Folio of Compositions with Commentary

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Abstract

This portfolio contains eight original compositions intended for concert hall performance, written for acoustic instruments, some with the addition of live electronics.

1. And the Vultures Started Circling (2017) – string quartet
2. Had You Done So Before, Perhaps You Would Still Be Free (2017) – quintet
3. Inside Out (2018) – big band
4. Rhythmic Extrusion (2019) – seventeen players
5. Numeration (2020) – cello & live electronics
6. Giant Steps (2020) – percussion trio & live electronics
7. Murmeration (2021) – tenor saxophone & live electronics
8. You'll Hear It (2021) – solo melody instrument & live electronics

Each piece contained within this portfolio forms an investigation into jazz processes that are applied to modern concert hall music. Some of these pieces employ a precise, statistical application of a jazz process such as rhythmic ratios or modal analysis, while others are informed more generally by themes of particular jazz performers or styles. Through the variety of pieces and commentary in this portfolio, genre definitions, and the limitations of them, are explored and challenged. The objective of my research is not to create jazz music, but to create music that has the genetic material of jazz. Throughout this thesis I attempt to distil various components of jazz and apply them to new music.

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Numeration (incl. patch notes) – cello & live electronics

Giant Steps (incl. patch notes) – percussion trio & live electronics

Murmeration (incl. patch notes) – tenor saxophone & live electronics

You'll Hear It (incl. patch notes) – melody instrument & live electronics

Pure Data Patches

Numeration.pd

Giant Steps.pd

Murmeration.pd

You'll Hear It.pd

Audio and Video Files

And the Vultures Started Circling – live recording (Performed by Diotima Quartet, 2018)

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Acknowledgements

I am indebted to a great many people without whom this project would not have been possible. I would like to thank my supervisor Dr John Stringer for his guidance and encouragement throughout the creation of this portfolio. The welcoming staff and students of the University of York Music Department have developed and inspired my passion for new music and I have forged connections over the past eleven years that will last a lifetime.

I would like to thank the musicians I have worked with throughout the composition of these pieces for their patience and commitment to creating new music. Many of my pieces are challenging for performers from any background and without the time investment made by these musicians I would not have been able to achieve this portfolio. These musicians include but are not limited to: Rupert Avis in recording *Numeration*, Will Howard in recording *Murmeration*, Diotima Quartet for their contribution to *And the Vultures Started Circling*, and the musicians of the Chimera ensemble for their recording of *Had You Done So Before, Perhaps You Would Still Be Free*: Adam Bonser, Athene Broad, Lucy Plimmer, Rob Wynne-Griffiths and Sirikorn Green.

Finally, I would like to especially thank my partner Alice Shepherd for her unwavering support and patience, and my family for always being willing to listen to my (sometimes unusual) music.

Author's Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, university. All sources are acknowledged as references.

The live electronic pieces use the software Pure Data (vanilla) with the following extensions:

- list-abs
- maxlib
- cyclone
- freeverb

1 Introduction

Scope of the Commentary

The compositions discussed within this thesis have been grouped into two categories: acoustic works (Chapter 2) and electronic works (Chapter 3), with each chapter providing commentary for four compositions. I have grouped the compositions in this way as my methods and approach to composing evolved when I started writing music that incorporated live electronics halfway through my PhD. The earlier works serve as evidence of my emergent voice in a solely acoustic idiom whilst the later works form a clearer representation of the composer I have become and the composer I want to be. While there is often analysis throughout the commentary, this is to ease understanding and in no means provides an exhaustive description of the many processes used in the construction of the works.

The Beginning

My performance focus for many years has been as a drummer and pianist in jazz ensembles. It was in these environments where I learnt the conventions of jazz band playing and first became interested in ways in which this largely improvised music could be transported to a contemporary composition platform. For example, the abundance of theoretical approaches to improvisation in jazz provide a perfect springboard for creating new music. My research interests initially began as an investigation into expanding the restrictions placed on jazz, but quickly evolved into investigating the application of jazz theory and traditions to modern art music, and as part of this investigation, an attempt to first distil the methods of jazz creativity into tangible products that can be used to generate new music. Each piece's commentary examines how I identified these products before applying them to my work. It is always the method of application, as opposed to

the final work, that qualifies as a 'tangible product' of this research; the pieces themselves represent an illustration of the method. Through the research in this thesis I aim to generate new methods of composition that can be applied more broadly than to solely the eight works presented here.

My compositions are mostly notated using a 'classical' approach to presentation. Performers of the majority of these compositions can be from any background except for *Murmeration* which requires a jazz saxophonist to fulfil the improvisation requirements of the score. I have included instruction for improvisation in accompanying performance notes for all relevant pieces.

Identifying the Genetic Material

In order to begin attempting to apply jazz traditions to new music, an investigation into what jazz *actually is* must first take place. William Taylor describes jazz as 'America's classical music'[1] and invites us to use Charles Rosen's description of western-European classical music as an analogue for jazz:

> The classical style appears inevitable only after the event. Looking today we can see its creation as a natural one, not an outgrowth of preceding style (in relation to which it seems more like a leap or a revolutionary break), but a step in the progressive realization of the musical language as it had existed and developed.[2]

The concept of identifying the style after the event is reinforced by Scott DeVeaux, who argues that although there were problematic definitions of jazz as it continued to evolve throughout the 20th century, it has since become possible to identify

[1] William "Billy" Taylor, "Jazz: America's Classical Music," *The Black Perspective in Music* 14, no. 1 (1986): 21.
[2] Charles Rosen, *The Classical Style* (New York: W.W.Norton & Company, 1971), 57.

consistencies in jazz historical analyses that clearly define periods of evolutionary stability.[3] DeVeaux continues to argue that this linear trajectory of the development of jazz holds until post-bebop, at which point evolutionary strands of jazz become increasingly fractal; coexisting styles being described as "mutually hostile".[4] Evidence to support this argument can be commonly found in jazz history books, where chapters often delineate explicit periods in jazz history that are defined by stylistic characteristics and practitioners but often take independent approaches to presenting post-bop jazz history.[5] Alyn Shipton describes the history of jazz until the 1970s as possessing a "straightforward narrative" and argues the technological advances in music distribution led to the end of the 'singular band' identity that jazz musicians inhabited in previous decades and meant many musicians spent their working life recording with a variety of musicians, leading to a fragmented working life.[6] This 'fragmentation' of jazz is further illustrated in Ted Giola's *The History of Jazz*, through his argument that jazz's evolutionary trajectory began to fragment in the 1960s with the arrival of "hard bop, West Coast jazz, soul jazz, modal jazz, third-stream jazz and free jazz", all jostling for prominence with their respective cohorts of devotees.[7]

Significant improvisation is a key component of jazz.[8] However, there are large quantities of big band repertoire from the 1930s and 1940s which would not qualify as 'jazz' were we to use 'significant improvisation' as a criterion.[9] It is possible to conclude that improvisation, of varying degrees, is important in defining jazz and therefore constitutes part of jazz's 'genetic material'. This folio explores improvisation from

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[3] Scott DeVeaux, "Constructing the Jazz Tradition: Jazz Historiography," *Black American Literature Forum* 25, no. 3 (1991): 525.
[4] Ibid., 526.
[5] Alyn Shipton, *A New History of Jazz* (New York: Continuum, 2010); Ted Giola, *The History of Jazz* (Oxford: Oxford University Press, 1997).
[6] Shipton, *A New History of Jazz*, 714.
[7] Giola, *The History of Jazz*, 278.
[8] James O. Young and Carl Matheson, "The Metaphysics of Jazz," *The Journal of Aesthetics and Art Criticism* 58, no. 2 (2000): 125.
[9] Mark Gridley, Robert Maxham, and Robert Hoff, "Three Approaches to Defining Jazz," *The Musical Quarterly* 73, no. 4 (1989): 519.

different angles, increasing in quantity of improvisation throughout the eight pieces. This trajectory culminates in the final work, *You'll Hear It*, which doesn't present any conventionally-notated material to the performer and requires a wholly-improvised performance from the musician and electronic patch.

One concern with drawing definitions for jazz is that every musician who defines themselves as a 'jazz musician' can be called an outlier of the genre by another jazz musician. Charlie Parker posited that bebop is "entirely separate and apart [from jazz]"[10] and when pressed for a definition he added that bebop is "just music. It's trying to play clean and looking for the pretty notes".[11] A month after this interview was published Dizzy Gillespie retorted by describing bop as "an interpretation of jazz … it's all part of the same thing".[12] Drummer Max Roach argues that the term 'jazz' should be eliminated altogether as the word was created by white producers to describe African-American music to their audiences at the start of the 20th century.[13] He goes on to invite us to develop our best understanding of what jazz means by listening to records; an inductive method of understanding jazz theory that I revisit throughout my folio by way of transcription and analysis. Within this thesis I offer snapshot examples of jazz culture that have resonated with me strongly, and use these to inform my identification of the genetic material of jazz, which go on to provide the foundation for contemporary composition. Where the largest pitfalls in definition arise, often in relation to theoretical application, I provide contextual arguments and embrace the ambiguous, often contentious, finer points of jazz theory.

[10] Michael Levin and John S. Wilson, "No Bop Roots in Jazz: Parker," *DownBeat*, September 9, 1949, 12.
[11] Ibid.
[12] John S. Wilson, "Bird Wrong; Bop Must Get a Beat: Gillespie," ibid., October 7, 26.
[13] Max Roach, "What "Jazz" Means to Me," *The Black Scholar* 3, no. 10 (1972): 2.

A Research Context

My compositions evidence the application of a wide variety of methods, approaches and inspiration. While there are myriad categorisation possibilities for existing artistic works, for the purposes of analysis and identifying starting points of inspiration I chose two categories within which I would place existing work that would serve as a departure point for the research conducted within this folio. While not all work with jazz and classical influences would fit into one of these two categories, the large majority could be defined in this way and help with generalisations in establishing my methods. The first category consists of work created by jazz musicians adopting the artistic themes of contemporary classical music. The ensemble configuration for these works often follow that of a traditional small jazz band: a soloist at the front with the addition of a rhythm section often comprising piano, double bass and drum kit. In this category the performer is almost always the composer and improvisation will constitute as much of the performance as that of playing a jazz standard. Examples include Avishai Cohen's trio with Mark Gulliana (drums) and Shai Maestro (piano), the Brad Mehldau trio, the Esbjörn Svensson Trio, The Bad Plus, GoGo Penguin, the Neil Cowley Trio, Fazer, Michel Camilo's trio and Shalosh among many others. These bands use a 'small jazz ensemble' configuration while their material is almost always original. Avishai Cohen's trio albums *Continuo*[14] (2006), *Gently Disturbed*[15] (2008) and *Seven Seas*[16] (2011) feature a distinctly modal-jazz approach to improvisation and make frequent use of ostinatos as a backdrop for soloists; techniques first popularised in the late 1950s by Miles Davis' band.[17] The music of these artists can be identified as possessing the

[14] Avishai Cohen, *Continuo*, Sunnyside Records, 2006, CD.
[15] *Gently Disturbed*, Razdaz Recordz, 2008, CD.
[16] *Seven Seas*, Sunnyside Records, 2011, CD.
[17] Henry Martin and Keith Waters, *Essential Jazz: The First 100 Years* (Massachusetts: Cengage Learning, 2008), 178.

'genetic material' of jazz, even if they don't immediately fit standard categorisations used by jazz historians.

The second category for identifying prior research is that of contemporary composers who write jazz-inspired music. These composers rarely perform their work and will delegate this task to 'classical musicians', jazz bands, or a combination of both.

Alongside the early developments of jazz at the start of the 20th century, composers from outside the world of jazz began incorporating jazz elements into their music. Stravinsky's 1919 theatrical work, *L'Histoire du Soldat*,[18] uses a combination of disruptive syncopation and hypnotic, jazz-inspired 'boogie' rhythms to represent the Devil destroying the hero's soul throughout the course of the performance.[19] Stravinsky's early experimentations with jazz influences such as *L'Histoire du Soldat* (for violin, double bass, clarinet, bassoon, cornet, trombone, and percussion) and *Ragtime*[20] (for two violins, viola, double bass, flute, clarinet, horn, cornet, trombone, cimbalom and percussion) largely retained classical ensemble configurations and were intended to be played by non-jazz musicians. It wasn't until 1945 that Stravinsky wrote explicitly for jazz musicians with his composition for Woody Herman's band, *Ebony Concerto*.[21] The strict nature of the fully-notated score meant Herman's band, used to improvising, found it notoriously difficult to perform and had to rehearse extensively before Stravinsky was ready to record the piece.[22]

Darius Milhaud became fascinated with the rise of jazz music at the start of the 20th century and his artistic output reflects the jazz influence on his compositional voice during this time.[23] *La Création du Monde*,[24] for a small orchestra of eighteen players,

[18] Igor Stravinsky, *L'histoire Du Soldat* (Mainz: Schott Music, 1919).
[19] Wilfrid Mellers, "Stravinsky and Jazz," *Tempo* 81: Summer (1967): 30.
[20] Igor Stravinsky, *Ragtime* (London: J. & W. Chester, 1920).
[21] *Ebony Concerto* (Los Angeles, CA: Warner Chappell, 1945).
[22] Ira Gitler, *Swing to Bop : An Oral History of the Transition in Jazz in the 1940s* (1985), 194.
[23] Marion Bauer, "Darius Milhaud," *The Musical Quarterly* 28, no. 2 (1942): 140.
[24] Darius Milhaud, *La Création Du Monde* (Paris: Max Eschig, 1923).

illustrates a confluence of classical and jazz themes; peaceful Bachian phrases are juxtaposed with syncopated piano stabs and blues-inspired motifs from the woodwind and brass.

A year after *La Creation du Monde*, Gershwin's *Rhapsody in Blue*[25] premiered at a concert commissioned by bandleader Paul Whiteman in New York titled "An Experiment in Modern Music". Gershwin, who was the pianist for the performance, had not yet completed notating the extensive piano solo sections and, as a solution, the conductor's score for the performance featured blank pages instructing the band to "wait for [Gershwin's] nod".[26] The notation decision Gershwin employed here, albeit a necessity for him, became an influence for the notation methods I used in some of the larger ensemble pieces in this folio. For example, *Inside Out*'s rehearsal mark C instructs different ensemble sections to await the conductor's cue to improvise over the rhythm section's groove.

Avant-garde composer George Antheil's 1925 work for large orchestra, *A Jazz Symphony*,[27] was also commissioned by Paul Whiteman and premiered by blues pioneer W.C. Handy and his orchestra.[28] Antheil's jazz-inspired style was more divisive than Gershwin's and his "rhythmically daring modernistic works and repetitive harmonies were often perceived by classical audiences of the time as unsettling and provocative."[29] Antheil's method was an attempt to subtly allow jazz approaches to influence his compositional voice rather than to create a typically 'jazzy' sounding piece for an orchestra. This is similar to Stravinsky's approach, particularly with *Ragtime*,[30] where the

[25] George Gershwin, *Rhapsody in Blue* (New York: Harms, 1924).
[26] Jessica Getman, "When Blue Was New," 2016, accessed 20 July, 2023, https://smtd.umich.edu/ami/gershwin/?p=628.
[27] George Antheil, *A Jazz Symphony* (New York: Schirmer, 1925).
[28] Matthew Mugmon, "George Antheil, a Jazz Symphony," 2013, accessed 20 July, 2023, https://americansymphony.org/concert-notes/george-antheil-a-jazz-symphony/.
[29] Julia Schmidt-Pirro, "Between the European Avant-Garde and American Modernism: George Antheil's "Ballet Mécanique"," *Soundings: An Interdisciplinary Journal* 89, no. 3 (2006): 405.
[30] Stravinsky, *Ragtime*.

jaunty rhythms of the cimbalom can be interpreted as having jazz roots without necessarily sounding like an appeal to a 'traditional jazz' audience.

Composed in 1949, Leonard Bernstein's *Prelude, Fugue and Riffs*[31] draws on methods from composers before him who were themselves influenced by early jazz such as Gershwin, Copland and Milhaud.[32] This points to a 'lineage' of influences; the rhythms Milhaud heard on the streets of Harlem in 1922[33] that made their way into *La Création du Monde*[34] became something novel through this process, no longer derivative of jazz but contributing to a new, evolving stylistic idiom. Successive composers being influenced by, for example, Milhaud, would 'inherit' stylistic features while adding their own. This theme is another example of how 'genetic material' of jazz can be investigated; by examining the 'ancestors' of compositional influence. Some of the pieces in this folio have a singular starting point, or 'parent', from which my piece is created. For example, *Numeration*, for cello and live electronics, takes the opening bars of the standard, *Autumn In New York*,[35] as a guide for the precise structural, formal and harmonic framework of the ten-minute composition, thereby 'inheriting' features that are not explicitly apparent without examination.

Not only was there constant cross-influence between classical and jazz throughout the 20th century, but also examples of 'influence-lineage' weaving back and forth between the two strands of musical history. Jazz pianist Dave Brubeck studied composition under Milhaud and it has been argued that Milhaud's tuition was integral to the development of Brubeck's harmonic language.[36] Gunther Schuller categorises the hybridisation of classical and jazz as third-stream; music that represents the confluence

[31] Leonard Bernstein, *Prelude, Fugue and Riffs* (London: Boosey & Hawkes, 1949).
[32] Katherine Baber, *Leonard Bernstein and the Language of Jazz* (Illinois: University of Illinois Press, 2019), 241.
[33] Bauer, "Darius Milhaud," 149.
[34] Milhaud, *La Création Du Monde*.
[35] Vernon Duke, "Autumn in New York," 1934.
[36] John Salmon, "What Brubeck Got from Milhaud," *American Music Teacher* 41, no. 4 (1992): 26.

of Western Classical traditions with early 20th century African-American music.[37] His 1959 composition, *Concertino*,[38] for jazz quartet and orchestra situates the jazz quartet in the foreground while the orchestra provides textural accompaniment. In contrast to Schuller's argument that third-stream is a successful hybridisation of two styles, Joyner argues that third-stream only serves to dilute the strongest qualities of classical and jazz.[39] I established early in the creation of the works contained within this thesis that I wanted my music to not particularly sound like an orchestral-jazz fusion, for example, 'jazz music with strings' or 'symphonic music with a beat', but instead to have jazz baked into its identity, hence my research angle describing the application of jazz's 'genetic material' to new music; genetics are sometimes easily identified but can also be subtly disguised, only being revealed after substantial analysis.

Composed in 1972, the second part of Michael Tippett's Third Symphony[40] references the composer's affection for the blues; long, wailing flugelhorn melodies combined with a sombre accompaniment from the lower brass draw similarity to early 20th century New Orleans funeral marches. Elsewhere in the work, the composer captures the harmonic language of the blues while maintaining a distinctly Tippettian colouration;[41] this is a piece that has the essence of what the blues means to the composer, without appearing as a pastiche 'blues composition'. Throughout composing this folio, I ensured that this philosophy was maintained with regard to creating new music that has a substantial connection to jazz.

Claude Bolling's 1975 Suite for Flute and Jazz Piano Trio[42] approaches the classical/jazz confluence differently to previously mentioned examples; with its jazz

[37] Ran Blake, "Third Stream and the Importance of the Ear: A Position Paper in Narrative Form," *College Music Symposium* 21, no. 2 (1981): 140.
[38] Gunther Schuller, *Concertino for Jazz Quartet and Orchestra* (New York: MJQ Music, 1959).
[39] David Joyner, "Analyzing Third Stream," *Contemporary Music Review* 19, no. 1 (2009).
[40] Michael Tippett, *Symphony No. 3* (London: Schott Music, 1972).
[41] Calum MacDonald, "Tippett's Third Symphony," *Tempo* 102 (1972): 26.
[42] Claude Bolling, *Suite for Flute and Jazz Piano Trio*, CBS Masterworks, 1975, CD.

'time' drum rhythms, walking bass lines and bop melodies, large parts of this piece sound like they could be excerpts from a typical jazz standard and contain very little classical influence at all. However, unusually for a piece that resembles jazz as closely as this, it is fully notated, facilitating the piano and flute to enjoy a complex contrapuntal dialogue and a whole-ensemble precision with regard to metric and temporal exploration. This methodology bears similarity to that of the first piece in this folio, *Had You Done So Before, Perhaps You Would Still Be Free*; the viola and cello feature in 'solo' sections where I use the advantages of precise notation to coordinate jazz-like 'hit points' throughout the rest of the ensemble.

Mark Anthony Turnage's works often combine the worlds of jazz and modern classical music. For example, his 1997 large ensemble work, *Blood on the Floor*,[43] requires both jazz and classical musicians for performance, with each type of musician playing to their strengths; the jazz musicians improvise extensively while the classical musicians are required to read conventional notation. The role of the classical musicians in a work like *Blood on the Floor* is to provide both an orchestral accompaniment to the jazz soloists but also creates relationships between jazz and contemporary classical, similar to the objectives of third-stream.

The two categories I use in this thesis to define existing works and to situate my research are not mutually exclusive and there are examples of some crossover. Lebanese trumpeter Ibrahim Maalouf, who has long collaborated with musicians from all backgrounds, incorporates 'classical' instruments into works of all scale from quartet[44] to orchestral.[45] Throughout his prolific work output, Maalouf meanders between assuming the role of the 'classical composer' and the traditional 'jazz band leader'. His music has served to influence my compositional voice over the years and my work for big

[43] Mark-Anthony Turnage, "Blood on the Floor," Argo, 1997, CD.
[44] Ibrahim Maalouf, "Hashish," *Diasporas*, Mi'ster Productions, 2007, CD.
[45] *Levantine Symphony N°1*, Mi'ster Productions, 2018, CD.

band, *Inside Out*, started life as an analysis of Maalouf's treatment of rhythmic interaction in a small ensemble. The compositions in this folio take inspiration from both categories, and many others, often drawing from multiple sources within the same composition.

This commentary chronologically presents my eight compositions in two halves; the first half deals with identifying and embedding jazz approaches to compositions using acoustic instruments and the second half introduces electronics as a means for generating new music. The compositions contained within the first half explore harmonic, rhythmic, textural and melodic relationships between instruments whereas the electronic compositions in the second half more explicitly explore the improvisation traditions of jazz in greater detail. The compositions within this portfolio use discrete components of jazz culture as the launchpad for creating new music. I did not set about attempting to apply every jazz rule to every composition, but chose select themes within jazz that have especially resonated with me.

The aim of this thesis is to demonstrate that it is possible to compose music that has its roots in jazz but is stylistically separate from it. My compositional objectives diverge from the that of the aforementioned composers in that my music doesn't necessarily resemble jazz on the surface, but has the genetic material of jazz embedded within its compositional approach. This notion directed me to the explicit research question that drives this investigation: can one compose with a new approach to the synthesis of jazz and contemporary music?

2 Acoustic Works

And the Vultures Started Circling (2017) – string quartet

Had You Done So Before, Perhaps You Would Still Be Free (2017) – quintet

Inside Out (2018) – big band

Rhythmic Extrusion (2019) – seventeen players

The four pieces contained within this chapter are all for acoustic instruments without electronics. They were created in the first half of my PhD and represent the foundation upon which I developed pieces for use with electronics. Regarding the embedding of 'jazz genetics', the following pieces in this chapter were created using a combination of holistic, abstract approaches and precise, theoretical methods which I will further explain within each piece's commentary.

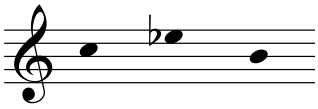
The following four compositions contain an increasing amount of improvisation and therefore performer agency. While *And the Vultures Started Circling* is fully notated, I used the next piece, *Had You Done So Before, Perhaps You Would Still Be Free*, as an opportunity to introduce improvisation to my writing, beginning to explore how performers can play inside and outside of modal parameters. The final two pieces in this chapter, *Inside Out* and *Rhythmic Extrusion*, begin to explore how free-time improvising common in contemporary jazz can be coordinated with a large ensemble. In all of these pieces, musicians are directed on how to approach the improvisation requirements of their part. At no point in the following four works do I require performers to understand jazz language or define themselves as a jazz musician in order to perform these pieces.

And the Vultures Started Circling (2017)

Circling, Cycling, Spiralling

Bebop is noted for being "harmonically adventuresome".[46] Additionally, the often-fast tempo can make it difficult for a listener to identify a tonal centre. The harmonic sequence in the 'head' section of a standard is relentlessly repeated throughout the performance, over which the ensemble will take turns improvising. For uptempo bebop standards, playing through the form once may last as little as twenty seconds, meaning the audience is exposed to hundreds of perpetual chord changes within an average-length performance. It was this restless, turbulent feeling that I set out to evoke in my first work in this portfolio, written for string quartet.

Patterns of perfect cadences used to approach further perfect cadences are described in jazz theory as 'back-cycling'.[47] This harmonic device compounds tension and deceives the listener's ear into believing a resolution is imminent. Themes of a spiralling sequence of perfect cadences, never fully resolving, drew me to the imagery of vultures circling. The objective of back-cycling is to harmonically approach the destination from afar, thereby creating an interesting sequence over which the performer can improvise. I used this piece to practise extending this philosophy; not just approaching a harmonic destination from a distance, but approaching the back-cycling device itself from a distance. There are three sections to the string quartet that reference the head-solos-head structure of jazz standards. The opening section gradually unveils a three-note motif in various transpositions, delicately testing themes of tonal movement that will become a focal point for the piece.



[46] Jerry Coker, *The Complete Method for Improvisation* (Lebanon, IN: Studio P/R, 1980), 14.
[47] Eddie Arkin, *Creative Chord Substitution for Jazz Guitar* (LA: Alfred Publishing Company, 2004), 71.

Figure 1: Three-note motif used as the ‘head’ in *And the Vultures Started Circling*.

The middle section takes inspiration from Charlie Parker’s top-flight bebop solos; the strings energetically exploring a constantly-shifting tonal base that never settles for more than a few beats. The ‘resolution’ provided in the final section is for the piece to fully explore back-cycling by moving backwards through the circle of fifths via dominant chords. There is no satisfying resolution in this section as the harmonic technique employed serves to build more tension, only this time in a tonally-conventional sense. The harmony in the final bars of the piece, detailed in Figure 2, registrally descends while uneasily shifting the tonal centre using dissonant altered extensions (often ♭9 and ♭13) over dominant chords.

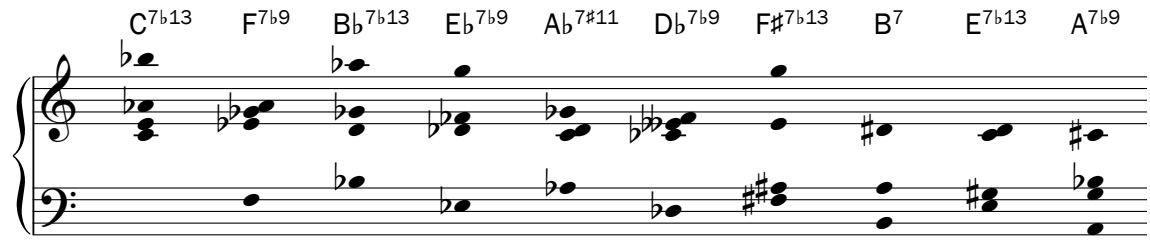


Figure 2: Back-cycling harmony used in b.190-204.

At this terminal point in the piece imagery of the vultures starting their final, coordinated descent came to mind. The series of dominant chords does eventually settle on a quiet, thinly-voiced, pizzicato Dm^6 chord which is immediately replaced by a shrill persistent tone, further highlighting the perpetual tension created within the piece as having been the focal point.

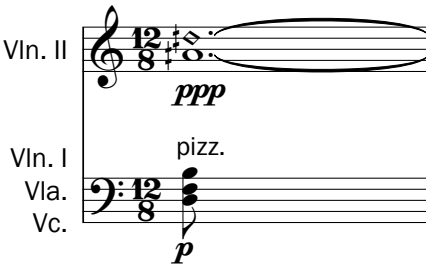


Figure 3: The final chord.

Creating Energy

The fast pace, metric irregularity and heavily syncopated stabs that ricochet throughout the ensemble in the middle section are reminiscent of snare drum comping patterns. The snare's role in a small jazz ensemble is to be both proactive and reactive; sometimes suggesting ideas for other band members to develop while other times responding to their suggestions. It is through this interplay that a musical dialogue is created and this theme became a key objective in the composition. It was in composing this piece that I developed a fascination with the language of drum kit comping in bebop. Much later in the portfolio I decided to dedicate a piece to exploring this percussive language.[48] The low register of the viola, and later cello, feature a staccato semiquaver rhythm that drives the momentum of the section, enabling the syncopation from the rest of the quartet to be clearly situated within the pulse for the listener. Within this steady, consistent 'bass line' framework I allowed gestures to emerge from the background using an oscillating rhythmic device that would develop to become a defining feature of my compositional voice in the remainder of my acoustic compositions. I use this device to generate pace and disrupt previously-established rhythmic expectations.

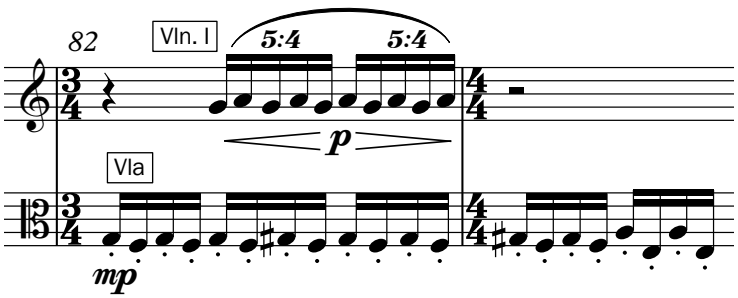


Figure 4: Oscillating gesture used to create energy and momentum.

[48] See composition 6: *Giant Steps*.

Had You Done So Before, Perhaps You Would Still Be Free (2017)

This quintet piece was designed as a continuation of the story *The Caged Bird and The Bat*, one of Aesop's lesser-known fables. Using an existing narrative afforded me space to explore themes I would want to develop within this and subsequent pieces. Jazz themes and ideas in this piece are initially abstractly referenced; for example, in big band writing it is common to see brass and percussion 'stabs' punctuate winding solo sections. This simple gestural device was used as the thematic impetus for the opening section where tutti hit points become increasingly frequent, almost willing the ensemble to increase momentum until a consistent pulse and underlying rhythmic framework is established from Part II (b.40).

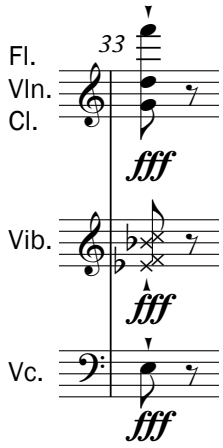


Figure 5: Hit points.

I used this piece to begin exploring how diatonic modes, one of the founding principles of tonal jazz improvisation, can be explored and developed within my music. *Had You Done So Before* quickly meanders through modal centres, occasionally pausing on a mode to allow it to be fully explored. Part II (*Freedom*) is initially securely located within F Mixolydian, allowing the consonant intervals from the mode's root to emotionally situate the music and reference the narrative's theme at this point (Figure 6). This is short lived when nine bars later the mode, based upon the same root, flattens the

second, third and sixth degrees while sharpening the fourth, introducing dissonant intervals from the root and redefining the mode as F Phrygian ♯4 (Figure 7).

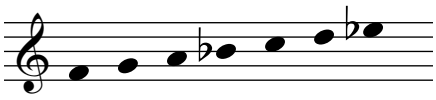


Figure 6: F Mixolydian used from b.40 (‘Part II – Freedom’).

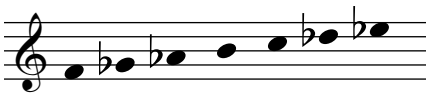


Figure 7: F Phrygian ♯4 used from b.49 (rehearsal mark B).

When writing this section, I was interested in not just situating music firmly within a mode but rather exploring how pitches from outside the mode can be used in a similar way to which jazz musicians will improvise ‘outside the changes’.

Inventing a Language

Part III (*Doubt*: b.71) begins to refine emergent ideas established in Part I and II. Until this turning point in the piece, all quintet members shared roles equally; momentum and activity ricocheting through the ensemble resembling a hive-like delegation of shifting roles. I decided this section would allow the vibraphone to develop its background character to become more proactive; driving the pace of the section and dictating the harmonic rhythm. The modal jazz standard *So What*[49] became the inspiration for the vibraphone’s function here; the Miles Davis composition uses two modes over which the ensemble creates an improvised discourse. Limited harmony combined with Bill Evans’ iconic quartal and quintal voicings on *So What* informed the vibraphone writing in this section (Figure 8). The textural space created within these voicings is an invitation for improvisers to fully explore and push traditional modal bounds; an idea that the woodwind and strings increasingly adopt as the section develops.

[49] Miles Davis, “So What,” *Kind of Blue*, Columbia, 1959, LP.

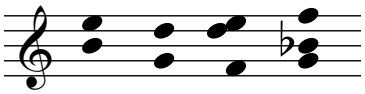


Figure 8: Chord sequence used from b.71–129.

In jazz improvisation, the chord does not solely dictate the mode the improviser will use; it is the chord's contextual function that informs the modal decision. Often a musician will use a different mode for the same chord upon that chord's repetition within the form. For example, on a dominant chord an improviser may choose to use the Mixolydian, Phyrgian dominant, or super-Locrian (altered) modes, with all of them having suitability in different situations. This freedom of choice is one of the most difficult aspects of defining what is the 'right' option for jazz musicians and only after years of listening and practice, developing their 'language', will a musician be able to make appropriately informed modal choices. The ambiguity surrounding modal decisions focussed my objective for this section: I would create modes for chords that would change upon the chord's repetition and use this to influence my pitch choices (Figure 10).

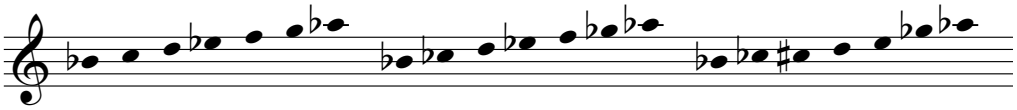


Figure 9: Mixolydian, Phyrgian dominant and super-Locrian modes that can all be used over the chord B♭7.

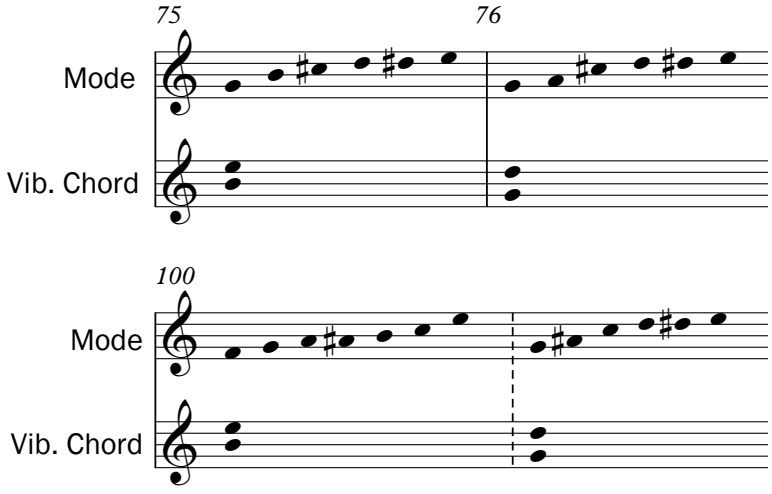


Figure 10: Modes used over the same first two chords in the sequence at different points in the piece.

The vibraphone's chords in Part III begin calmly, subtly highlighting the harmonic pace of the section and allowing the audience's ear to acclimatise to the modes used for each chord. The modes change with each repetition of the chord sequence, thereby creating a perpetually-evolving modal language that accompanies the repetitive chord pattern.[50] When playing 'within the changes', jazz musicians will use the modes they believe are best suited to the harmony. Ignoring the mode, or deliberately avoiding modal pitches is referred to as playing 'outside the changes'[51] and is an element of jazz theory I was keen to explore in this section of the piece. Performers are always aware when they are to play 'inside' or 'outside' (Figure 11) and it is this 'language' that is the area of investigation in this section, not necessarily the resultant effect.

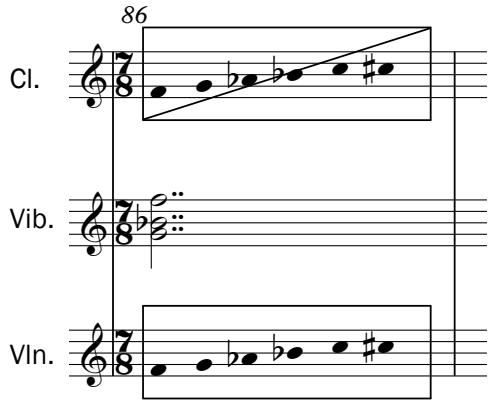


Figure 11: The violin is instructed to improvise 'within the changes' while the clarinet is instructed to improvise 'outside'.

This piece represents a refinement of themes through its journey; the final section representing my starting point for the next piece in the folio, through which I further examine, albeit from a different angle, how I apply the themes and traditions of jazz to writing new music.

[50] I returned to the concept of an 'evolving modal language' in my final piece, *You'll Hear It*, in which the live electronics continuously analyses the performer's improvisation to create a mode with its own 'language'.
[51] Jerry Coker, *Elements of the Jazz Language for the Developing Improvisor* (LA: Alfred Music Publishing, 1997), 83.

Inside Out (2018)

Rhythmic Inaccuracy

Until this point in the portfolio, most of my exploration into developing jazz theory had revolved around the application of traditional jazz modes, either prescriptively notated or briefly improvised. This research is one part of the genetic material of jazz, and there are many other avenues that I wanted to explore. Ibrahim Maalouf's treatment of rhythmic development in his jazz quintet piece, *Questions & Answers*,[52] served as the departure point for this research conducted in writing this big band piece. The final section of Maalouf's piece features a rhythmically destructive process whereby the performers repeat a phrase, initially in rhythmic unison, becoming increasingly out of time with one another upon each repetition. A style as improvised and pulse-driven as jazz lends itself to the manipulation of beat-placement. While playing 'slightly out of time' is popular in small-band jazz performance, the device is rarely seen on a larger scale. *Inside Out* provided an opportunity to explore how this process can be applied in various guises to a large ensemble.

When composing contemporary music for a traditional big band, I was mindful of the cultural dissonance that may be encountered. Early work in this area includes Stravinsky's 1945 composition, *Ebony Concerto*,[53] written for Woody Herman's First Herd band. Instead of writing a traditional, groove-based drum kit part, Stravinsky treats the drum kit like an autonomous agent; allowing the instrument to be precisely supportive by way of a fully-notated part. I drew on this source of inspiration for my own drum kit writing in *Inside Out*, allowing the role of the drum kit to adapt as the piece develops. At the start of the piece the drum kit is more traditional; a syncopated cymbal groove outlines a consistent pulse upon which pitched instruments slowly introduce melodic material. As

[52] Ibrahim Maalouf, "Questions & Answers," *Wind*, Mi'ster Productions, 2012, CD.
[53] Stravinsky, *Ebony Concerto*.

the piece advances, the role of the drum kit increasingly references Stravinsky's drum kit writing and, after introducing the orchestral bass drum at letter G, the drum kit's character integrates with the ensemble more directly, evolving into a semblance of classical percussion writing. Mark-Anthony Turnage's writing has been compared to a blend of Stravinsky, James Brown and 'bluesy rhythms'[54] and as a result his compositions provide a useful departure point for new large-ensemble contemporary music that has origins in jazz. Where Turnage's music is often groove-driven and texturally underpinned with rhythm section ostinatos,[55] I wanted to explore techniques for a large ensemble to intentionally play out-of-time but remain coordinated.

My exploration into rhythmic displacement techniques used by Ibrahim Maalouf began with beat placement analysis. Figures 12 and 13 are time-based transcriptions of the trumpet and tenor saxophone playing the same phrase out of time with one another in *Questions & Answers*. The first is from the start of the final section, where both musicians are mostly in time with each other. The ensemble gradually becomes increasingly out of time with itself upon each phrase repetition (Figure 13).

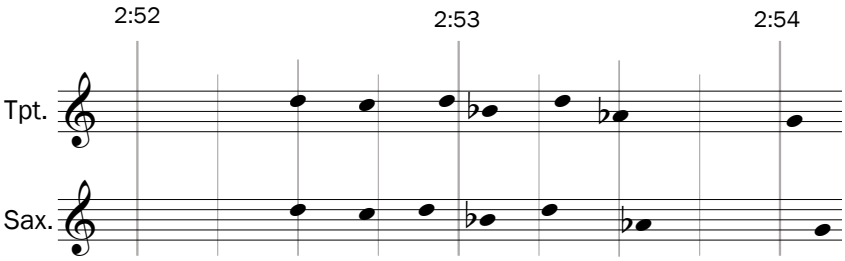


Figure 12: Trumpet and tenor saxophone rhythmic displacement in Questions & Answers. Analysis starts at 2:52.

[54] Martin Anderson et al., "London: Bbc Proms 2010," *Tempo* 65, no. 255 (2011): 45.
[55] Examples include Turnage, "Blood on the Floor."; *Canon Fever* (NY: Boosey & Hawkes, 2011); *Hammered Out* (NY: Boosey & Hawkes, 2010).

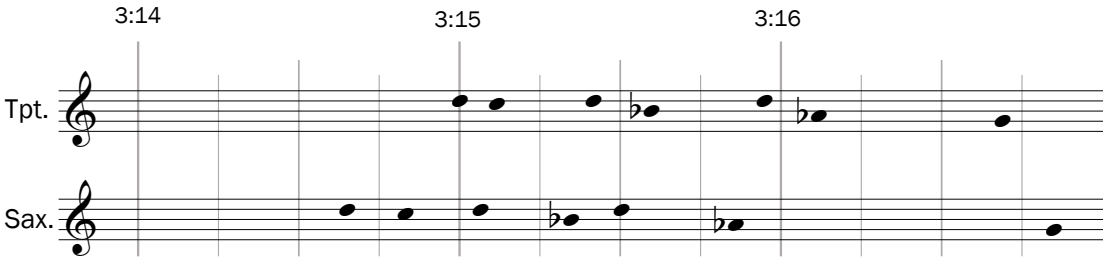


Figure 13: Increased rhythmic displacement over the same phrase from later in the piece. Analysis starts at 3:14.

In writing this piece, I considered how I could analyse and incorporate improvised rhythmic jazz traditions to my writing. Compositions in this portfolio leading up to this piece had featured minimal improvisation. As jazz is heavily dependent on improvisation for material generation, I aimed to develop ways in which I could increase performer agency in my pieces. The process began with identifying features from my own experience as a small-ensemble jazz drummer. One such tradition that bears similarity to Maalouf's rhythmic disintegration device is the way in which a jazz band will often end a standard. It is very common for the final few beats to be played in rhythmic unison while slowing down, directed by the 'front person'; usually a saxophonist or trumpeter. I applied this theory to letter D where the conductor directly controls when each rhythmic impulse begins.

As playing in-time usually means relying on a pulse, I decided to remove the possibility of a pulse at letter D and instead instruct the musicians to play a phrase by a 'deadline', notating the number of seconds within which the phrase should be played. Giving musicians different time-frames within which the same phrase must be completed creates a situation that promotes rhythmic disunity and allows the musicians freedom to work within independent temporal frameworks. By virtue of the conductor cueing the start of each entry, phrases will start in perfect unison before rhythmically disintegrating as the phrase advances. The conductor is instructed to wait as long as they like between phrases, resulting in some musicians completing their phrase while others with a longer time limit will be part way through when the conductor cues the next cell. Unless their

part instructs a phrase be played in the subsequent cell, musicians are required to complete their phrase if the conductor advances before they have finished playing.

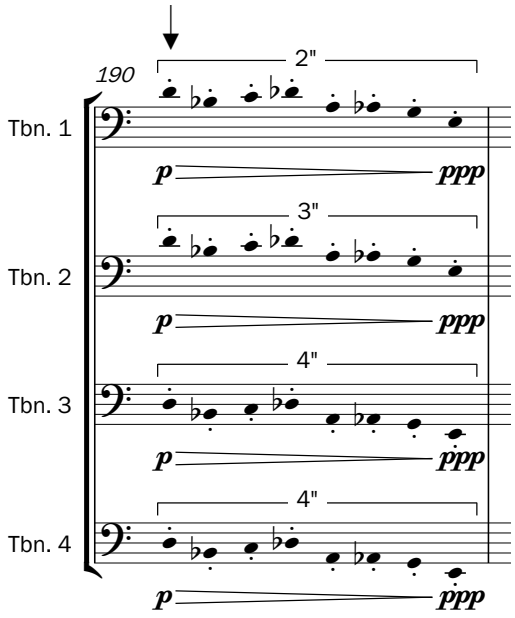


Figure 14: The trombones are instructed to play the same phrase (in different octaves) over their respective time durations.

Starting at letter C, the conductor takes responsibility for delegating solos over the rhythm section accompaniment. However, when a new soloist is selected, the previous player continues to improvise, creating a dense cacophony as the section advances. The conductor can stop performers improvising by gesturing to them again, but the conductor is required to instruct the whole ensemble to be improvising by the end of the section. Throughout the course of this section the performers are to listen for ideas around them, developing them at different tempi. The performers are directed to play rhythmically, occasionally 'locking-in' with other ensemble members' pulse but should look to change to a new tempo within a few seconds for the section to maintain a sense of disorder and confusion. The performers are given a stimulus for improvisation, within which they are to initially reference the boxed material in pitch-order before deviating as they wish. The ensemble is divided into three sections; woodwind, trumpets

and trombones. The conductor is encouraged to not only direct individual musicians to improvise but to also cue the three instrumental sections in the same manner.

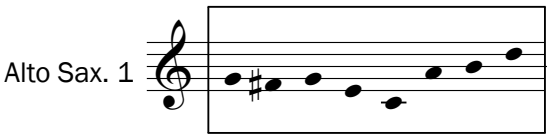


Figure 15: Improvisation stimulus for the woodwind section.

These rhythmically-driven improvisation devices showcase the theme of disintegrating rhythms with a large amount of performer agency. Alongside improvised sections, I also looked to explore this process in a more precise, fully notated fashion. Letter B (b.101-182) uses motivic development as a vehicle for applying rhythmic disintegration, allowing ideas to be passed around the ensemble, overlapping one another and being rhythmically augmented to generate new motifs that are then explored in the same manner. Upon later reflection, this section of *Inside Out* provides foundational evidence for the processes explored in the final piece in this portfolio, *You'll Hear It*, whereby improvised germinal melodic ideas are repeatedly developed between a live performer and electronic system.

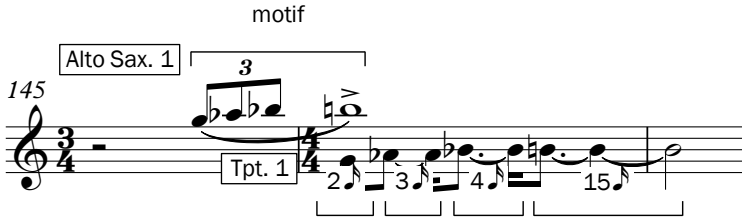


Figure 16: Rhythmic augmentation in the trumpet's imitation of the alto saxophone motif.

The final section of *Inside Out* also references the head of Jason Linder's contemporary jazz trio composition, *Seven Ways*,[56] in which he also halves the ensemble to create a hocket-like rhythmic pattern except this division is based on pitch. The electric bass, bass drum and lower register of the synthesiser form one group while the

[56] Jason Linder, "Seven Ways," *Now Vs Now*, Anzic Records, 2009, CD.

cross-stick on the snare drum and middle-register synthesiser chords form the other. These two groups interact back and forth, creating a 'ping-pong' effect of low/high stabs (Figure 17). I used this 'binary register' theme in writing *Inside Out*'s coda, allowing instrument roles to change throughout the section; b.359's high-register group is comprised of trumpets, whereas the woodwind section take the role of the high-register group in b.364.

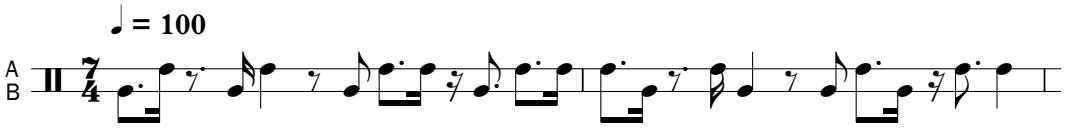


Figure 17: Transcription of the opening of *7 Ways*. Group A: cross-stick on snare, middle-register synthesiser. Group B: electric bass, bass drum, low-register synthesiser.

Altered Approaches

Large sections of this piece use a mode native to jazz harmony known as the altered scale. Traditionally it is applied to dominant chords and therefore creates harmonic tension. Staring with a mixolydian mode, the root, major third and minor seventh are retained with the following adjustments made to the remaining pitches: ♭9, ♯9, ♯11 and ♭13. Due to both the flattened and sharpened ninth pitches creating inconvenient spellings, many pitches in this piece are re-spelt in a more logical fashion.

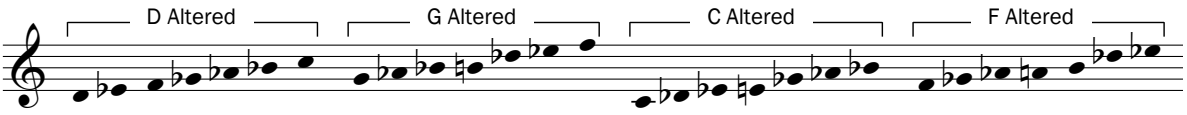


Figure 18: Enharmonic equivalent spellings of altered modes used in *Inside Out*.

And the Vultures Started Circling explores harmonic tension using dominant chords with altered extensions. The harmony in my string quartet moves quickly, adopting the back-cycling theory of a succession of unresolved perfect cadences. I decided this piece would further examine how altered harmony prevalent in jazz theory can be adapted to increase tension. In contrast to my string quartet, *Inside Out* features large sections exclusively in one altered mode which enables the mode to be explored

from different angles. Letter G marks the beginning of this rigorous examination. Each bass pedal in this unusually slow section announces a new modal framework while instruments explore their roles and test functions of pitches within the given altered mode. The end of the piece allows chord voicings to become the focal point, relentlessly generating tension by re-voicing the same altered dominant chords and unconventionally stacking every pitch in the mode in a similar register. The intense dissonance encourages the resultant timbre to adopt a percussive sound, further integrating the rhythm section's role with the rest of the ensemble.

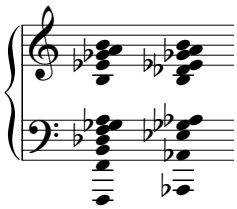


Figure 19: Two chords repeatedly used in the closing bars using the F altered mode.

Rhythmic Extrusion (2019)

Whilst completing my undergraduate degree I formed a Cuban music ensemble of around fifteen members to play Cuban standards at dance events. During my Master's year I examined how rhythmic fundamentals of the tradition could be retained whilst adapting the music to unconventional metres, creating a Cuban music that, unusually, could not easily facilitate dancing. The research on atypical metres from my MA provided a suitable foundation from which to further transport the unique qualities of the Cuban musical tradition into a contemporary setting. Jazz and Latin American music have an intertwined history and jazz musicians will very often also be proficient Latin American musicians, so it seemed fitting to use Cuban music as the inspiration for a contemporary piece exploring rhythmic interaction, particularly as Cuban music has such a strong relationship with rhythm. It can be argued that part of the genetic material of rhythms used in jazz are those from the Caribbean, in particular Afro-Cuban music.[57] Therefore, it was important to me to create a piece that examines these rhythms and alongside it, other conventions of music from Cuba.

Each of the nine sections, denoted on the score with letter markings, serve to either introduce or develop material, with a theme for each. The opening section introduces the listener to timbres within the percussion section and begins to develop rhythmic interplay between the performers. There is no strong pulse at this formative stage and performers are directed to be rhythmically free (Figure 20). The traditional Cuban percussion trio of timbales, bongos and congas was chosen as the percussionists' initial instruments but traditional rhythms for these instruments would not be explored until much later in the piece.

[57] Christopher Washburne, "The Clave of Jazz: A Caribbean Contribution to the Rhythmic Foundation of an African-American Music," *Black Music Research Journal* 17 (1997): 59.

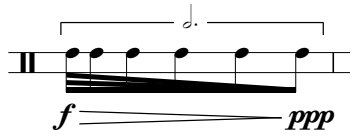


Figure 20: Conga in b.28.

Thomas Ades' large orchestral work *Tevot*[58] provided direction for devices in unveiling melodic material. The opening minutes of *Tevot* feature shimmering timbral oscillations from woodwind and strings, from which a solo horn melody consisting of a rising minor seventh that chromatically resolves downwards briefly emerges. Allowing melodic ideas to slowly blossom out of a timbral 'sound-world' became an overarching theme of *Rhythmic Extrusion*. I created a motif to similarly emerge from the background. This 'wailing' gesture, introduced when the first pitched sounds are heard at letter B, reappears throughout the piece in various guises. Like the broader aspects of the piece, it too follows an evolutionary pathway and my treatment of this motif throughout the composition allowed me to continue to develop my own voice in a previously-unexplored manner.

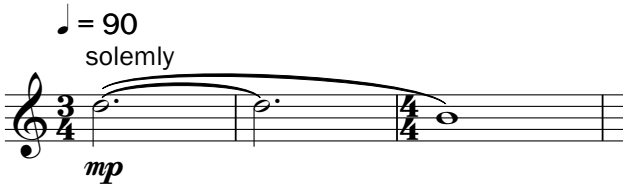


Figure 21: 'Wailing' gesture introduced by the trumpet in b.31 (letter B).

Cuban music has strong ties to polyrhythmic complexity and rhythmic precision. Rhythms chosen by a performer must fit with the idiosyncrasies of the style and appropriately interlock with other rhythms around the musician. In letter C I looked to a device I first used in *And the Vultures Started Circling* of oscillating pitches fading in and out of focus to develop rhythmic interplay and reference the dense polyrhythms that characterise faster Cuban styles such as *son*.

[58] Thomas Adès, *Tevot* (London: Faber, 2007).

The following section further unveils themes of the piece's conclusion, increasing activity and interplay through coordinated hit points and introducing the first solo material. As with jazz, soloing is common in Cuban music. Alongside a notated solo, I increased performer agency by including a boxed pitch set that the performer is directed to use for improvising.

Letter E marks an evolutionary advancement in this piece's narrative. As a pianist, the *son montuno* style's characteristic piano *guajeo*s have always attracted my interest. Performing a similar function to rhythm section comping patterns in jazz, the arpeggiated chords that comprise *guajeo*s allow harmonic and rhythmic material to be communicated in a supportive role. *Guajeo*s will traditionally interact with the *clave*; the rhythmic 'key' that bonds the various rhythmic components of a Cuban band together. The Dominican pianist Michel Camilo's piano *guajeo*s that accompany Horacio Hernández's drum solo in *Hurry Up and Wait*[59] informed the initial piano writing at this point. However, where Camilo's composition remains in $\frac{5}{4}$ during the *guajeo*, this section in *Rhythmic Extrusion* features an ambiguous, perpetually-shifting metre while retaining a strong sense of pulse. The rhythms in the opening of this section are almost attempting to 'find' the *clave*; the inconsistent pattern played on the claves by the second percussionist from bars 193 to 204 references the popular *2-3 son clave* (Figure 22) but rather than settling into an ostinato it explores various configurations of beat placement in its attempt to 'lock in' with the piano *guajeo*.

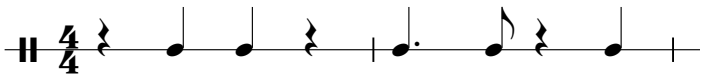


Figure 22: *2-3 son clave* pattern.

The following section expands on a homophonic device I explored in *Inside Out* whereby blocks of sound with contrasting timbral combinations lurch between one

[59] Michel Camilo, "Hurry up and Wait," *Spirit of the Moment*, Telarc Jazz, 2007, CD.

another, generating pace and momentum. Inspired by the relentless energy of Tito Puente's timbales solos, this section drives the piece through to the final main section where all the themes from the previous ten minutes culminate. The $\frac{12}{8}$ 'bell pattern' (Figure 23) used in letter G references the West African compound time *bembé* rhythm to which many elements of the syncretic Afro-Cuban style are closely related.[60] Small cluster chords on the piano are used in place of high and low cowbells that would traditionally play a 'bell pattern'. The piano, used percussively in this section, is the main rhythmic force, giving the percussion instruments space to explore the groove. The 'wailing' gesture appears once again, this time as a prominent solo from the horn before the whole ensemble employ staccato stabs to announce the piece's culmination of energy. After a ten-second pause, I included a short coda that frames the piece's evolutionary journey and features a condensed summation of the main themes of the composition.

Figure 23: *Bembé* pattern.

[60] Peter Manuel and Orlando Fiol, "Mode, Melody, and Harmony in Traditional Afro-Cuban Music: From Africa to Cuba," *Black Music Research Journal* 27, no. 1 (2007).

Summary of Acoustic Works

Upon completing the remainder of the pieces in this portfolio, I returned to the first piece, *And the Vultures Started Circling*, to examine emergent traits of my compositional style. In many ways the string quartet begins to reveal creative themes that I investigate in increasing detail throughout the portfolio. Aspects of jazz harmony, tension and energy are explored in the writing; ideas that are re-examined from different angles in later works. *Had you Done So Before, Perhaps You Would Still Be Free* facilitated the beginnings of improvisational examination and along with it, the application of modal theory. *Inside Out* allowed me space and scale to explore the relationships between sections of the big band, enabling interplay to flourish and new compositional techniques to emerge in the process. The themes of 'disrupting the traditional' that I explore in this piece made the title seem an obvious decision whilst retaining the whimsical sense of character that I feel this piece embodies. *Rhythmic Extrusion* provided an investigation into the 'rhythm of jazz' accompanied by an Afro-Cuban backdrop.

Looking at theoretical approaches throughout composing these works directed me towards computational methods for aiding the further application of jazz techniques and traditions to new music. I decided that in order to move forward, live electronics could provide opportunities for even further exploration in this area. While improvisation and performer agency are explored within these acoustic compositions, I felt at this point in the folio that I wanted to develop these themes further, as it can be argued that they are a necessity for a jazz.[61] Moving towards live electronics allowed interaction not just between ensemble members but engagement between human performer and machine; facilitating further investigation into applying the genetics of jazz to new music.

[61] Philip Alperson, "A Topography of Improvisation," *The Journal of Aesthetics and Art Criticism* 68, no. 3 (2010): 280.

3 Electronic Works

Numeration (2020) – cello & live electronics

Giant Steps (2020) – percussion trio & live electronics

Murmeration (2021) – tenor saxophone & live electronics

You'll Hear It (2021) – solo melody instrument & live electronics

This chapter is comprised of compositions connected through their use of live electronics. *Numeration* explores granular synthesis, combining research of Xenakis with diatonic modal theory abundant in jazz. *Giant Steps* uses live electronic processing to explore ways within which an unpitched percussion ensemble can fully perform a jazz standard. *Murmeration*, for tenor saxophone and electronics explores the theme of *dialogue* in jazz using live sampling and the final piece, *You'll Hear It*, features an electronic system that identifies patterns and rules within a live improvisation and responds accordingly, mimicking the style of the improviser while simultaneously introducing novel material to the performance.

Not Proper Jazz

Compared with electronic advancements in contemporary classical composition throughout the 20th century, the proponents of jazz initially displayed relatively little interest working with electronic media; one argument being that jazz's dependence on improvisation in live performance was inherently incompatible with early fixed electronic media such as magnetic tape.[62] Lennie Tristano, one of the few jazz musicians in favour of utilising electronics before the jazz fusion developments of the 1970s, discussed the stigma surrounding the question of authenticity in his electronically-manipulated jazz in

[62] Thom Holmes, "The Roots of Electronic Jazz, 1950–1970," *Jazz Perspectives* 10:2-3 (2017): 208.

an interview with the *DownBeat* journalist, Nat Hentoff: “One of the people who got so hung up on the subject was Leonard Bernstein. … Bernstein finally decided it was a multiple track recording. He couldn’t stand to believe it wasn’t”.[63] While Tristano explains he intentionally never provided a definitive answer in order to encourage people to enjoy listening rather than dissecting electronic methods, Bernstein’s frustration with his supposed use of multitracking on a jazz record illustrates a social incompatibility between electronics and jazz that has pervaded much of their coexistence throughout the past century.

Aside from outlying examples such as Tristano’s work, jazz and electronic music rarely interacted until the advent of jazz fusion in the 1970s. It can be argued that at this turning point in jazz’s history, the use of electric instruments and effects permeated jazz fusion so comprehensively that renaming the style ‘electric jazz’ would provide a more accurate categorisation.[64] Herbie Hancock was famous for his incorporation of both electric instruments such as the synthesizer alongside liberal application of studio techniques including reverb and delay, for example in his 1973 jazz-funk album, *Head Hunters*.[65] Miles Davis’ experimental albums *Bitches Brew*[66] (1970) and *On the Corner*[67] (1972) were influenced by Stockhausen’s tape manipulation techniques,[68] however these were employed in the editing phase by the producer, Teo Macero, and only after the musicians had recorded the albums. In his autobiography, Davis explains his incompatibility with computers at this time in his career while discussing collaborative methods with guitarist John Bigham: “He writes off a computer, and when he starts trying to explain his shit to me, he loses me talking all them technical computer terms.”[69]

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[63] Nat Hentoff, "Multitaping Isn’t Phony: Tristano," *DownBeat*, May 16, 1956, 11.
[64] Jens Jørgen Gjedsted, "Electric Jazz," *Fontes Artis Musicae* 30, no. 3 (1983): 132.
[65] Herbie Hancock, *Head Hunters*, Columbia, 1973, LP.
[66] Miles Davis, *Bitches Brew*, Columbia, 1970, LP.
[67] *On the Corner*, Columbia, 1972, LP.
[68] Paul Tingen, "The Most Hated Album in Jazz,” 2007, accessed 20 Dec, 2022, https://www.theguardian.com/music/2007/oct/26/jazz.shopping.
[69] Quincy Troupe and Miles Davis, *Miles, the Autobiography* (New York: Simon and Schuster, 1989), 389.

The late 1970s saw some jazz musicians increasingly adopt electronic systems, whether that be the use of electric instruments, electronic effects applied to their acoustic instruments, or a combination of both techniques. Ornette Colman's 1977 free jazz studio album, *Dancing in Your Head*,[70] used two electric guitars, two electric basses, two drummers alongside Colman on the saxophone; the majority of the performers playing an electric instrument. When Miles Davis released his 1986 album, *Tutu*,[71] he made extensive use of drum machines and synthesizers; a departure from tradition that divided reception.[72] Elsewhere, the definition of jazz was being further tested as styles such as nu jazz and acid jazz rose to prominence throughout the 1980s and 1990s. These styles often sampled existing jazz recordings and rarely included traditional jazz musicians in their band line-ups.[73] In response to the cultural diversion towards reliance on electronic sounds that jazz appeared to be taking, the 1990s saw a conservative movement of traditionalist jazz musicians attempting to revive the pre-fusion practices.[74] Wynton Marsalis looked to the New Orleans big band tradition of the early 20th century as a focal point for his music and staunchly avoided incorporating electric instruments such as the bass guitar in his band.[75]

Definitions of jazz became increasingly divergent, and some jazz musicians went beyond the established use of electronics to enhance human performance and began inventing systems that could *create* jazz. The later part of the 20th century heralded a new type of jazz musician: the programmer. These practitioners can be defined through their presentation the electronic component of their creative output possessing the

[70] Ornette Coleman, *Dancing in Your Head*, Horizon, 1977, LP.
[71] Miles Davis, *Tutu*, Warner Bros., 1986, LP.
[72] George Cole, "How Miles Davis Made Tutu," 2021, accessed 11 November, 2022, https://www.jazzwise.com/features/article/how-miles-davis-made-tutu.
[73] Bands such as *Jamiroquai, The Brand New Heavies* and *United Future Organization* were some of the more famous exponents of the nu jazz and acid jazz scenes of the 1980s and 1990s.
[74] Shipton, *A New History of Jazz*, 605.
[75] Ibid., 716.

primary point of interest. George Lewis' 1987 software, *Voyager*,[76] is an early example of an electronic system that can both respond to live stimuli and demonstrate independent behaviour,[77] and served as a starting point for the research to be conducted in *You'll Hear It*. *Voyager* is designed to respond to improvisation, creating clusters of virtual instruments that react to either a microphone or MIDI input. Inspired by, but diverging from, the objectives of Lewis' work, *You'll Hear It* has a focus on a clinical precision in its processes for analysis and improvisation.

Voyager is regarded by Lewis as a *player* rather than an *instrument*.[78] Lewis' analysis of the role of the *Voyager* system as an independent agent (player) rather than a passive, response-driven system (instrument) directed me to question the role of electronics in my work, in particular regard to agency:

> I conceive a performance of *Voyager* as multiple parallel streams of music generation, emanating from both the computers and the humans – a nonhierachical, improvisational, subject-subject model of discourse, rather than a stimulus/response setup.[79]

Numeration, *Giant Steps* and *You'll Hear It* present the electronic systems as a component of the ensemble aggregate and thereby an independent agent whereas the computer's role in *Murmeration* is as an extension of the saxophonist's agency. In all four of these pieces, there is a bias towards the 'unexpected' from the electronics which strengthens throughout the chapter. *You'll Hear It* represents the highest degree of

[76] George E. Lewis, *Voyager* (1987), computer software.
[77] "Too Many Notes: Computers, Complexity and Culture in "Voyager"," *Leonardo Music Journal* 10 (2000): 33.
[78] Ibid., 34.
[79] Ibid.

agency from the patch as there is no preconceived patch instruction: the patch relies entirely on 'listening' to the performer in order to respond.

My aim in creating *You'll Hear It* was to construct a system that allowed the work to develop in real time rather than that found in the recent work from The Georgia Tech Centre for Music Technology's jazz robot, Shimon (2016),[80] which is able to create a novel performance by first repeating a phrase improvised by a human, then expanding upon the stimulus, generating new material.[81] The system has been trained using a corpus of historical jazz solo transcriptions. When listening to Shimon improvise in an ensemble, it can be hard to differentiate between material that is reactive to live stimuli and material that is informed by prior analysis of existing jazz solos. This is perhaps a strength of the system as creativity in jazz can be argued to require both a performance that is novel to the individual but also that which is based upon existing elements; a tradition or culture.[82] However, if there is nothing audibly novel from a machine performance that uses historically-informed improvisatory grammar, it could be argued that the system appears unresponsive to live stimuli; only generating material based upon what it 'knows' prior to the performance as opposed to responding to live material.[83] My research departs from aforementioned examples of similar research as *You'll Hear It* begins each performance by 'knowing nothing' and constructing its understanding of improvisation only upon that which it experiences during the performance itself.

[80] The Robotic Musicianship Group at Georgia Tech Center for Music Technology, accessed Dec 18, 2022, https://www.shimonrobot.com/info.
[81] Georgia Tech Centre for Music Technology, "Shimon Zoozbeat Monk Coltrane Short," 2016, accessed Jan 5, 2023, https://www.youtube.com/watch?v=FEpQwi0Pgvw.
[82] P.N. Johnson-Laird, "How Jazz Musicians Improvise," *Music Perception: An Interdisciplinary Journal* 19, no. 3 (2002): 420.
[83] Ethan Hein, "Computer Improvisation," 2013, accessed Jan 2, 2023, https://www.ethanhein.com/wp/2013/computer-improvisation/#more-8712.

The most recent example of a system that responds to live, improvised input from a performer is the project *Jazz as Social Machine*,[84] currently under development by Dr Thomas Irvine. The system attempts to recreate music that, using AI machine learning, attempts to sound like jazz.[85] In contrast to this research, *You'll Hear It* attempts to create music that sounds like the performer, whether that original performance 'sounds like jazz' or not, but has its methodological origins in that of jazz improvisation. *Jazz as Social Machine* analyses recorded jazz repertoire and generates material that is informed by existing material whereas *You'll Hear It* only analyses what has been created during the performance itself, which connects to the title's theme of only understanding something when it is required.

Stochastics vs. Informed Decisions

When improvising as a performer, I prioritise actively listening to other ensemble members to inform my own creativity. This forms the foundation of a musical dialogue; the development of ideas through interaction and is an integral component of jazz. By the very nature of electronics not being able to think creatively, this artistic obstruction provided a challenge in regard to improvisation objectives. There are many times in my compositions where the electronics appear to act creatively. While the patch is always strictly following a set of pre-defined rules, an objective I set myself was to create an electronic system that sounds as organic in performance as human musicians. To help the patch succeed in this 'musical Turing Test' I approach spontaneously generated electronic data via a number of methods. Stochastic processes instruct the patch to select data such as pitches from within defined parameters. These parameters can be adjusted over time, enabling a carefully evolving soundscape. Alongside these proactive methods, there is the capability for a patch to react to the performer's actions. Music can

[84] Dr Thomas Irvine, *Jazz as Social Machine* (ongoing), computer software.
[85] Ibid.

be played, analysed and an original electronic response rendered all within a handful of milliseconds, creating a seemingly instantaneous response to the acoustic stimulus. A combination of proactive and reactive processes provides the illusion of creativity from the patch and serves to create an immersive, cooperative experience for performers.

Electronics has the unique characteristic of being exact, sometimes too exact. As a result, time is often invested in making electronics sound approximate and therefore more organic.[86] While I have often aimed for a vagueness within elements of my patches, I have also attempted to creatively apply the precision with which an electronic system can achieve with ease that which is impossible for a human performer.

The dataflow software Pure Data[87] provided the platform for creating the electronic component of these compositions. The simple, 'lo-fi' interface displays programming information through blocks and lines making it intuitive to write and debug. I had extensive experience using the software before starting the pieces in this folio and its open source, free access greatly aids future performances.

[86] Pitch-drift in synthesisers and intentionally-imprecise beat placement in drum machines are common examples.
[87] Miller S. Puckette, *Pure Data*, version 0.49-1 (2018), computer software.

Numeration (2020)

Autumn in Old York

Inspiration for this piece came from the opening phrase of Vernon Duke's *Autumn In New York*.[88] I wanted to explore ways in which the opening few seconds of a jazz standard could be the framework for around ten minutes of new music. Using as much detail as possible from the opening four bars, I created a scaled-up timeline that would be used a map for my piece. Each bar would become a section and the melodic shape within a bar would inform that section's character and themes. Duke's harmony, and the appropriate modes derived from a jazz interpretation of the chord sequence, would provide a large component of the electronically-synthesised material while a famous Billie Holiday recording[89] of the same part of the song would become a sample from which the electronics would deconstruct and reassemble thousands of extremely small fragments through granular synthesis.

This piece tells a story of transformation. The paradigm of something electronic being derived from natural origins is inverted, creating an evolutionary path from synthetic to organic. Early drafts achieved this by the live electronics playing a lighter role as the piece develops but I later decided this piece should be observed as a duet and as such, both cellist and computer would share roles throughout, both guiding the narrative with equal responsibility.

Through a host of electronic processing techniques, the piece would tell a story of words being born from synthetic origins. The opening section, *Descent*, comprises only synthetically rendered content. *Ascent* begins to introduce formative vocal gestures and culminates in a barrage of heavily-veiled vocal grains projected at the audience. Agency is reversed as the cello takes the initiative through the third part, *Stasis*, to unveil the

[88] Duke, "Autumn in New York."
[89] Billie Holiday, "Autumn in New York," *Billie Holiday*, Clef Records MG C-161, 1954, 10-inch LP.

thirteen-second Billie Holiday sample in its entirety for the first time in the piece, albeit extruded over a two-minute window. Finally, *Quiet* granulates fragments of the sample and renders them in bursts of their original order; presenting the listener with hints of whole words. I wanted the piece to feature a semblance of genuine interplay found abundantly in jazz ensembles. At times the cello is reactive, mimicking fragments of spontaneously-rendered electronic content, while during other sections, such as in *Stasis*, the patch responds to the improvised cello part, giving the performer control over the speed at which the section proceeds. The timeline model for mapping the piece (Figure 24) is initially used precisely, with millisecond-precision facilitated by the electronic interface. As the piece advances and the balance of agency is skewed more heavily toward the cello the precision relaxes, allowing the pacing room to breathe and interplay between the 'duet' to become more organic.

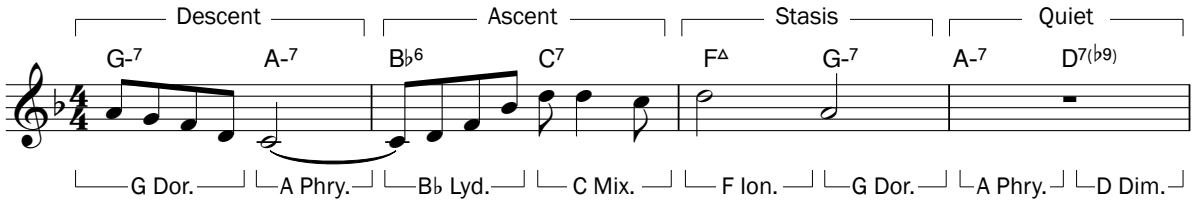


Figure 24: Opening segment of *Autumn In New York* with analysis required for *Numeration*. Modes are: G Dorian, A Phrygian, Bb Lydian, C Mixolydian, F Ionian, G Dorian, A Phrygian, D Diminished (half-step/whole-step).

One pedagogical tool in jazz improvisation is to select pitches from a harmonically-dictated mode.[90] Using live electronics, I wanted all seven pitches from a diatonic mode to be selected and rendered in quick succession to form pointillistic washes of sound, which I describe as modal aggregates. Jazz critic Ira Gitler's description of John Coltrane's virtuosic scalic passages as "sheets of sound"[91] first inspired the design of modal aggregates in *Numeration*. As the time interval between each pitch is decreased to a few milliseconds, the individual 'grains' of sound become increasingly unrecognisable as discrete pitches and the monophonic onslaught becomes a blur. The

[90] Mark Levine, *The Jazz Theory Book* (Petaluma, CA: Sher Music, 1995), 33.
[91] Ira Gitler. Liner notes for *Soultrane*, by John Coltrane. Prestige Records, 1958, CD.

composition carefully introduces the concept of accelerating the modal aggregates to guide the audience's ear through the process, allowing unique characters of each mode time to be fully explored.

The majority of the modes used within the opening four bars of *Autumn In New York* use the same pitches; G Dorian, A Phrygian, Bb Lydian, C Mixolydian and F Ionian are all comprised of the pitches G, A, Bb, C, D, E and F. When the pitch order is randomised and rendered by the electronics, turning the mode into a simple pitch set, there is no discernible difference between one modal aggregate and the next. To create a contrast between points in *Numeration* that reference modes from *Autumn In New York* I decided to transpose the modes so they all start on F. The audience's ear becomes accustomed to the pitched consistency of one aggregate and thus an advancement to the next mode in the sequence generates a shift in character.

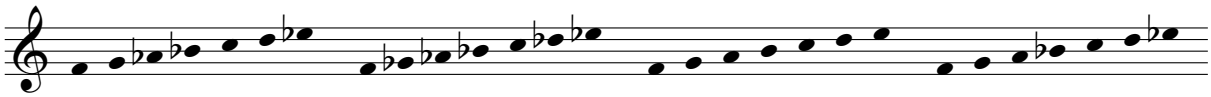


Figure 25: The modes used in the first half of *Numeration*: F Dorian, F Phrygian, F Lydian and F Mixolydian.

Numerating

When employing granular synthesis in my piece I was mindful not to create the typical 'granular synthesis sound' a listener might expect when encountering the technique. For guidance on the treatment of live instruments and electronics I first looked at the original granulation processes pioneered by Xenakis in his piece for nine strings instruments and tape, *Analogique A et B*.[92] Part A, for strings, introduces the listener to the themes and timbres that are then heavily granulated by the solo tape entity in part B. I was drawn to the duality of 'performance units' in this piece trying to communicate with one another and form a dialogue. This inspired *Numeration* to become a piece with a character comprised of opposites: the acoustic communicating with the electronic, 'descent'

[92] Iannis Xenakis, "Analogique a Et B," Salabert, 1959.

followed by ‘ascent’, languid romantic melodies from the cello contrasted with staccato attacks from the patch.

By building the granulation system rather than using a premade granulator I maintained artistic control over the precise treatment of grains and was able to manipulate the processes as required. Maintaining the narrative trajectory of synthetic to organic, the first half of the piece uses sine waves played at the correct frequency to generate pitches within modal aggregates whereas the second half uses more natural sound sources for granulation. Alongside using the Billie Holiday sample, I transcribed the opening four bars of the recording and adapted it for the cellist to record in multiple layers. Both the original Holiday sample and the cello adaptation of the same material is used extensively in the improvised third section where grain clouds are triggered by the cellist’s actions. The transcription and adaptation are on the following two pages.

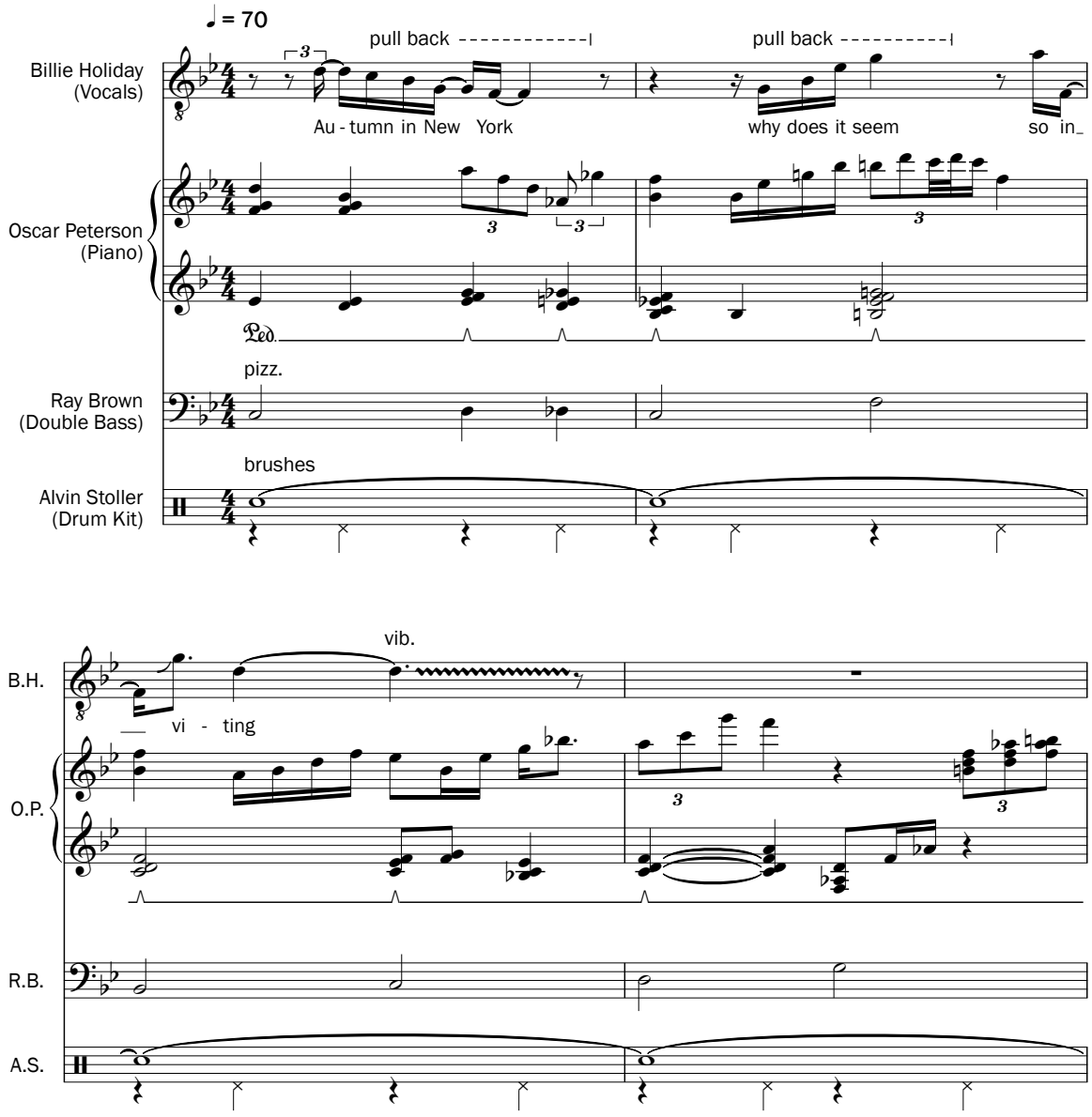


Figure 26: My transcription of the opening four bars of *Autumn In New York*.[93]

[93] Holiday, "Autumn in New York."

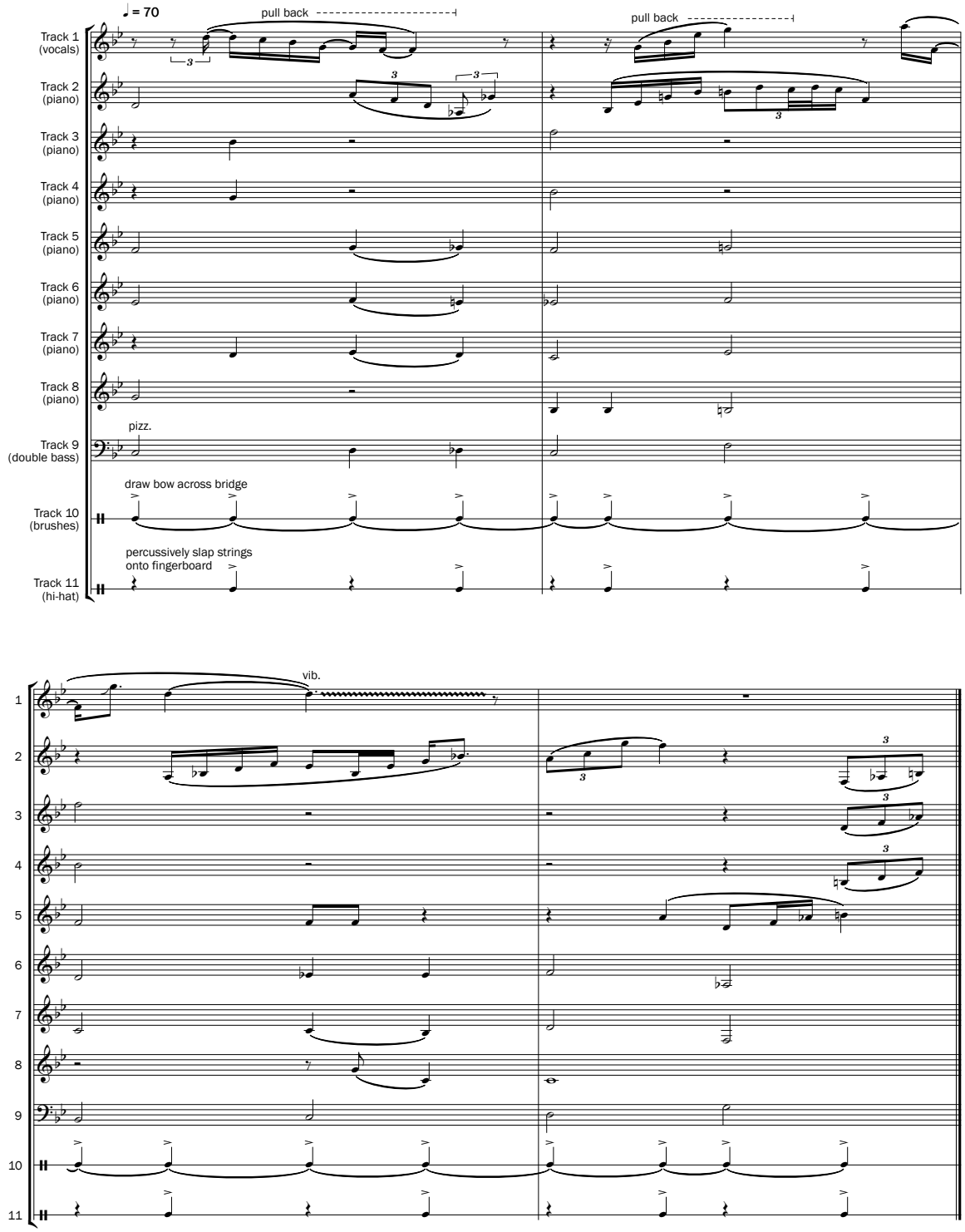


Figure 27: My eleven-cello adaptation of the opening four bars of *Autumn In New York*.

The adaptation of the vocal line was played freer than the rhythm section's, with less emphasis on strict time and the track being placed higher in the mix. For the piano material, the cellist was instructed to play arco, harshly attacking each note followed by an immediate diminuendo to simulate the decay of piano strings. Most gestures were

recorded separately and rhythmically quantized during the editing stage to secure the meticulous beat-placement required to resemble a single musician playing many notes at once. For the double bass adaptation, the cellist played pizzicato which was electronically transposed an octave lower after recording. The hushing sound of brushes on a snare drum was recreated by instructing the cellist to draw the bow across the bridge. A slight lean into the bridge on each crotchet enhanced the reciprocal effect of brushes repeating their cycle across the drumhead. The taut attack of the hi-hat became a brisk pressing of the strings against the fingerboard, creating the desired snapping sound.

The recorded cello adaptation is used alongside the original Billie Holiday sample in the third section of *Numeration* where pairs of grains, one from each of the two samples at the same location, are sequentially repeated at a steady tempo. Each time the cellist plays a note the playback location advances a very small amount along the track's length. The result is a ricocheting effect that displays a clear interaction between the cellist and patch and, in contrast to earlier sections, marks the first time the cellist has agency over the piece's progression. Alongside this process I sought to apply an interpretation of the vocal energy created in Francesconi's work for soprano, chamber orchestra and live electronics, *Etymo*.[94] In the opening minutes, the soprano's abrupt utterances are peppered with heavy delay and reverb effects, among many other processing techniques. The chamber orchestra compliment the voice with similar pulsating staccato gestures. To pay homage to this dense maelstrom, I created a system that randomly selects an extremely short vocal sample of Billie Holiday's recording each time the cellist plays a pizzicato note. The patch plays the vocal sample instantaneously, merging the forces and giving the performer autonomy over both cello and vocal sounds in a wholly improvised space.

[94] Luca Francesconi, *Etymo* (Milan: Ricordi, 1994).

In composing this piece one of the many challenges was to explore ways in which the vocal sample could be manipulated from different angles to 'reveal' words as the piece progresses. The first fragments of vocal content subtly emerge in the second section, *Ascent*. Initially, millisecond-long grains from the are Billie Holiday audio sample are rendered in rhythmic unison underneath the electronically-generated pitches. As the section proceeds, a band pass filter[95] applied to the vocal grains blends the material with the pitches of the modal aggregate and a gradual fade-in allows the vocal fragments to organically evolve out of, and eventually diverge from, its electronic counterpart. Toward the end of the section, the vocal sample processing and modal aggregates diverge from each other, and the cellist, in an escalating battle; the respective tempi and volumes violently fluctuate and lose all rhythmic synchronicity all the while accelerating. The band pass filter is steadily widened, allowing frequencies outside the original parameters to come to the fore. Grain lengths and individual grain playback rates are increasingly randomised over a broadening range, contributing to the developing frenzied character of the section. The electronic modal material transforms into a wash of white noise, responding to the vocal excitement and generating a cacophony of pitches to heighten the tension. As the section concludes, the modal grain clouds begin to rise and fall in register, referencing the ebb and flow of the cello glissandi at the start of the piece. As the pinnacle of *Ascent*'s excitement unfolds, all amplified signals, electronic and acoustic are suddenly processed by an extreme reverb. The hive of activity vanishes beneath the reverb; the residual sound a long decay into silence. Stockhausen's *Mikrophonie I*[96] and *Mixtur*[97] use ring modulators to create a reverberant 'echo chamber' that inspired the 'freeze and fade' process in *Numeration* which, through its further use in *Giant Steps* and *Murmeration,* became a hallmark of my compositional voice in live electronic writing.

[95] The band pass filter initially allows frequencies very close to 300Hz through; all other frequencies are attenuated.
[96] Karlheinz Stockhausen, *Mikrophonie I* (Universal Edition, 1964).
[97] *Mixtur* (Universal Edition, 1965).

To create a section described as quiet, I decided to examine ways in which 'quietness' could be interpreted. Fading out the volume level seemed too prosaic an interpretation; I instead chose to 'quieten' other forces as the section proceeds. The contrast in timbre between the cello and patch lessens as grain playback speed is equalised to create less variety in timbre and pitch. The section begins rhythmically chaotic; volleys of grain clouds cascade from the voice and cello samples, lurching violently between both tempo and volume levels. As the section stabilises, a calm, steady pulse is established, quietening the activity before the final gesture; a coordinated pizzicato note, the placement of which is chosen by the cellist.

Performance and Logistics

As with the majority of electronically-processed live music, an acoustically dry performance space is ideal for this piece. The patch outputs a stereo signal that should be sent to speakers widely spaced either side of the cellist to maximise the spatial effect. The cello requires a microphone[98] for both amplification and sound processing. The cellist and computer monitor are required to face one another in the performance, perpendicular to the audience in the centre of the stage. This creates a visual representation of the musical dialogue between performer and electronics and references the jazz tradition of ensemble interplay. I experimented with the performance featuring the computer being wheeled on from the opposite side of the stage at the same time as the performer enters but in practice this was logistically too difficult and it made much more sense to have a computer screen and microphone set up ahead of the performance.

As *Numeration* does not require an engineer to trigger components of the patch during the performance, an intuitive interface was essential for communication between performer and patch. The performer can easily input data to the patch through a MIDI

[98] This should be a purpose-built cello microphone to minimise the possibilities of audio feedback.

controller or microphone signal, but the patch should be able to relay extra-musical information back to the performer, much like the requirement of physical communication between two musicians. In order to synchronise the many pre-determined and improvised events in the piece I used a method known in the film score recording industry as using 'streamers and punches'. Similar to a loading bar, a vertical line scrolls across the screen representing performance progress and highlighting event transitions (Figure 28). Numbers illuminate at the end of the streamer animation to communicate a change of material on the score. For example, the number illuminated during the *Ascent* section dictates the mode number the performer should reference on their score for their improvisation.

Figure 28: Streamer interface used for coordinating section lengths.

Departing from previously-established notational themes in this portfolio, I decided to create a 'lead sheet' style score aesthetic for *Numeration.* This allowed me to creatively explore ways in which the performer and live electronics could develop a dialogue.

Identifying Patterns

All of my compositional work until this piece possessed two characteristics that were starkly different from *Numeration*. The pieces prior to this were mostly notated and did not use live electronics. Through writing this piece I noticed there were defining features of my emergent compositional style that endured even after such a marked shift in methods. The most profound of these features was a developed form of the 'oscillating gesture' used liberally in the first four compositions in this portfolio (Figure 29). The use of this gesture links to another theme of previous compositions in this portfolio; gradually

unveiled material. *Numeration* has themes of unveiling 'the voice' and pieces later in the portfolio also displayed similar themes.

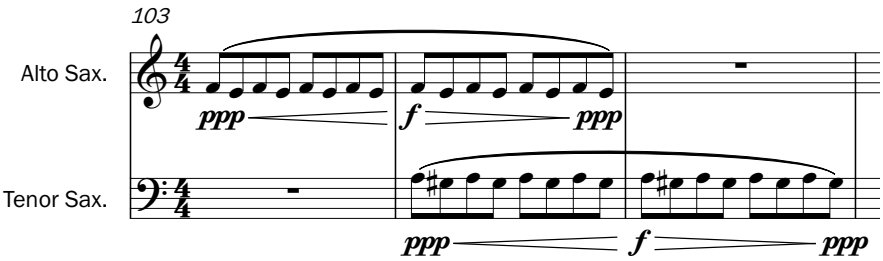


Figure 29: Oscillating gesture in *Inside Out*.

Figure 30: Waveform of the opening ten seconds from the live electronics.

Where I had used modal improvisation in my previous work, I looked to use this piece to further explore how modes can be used as the foundation for pitched decisions. In the *Ascent* section the patch improvises[99] using pitches from the Lydian and Mixolydian modes. In order to reference the melody in the map for this section, I decided to create new modes that would be based upon each of the melody's pitches that the cellist would use as the starting point for their improvisation.

I decided the modes used in *Ascent* would be built from the pitches within the harmonic series above the starting pitch. For example, the first note in the map of *Ascent* is a C (Figure 31), which means the mode used at the start of *Ascent* is built from the pitches within the first eleven harmonics above C, approximated to the nearest semi-tone within equal temperament. After omitting octave duplications, the remaining pitches create a mode of seven notes; the same number a jazz musician would use to diatonically improvise over a chord. To present the mode to the performer, I arranged the pitches in ascending order; the fundamental harmonic taking its place as the lowest

[99] I explored whether a computer's random decisions can be defined as improvising in my final piece in this portfolio, *You'll Hear It.*

pitch in the mode (Figure 32). The performer is instructed to treat the pitches that occur earlier in the mode with more importance than those that occur later. While available pitches are determined by a mode the remaining elements of improvisation such as rhythm, dynamics and articulation are left entirely to the performer's discretion. The modal advancement when this time interval elapses is governed by the patch and communicated to the cellist through a streamer and punch within the patch interface. As the map represents a timeline of ten minutes, each mode for improvising in this section lasts exactly eighteen seconds.

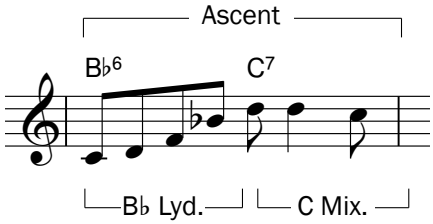


Figure 31: Map for *Ascent* section.

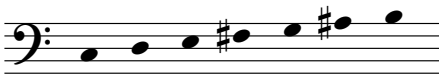


Figure 32: First mode used for improvisation in *Ascent*.

Numerated

Reordering information is a recurrent theme of this piece. This process provided the title *Numeration* from the longest possible English anagram of *Autumn In New York*. The process of numeration means "assigning a number to something"[100] which references how the electronics patch interacts with musical content throughout the piece. In creating this piece, I discovered other avenues for exploration within which the conventions of jazz could interact with live electronics to create new music.

[100] *The Oxford Dictionary of English*, (Oxford: Oxford University Press, 2017), s.v. "Numeration.".

Giant Steps (2020)

Deconstructing the Drumming

There are a great many drummers that have influenced my personal style in playing the drums. However, if pressed to select one drummer whose influence has had a more profound effect than others it would be Elvin Jones. As jazz is an improvised style, imitation is often the primary method of learning and I remember spending many hours in my formative years intensely listening and copying Jones' recordings, attempting to tap into the essence of his playing and what earned it the reverence it holds within the jazz canon. Over the last two decades, I have cultivated an impression of how Jones sounds, and I wanted to create a piece that represents a personal reflection of Jones' playing. It wouldn't sound like Elvin Jones, but rather how Jones sounds *to me*.

The role of the drummer cannot be singularly defined; it can be supportive, reactive and assertive within the same piece. As a drummer, I enjoy the ambiguity of my role, as it invites new ideas easily. Jones is credited as being a major force in the development of modern drumming and in particular the role of the drummer;[101] jazz bassist Ron Carter invites us to compare pre- and post-Jones recordings to demonstrate the gravity of Jones' impact in jazz drumming.[102]

Traditionally within most jazz, there are two distinct modes of improvising that a drummer will employ: either supporting the band with consistent cymbal patterns and occasional drum hits (comping) or playing on their own, commanding the direction of the music as they see fit (soloing). Comping can be misinterpreted as playing a repetitive pattern, a 'drum beat', but it is vital that the comping be just as interesting and fluent as a solo.[103] Jazz critic John Fordham describes Jones' rhythmic feel as "joltingly strong, but

[101] Geoffrey M. Curran, "From "Swinging Hard" to "Rocking Out": Classification of Style and the Creation of Identity in the World of Drumming," *Symbolic Interaction* 19, no. 1 (1996): 55.
[102] *A Different Drummer: Elvin Jones*, directed by Edward Gray (Efor Films, 1979), film.
[103] Steve Watts. Interview with Kier Hall. Personal Interview. York, February 2, 2016.

restlessly disassembled and reassembled all over the drums, all the time - like a constant solo, but with an unmistakable underlying rhythm."[104] Jones' playing removed the traditional division between roles of soloist and accompanist: without clear section markers from other ensemble members such as periodically pausing for a drum solo, it can often be difficult to distinguish his soloing from his accompanying. The theme of both solo and accompanying material inhabiting the same musical space became inspiration for instrumental roles within my piece not being clearly defined at any particular moment. Jazz author and close friend of Jones, Dan Sabanovich, writes that "Elvin's complex, ever-changing style could at times be compared to a wall of sound, which seemed as if two or three drummers were playing at once."[105] This particular analysis guided me to writing this piece for a small percussion ensemble.

In order to fully understand creative language used to improve, it is necessary to transcribe and analyse examples from existing repertoire.[106] To investigate and attempt to quantify the quintessential sound of Elvin Jones, I transcribed fragments of his playing within three of my favourite recordings, each featuring a different style of drumming; medium swing standard comping, upbeat four-bar solos, and fast, hard-bop comping. In order to precisely analyse Jones' playing, I found it necessary to identify the primary and ancillary components of the material. Simply notating when the snare is struck, for example, would not provide the detail required to understand the nuances of snare drum phrasing. I chose to notate the following techniques that can apply to any drum; ghost notes,[107] normal playing, rim shots[108] and accents. Where accents appear above multiple drum voices, they refer to all the voices being accented. Below is my

[104] John Fordham, "Elvin Jones," *The Guardian*, May 20, 2004, accessed Jun 22, 2020, https://www.theguardian.com/news/2004/may/20/guardianobituaries.artsobituaries.
[105] Dan Sabanovich, "Inside the Drumming of Elvin Jones," *Drum! Magazine*, Sep 9, 2013, accessed Jun 22, 2020, https://drummagazine.com/inside-the-drumming-of-elvin-jones/.
[106] P. F. Berliner, *Thinking in Jazz. The Infinite Art of Improvisation* (Chicago: University of Chicago Press, 1994).
[107] The drumstick plays very lightly near the edge of the head: 
[108] The drumstick tip and shoulder strike the head and hoop simultaneously: 

transcription and analysis of Jones' comping patterns within the bass solo of *Foolin' Myself* (from Lee Konitz's 1961 album, *Motion*).[109]

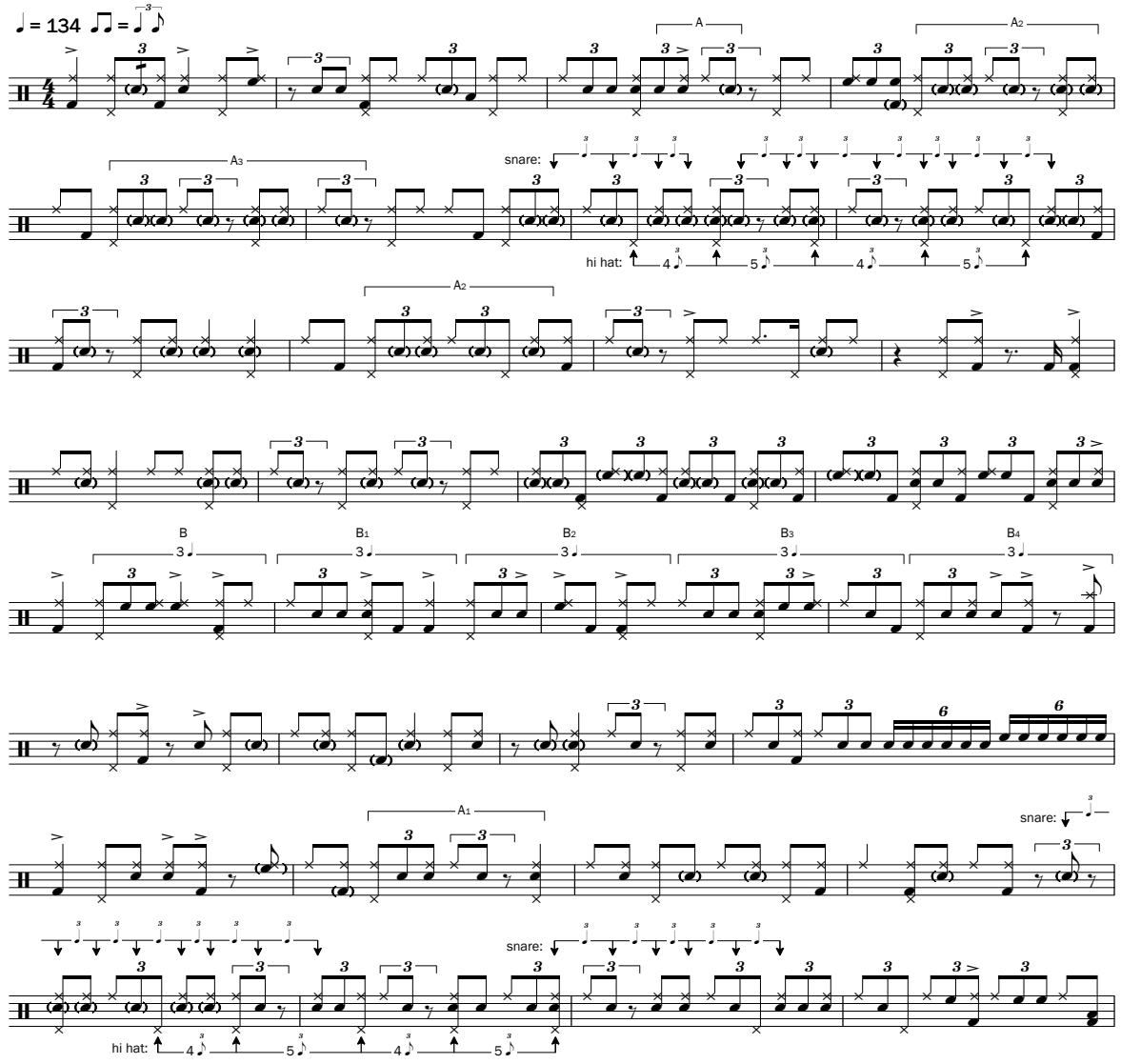


Figure 33: Transcription and analysis of drum part to *Foolin' Myself* (3:53 – 4:50)

Turbulent, off-beat snare patterns, dense polyrhythms and a flowing orchestration around the drum kit characterise Jones' playing in this example. The cell labelled A (Figure 34), mostly starting on the second beat of a bar, demonstrates his unique employment of the "multi-layered complexities of African rhythms."[110] This heavily

[109] Lee Konitz, "Foolin' Myself," *Motion*, Verve Records, 1961, LP.
[110] Mark Stryker, *Jazz from Detroit* (Michigan: Michigan University Press, 2019), 168.

syncopated, additive sequence is combined with a traditional $\frac{4}{4}$ 'jazz-time' pattern on the cymbals to increase polyrhythmic complexity.

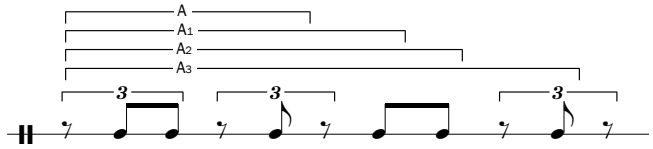


Figure 34: Cell labelled 'A' in transcription of *Foolin' Myself*.

The cell labelled B (Figure 35) demonstrates a three-beat cycle within a quadruple metre. Jones uses a typical jazz-waltz comping pattern within a quadruple metre, disrupting the downbeat feel and briefly creating an illusion of $\frac{3}{4}$.

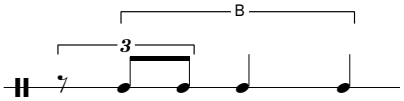


Figure 35: Cell labelled 'B' in transcription of *Foolin' Myself*.

Jones' style was unconventional, and in his earlier years as a professional drummer he received criticism for his unique style.[111] John Coltrane's ensemble allowed Jones to explore his creativity with unbridled autonomy.[112] One of Coltrane's most successful albums, *A Love Supreme*, is considered to be among the most prestigious examples of Jones' playing. In *Resolution*[113] (transcribed below), Jones uses two drumstick techniques for his ride cymbal: playing with the tip of the stick on the top of the cymbal which I notate as  and playing with the shoulder of the stick on the edge of the cymbal, often described as "crashing the ride". As he doesn't use a separate crash cymbal in this passage, I have notated the latter technique as a conventional crash tone:  . After launching into a busy introduction, Jones builds tension by steadily increasing rhythmic complexity. Phrases become longer, interleaving into one another and the

[111] *A Different Drummer: Elvin Jones*.
[112] Ibid.
[113] John Coltrane, "Resolution," *A Love Supreme*, Impulse!, 1965.

driving force of the hi-hat deviates from its steady two-and-four pattern to enhance the syncopation. As in previous examples, Jones disrupts the downbeat with triplet crotchet snare phrases over a consistent ride pattern. Towards the end of the transcribed section, the energy elevates and the drums become a persistent wash, all the while staying in lock step with the other ensemble members.

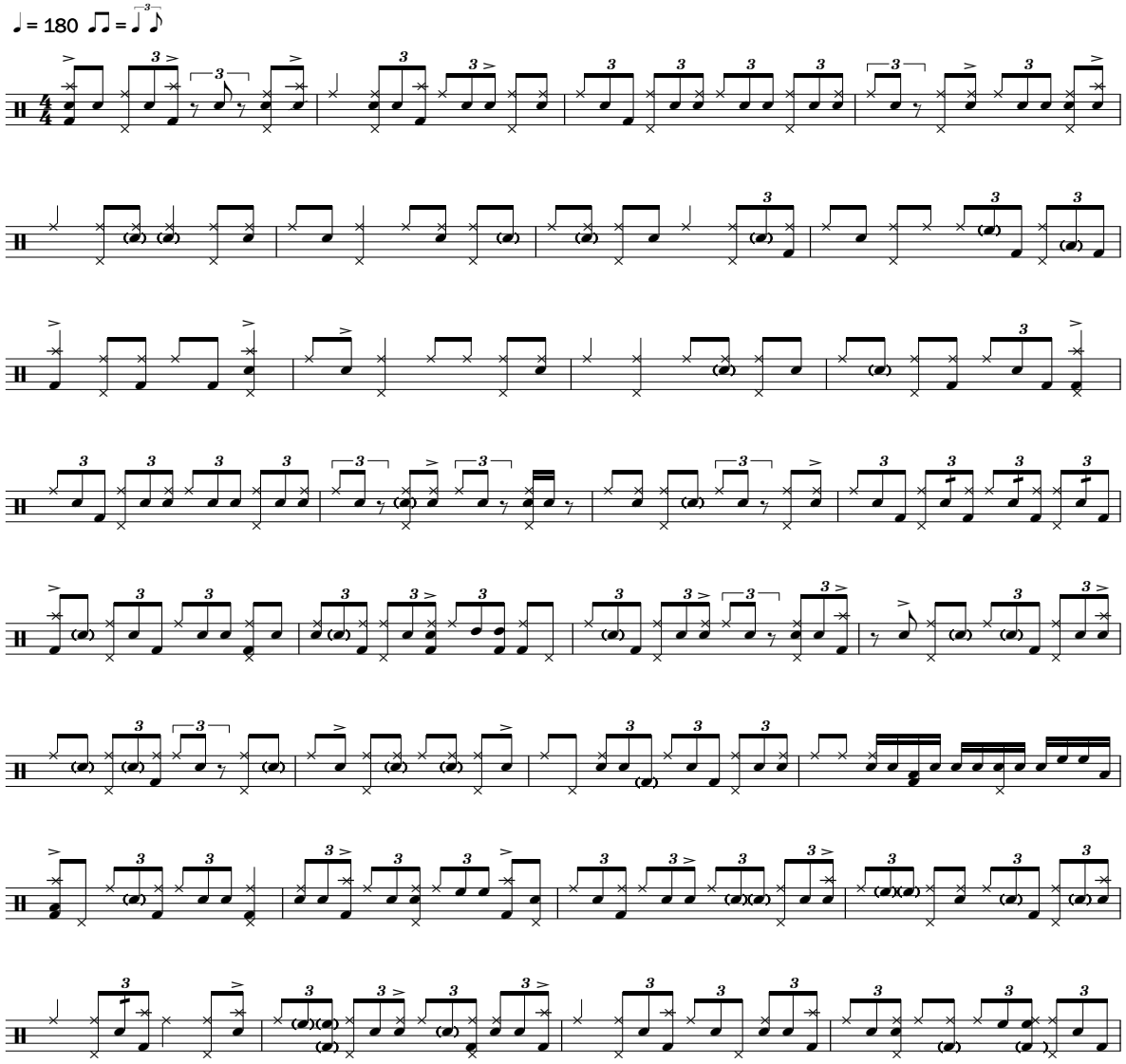
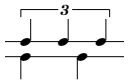


Figure 36: Transcription of drum part to Resolution (3:56-4:39)

In the transcription below of Jones' live performance with Sonny Rollins,[114] phrases lasting three crotchet beats are common. Jones has a "keen melodic instinct"[115] and his solos detailed here demonstrate his deftness in coherently shaping his melodic ideas. As my piece would only use unpitched instruments, creating melodic interest in my percussion writing became an objective for exploration and I used live electronics to generate as much melodic interest as I did rhythmic.

Many of Jones' comping ideas emerge from a 'three against two' polyrhythmic cell:  . This has become a feature of his style and influenced the way in which cells like this could be deployed thematically in my piece. A distinguishing feature of this recording is the band's use of the structural device, 'trading fours'. It is common in small bands for solos to be passed back and forth in quick succession, known as 'trading solos'. These short solos will be a consistent length; two, four or eight bars with the drummer often included as one of the pair of soloists. As 'trading' was such an integral part of Jones' performance identity I wanted to create a way of using this device as a starting point for soloing in my piece; from there extrapolating the theory and generating a new dialogue between the performers and patch. Each set of 'fours' overruns slightly into the start of the next performer's set. This dovetailing of solos was a key feature of Jones' playing that I was keen to employ when creating my piece. Jazz author Alyn Shipton describes Jones' speciality as being able to create "a dense maelstrom of polyrhythms,"[116] and this particular analysis directed me to explore ways of generating a 'maelstrom' in *Giant Steps* that, regardless of polyrhythmic density, always referenced the pulse.

[114] Sonny Rollins, "Four (Live at the Village Vanguard, New York City, Ny/1957 Evening Take)," *A Night At The Village Vanguard*, Blue Note Records, 1957, LP.
[115] Sabanovich, "Inside the Drumming of Elvin Jones".
[116] Shipton, *A New History of Jazz*, 552.

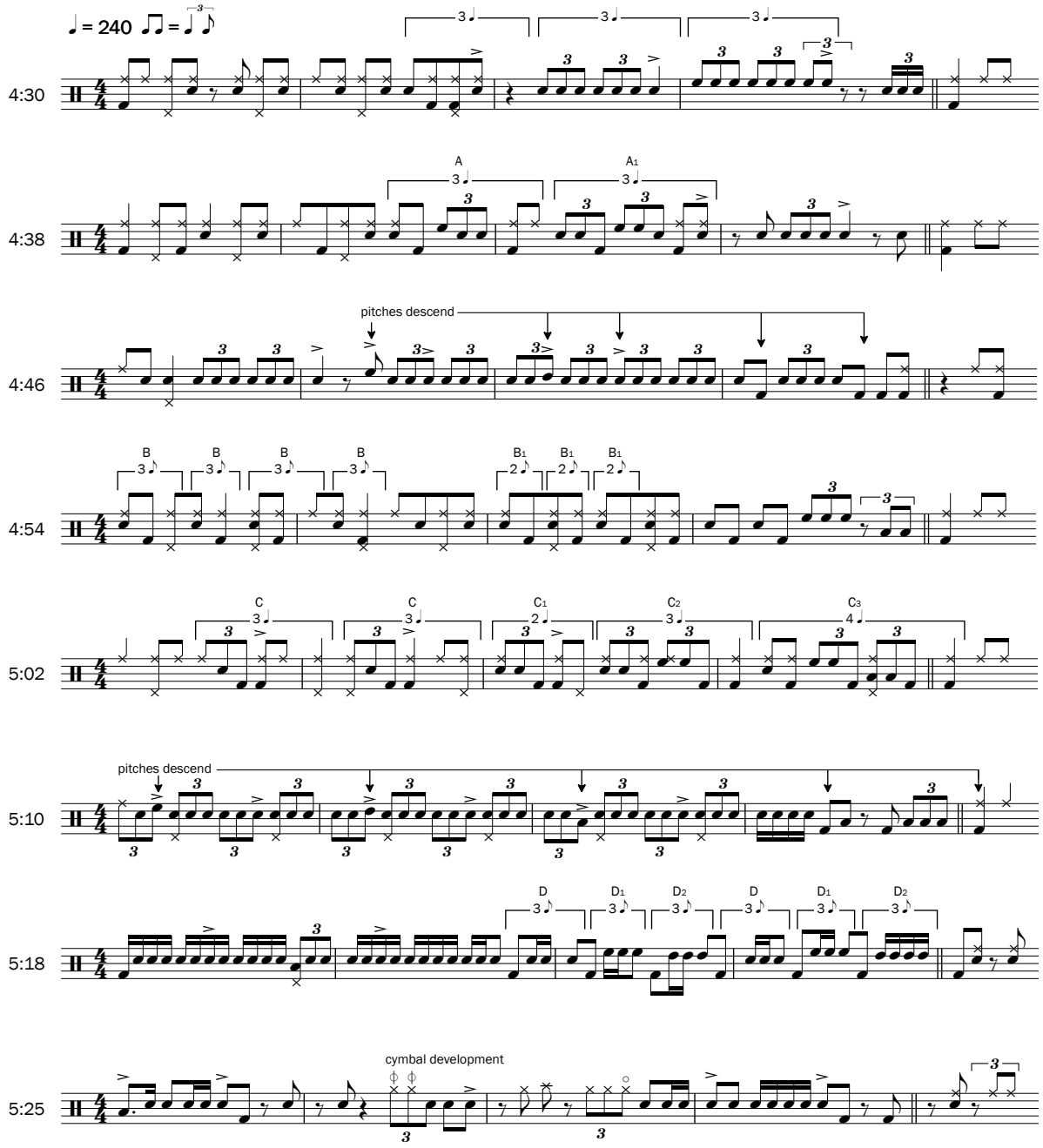


Figure 37: Transcription of drum part in *Four* (4:30-5:29)

Deconstructing the Drum Kit

With a sense of my piece's direction secured, I needed to define how my piece would sound. A jazz musician's repertoire is built of standards; well-known pieces that provide a platform for improvisation. I decided my piece would be an interpretation of a standard: Jones' work with Coltrane in the early 1960s was considered his some of his most

progressive so I used Coltrane's popular composition, *Giant Steps* as the starting point for this work.

Structurally, the performance of a jazz standard will usually consist of the melody, known as the head, followed by a solos section before finally another performance of the head to conclude. The majority of the piece consists of the solos section which will not usually reference the melody from the head at all. Occasionally performers will change this structure, omitting the head the first time or only playing the last eight bars of the head at the end. I decided my structure would start with solos, building up to the head to finish. My interpretation of the 'solos' section would be somewhat improvised and mostly notated.

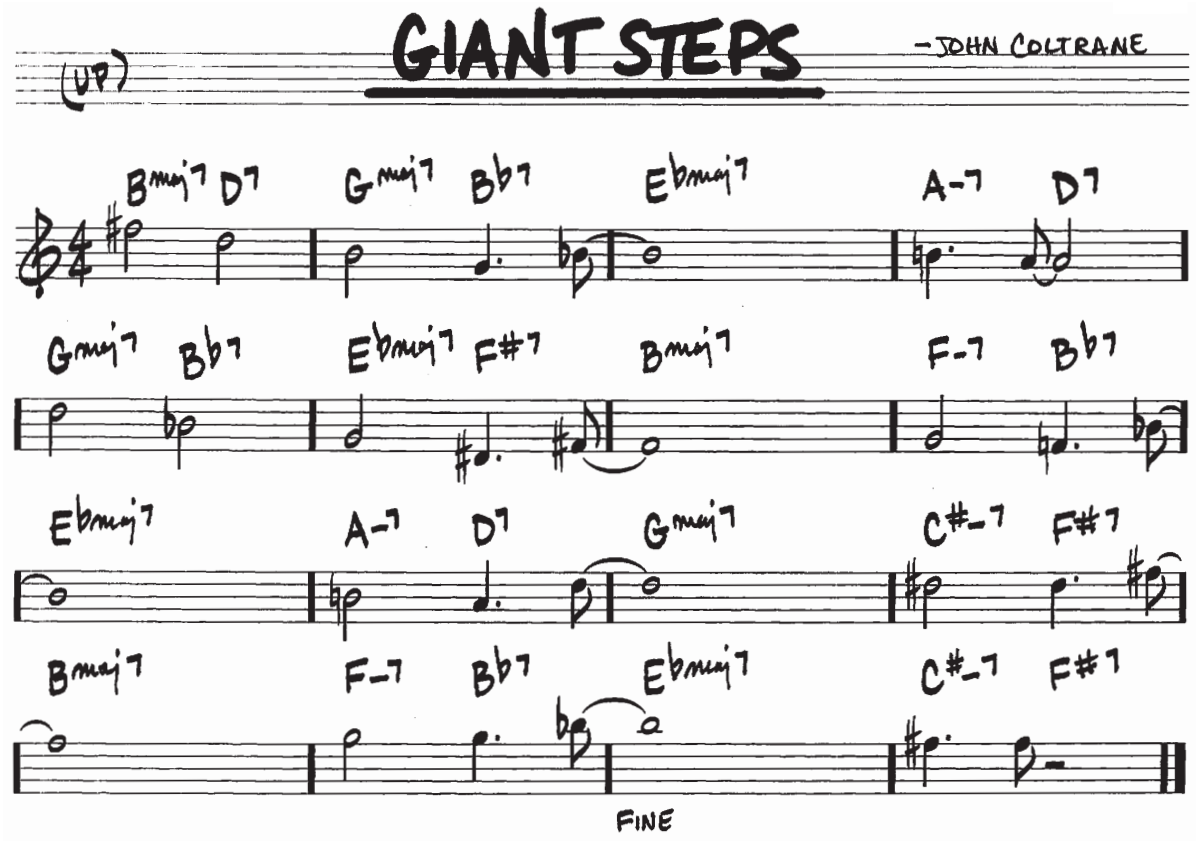


Figure 38: Lead sheet for *Giant Steps*[117]

On choosing numbers of percussionists, I settled on the number three for a variety of reasons. I was attracted to the simplicity of three tonal centres within *Giant*

[117] *The Real Book - 6th Edition*, (Wisconsin: Hal Leonard, 2004), 157.

Steps, each a major third apart and only exploring three chords in each tonal centre. Triplet patterns, common in jazz, and Jones' unique three-over-two rhythmic phrases all further pointed me towards three becoming a theme for this piece. In designing the patch, I also chose three 'virtual percussionists' that would each have their own library of percussive sounds.

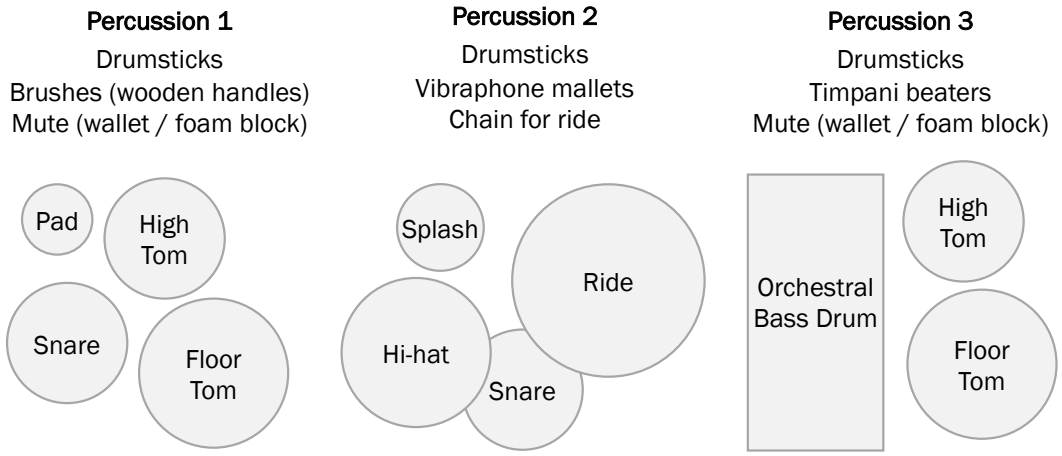


Figure 39: Deconstructed drum kit in *Giant Steps*.

Multiple percussionists facilitate a greater scope not just of textural density, but of timbre. A single drummer, particularly within jazz, will often only use sticks or brushes and while there has been some exploration in beater variety within jazz, this practice remains largely within the domain of classical percussion. My previous electronic work had attempted to saturate the performance space with thousands of sounds per second, both electronically synthesised and digitally recorded. I decided this piece would explore economy of sound; a virtue that, it can be argued, is much more difficult when dealing with live electronics that so easily generate great textural density. One 'ground rule' I created was to limit the sound-creation capability to that of a human performer, thereby challenging myself to treat the three 'virtual percussionists' much like real percussionists in terms of composing to create interplay. Jazz author Richard Cook describes Jones as being "torrential with his cross-rhythms, dividing and remoulding the time while working

as a percussionist – a continuous hiss of cymbals- and a kit-drum colourist".[118] I kept this image at the front of my mind when making creative decisions regarding how the performers and patch would interact. By establishing these rules before starting the patch, I could work the methodology into the patch's architecture, keeping each of the three 'virtual percussionists' as 'real' as possible.

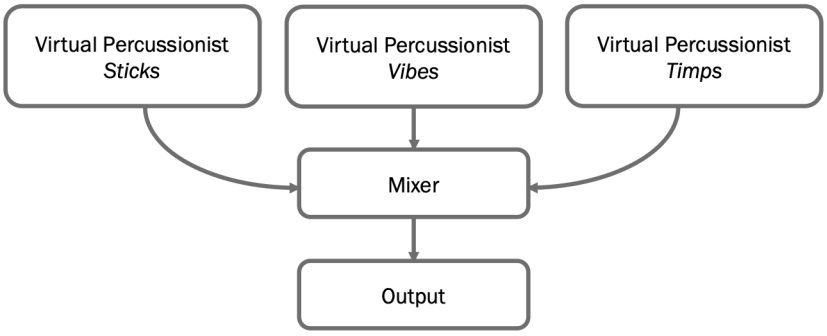


Figure 40 Patch architecture for *Giant Steps*.

There is relatively little information contained within a jazz chart. The data can often be distilled into three component parts; melody, harmony and rhythm. An unpitched percussion ensemble can interpret the rhythmic component of a lead sheet easily, but the melodic and harmonic information posits a much more difficult interpretation. It was at this early point in designing the piece that I decided I would require live electronics to allow the percussionists to fully explore the standard. The granular synthesis and modal aggregate experimentation from my piece *Numeration* provided the foundation for my new patch. I started by rhythmically quantising the granulation process, which would facilitate precise rhythmic interplay between performer and electronics, and created a set of samples that would define the sound of the patch. Instead of the single-sample granulation used in *Numeration*, I created a set of samples, each being a pitch derived from the modes in the Coltrane standard, *Giant Steps*.

[118] Richard Cook, *Blue Note Records: The Biography* (Boston: Justin, Charles & Co., 2004), 111.

Giant Steps has three tonal centres; B major, E♭ major and G major. Each of these keys uses a ii-V-I perfect cadence ubiquitous in jazz, creating a total of nine chords. In the context of the piece, each of these chords would use a different mode as the starting point for improvisation, generating nine modes a performer would use to create new music.

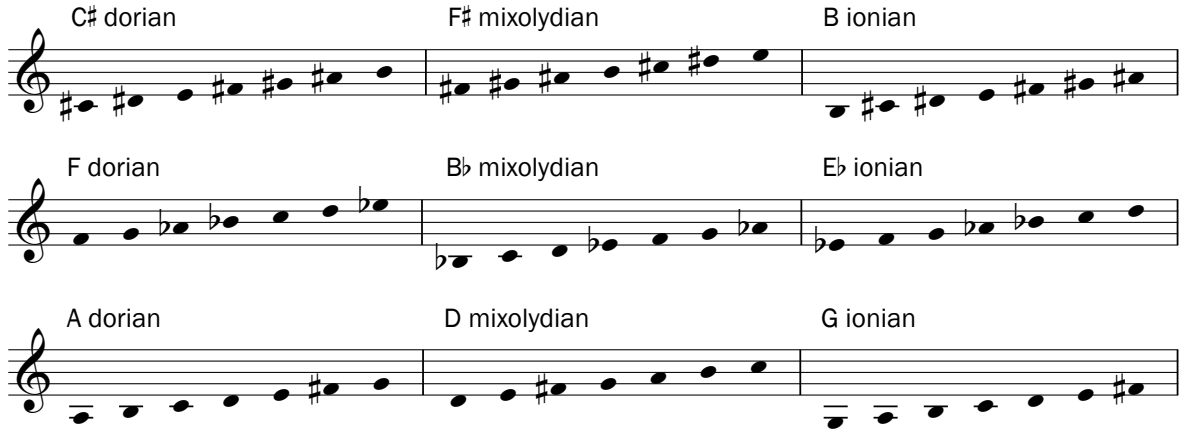


Figure 41: Modes used within *Giant Steps*

Although these modes could all fit within one octave, I decided to create registral space for the electronics. I arranged each mode in ascending pitch order and created a set that included all pitches (including octave duplications).

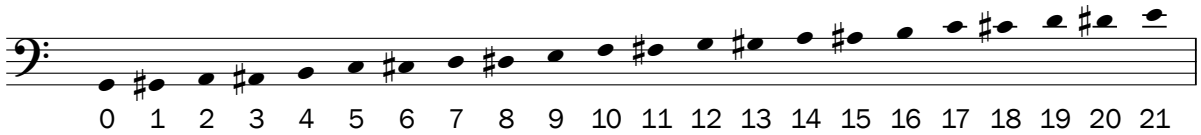


Figure 42: Pitch set created from combining pitch-ascending arranged modes in *Giant Steps*. The numbers beneath each pitch are the sample names used by the patch.

I recorded a tom-tom from my drum kit and electronically transposed the sample to create the twenty-two required pitches. The tom-tom was recorded being stuck with a drum stick, a vibraphone mallet and a timpani beater which, when all three timbral variations were transposed, created a total of sixty-six samples used in the piece.

Playing with Time

The tempo at the start of a jazz performance will be announced via a ‘count off’ wherein the lead performer will count four beats out loud, enabling the band to play at

the same time. To allow the same instantaneous freedom of tempo, the patch 'listens' to the first percussionist's opening bar and, through recording the time interval between hits, determines the tempo the percussionist has set for the piece. By the second bar the patch has ascertained the tempo and starts to play. This technique removes the requirement for a click track or synchronised start facilitated by a screen or engineer, further enabling the patch's behaviour to mimic that of three live percussionists in regards to ensemble interplay.

Some of Jones' playing, particularly his soloing, is so rhythmically complex that it can be hard to identify a consistent pulse. Despite the apparent temporal freedom, Jones always maintains strict $\frac{4}{4}$ time and his solos will usually align with the piece's form.[119] I decided my piece would reference rhythmic ambiguity that is characteristic of Jones' drumming through a combination of out-of-time improvising being deployed simultaneously alongside strict-time material. As the piece advances, these sections become less prescriptive, enabling more creative decisions from the performer. The seemingly tempo-less chaos from free time solo sections in *Giant Steps* generates a similar energy to the freefalling complexity found in Jones' solos, albeit from a different compositional angle.

[119] Jones was also known for developing jazz drumming in $\frac{3}{4}$, but the vast majority of his playing during his period working with Coltrane was in $\frac{4}{4}$.

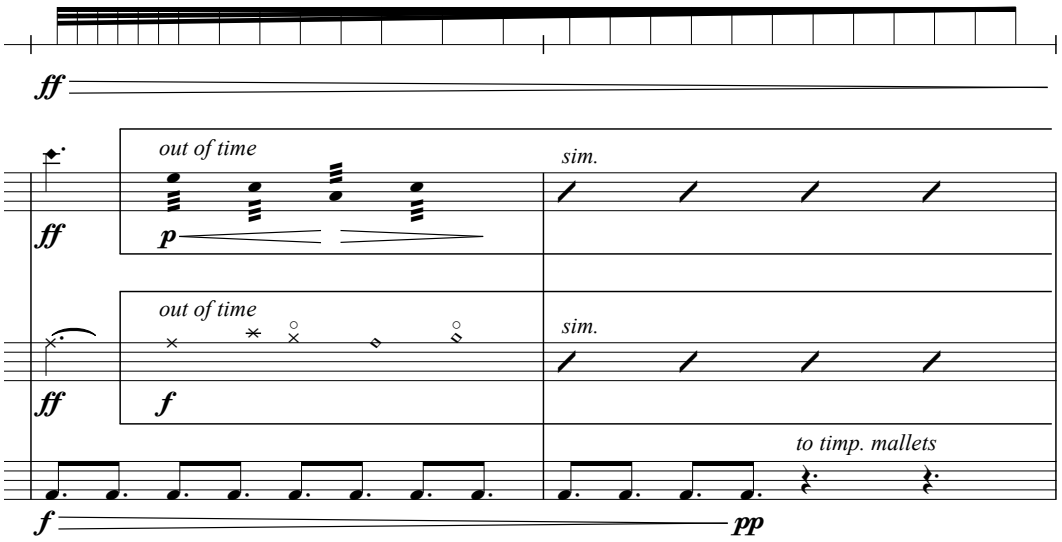


Figure 43: Free time notation in the opening section of *Giant Steps*.

The first percussionist communicates with the patch via two methods; a MIDI drum pad is used to trigger events in tandem with a surface-mounted snare drum microphone that detects activity and responds appropriately. At times, interacting with the patch will create a quaver pattern that briskly disappears into the background (Figure 44), while other times an interaction will trigger a volley of staccato pitches using a mode from the original standard, advancing the mode through the form with each impulse (Figure 45). Live jazz performances will very rarely incorporate a click track; a feature I was keen on maintaining in my electronic compositions. While a click track could have been used to synchronise performer and patch in *Giant Steps*, I wanted the theme of 'dialogue' to permeate all areas of the performance, encouraging the live ensemble performers to listen to their electronic counterparts and vice-versa.

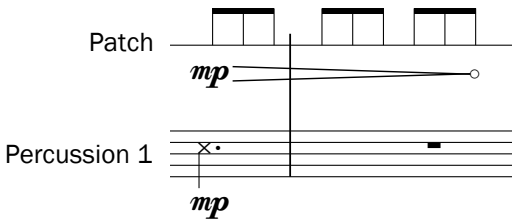


Figure 44: Cross-stick on snare drum triggering fading drum hits from the patch in b.61.

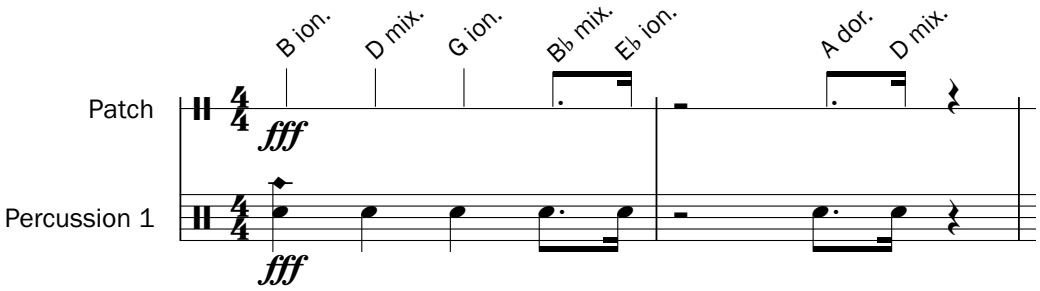


Figure 45: Each strike of the snare head instructs the patch to improvise using the annotated mode (from b.165).

Murmeration (2021)

During my research into improvisation and technology and specifically the relationship between the solo artist and their interaction with technology, I first looked at pioneering works within this area. Bill Evans' 1963 solo album *Conversations With Myself*[120] was developed using a highly unusual approach to ensemble interplay within jazz. Each track featured three overdubbed recordings of Evans playing piano, through which he created a unique album of standards that has become one of his best-known works. While innovative to the bebop scene of the time, the overdubbing studio technique was already commonly used in mainstream popular music in the 1960s and had even been employed in some early jazz recordings.[121] However, Evans' use of a single instrument to create an ensemble recording challenged established bebop conventions and used technology to question what jazz interplay actually constitutes; one of the defining advancements of bebop on previous jazz was the employment of the small ensemble that became a staple of the genre.[122] Composed almost simultaneously from within the contemporary classical world, Stockhausen's *Solo*[123] for melody instrument and feedback enabled a soloist to improvise with themselves within a single performance via a team of engineers recording live material onto magnetic tape, editing it and playing it back to the soloist throughout the performance.

While *Murmeration* has a historical basis informed by Evans and Stockhausen, there is ample new research into the relationships between performer and electronic improvisation systems. A very recent example is Robert Keller's 2019 improvisation assistance software, *Impro-visor*,[124] which facilitates a theme of 'idea generation' through interaction with the system and provides a departure point for the research

[120] Bill Evans, *Conversations with Myself*, Verve V6-8526, 1963, LP.
[121] An early example includes Sidney Bechet's popular 1941 recording of the Tin Pan Alley standard "The Sheik of Araby" in which Bechet overdubbed his performance on six different instruments.
[122] Eric Porter, ""Dizzy Atmosphere": The Challenge of Bebop," *American Music* 17, no. 4 (1999): 422.
[123] Karlheinz Stockhausen, *Solo* (Universal Edition, 1965/1966).
[124] Robert M. Keller, *Impro- Visor*, version 10.2 (2019), computer software.

conducted in *Murmeration*. Keller's software enables a musician to develop their jazz 'language' by accompanying their practice and allowing them to play along with computer-generated solos.[125] The performer communicates with the software by first inputting notation via an engraving interface that acts as 'inspiration' for the system, after which the performer plays along and uses the software to develop creativity. *Impro-visor* has a wide range of different 'grammar' settings for how it approaches improvisation, ranging from chord-scale theoretical interpretations of harmony to stylistic approaches inspired by jazz musicians (grammar settings include improvising in the styles of Chet Baker, Bud Powell and Cannonball Adderley, among many others). To identify 'grammars' (and thereby attempt create 'rules' for improvising jazz), *Impro-visor* generates a complex stochastic model of user-engraved melodies and recorded solos by famous jazz musicians;[126] a process which inspired the research in the final work of this folio, *You'll Hear It*. Similarly, *Murmeration* improvises with the performer in real time, however its stylistic model is created by live sampling excerpts of the performer's material throughout the composition, rearranging the samples and playing them back, creating novel material with which the performer uses to further develop ideas.

The two works that mainly inspired this piece, *Conversations with Myself* and *Solo*, were written a time in jazz's history characterised by daring tempi, complex metres and virtuosic solos.[127] Highly complex melodic lines from a front person would be supported by an equally energetic trio of piano, bass and drums. Attempting to capture this combination of freedom of expression with ensemble interplay would challenge me to use electronic interaction and processing more creatively than my previous works. I decided the performer would use a MIDI footswitch to trigger events in the patch. Much

[125] "Welcome to Impro-Visor," 2020, accessed Nov 22, 2022, https://www.cs.hmc.edu/~keller/jazz/improvisor/.
[126] Jon Gillick, Kevin Tang, and Robert M. Keller, "Machine Learning of Jazz Grammars " *Computer Music Journal* 34, no. 3 (2010).
[127] Coker, *The Complete Method for Improvisation*, 11.

like the drum pad in *Giant Steps*, this single method of input would activate different patch functions depending of the frequency of presses within the performance. An accidental press could be reversed by an engineer monitoring the patch's interface throughout the performance. I chose the bebop standard *Donna Lee* as a starting point for writing this piece. I wanted this piece to equally explore the capability of the tenor saxophone alongside the compositional detail included within *Donna Lee*.

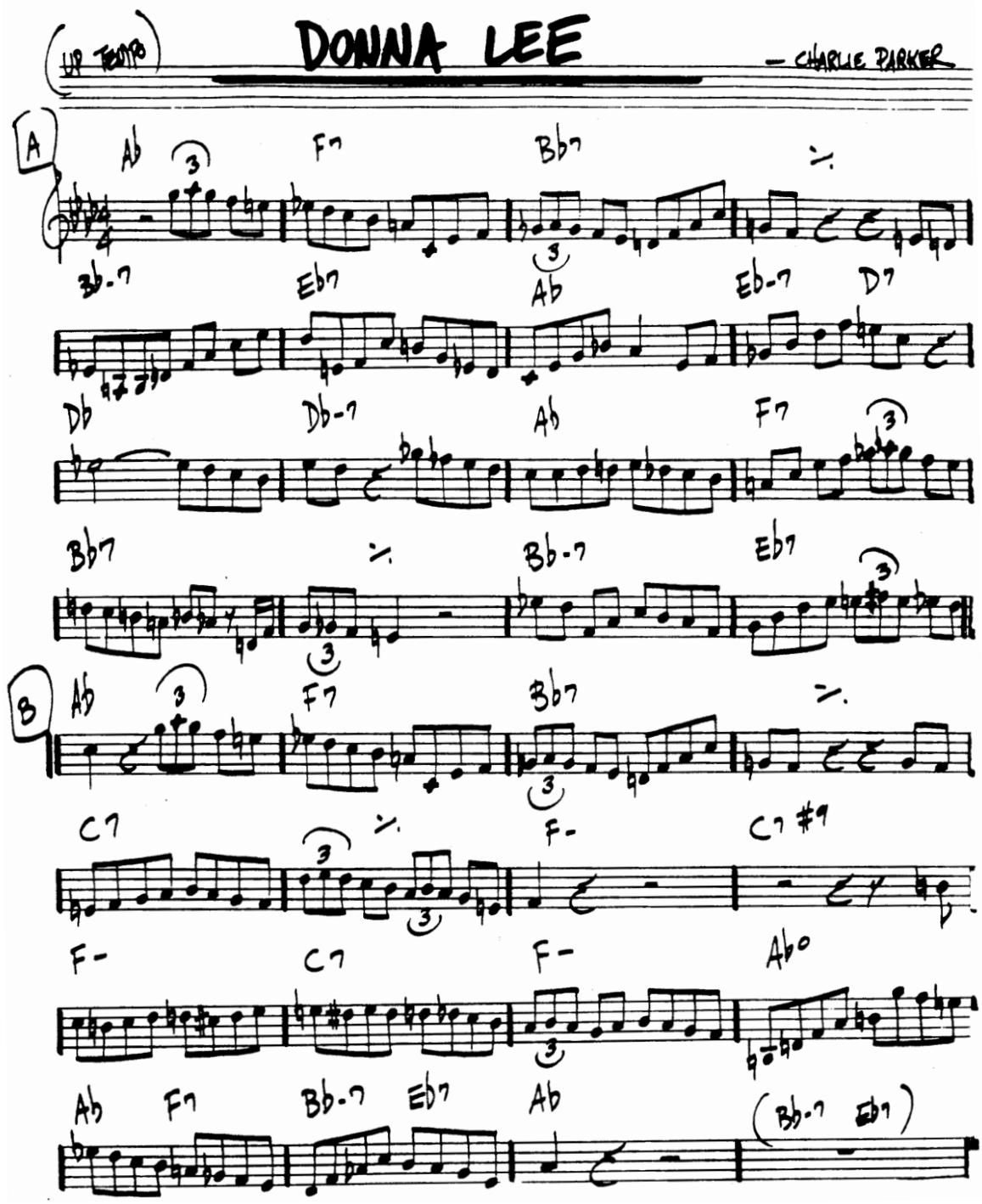


Figure 46: Lead sheet for Donna Lee[128]

An Orchestra of Saxophones

I wanted this piece to allow the timbral idiosyncrasies of the tenor saxophone to evolve before the audience; to go from nothing to everything over the course of the performance. The theme of 'construction' required the method through which the saxophone creates sound to be carefully, and interestingly, introduced to the listener. Jonathan Harvey's use of live electronics in his fourth string quartet[129] guided me in developing the sound world within *Murmeration*. The role of Harvey's electronics in his string quartet develops the live sound rather than introducing new 'alien' sounds to the setting. By doing this, the sounds the audience hear are often understood to be 'string quartet sounds', albeit heavily transformed. My design for introducing the saxophone began with exploration into how air simply being blown through the instrument could invite the audience's curiosity. Inspired by the spatialisation of sound in Harvey's live electronic writing, I decided the air sound would be sampled by the patch and 'drift' around the auditorium via 5.1 surround sound. The patch would play the sample in reverse while gently fluctuating the speed and therefore pitch of the sample. The surround sound component of *Murmeration* would become a main theme of the piece, allowing each of the six speakers to assume different roles throughout; sometimes mimicking and reinforcing the saxophonist's material and at other times becoming six 'virtual saxophonists,' each with their own melodic line.

In contrast to my live electronics work up to this point, all the electronic material heard by the audience in *Murmeration* is a manipulation of live sampled saxophone from within the performance itself. *Numeration* used large amounts of synthesis and *Giant Steps* had pre-recorded one-shot sample libraries so I resolved to ensure this piece had a

[128] *The Real Book - 6th Edition*, 123.
[129] Jonathan Harvey, *String Quartet No.4* (London: Faber, 2003).

completely ‘live’ nature, much in the way the electronic design of Stockhausen’s *Solo* was entirely built of live samples taken from within the performance. The looped, evolving short air sound sample (Figure 47) is followed by key clicks that are treated to the same electronic processes as the air noise, creating a whirling, susurrus texture that encapsulates the audience. Next, the first discernible pitch in the piece, a low concert A♭, fades in. It, too, is sampled but when immediately looped is subjected to a semi-tone pitch bend over six seconds. This gesture serves as an introduction to the tuning manipulation that features later in the piece.

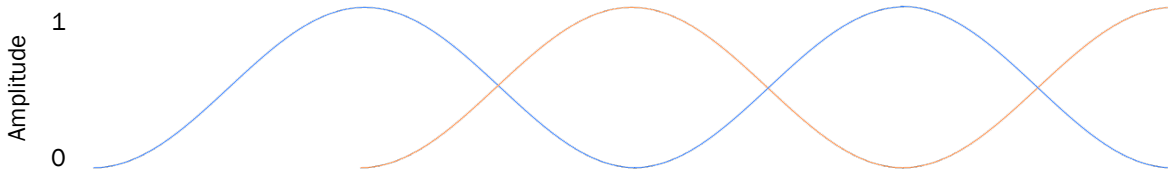


Figure 47: Illustration of the sample-looping process used in Murmeration created by two samples played half out of phase with one another. Each sample’s amplitude follows a Hann function, creating a loop with no end point.

I identified a theme of ‘reversal’ early on in the composition process. Starting from the end and working backwards alongside reversing playback direction of samples taken within the piece directed me to look for further ways of reversing processes. Referencing the common ‘head-solos-head’ structure of jazz performances, I used a pitch-retrograde of the *Donna Lee* melody as the first performance of the head. This section features a rhythm delay effect with which the performer is instructed to play in time. However, unlike *Giant Steps*, the patch’s tempo fluctuates, encouraging the performer to attempt to maintain pace with the patch’s rubato. The delay effect bends pitches to match the tempo, bending notes lower as the delay slows and vice versa. The head section builds in textural density, culminating with the reintroduction of distorted sounds from the opening. The pitch-bending delay stabilises and fades while the frantic key clicks become a repetitive, reversed tongue slap sound, closely resembling an off-beat closed hi-hat uniquely found in jazz. The tempo slows dramatically, changing energy from a post-bop rampage to a peaceful, ballad-like atmosphere.

By layering and adjusting the playback speed (and therefore pitch) of the sampled A♭ from the start of the piece, the patch provides equally-tempered chords from *Donna Lee* voiced in traditional jazz-like ways over which the performer is instructed to improvise. The performer decides each chord's duration through the footswitch input. Colla voce tempo pacing is used abundantly in jazz ballads but becomes increasingly impractical as tempi increase in other jazz styles. The ability for the performer to quickly and precisely advance harmony through the form of *Donna Lee* while improvising in an uptempo bebop style in this section is a unique advantage afforded by live electronics. I divided the six-part harmony equally between the six speakers to give the illusion of seven saxophonists surrounding the audience; using one voice per speaker, the audience is able to clearly discern the melodic movement within the independent parts as the harmony evolves.

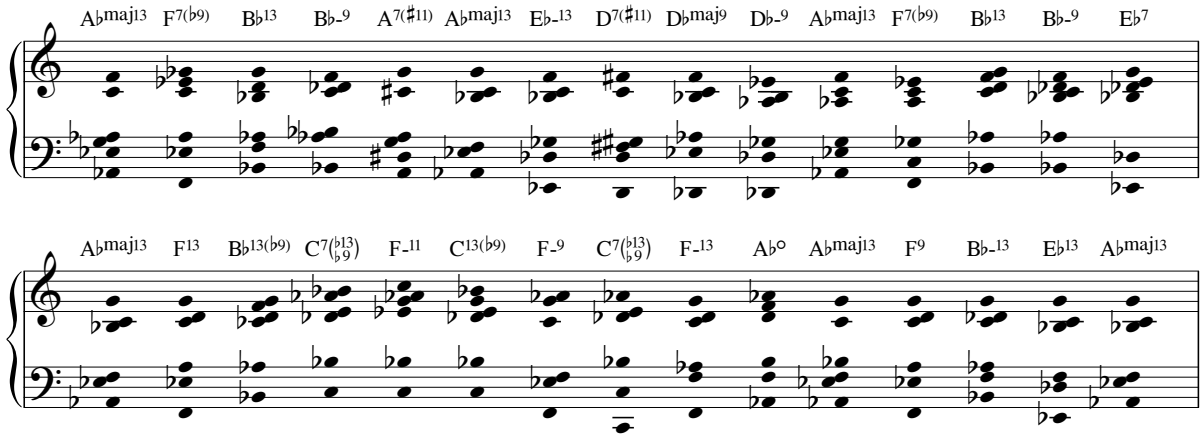


Figure 48: Arrangement of harmony from *Donna Lee* for six parts.

Creating a Dialogue

Throughout the solo section the patch takes 'snapshot' recording samples of phrases for use in the following 'trading fours' section. As with many other areas of this piece, the performer has agency over pacing, determining the length of the patch's and their own improvisation. Prior to the final head section, the patch generates a solo in a completely unique fashion; it uses the sampled A♭ from the start of the piece once more, albeit this

time through changing the playback speed and amplitude, it aleatorically improvises phrases that are similar to the head material from the start. After two minutes of the patch's solo, the performer begins to play short melodic cells built from the melody in *Donna Lee*. Mark Gridley argues that criteria for successful jazz improvisation must allow for both repetition *and* non-original ideas and describes expecting jazz musicians to improvise novel material with each performance would be akin to expecting an author to invent new words and sentences each time they write.[130] As using both repetition and non-original ideas can be considered a fundamental approach to improvising jazz, and therefore part of the genetic material, I have endeavoured to ensure electronic improvisation in *Murmeration* adheres to both these criteria.

Adjusting the playback rate to build chords allows a precision of tuning configurations otherwise impossible without electronics. I used this theme to explore a departure from equal temperament in the final section of the piece. Bud Powell's piano voicings on Charlie Parker's recording of *Donna Lee*[131] provided the initial starting point for voicing and tuning decisions within this section. Powell's texturally sparse 'shell' voicings heavily relied on consonant intervals. I chose Pythagorean tuning as its method of stacking 'pure fifths' for interval construction would suit voicings created to imitate Powell's. Similar to the patch's accompaniment to the saxophone solo earlier in the piece, sustained block chords are created by manipulating playback rate of a sampled pitch. The patch is able to calculate the appropriate relative playback speed for each pitch within a chord and create the desired transpositions. For example, the chord of E♭7 may be voiced using a shell voicing of 1, 5, 7. The patch first calculates the intervals from the sampled A♭ required to create the chord tones in E♭7 (a major second, perfect

[130] Gridley, Maxham, and Hoff, "Three Approaches to Defining Jazz," 519.
[131] Charlie Parker, "Donna Lee," *Session 6*, New York: Savoy Records, 1947.

fourth and perfect fifth). The playback speed is then adjusted to create these intervals.[132]

One of the most notable turning points in jazz's history was bebop's expansion on the simple harmonic language of earlier jazz.[133] From the 1940s to the 1960s chord voicings became increasingly adventurous, with the appearance of altered extensions becoming more frequent throughout the period. I decided I would create a set of chords whose voicings would follow a similar stylistic trend as the sequence repeated. Using increasingly dissonant ii-V-I perfect cadences in A♭ I created a sequence voiced for ten 'virtual saxophones,' the speaker allocation for each voice shifting throughout the section.

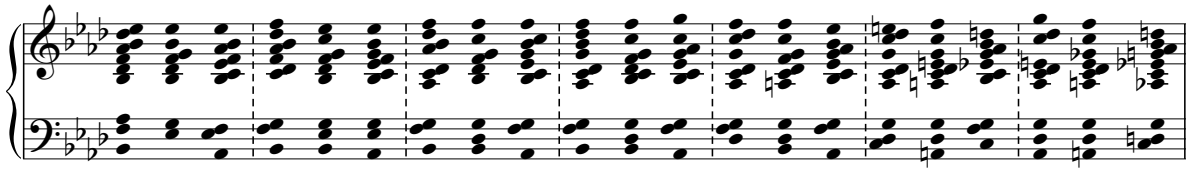


Figure 49: ii-V-I voicings used by the patch in the final section of *Murmeration*.

[132] Major second: $\frac{9}{8}$. Perfect fourth: $\frac{4}{3}$. Perfect fifth: $\frac{3}{2}$.

[133] Porter, ""Dizzy Atmosphere": The Challenge of Bebop," 422.

You'll Hear It (2021)

"you'll hear it" – what the musician who called the tune sometimes says to another musician who's not sure of the changes.[134]

When performance bookings were cancelled due to the COVID-19 pandemic, I looked to create a solution for musicians to be able to continue developing improvisation until they could play together again in person. I wanted to devise a system that enabled the creation of original ideas through a musical dialogue in the same way jazz musicians communicate with each other in a performance; bouncing ideas between ensemble members to create something new. I decided to create a piece that would encourage a dialogue between a human performer and their electronic counterpart, the process of which would energetically invent ideas without trying to retain or replicate any of them for use in a future performance. Every time the piece would be played, a completely new experience would be created for the 'ensemble' and audience.

Throughout a performance, *You'll Hear It* analyses a variety of data and builds a statistical profile of how the performer is improvising. As more is played, more data is fed to the analysis systems, allowing a computer-generated response that has an increasingly stronger resemblance to the stylistic idiosyncrasies of the performer. To create a faithful stochastic profile the performer, second-order Markov chain models of pitch and rhythm sequences, commonly used in computer improvisation,[135] are used extensively within *You'll Hear It*'s modelling systems.

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[134] Levine, *The Jazz Theory Book*, xiv.
[135] Gillick, Tang, and Keller, "Machine Learning of Jazz Grammars " 57; Donya Quick and Kelland Thomas, "A Functional Model of Jazz Improvisation," *ACM SIGPLAN Workshop on Functional Art, Music, Modeling, and Design* 2019 (2019); Donya Quick and Clayton T. Morrison, "Composition by Conversation," *International Computer Music Association* 2017 (2017).

Striking the Balance

When beginning to design the patch, I had a single objective in mind: create a responsive system that sounds like it is genuinely creating new material based on the performer's improvisation. In a system that sounds creative, the output needs to reference the input, but not so closely that it sounds like it is simply recording and playing the performer's material. Similarly, the output shouldn't sound too randomly-generated; this can make the audience question whether the system is actually 'listening' at all. Then there is the question of authentic creativity: as the computer cannot have an original 'thought,' it will need to sound proactive but only within set parameters. If it suggests too many new ideas it will sound broken, and if it doesn't suggest anything new throughout the performance it will sound uninteresting. To solve these problems, I decided to start by asking the question 'what counts as a good improvisation?'.

My research started with duet improvisations with jazz musicians over Zoom. We would freely improvise together, not communicating our intentions beforehand or pre-determining any characteristics of the piece we were about to create. The complexities of 'remote improvising' such as low-quality audio, time delay and automatic volume ducking greatly disturbed our sense of interplay and we found ourselves having to be bolder with our suggestions, knowing there was a strong chance the other player had just started a diversionary idea that would arrive in our respective headphones half a second later. Listening to the early recordings of these musical dialogues revealed hesitant, robotic, stilted interaction and it took some time to adjust to improvising together in a socially-distanced world. When trying to quantify features that made themselves apparent in this unique environment, one feature that stood out the most was that of pitch choices. The recordings revealed we would often reference pitches the other had played recently, rarely treating them in precisely the same way but, nonetheless, we were building and

deconstructing modes ad-hoc. This reminded me of the way modes advance throughout jazz performance: sometimes a mode will pass by too quickly for a listener to fully understand how the mode has been used but the ensemble will nonetheless understand its function. This ever-evolving modal framework inspired one of the key features of my software; to be able to store and analyse recent pitches in order to generate a hierarchy of pitch importance and function, thereby creating a mode. *You'll Hear It* continually stores and analyses the most recent seven pitches; the 'live mode' constantly evolving as more notes are played by the performer.

In jazz, it can be extremely problematic to attempt to quantify how to successfully use modes in improvisation. While there are seven pitches available to the improviser at any one point in diatonic jazz, not all of them are given equal importance. It is generally agreed that pitches of the mode that coincide with chord tones used to instruct the performer of the appropriate mode will often be given prevalence, regularly coinciding with a downbeat, and pitches such as the fourth degree of the ionian mode are so unrecommended they have been described as an *avoid note*.[136] However, even these basic rules that are taught at the early stages of learning to improvise jazz are contended.[137] Jazz musicians will often describe an improviser who fully understands how to navigate modes in their soloing as having a developed sense of 'language' – something that is inductively learnt through listening, transcribing and practising as opposed to being taught theoretically.[138] *You'll Hear It* follows this philosophy as closely as possible to identify the 'language' the performer is using, and therefore doesn't start with any preconceptions about what the performer might play or how it should proceed in its response. Indeed, if the exact same stimulus was provided twice to *You'll Hear It*, the

[136] Levine, *The Jazz Theory Book*, 34.
[137] Robert Rawlins, "Review of Mark Levine: The Jazz Theory Book," *MTO* 6 (2000), accessed Jun 10, 2020, https://mtosmt.org/issues/mto.00.6.1/mto.00.6.1.rawlins.html.
[138] Martin Pfleiderer et al., *Inside the Jazzomat. New Perspectives for Jazz Research.* (Mainz: Schott Campus, 2017), 7.

response would be different each time. This nondeterministic trait of the system affords performances *creativity.*[139] I returned to the preliminary duet recordings throughout designing *You'll Hear It* to compare the patch with human responses to the same stimuli. Throughout the development process, the responses given by the system became less identifiable as having been created by a computer and started to follow themes that were identified within the duet sessions.

How the patch works

Beyond clicking 'start' to inform the patch that the piece is about to start, there are no other controls required by the performer or engineer. Using the microphone as the interface, the patch will immediately begin analysing the performance; the choice of pitches, phrasing characteristics, amplitude evolution through notes, rhythmic sequences, melodic patterns, even the timbre of the instrument will be analysed and inform the patch's response. After five notes have been played by the performer, the patch will start to respond, continually allowing its novel material to be informed by the performer. The patch builds an increasingly clear picture of the performer's improvisational grammar with each note that is played; for example, after a few minutes the patch will have thousands of pieces of data to help it understand the modes and methods the performer is using. The patch will successfully interact with any pitched instrument, as long as the range of the instrument sits within the 88-key range of a piano and the performer only plays monophonically.[140] The patch will base its own sound on that of the performer's, analysing the spectral components of the performer's instrument and learning how to recreate a similar timbre.

[139] Johnson-Laird, "How Jazz Musicians Improvise," 419.
[140] As the patch analyses partials within each pitch, playing chords corrupts the patch's ability to track notes.

The architecture of the patch is informed by the 'listening → analysing → responding' cycle also adopted by the systems *GenJam* (2001)[141] and *Odessa* (2015).[142] Where *GenJam* requires the performer to select what tune they will play from a library of standards before the performance begins, [143] *You'll Hear It* requires the performer to press 'start' which signals for the system to being 'listening' to the microphone input. *Odessa* bears more similarity to *You'll Hear It*'s approach to interaction by way of them both being defined as 'subsumption systems'; *Odessa* possesses no "formal knowledge such as scales, tonal keys, motifs etc. and also lacks any representational model. In contrast, in other free improvisation systems, one or more of these means are typically used".[144] However, where *Odessa* deals with polyphonic improvisation, *You'll Hear It* solely processes monophonic input. The second point of divergence between these two systems is that *You'll Hear It's* entire understanding of the human performer's intentions is built upon various complex stochastic models where *Odessa* achieves computer responsive improvisation without probabilistic analysis.[145]

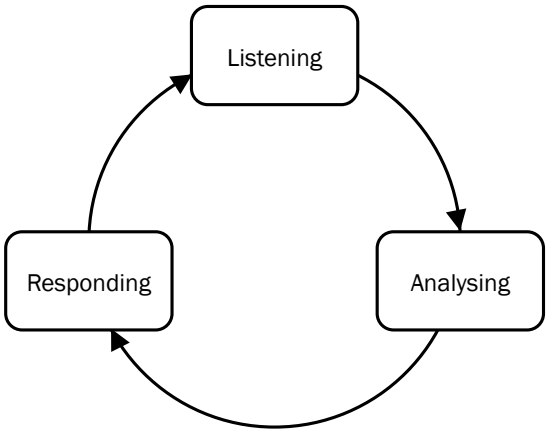

Figure 50: *You'll Hear It*'s perpetual feedback cycle

[141] John A. Biles, *Genjam* (2001), computer software.
[142] Adam Linson, *Odessa* (2015), computer software.
[143] John A. Biles, David W. Corne, and Peter J. Bentley, *Creative Evolutionary Systems* (Amsterdam: Elsevier, 2001), 166.
[144] Adam Linson et al., "A Subsumption Agent for Collaborative Free Improvisation," *Computer Music Journal* 39, no. 4 (2015): 99.
[145] Ibid., 112.

Timbral Replication

In creating live electronics, I find one of the most difficult challenges is choosing what the electronics will actually sound like. I decided to essentially *not* decide what the electronics would sound like, and instead to allow the performer and the patch, in their own way, to make this creative choice. The patch 'listens' to the timbral properties of the notes the performer plays and records information about them. Then, when the patch is satisfied that it has successfully recorded the right sound, it will begin improvising in the style of the performer, recreating the timbral characteristics of the performer's instrument. The patch builds the sustain component of the live instrument's timbral profile by recording each note's spectral properties; the frequencies that combine to form the pitch and their respective amplitude strengths. The process of separating the first sixteen partials into their amplitude and frequency data is carried out ten times per pitch over a matter of milliseconds, generating three hundred and twenty points of data to replicate one pitch in the timbral style of the performer's instrument. Analysing each pitch ten times increases by allowing the patch to check deviation between samples. Figure 51 plots the spectral properties of a middle E played on a piano (orange) and flute (green) recorded by the automatic timbre sampling subroutine in *You'll Hear It*.

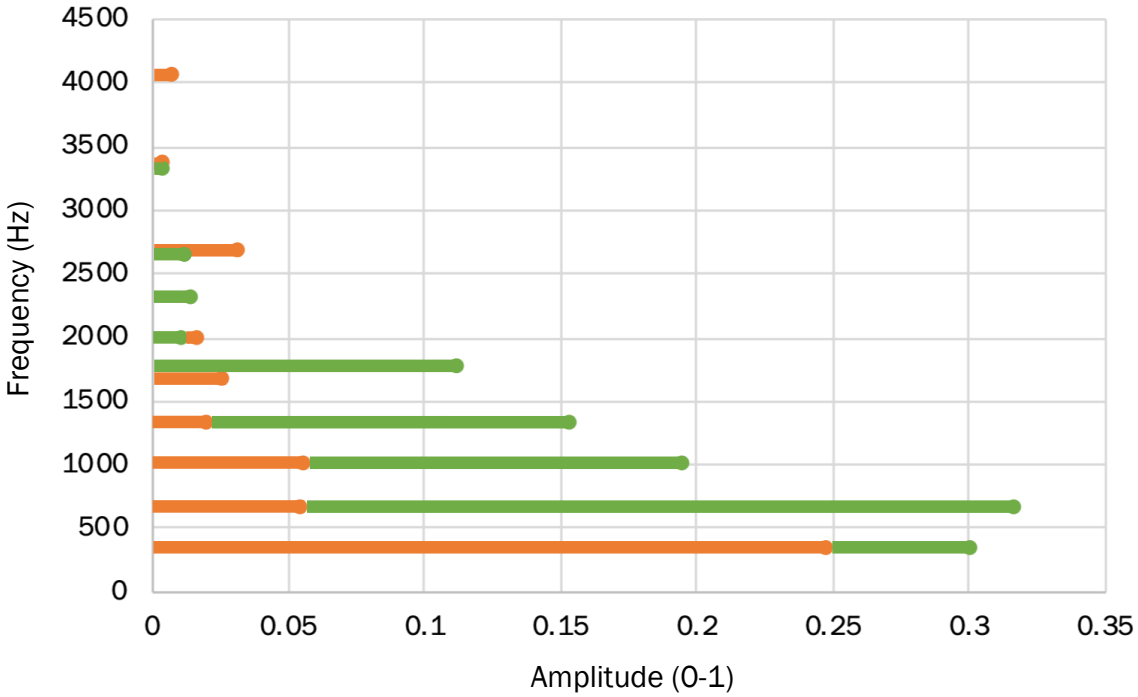

Figure 51: Partials recorded by *You'll Hear It* for a middle E played on a piano (orange) and flute (green).

In the early stages of creating this patch I discovered some samples of the acoustic instrument recorded perfectly while others failed to capture the instrument at all.[146] I created a system to check the quality of the recorded samples. When analysing the spectral components of 'good' samples, I found there would be roughly consistent frequencies and amplitudes between samples. I created a 'quality control' system which would automatically ascertain whether a recorded pitch would be used in the performance or flagged to be re-recorded the next time it is played by the performer. Each partial's frequency and amplitude are compared with each of the other corresponding piece of data within a snapshot window of ten samples. For example, the fundamental partial in sample one is compared with the fundamental in samples two, three, four and so on. If the data has a standard deviation below a tolerable threshold, the next partial is checked. This continues with all sixteen partials until an allowable number of 'passes' is reached. At this point the pitch is labelled as 'good' and will be

[146] Failed samples either included two pitches where the software should only have recorded one, or were silent as the note had finished by the time the recording had started.

used by the electronics to respond to the performer. Although there is extensive existing research into timbral synthesis, during my research I have not been able to find another electronic improvisation system that uses partial analysis to fully reconstruct the timbre of the performer's instrument.

The Score

Following the theme of spontaneous creativity throughout designing this piece, I wanted the score to showcase the versatility of the patch. A rendering of this piece consists of three randomly-selected movements that change with each performance. This gives each performance a unique quality and draws the audience's focus toward 'the performer' instead of 'the composer'. The performer will randomly choose three graphic scores off-stage before the performance but not look at them until they are about to play. This process ensures the performer and patch both have equal preparation time for how they will improvise. Taking graphic scores as inspiration for an improvised ensemble performance references the spontaneous nature of jazz band performances. The graphic scores are like lead sheets; some of the information is prescriptive, but the piece is largely open to interpretation. Attempting to create balanced levels of agency between a human and computer performer will always be fraught with pitfalls; the patch doesn't ever get to 'see' the graphic score. Also, it could be argued the patch is not truly being creative but rather randomly generating responses based on probability. Lastly, the human can always decide to just turn the computer off if they do not like the result; this betrays an imbalance of power within the 'ensemble'. However, being an artistic endeavour (as opposed to scientific) I am satisfied with the equality of roles the human and computer assume within this piece.

Summary of Electronic Works

Creating *Numeration* allowed me to use electronics as a form of 'musical microscope'; intensely analysing four bars of a jazz standard to map out a ten-minute composition. A recording of the standard and adaptation for eleven cellos being electronically processed to further scrutinise what constitutes the standard and apply its genetics to a new work. *Giant Steps* attempts to capture the essence of the drummer, Elvin Jones, and creating this composition encouraged me to work more abstractly in my methods; being less prescriptively motivated with regard to electronic precision and allowing my own voice to develop as it did with solely acoustic pieces. *Murmeration* marked the beginning of an intense exploration into spontaneous performer communication to create novel material. The electronics 'listen' to the saxophonist's phrases and reorder them, mimicking 'trading', among other communication styles popular in jazz practice. Each performance of *You'll Hear It* is entirely improvised, referencing the themes of spontaneity and interplay in jazz. It can be argued that with *You'll Hear It*, similarly to George Lewis' *Voyager*, I haven't necessarily created a piece of music but rather a *program*, a *system* and a *composition*.[147] To demonstrate the versatility of the patch, I have included performances from four different instruments within the accompanying media to this commentary. An electronic system that is supposed to mimic a human is never perfect, and I fully embraced this fallibility when designing this piece. By disassembling and reconstructing pitches in this way from a live source, the final sound is always going to be obviously processed; transformed into something new just by taking it apart and reassembling the pieces. This piece enjoys not being perfect; the artefacts created through digital manipulation of live sound complement the 'dialogue' theme I had in mind when I started designing it. The flaws

[147] Lewis, "Too Many Notes: Computers, Complexity and Culture in "Voyager"," 39.

created through the processing density in *You'll Hear It* allow space for a spontaneous conversation between two ensemble members. Mistakes and glitches become new material, ready to be explored and developed by both performers.

4 Conclusion

The aim of these compositions was to use the genetics of jazz as starting point for new art composition. Through this journey I have demonstrated that jazz cannot be quantified as one 'thing'; the swing rhythm, extensive improvisation or AABA standard form do not constitute jazz. However, through forensic investigation from multifarious angles, I have distilled a variety of factors that I argue are part of the genetic material of jazz; some are broad and commonplace while others are from narrow, specific corners of jazz.

Upon reflection, there is scope for further development of research themes from earlier works of this portfolio. For example, *And The Vultures Started Circling* incessantly stacks dominant chords to increasingly build tension near its conclusion; this technique could lend itself to adaptation for a larger scale work which solely focuses on maximising chord tension. The opportunities to facilitate improvising 'outside' in *Had You Done So Before, Perhaps You Would Still Be Free* are brief and potentially too complex to allow a full exploration of this theme. A conclusion derived from composing this piece would be that to create spontaneous melodies 'outside', the parameters of 'inside' would need to be more coherently established first. In addition to this, the notation decisions I made for direction performers to play 'outside' relied on indicating which pitches were not to be used. In hindsight, musicians would have potentially found it easier to have been shown the pitches that *are* available instead of being told what *not* to play.

A turning point of this portfolio was the introduction of live electronics to my compositional methods. I found the reliable precision of electronics aided research avenues otherwise impossible to explore. For example, creating *Numeration* allowed me to 'zoom in' to the jazz tradition of improvisation over chord changes; generating millions of harmonically-dictated pitches in real-time with millisecond accuracy. *Giant Steps* is the closest to a traditional standard; there are features that are present in much of jazz such

as soloing around the ensemble, the triplet-feel interplay and the 'head-out' section to conclude. In many ways this piece is not a composition, but rather an arrangement of the John Coltrane standard for three percussionists and live electronics. *You'll Hear It* and *Murmeration* explore improvisation and themes of ensemble dialogue in great detail through electronics. *You'll Hear It*'s stochastic modelling is based entirely upon what the system encounters during the performance but there is ongoing research being conducted[148] to build a stochastic model of as much existing jazz repertoire as possible through the creation of the Weimar Jazz Database[149] whose aim is to improve jazz research.

There are by-products of this thesis that are not objectives of the intended research but have been created as a result of the research processes. For example, this folio explores improvisation; performers spontaneously interacting with each other, the score, and electronics. There are many methods of interaction which would serve as a way of introducing non-improvising musicians to types of improvisation, as a creative tool. Similarly, there are components of the later work, in particular *Murmeration* and *You'll Hear It* which could be used as pedagogical tools for developing creativity. Further research in this particular area could begin by the development of an interface alongside a set of objectives the user could choose to program before their practice session, much like the grammar settings of the *Impro-visor* system.[150] Another by-product of this folio is the research advancement into the interaction between a human performer and electronic system. Electronics are treated as an ensemble member (*Numeration*), an aid for a human ensemble (*Giant Steps*) and as a system for exploring one's own creativity (*Murmeration*). From the first four pieces in this folio (the acoustic works) there are also

[148] Martin Pfleiderer, "The Jazzomat Research Project," 2019, accessed 20 Nov, 2022, https://jazzomat.hfm-weimar.de/.
[149] Martin Pfleiderer et al., "Weimar Jazz Database (Wjazzd)," 2019, accessed 20 Nov, 2022, https://jazzomat.hfm-weimar.de/dbformat/dboverview.html.
[150] Robert M. Keller, Impro- Visor, version 10.2 (2019), computer software.

developments that have arisen as a by-product of the primary research objectives, such as the ensemble-section coordination in *Inside Out* and the research into chamber music interplay in *Had You Done So Before, Perhaps You Would Still Be Free*. The exploration of these methods, albeit ancillary to my primary research objectives here, hopefully allow further research into these areas and provide stepping stones from existing research.

This PhD tells the story of my developing character as a composer. The pieces within this portfolio are increasingly demonstrative of the composer I want to be, with the final two pieces, *Murmeration* and *You'll Hear It*, representing the destination of my compositional trajectory to date. As with any artistic endeavour, there is always scope for improvement. My immediate intention is to further explore the systems used in my electronic compositions; live sampling, autonomous improvising and granulation being starting points from which I will continue to develop. I also intend to refine the systems within *You'll Hear It*; increasing its precision and expanding avenues of communication between performer and patch.

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