges from these experiments. *Limber* features a synthesiser bass line pivoting between subdivisions of three and four, implying tempo shifts. At the end of each repeat there is a skipping semiquaver, creating a rupture. (figure 42).

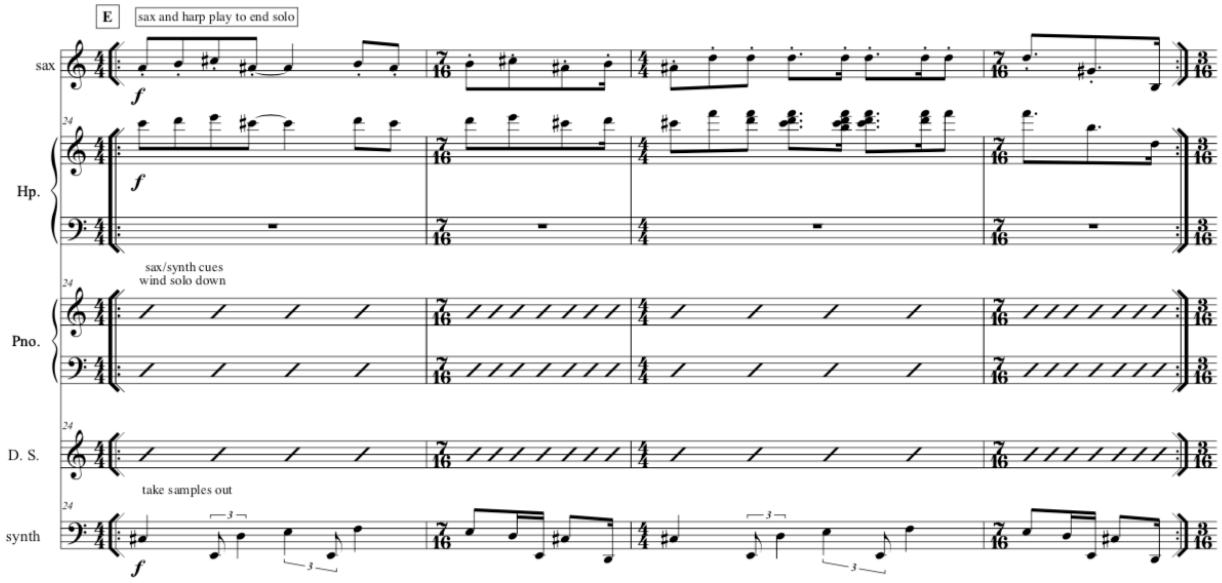

Figure 42: piano solo in Limber

Lehman introduces polyrhythms into his work, connecting them to the perceptual phenomenon of segregated and sequential listening, where multiple tempos run in parallel, providing multiple pathways for perceptual entrainment. This was already an established tradition in Afrological improvisation, making for a seamless integration with Spectral harmonic thinking.

Loom

In *Loom*, the first bar of figure 43 shows the harpist's left and right hands phasing in a 5:4 ratio, which is the rhythmic ratio of a major third (the interval between the 4th and 5th partials). The second bar phases in a 5:3 ratio, although the pattern is complicated by the quaver against the dotted quaver. The third bar sets up a 3:2 pattern. Another layer is added through a shared set of accents bringing out an additive/subtractive process of 3+4+5 etc (Figure 43).

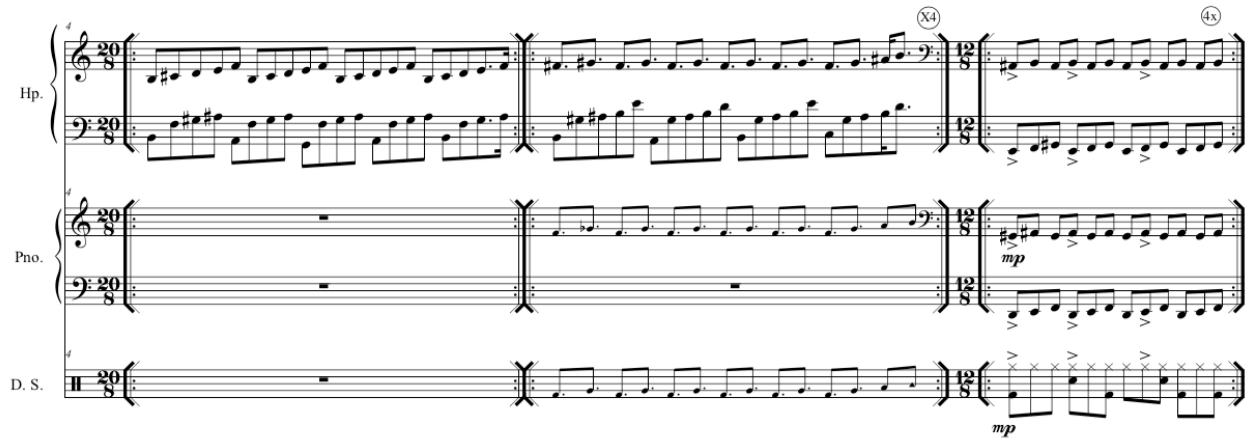

Figure 43: additive and subtractive processes in Loom

In figure 44, the pianist improvises using rhythmic combinations based on number ratios, with the additional instruction to continue ascending toward the holding pattern at the end of the line.[24] The rest of the ensemble play a supporting role to the pianist.

[24] I use the term holding pattern to designate an openly repeated aural cue, a useful compositional device, as it frees performers to bring an idea to a natural conclusion before joining the ensemble for the next adventure).

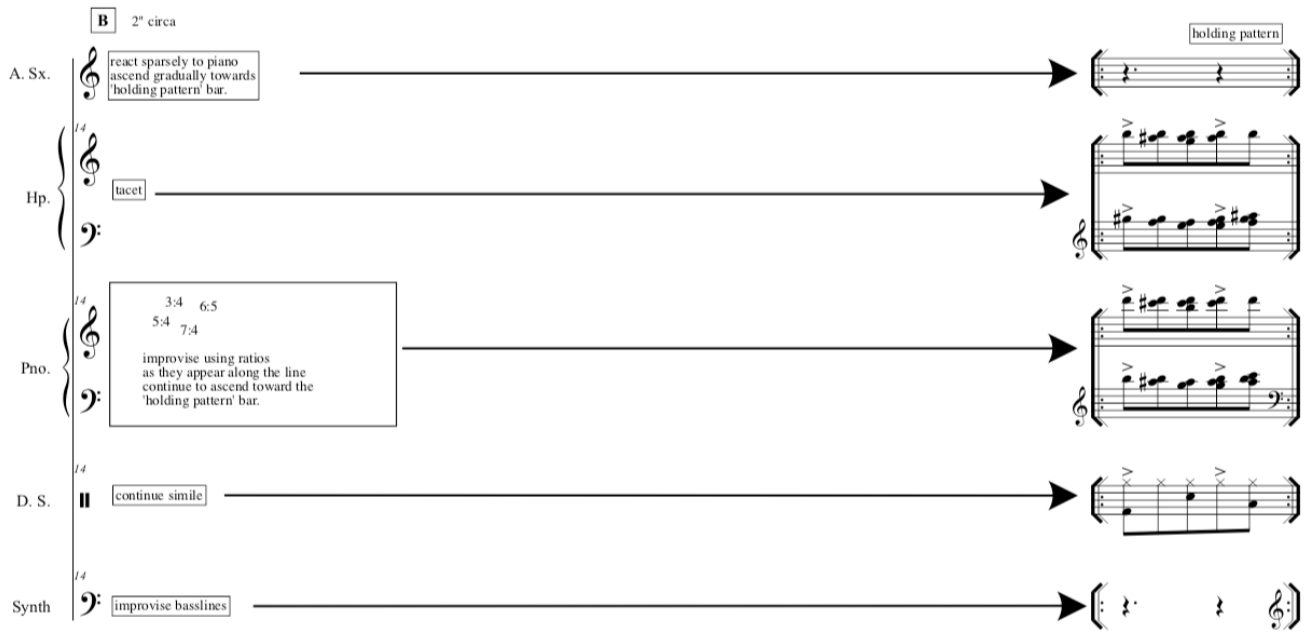

Figure 44: polyrhythmic piano solo in Loom

In figure 45, the synth player improvises an ascending pattern moving rapidly through the preprogramed pitches from the gong partials. The other instrumentalists improvise sparsely, playing supporting roles. Compositionally, there is a greater contingency as notation has given way entirely to verbal instructions. Following Grisey's ideas, I equate an increase in unpredictability (contingency) with an increase in disorder.

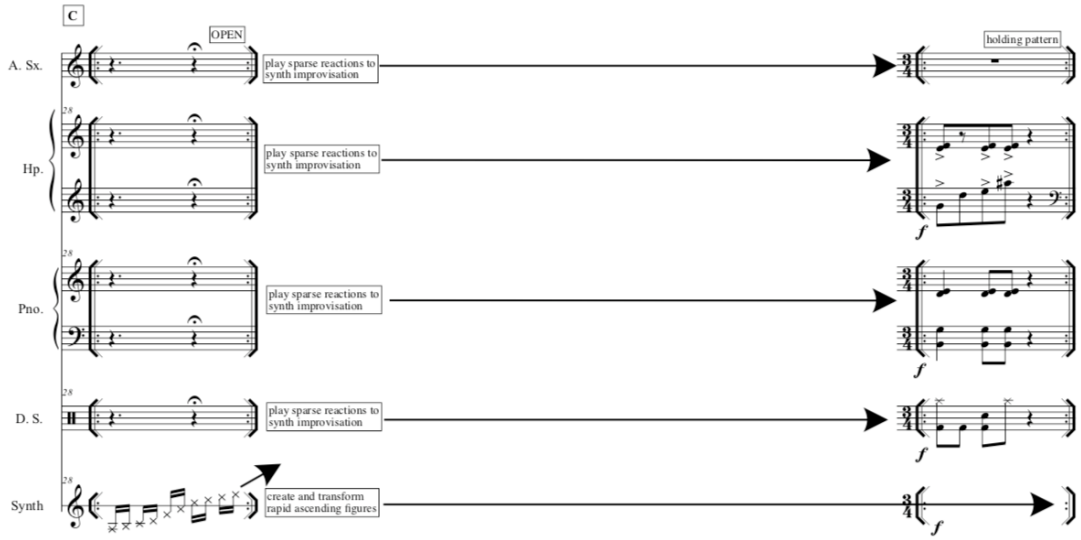

Figure 45: verbal instructions in Loom

In figure 46, the ascending figure is rhythmically augmented, with a scurrying semiquaver motion at the end of each repeat. The saxophonist solos over this rhythmically ambiguous background, which is truncated during each repeated segment, increasing tension. The semiquaver ratio of 7:5 is knitted together by the drums. As an example, the drummer hits the bass drum every seven semiquavers, lining up with the pianist's right hand. The constant semiquavers focus the right hand of the harp, which plays every five semiquavers, the left hand of the harp, which plays every four semiquavers. The synth player improvises an ambient background, altering a Tibetan gong sample (made from the gong used to design the harp scordatura), using an array of effects.

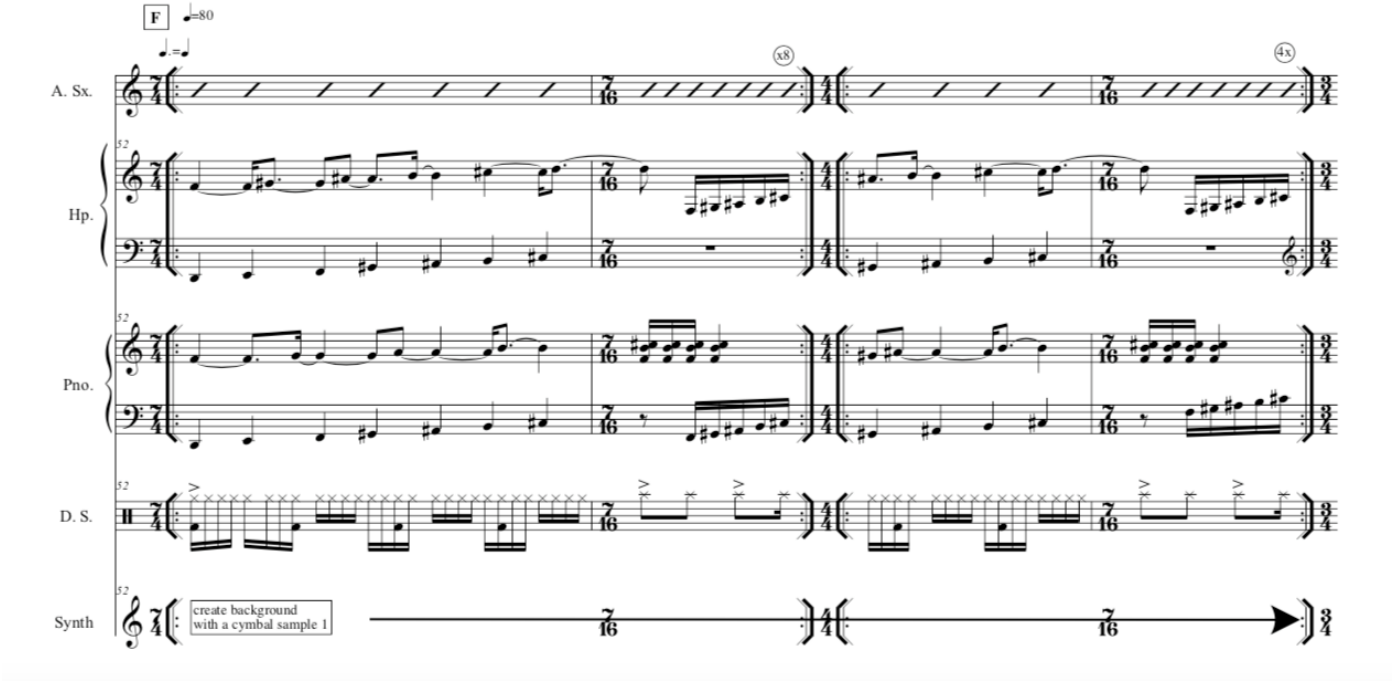

Figure 46: polyrhythmic frames in Loom

In figure 47 the harpist is foregrounded as the most unpredictable element, improvising in the upper range, interpolating wild upward sweeps (taking up the upward sweeps of the synth earlier in the movement). At H, the synth player adds to the mix, reintroducing improvised ascending figures, while the drummer and the pianist improvise. This leads into to the climactic moment of the entire work.

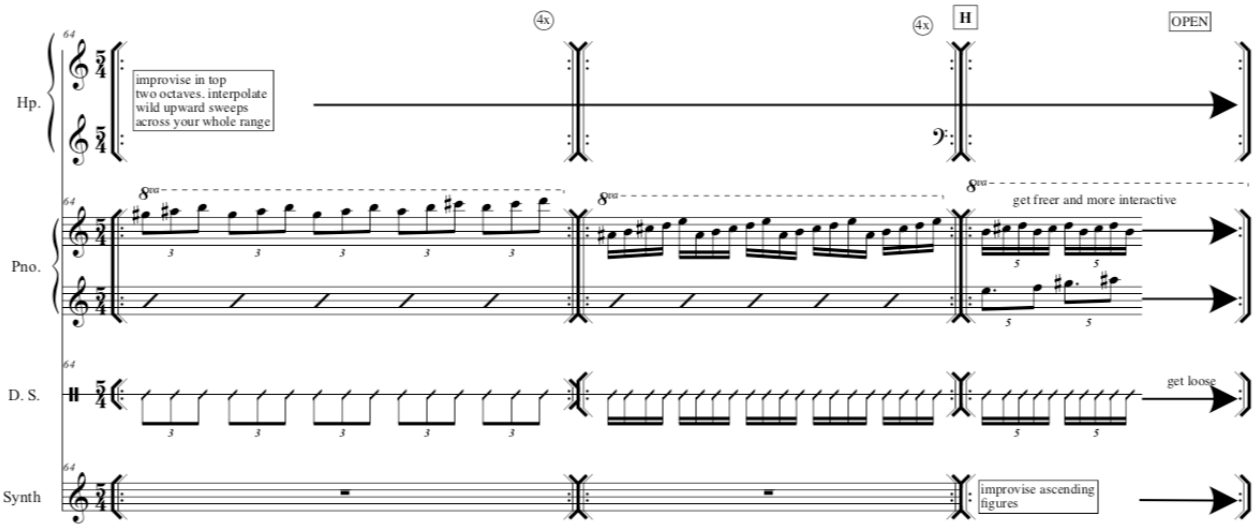

Figure 47: wild harp solo, the move to chaos in Loom

Impact zone

Verbal instructions for *Impact Zone* draw on the connection made between rhythmic predictability and disorder Grisey developed in *Tempus Ex Machina* (figure 48). The gradual introduction of repetition reintroduces order and predictability. I extend this idea through equating a lack of interaction with other performers with disorder. The more intertwined and referential the performers' musical statements become, the more predictable (organised) the music becomes. At this point there is no musical notation to reference, so material must be drawn from memory, recursively referencing previous material. The performer may also introduce elements from future movements, as well as intuitive interpolations. This symbolises the lightning-fast perceptual memory in Husserl's concept of protention and retention.

Impact Zone

Improvise

Drawing on material from the other movements

Move from flux towards calmness and predictability

From no repetition of material to repetition

From no interaction to interaction

Figure 48: maximum unpredictability in Impact Zone

Surfacing

Surfacing is the most still and calm of the entire work. In figure 49, the harpist's five-chord cycle phases across the pianist's nine-chord cycle. The performers continually discover new chordal combinations through emergent combinations.

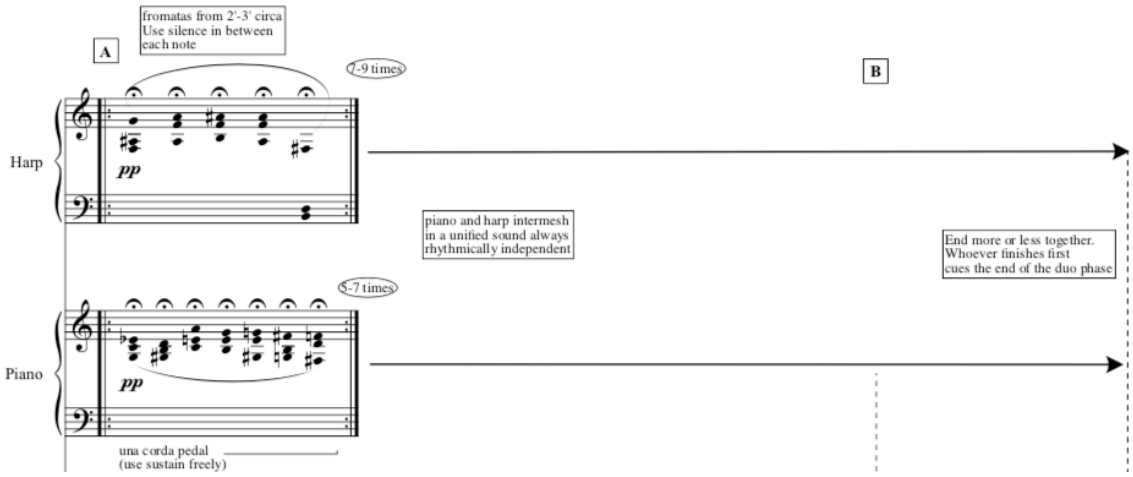

Figure 49: phasing pattern in Surfacing

Barrelled

Barrelled is the most flowing groove in the work, a steady, relaxed progression, with overlapping wave-like melodies (figure 50). The wave-like melodies are constantly varied through additive and subtractive rhythmic processes changing rest lengths, creating an unpredictable melodic flow. Later in the movement, this background forms the basis for the harpist's improvisation.

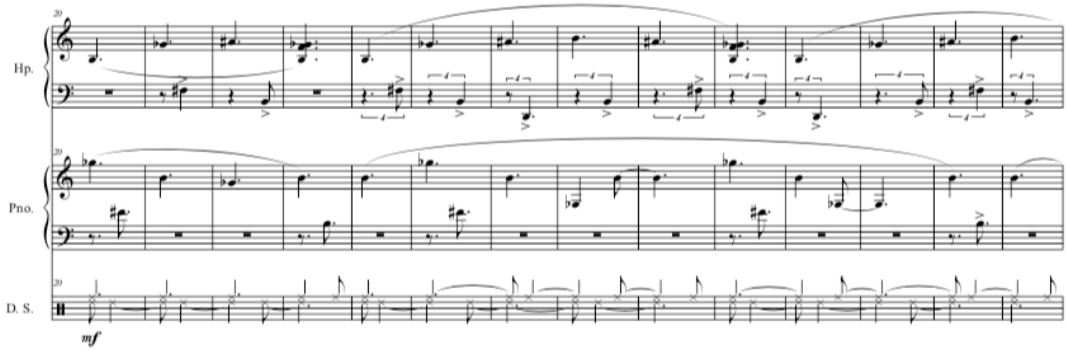

Figure 50: calm and steady groove in Barrelled

One more

One more recapitulates material from *Resolve*. The movement closes with the drummer sprinkling rice on the Tibetan gong. The clarinet plays fragmented upward portamentos. The pianist reaches into the piano, moving the preparations around, and the harpist detunes the scordatura, converging the pitches towards a B3, the strongest formant of the Tibetan gong (most pitches will not reach this pitch, it is just an inward direction, an exploration of harmony while undoing the scordatura). The modular synthesiser player bends the pitches of the preset sine waves, undoing the aggregate. I equate a movement away from the central temperament of the Tibetan gong aggregate as system an increase in disorder. (figure 51).

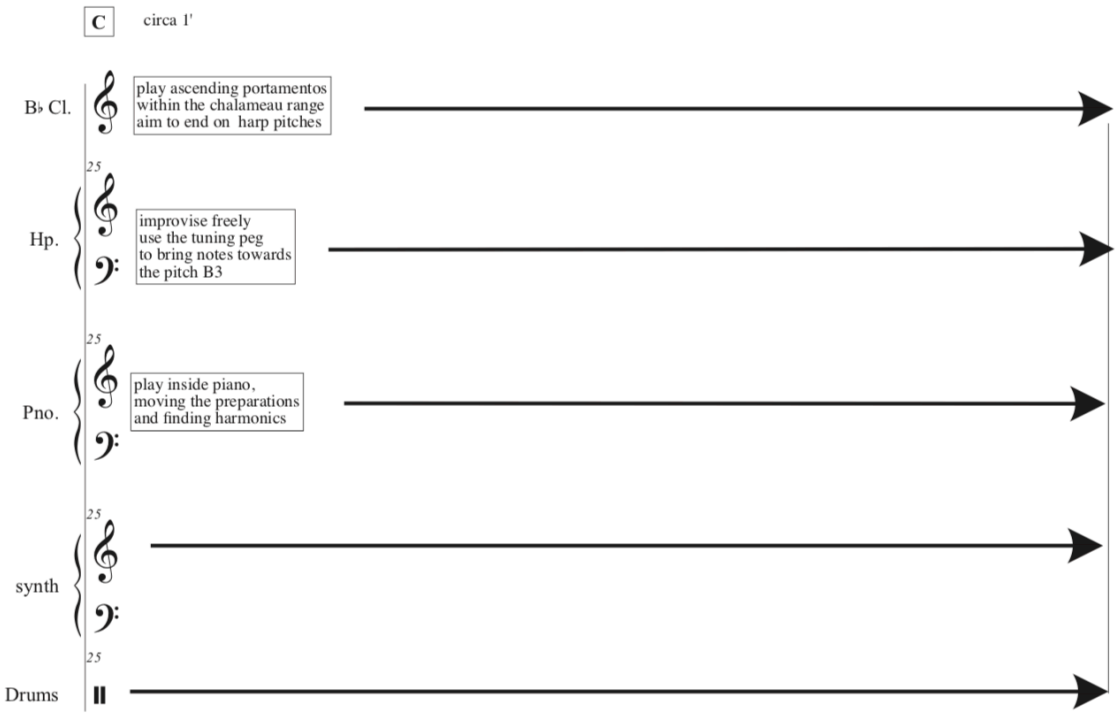

Figure 51: One More: undoing the scordatura

I see my compositions as spaces for improvisational networks to evolve. Throughout multiple iterations of a work, details will change, referring to and altering what went before. Each ensemble will develop a repertoire of responses and memories, a language connected to the work. The openness of the works allows experimentation, aiming to bring new formal emergences and sounds into reality through a connection with Spectralism. Through composing forms requiring constant diversification, I also hope to inspire and sustain a psychological transformation within the improvisational network, and also, perhaps, the audience.

Conclusion

Spectralism decomposed is a cross-disciplinary experiment connecting perspectives drawn from Spectralism with the art of improvisation, expressed through an improvisational network. I view Spectralism as an emergent complex of interwoven ideas, as an open concept. Goehr (1992) defines an open concept as evolving through connections, 'say, of a past event inspiring the production of a new event, or of a desire to develop, expand, or improve upon something done in the past – the sense of working within a tradition' (p. 82). I cast a beam of light into the immense diversity of musical techniques that have flourished within Spectralism, as well as into the broader zeitgeist of science and ecology influencing redefining their approach to musical form, seeking paths to establish improvised trajectories.

Georg Friedrich Haas, a leading second-generation Spectral composer, writes of his experience upon hearing Murail speak at Darmstadt:

> I remember a fascinating lecture by Tristan Murail in Darmstadt: the orchestral work which was subsequently performed was markedly different from what I had expected on the strength of the lecture. I realized much later that the pieces which correspond to what I had expected from Murail would need to be composed by myself. (Varga, 2011, pp. 104-105)

This too, was my experience. My initial desire to expand improvisational language through an engagement with Spectralism soon ballooned into a more complex vision as the intellectual diversity of the first generation of French Spectral composers became apparent. The eclectic and polemical writings of Tristan Murail, Gerard Grisey and Hugues Dufourt suggested that their ideas could not only be opened up for improvisation, they also whispered of a nascent and hidden directive to include improvisation as a creative strategy: after all, for French Spectral composers, the map is not the territory.

In *Tempus Ex Machina*, Grisey talks of encoding vast temporalities into his works, such as the time of whales, or the time of insects. I pan out to imagine works sustaining a disorder-order continuum across vast spans of time, diversifying through improvised processes and emergences. I imagine my works as strange attractors around which the improvisational network sustains endless variations, responding to spontaneous emergences of the moment. Landgraf (2011). writes that 'In neocybernetic discourses and in contemporary systems theory, the term 'emergence' describes the arrival of something qualitatively new that was neither predictable, nor planned. These emergences are 'errors, interferences and disruptions…' within the recursive process, which enable the system's stability while changing it' (p. 36).

Through composing for the improvisational network, I establish a web of intersecting improvised processes emerging through the flux of the present, allowing for the emergence of unanticipated forms. Murail (2005d). observes that 'music exists only at the moment it is heard; but it is often heard symbolically, by the composer, for

example, at the moment he conceives it, and then over the long chain of distortions that finally lead to its public reception' (p. 161). I also experience this process of distortion and welcome it. For me, this creative and temporal slippage offers an impetus for creative action, a process I celebrate and encourage through improvisational strategies. Reflecting on Spectralism, Grisey (2000a) concluded that the time for utopias was over, that 'all ideas of rupture with musical tradition seem illusory' (p. 3). It is into this continuity that I offer my work, inviting others to continue on from where I leave off.

Composition portfolio

Composition: *impOsition*, a Spectral etude for improvising orchestra

Premiere performance: Sydney Conservatorium of Music, October 18, 2016

Ensemble: Sydney Conservatorium of Music Modern Music Ensemble

Length: 11' 10"

Attached files: Video of a live performance, musical score (Kay, 2016).

Composition: *superimpOsition*: For improvisers and animated score

Premiere performance: Vivid New Music at the Con, Recital Hall West, Sydney Conservatorium of Music, May 2, 2017

Ensemble: Martin Kay (alto saxophone), Steve Barry (prepared piano), David Reaston (guitar/pedals), Mathew Bruce (violin/Tibetan gong), Jamie Cameron (drums)

Length: 17'

Attached files: Video of live performance, animated score (Weymouth-Wagstaff), compositional guide to the animated score (Kay, 2017c).

Composition: *In the Deep End*

Premiere performance: Recital Hall West, Sydney Conservatorium of Music, October 31, 2017

Ensemble: Martin Kay (alto saxophone/clarinet), Steve Barry (prepared piano), Emily Granger (scordatura harp), Ben Carey (modular synthesiser), Jamie Cameron (drumkit/Tibetan gong)

Length: 55'

Attached files: Video of live performance, musical score *(Kay, 2017a).*

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