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The grain of the digital audio workstation

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Michael Terren
28 May 2019

Abstract

This thesis explores the material conditions and practices of the digital audio workstation (DAW), treating them as a subject of musical composition. The DAW is a software application currently ubiquitous in facilitating the creation of recorded and electronic music. Despite its prominence, few have articulated its unique possibilities for compositional practice, or historically contextualised the emergence of such practices. To clarify the locus of inquiry, a theoretical framework termed *the grain of the DAW* is developed. Derived primarily from Roland Barthes' notion of the grain (1977), it is understood as the sonic effects in a recorded musical work that infer the unique material conditions and practices associated with a sonic medium. It is argued that compositional techniques can foreground or conceal this grain, the latter of which is more common in many musical traditions. Employing practice-led research strategies and methods derived from experimental electronic music, compositional techniques that foreground the grain of the DAW are investigated, culminating in an album entitled *Thru*, the creative component of this thesis. Composition in this mode involves negotiating between sound design, arrangement, mixing, critical listening, data organisation, and managing conceptual burden (Duignan, 2008). It also involves situating the DAW as a socially constructed technology (Sterne, 2012; Pinch & Bijker, 2012), promoting individualised musical practice and mobilising several metaphors that articulate this condition.

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- Bee Mask – *When We Were Eating Unripe Pears* (Spectrum Spools, 2012)
- "Blue" Gene Tyranny – *Out of the Blue* (Lovely/Unseen Worlds, 1978/2007)
- Brett Naucke – *Seed* (Spectrum Spools, 2014)
- DJ Olive – *Balm* (Record Blanks, 2012)
- Ellen Arkbro – *For Organ and Brass* (Subtext, 2017)
- Félicia Atkinson – *Hand in Hand* (Shelter Press, 2017)
- Haron – *Wandelaar* (Queeste, 2018)
- Jo Johnson – *Weaving* (Further, 2014)
- Jlin – *Dark Energy* (Planet Mu, 2015)
- Kara-Lis Coverdale – *Aftertouches* (Sacred Phrases, 2014)
- Karima Walker – *Hands in Our Names* (Orindal, 2016)
- Klein – *cc* (self-released, 2018)
- Laurel Halo – *Raw Silk Uncut Wood* (Latency, 2018)
- Lawrence English – *Cruel Optimism* (Room 40, 2016)
- Maggi Payne – *Crystal* (Lovely, 1991)
- Meyers – *Negative Space (1981-2014)* (Sympathy Ltd, 2015)
- Meyers – *Struggle Artist* (Shelter Press, 2018)
- Neel – *Phobos* (Spectrum Spools, 2014)
- Objekt – *Cocoon Crush* (PAN, 2018)
- Rafael Anton Irisarri – *A Fragile Geography* (Room 40, 2015)
- Richard Skelton – *Landings* (Type/Corbel Stone Press, 2009)
- Second Woman – *Second Woman* (Spectrum Spools, 2016)
- Skee Mask – *Compro* (Ilian Tape, 2018)
- Taylor Deupree – *Faint* (12k, 2012)
- Visible Cloaks – *Reassemblage* (RVNG Intl., 2017)

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1 Introduction

This thesis is concerned with the digital audio workstation (DAW), a software application used to create recorded music. This complicated software is virtually ubiquitous in the 21st century. It is unusual for a recorded musical work to *not* be mediated by a DAW at some point in its creation, and it is increasingly common for compositions to be made entirely within the DAW by one person. Despite its ubiquity in today's sonic landscape, there is a disproportionate lack of research around the compositional practices associated with DAWs, their historical contexts, and the unique possibilities and techniques that DAW-based practice can provide. This thesis explores aspects of all three.

I am a maker of experimental electronic music, which I broadly and perhaps optimistically understand as music derived from unusual methods, mostly involving electrical sound sources, that attempts to explore what *else* music can be. I also draw from other traditions including ambient music, electroacoustic music, and electronic dance music. I am well-versed in the technical aspects of DAW-based composition, a practical background that informs this entire thesis. I take a practice-led research approach, one that is "initiated in practice, where questions, problems, challenges are identified and formed by the needs of practice and practitioners … [and] the research strategy is carried out through practice, using predominantly methodologies and specific methods familiar to us as practitioners" (Gray, 1996). The primary creative outcome of the research is an album entitled *Thru*, which seeks to address the question: *What compositional techniques can foreground the unique material conditions and practices of the DAW?* I draw from reflective journaling, extensive compositional experimentation, over a hundred DAW sessions created during the research, and after-the-fact musical analysis in arriving at the compositional techniques that enact this foregrounding. These techniques aim to extract practices idiomatic to the DAW and unique from other (antecedent) compositional tools, such as multitrack tape recorders, sampler-sequencers, drum machines, synthesisers, and music-oriented programming languages. These comparisons are derived from historical analyses of these instruments as used in predominantly electronic music practices, while drawing from my own experiences and observations as someone whose creative practice is almost exclusively mediated by the DAW. This mode of practice comprises negotiations between sound design, arrangement, mixing, listening and reflection, managing data, and managing conceptual burden (Duignan, 2008).

In order to arrive at the above research question, I propose a theoretical framework that I term *the grain of the DAW*, derived from work by Roland Barthes, Pierre Schaeffer and Michel Chion, Alexander Galloway, and Brian Kane. I define the grain of the DAW as *the sonic effects in a recorded musical work that infer the material conditions and practices of the DAW*. The grain of the DAW is understood as a musical feature unique or idiomatic to the DAW and DAW-based practice. I argue that various compositional techniques can either conceal or foreground these sonic effects. The primary research question can thus be refined: *What compositional techniques can foreground the grain of the DAW?* The grain is an historically contingent and socially constructed category, constituted by its mediatic condition, the "complex web of practice and reference" between musical media (Sterne, 2012a, pp. 9–11). This negates conventional definitions of the grain, that often refer simply to the transductional noise introduced by a musical medium.

I also situate DAW-based compositional practice in historical and social context. I suggest that the DAW is the confluence of several music technologies and approaches to understanding music and sound, and the amalgamation of the once-separable occupations of the composer and producer/audio engineer (Moorefield, 2005). I understand this to be derived from two social constructs: a longstanding tradition that valorises the individual as the locus of artistic expression; and neoliberalism, a political framework which encourages the 'atomisation' (Boykoff, 2011) of workers at the expense of collectivism. Relatedly, the DAW's development introduces notions of individual control over sound. To this effect, conceptual metaphors are employed to understand the DAW as a medium enabling the control of sound as an infinitely-malleable substance. The notion of sound as sculpture, sound as a visualised (and thus quantified) medium, the DAW as a musical instrument (Bell, 2018), and the DAW as a recording studio in and of itself, are explored.

The DAW is used widely by amateur music-makers, popular musicians, and audio engineers, fostering a wide and diverse array of musical practices and genres. While this thesis cannot encompass all of these practices, it is hoped my encounters with the DAW via my experimental electronic music practice may shed some light on this near-universal yet rarely articulated condition of recorded music today.

1.1 Personal background

At a personal and fundamental level, this thesis seeks to explore and clarify my relationship with the world, as someone who makes experimental electronic music using a DAW. I have been using DAWs to make music for nearly twenty years. I have since released three small collections of music prior to *Thru*: two EPs on Australian labels, and one self-released mini-album. I predominantly make experimental electronic music, employing a technical vocabulary that is almost exclusively mediated by the DAW. I also occasionally do freelance work in audio engineering, sampler/synthesiser management for a local symphony orchestra, and work as a sessional lecturer, teaching around music composition and music culture. The DAW figures its way into all of these jobs.

My first experiences with a DAW were when I was about seven years old, when my Dad brought home a lite version of the popular DAW, Cubase.* I recall the head-scratching and tedium of him trying to interface the computer with a Yamaha piano keyboard we had at the time. With this setup, I made covers of pop songs and video game soundtracks I liked, being particularly fond of the orchestral sounds in the General MIDI available in Cubase. I dabbled in writing original music and improvising, but I felt too self-conscious doing it on the family computer. At 14, I was given a hand-me-down laptop, and I installed a pirated copy of Guitar Pro 5,† a guitar tablature and sequencer program. In my bedroom, bolstered by a growing collection of pirated music and software (a practice I do not participate in today but was nonetheless central to my development of interest in electronic music), I wrote songs in pop, post-rock, and progressive rock contexts for my friends and I to play. The songs became increasingly complicated and unplayable, and most were never realised outside the Guitar Pro environment. At 18, now a university student, I won some prize money which prompted some purchases for making electronic music—a copy of Logic Pro 9,‡ a condenser microphone, and a MIDI controller. Through tutorials on YouTube, I taught myself electronic music composition and production. I have pursued electronic music ever since, almost exclusively mediated by the DAW.

By 2014, I had become disillusioned by my electronic music practice. It was a shocking year for progressive politics and the arts in Australia, and I felt the music I was making wasn't responsive enough to the escalating political situation. I had become

* https://new.steinberg.net/cubase/
† https://www.guitar-pro.com/en/
‡ https://www.apple.com/au/logic-pro/

increasingly aware of the extent to which my practice, being a relatively solitary one, was influenced by a neoliberal tradition of independence and a do-it-yourself (DIY) ethic emblematic of the contemporary gig economy. The privileges I had enjoyed all my life had become clearer. I thought this problem was endemic amongst electronic music in general, and that very few electronic artists were musically engaging with these issues in a meaningful way. If they were, I couldn't hear it in their music. This led me to question the conditions under which electronic music is made, listened to, and understood—in other words, to "thicken the plot" by embroiling electronic music in social context (Bernstein, 2010).

This research is also informed by a handful of other observations about current practices and aesthetics in experimental electronic music. As I will explore further in Chapter 1.3.2, I noticed a tendency in experimental electronic music to venerate analogue, modular, or boutique forms of electronic sound generation. While this is not a problem as such, I perceived that this tendency towards "technostalgia" (Pinch & Reinecke, 2009; T. Taylor, 2001) involved neglecting newer technologies such as DAWs, which are nonetheless often crucial to experimental electronic music practice. As an artist, I feel a responsibility to critically engage with contemporary issues and the circumstances pertaining to myself and my peers, and I felt that the experimental electronic music 'scene' wasn't doing enough to engage with those issues. I am also drawn to the notion that artists can engage ethically and critically with the world by bringing their means of production into a symbolic alignment with ideal, ethical, and utopian imaginings of the world. In other words, at its ideal, art practice is best praxis in microcosm. This requires an open-minded and holistic understanding of my materials; a grasp of critical studies of culture, sociology, and politics; and a recognition of art's embedded and imbricated position therein. This research project encapsulates my efforts to bring my practice closer to this ideal form.

As I have suggested, the DAW is not a fashionable object of inquiry in experimental electronic music. It is common for artists to shy away from describing their use of the DAW, despite extolling the idiosyncrasies of a certain synthesiser or analogue instrument, an emergent trend Stuhl describes as "analog fetishism" (Stuhl, 2014). These descriptions come from a place of affection seldom expressed towards the DAW. I do not love DAWs either, despite my practice relying on them, but as this thesis suggests, the DAW's confluence of histories in music, sound, technology, software, and culture are incredibly deep and complex. I do not wish to adulate the DAW here, and there are good reasons

not to. Practices and cultures in which the DAW plays a central role are complicit in misogyny, racism, ableism, and other forms of exclusion (Abtan, 2016; Bell, 2015b; de Carvalho, 2011). It perpetuates a colonial narrative of technological mastery and control (Rodgers, 2010), and maintains egregious metaphors of domination, such as the terminology of 'master' and 'slave' (Diduck, 2018; Eglash, 2007). But the practices that have flourished under the auspices of the DAW are incredibly diverse and affirming, giving people who may have been excluded from recording studios on the basis of prejudice or financial burden a platform for musical expression. Many have described this as an effective 'democratisation' of music recording (Leyshon, 2009; Pras, Guastavino, & Lavoie, 2013; Sexton, 2009), and many have critiqued this use of the term (de Carvalho, 2011; Strachan, 2017). More work needs to be done by those DAW practitioners in a position of privilege and power, such as myself, to ensure that access to the techniques and uses of DAW production are equitable for all. It is with this optimism that such an equitability is achievable, and that an equitable musical landscape can yield heterogeneous and manifold musical practices, that I pursue this creative exploration of the DAW.

1.2 Research scope and definitions

A hard-and-fast definition of the DAW is difficult to state simply, due to the complexity and quantity of activity enacted within it. I may start with a list of the most popular DAWs available on the market today (in alphabetical order). When one refers to the DAW today, they likely mean one of the pieces of software shown in Table 1.

Like arguably all music technologies and practices, DAWs are concerned with organising sound and silence over time. In the DAW's graphical user interface (GUI), this is visualised diagrammatically on a two-dimensional plane. The horizontal axis represents time, with the beginning of the audio at the left, represented by the time 0:00, and extending rightward for any duration (in practice, this is up to six hours). This linear representation of time is usually called the *timeline* (Goodman, 2008), and is usually visualised through a grid-like guide that can both represent minutes-seconds time or bars-beats time when a tempo and a time signature are specified. A *playhead* represents the 'now' point. When one presses 'play,' the playhead scrolls along horizontally.

The vertical axis comprises discrete *tracks* or *channels*, a fundamental organisational

Developer	DAW	Website
Ableton	Live	https://www.ableton.com
Apple	Logic Pro	https://www.apple.com/logic-pro/
Apple	GarageBand	https://www.apple.com/mac/garageband/
Avid	Pro Tools	https://www.avid.com/pro-tools
Bitwig	Bitwig Studio	https://www.bitwig.com/
Cockos	Reaper	https://www.reaper.fm
Image-Line	FL Studio	https://www.image-line.com/flstudio/
MOTU	Digital Performer	http://www.motu.com/products/software/dp/
Presonus	Studio One	https://www.presonus.com/products/Studio-One
Propellerhead	Reason	https://www.propellerheads.com/en/reason
Steinberg	Cubase	https://new.steinberg.net/cubase/

Table 1: List of popular DAWs, their developers, and websites

unit of the DAW. Tracks function like containers for sound, in which sounds can be placed with respect to the timeline. Each track has a set of controls and parameters, the simplest one being volume. Tracks can also be individually processed by adding *plug-ins*, self-contained tools that process and manipulate incoming sounds on the track in some way. A commonly used plug-in is an equaliser (EQ), or more creative effects such as reverb. Plug-ins are sequential—they are placed one after another. They are also *real-time*, meaning that changes in a plug-in's parameters are instantly audible.

Two kinds of data can be placed in the timeline: digital audio and MIDI. Audio refers to sound files, of a variety of formats but most appropriately .WAV or .AIFF files, that can be recorded directly into the track or imported from elsewhere. MIDI (Musical Instrument Digital Interface) is a protocol that facilitates arranging notes, analogous to a piano keyboard, and control data with respect to time. MIDI doesn't generate sound by itself—it is primarily used to drive software instruments, which can include software synthesisers (often shortened to *soft synths*), software samplers, or some combination thereof. Software instruments take MIDI input and generate sound, also in real-time. MIDI control data can be used to 'automate' virtually any parameter in the DAW, or its plug-ins or soft synths, with respect to time. MIDI information can be recorded 'live' with a (hardware) MIDI controller or MIDI keyboard, and edited after the performance. Audio and MIDI have separate tools for manipulating and editing each.

These aspects make up the most fundamental components of all DAWs today. There are many features common to all DAWs that I have not articulated here (for example, auxiliary sends, sidechain processing), and each DAW has different methods and features, but they are all structured around these premises. In this research I try not to emphasise any individual DAW. This is partly a defensive mechanism. The DAW market is a dynamic and contested space, and DAW-based practitioners invariably have strong opinions on what DAWs are preferable over other. I am not interested in positioning myself within this market any more than possible. The DAW I use and know the most is Ableton Live 9, and while I have experience with several DAWs, almost all of my demonstrations in this research use this DAW. I otherwise have no affiliation with Ableton. It is unviable for me to use several DAWs for this project due to the costs involved. As such, my research approach emphasises generalisations pertinent to all DAWs in use today, rather than the specific idiosyncrasies of Ableton Live. I acknowledge that this platform-agnostic approach may reduce, or present bias towards, my immanent and intimate experiences with my DAW of choice that might be unique, however general relations are a more universally applicable way to address the research question.

I have alluded to the unique technical, material, historical, and cultural complexity that the DAW and its practices pertain. I believe that DAW studies, for lack of a better phrase, will soon become an important aspect of contemporary musicology and technology studies. That said, there is only so much a thesis such as this can achieve, and must be limited in its scope. My main intentional constraint was a decision not to seek primary interviews with makers of DAW-based music or DAW designers. While this would be an important next step for DAW studies, it would require a vastly different set of methodologies that I feel would negate my compositional practice-as-research. Several practices and technologies I have ignored or paid very little attention to, such as tracker software (exemplified by software such as Renoise*) and audio editors (such as Audacity,† Adobe Audition,‡ or iZotope RX§). Referenced scholarship around early DAWs in the 1980s and 90s are thin on the ground, and I have undoubtedly missed important technological milestones.

I have limited the stylistic and aesthetic scope primarily to experimental electronic music, ambient music, and experimental electronic dance music. I acknowledge that

* https://www.renoise.com
† https://sourceforge.net/projects/audacity/
‡ https://www.adobe.com/au/products/audition.html
§ https://www.izotope.com/en/products/repair-and-edit/rx.html

much scholarship around DAWs is carried out in terms of popular music practices (Brøvig-Hanssen, 2013). Stylistically, however, popular music has little in common with the focus of this inquiry. I have also largely ignored the practice of mastering engineering. Although undoubtedly artistic and employing DAWs, mastering involves a less compositional and more technical skillset than the average maker of DAW-based music.

1.3 Contextualising the research

I understand this research as drawing from and contributing to two fields in particular: sound studies, and experimental electronic music. Sound studies comprise a broad field of inquiry concerning practices and social forms relating to sound and music, while experimental electronic music is a stylistic tradition of music practice concerned with developing musical processes and aesthetics that challenge perceived status quos or hegemonies. Here, I will further describe these fields and situate this thesis within them.

1.3.1 Sound studies

Sound studies is described by Jonathan Sterne as an interdisciplinary field "that takes sound as its analytical point of departure and arrival. By analysing both sonic practices and the discourses and institutions that describe them, it redescribes what sound does in the human world, and what humans do in the sonic world" (Sterne, 2012b, p. 2). Sterne writes that practitioners of sound studies—*sound students*—often enact their inquiries in conjunction with other fields. "Most sound students are also something else: historians, philosophers, musicologists, anthropologists, literary critics, art historians, geographers, or residents of one of the many other postwar 'studies' fields" (Sterne, 2012b, p. 3). Pinch and Bijsterveld describe sound studies as a way to expand on the possibilities of music studies. The field is concerned with "the material production and consumption of music, sound, noise, and silence, and how these have changed throughout history and within different societies, but does so from a much broader perspective than standard [music] disciplines" (Pinch & Bijsterveld, 2004, p. 636). It encompasses several methodologies, and it can emphasise any of the practices or conditions concerning sound, hearing, and listening.

Sound studies, or what has been termed *sound culture* (LaBelle, 2010) and *auditory culture* (Bull & Back, 2003), has been the grounding framework for exploring the material and cultural conditions of the technologies on which music is created, consumed, and

distributed. These studies are diverse, often proceeding from Paul Théberge's landmark study *Any Sound You Can Imagine* (1997). Georgina Born's account of technological developments at IRCAM (Born, 1995), Dave Tompkins' study of the vocoder (2011), Michael Bull's work on the iPod (2012), Andrea Bohlman et al's study of tape (2017), and several studies on the synthesiser (Goldmann, 2015; Pinch & Trocco, 2004; Rodgers, 2010) are prominent examples.

A canonical text in this area is Sterne's *The Audible Past* (2003a), exploring the cultural conditions that enabled sound reproduction technologies to emerge throughout the 19th and 20th centuries. The research questions he suggests, in some ways, inspire this thesis:

> If there is some social magic in the digital transmission and storage of sound, it is not to be found in the brute fact of the technology itself. Instead, we would have to ask the same questions of CD, DVD, or MP3 players, hard-disk recorders, wireless telephones, and digital-audio workstations that we asked of the telephone, the phonograph and the radio. Why *these* technologies, *now*? What social forms, what social relations, do they encapsulate? If they are part of a reorganization of sound, then where is that shifting boundary between sound and not-sound this time? (pp. 336–337)

Several studies have drawn from these questions to articulate the significance of digital sound technologies. Diduck's cultural history of the MIDI protocol is instructive on this point: "the history of electronic music technology, like the histories of other new devices, formats, and media, is one of consolidation, compression, miniaturization, and standardization" (2018, p. 203). Technologies like MIDI also enable "the technical ability to solitarily create an entire compositional sound in an affordable home studio … [contributing] to a recent culture of auteurist electronica artists" (Diduck, 2015, p. 60), a point which I investigate further in Chapter 3. Diduck's work is particularly useful here for pointing out that music technologies are not devoid of politics, despite their tendency to be regarded as apolitical or neutral by the musicians who use them.

Studies that focus on the DAW are situated across various, scattered disciplines, and have mostly emerged very recently. Greg Milner's 2010 history of recorded music in *Perfecting Sound Forever* is particularly notable, describing the emergence of Pro Tools and pointing to its radical upheaval of musical traditions and principles:

> "mixing (and editing), as opposed to recording (and letting it be), is the dominant mode of music today. The rise of DAWs is of a piece with the rise

> of sampling and sequencing, as well as digital sound files and iPods all of which contribute to music's reduction into a universal code that can be recombined at will. Call it the Pro Tooling of the world, a musical condition of which Pro Tools itself is merely the most obvious example" (Milner, 2010, p. 301)

In this condition of 'the Pro Tooling of the world,' the musical emphasis is "all about arrangements, orchestrations, the mix—not so much about playing and recording" (Milner, 2010, p. 346). Although the findings of this thesis suggest that this "musical condition" promoted by DAWs is more complex than simply enabling all recorded sound to be controlled and manipulated, it is an important early attempt to situate DAWs within historical and musical context. Other historical studies include Prior's analysis of DAWs (2008) suggesting that the popular reception of the DAW reprises old anxieties around authenticity, and Leyshon's study of recording studios (2009) concerns the economic shifts resulting from the penetration of DAWs and music software into the recording studio environment and subsequently home studios.

Several studies and critiques of the DAW have emerged from fields associated with human-computer interaction and New Interfaces for Musical Expression (NIME), although these are largely technical and less concerned with humanities-based approaches. Duignan's thesis on DAW-based practice (2008) analyses the activity of music producers and their interaction with DAWs, suggesting a need for DAW designers to employ better methods of data abstraction, management, and redundancy. Duignan also interrogates the DAW interface and its overt visual analogies to the multitrack tape console. This interface design principle is often critiqued by NIME theorists, who also understand the DAW as a hegemonic medium whose limitations can be overcome through new instrument designs. According to Breinbjerg, new computer-based musical traditions such as live coding attempt to transcend "the rigid metaphors of commercial music software" (2011, p. 166) which he claims does not address "the true nature of the machine" (p. 175). Magnusson suggests that "the digital audio workstation, through its affordances of copying, pasting and looping, assures us that it is perfectly normal to repeat the same short performance over and over in the same track" (2009, p. 171), and this can represent "the fossilization of music into stylistic boxes" (2010, p. 62). Davies suggests that DAWs, increasingly shipping with their own synthesisers, samples, and plug-ins, "leads to producers composing in a seemingly hermetic environment," encouraging normative compositional strategies (Davies, 2017, pp. 15-16).

Several studies of DAWs have emerged very recently, in academic and music journalism contexts. The *Journal on the Art of Record Production* has published many works that historicise and interrogate production practices, including some that primarily revolve around DAW-based practices (Bennett, 2012; A. Williams, 2012), although these largely come from commercial production contexts rather than amateur or experimental contexts. The work of Adam Patrick Bell is notable from a pedagogical context (Bell, 2018), analysing the way amateur musicians in home environments navigate the steep learning curve of DAW-based practice. Bell suggests that music educators are struggling to catch up with the rapid development of DAWs, resulting in DAW designers becoming *de facto* music educators (2015a), and critiques the suggestion that DAWs 'democratise' music, providing evidence that those who participate in online music production communities are mostly white and male (2015b). Similar claims are echoed by de Carvalho (2011) and Tavana (2015).

Robert Strachan's recent study of DAW-based creative practice precedes, and in some ways undercuts, my own thesis, providing exemplary data on the cultural milieu in which the DAW emerges and techniques of music composition enacted in the DAW (Strachan, 2017). I found this study quite late in the process of compiling this thesis, and while there is some overlap of concepts explored, their proximity is indicative of the growing significance of studies that centre DAW-based practice.

1.3.2 Experimental electronic music

The stylistic tradition in which I situate my practice and research can broadly be described as *experimental electronic music*. Defining such a field is notoriously difficult (Demers, 2010), and the established texts that use the term offer little concision on what precisely it means (Holmes, 2008; Lucier, 2012). Myatt understands it as music that may use similar tools to academy-affiliated electroacoustic and computer music but are "not supported by the academic economy" (Myatt, 2008). Noted for its heterogeneity of practices that "reject the notion of single, unified genres," Myatt uses Mark Fell's term "oppositional and independent practice" to describe artists who work "in opposition to received musical aesthetics" such as electroacoustic music, spectromorphology, or Western art music traditions. The extent to which experimental electronic music is actively shunned from the academy in 2019 is questionable—indeed, many of the artists I refer to in this overview are masters graduates or doctoral students.

I understand experimental electronic music, perhaps optimistically, as music derived from unusual methods, mostly involving electrical sound sources, that attempts to explore what *else* music can be. This practice is enacted in opposition to a perceived status quo or hegemony, of which many have emerged and receded. Experimental electronic music often draws together many stylistic traditions—in my practice, for example, I draw from traditions including ambient music, electroacoustic music, noise, drone music, soundscape composition, and electronic dance music. Experimental electronic music is more than just 'weird sounds,' rather it is an ethos of inquiry, towards new forms, expressions, and contexts in a musical framework.

A common (but not universal) thread among contemporary experimental electronic music is a preoccupation with the instruments and materials involved. This often involves deconstructive approaches to instruments, foregrounding their flaws, contingencies, and idiosyncrasies, to generate new material. I have observed that in much experimental electronic music of the 2010s, these instruments have typically been vintage synthesisers, modular synthesisers, drum machines, hardware samplers, or other instruments of some rarity or idiosyncrasy compared to ubiquitous software synthesisers and DAW technologies. Proponents of experimental electronic music in this vain who have been influential on my practice include Taylor Deupree (2012), Helena Hauff (2018), Tim Hecker (2011), and Brett Naucke (2014), and Oneohtrix Point Never's early work (2009), among countless others. This also coincides with renewed interest in artists working with (and against) these instruments in the past, with reissues of works by Suzanne Ciani (2016), Roland Kayn (2017), Pauline Oliveros (2012), Laurie Spiegel (2012, 2019) and Jaap Vink (2017) among many others garnering critical praise.

To be clear, this enthusiasm for analogue instrumentation is not a problem as such, but the DAW rarely receives the same scrutiny via the methods of experimental music. I do not wish to single out the artists above for neglecting to address DAW-based practice, as if that were a deficit. I do not have a vendetta against analogue equipment—my practice is heavily informed by that zeitgeist—but I am interested in using tools that are new, developing *now*, and have been critically overlooked. DAWs may retain hegemonic status in the creation of recorded music, a status quo which should rightly be countered, but the way it is ignored from scrutiny may also be interpreted as an emergent status quo in experimental electronic music aesthetics, the questioning of which motivates this research.

Experimental electronic music methods around instrumental exploration are exemplified by artists like Canadian composer Sarah Davachi, whose work explicitly centres the exploration of instruments in her work, taking sparse analogue and acoustic instrumentation and foregrounding their barely-perceptible instabilities. "I'm pretty keenly interested in musical instruments in their role as both objective sound sources and meaningful historical objects," Davachi says. "I think that the sensual thing-ness, if I may get Heideggerian for a brief moment, of most musical instruments and their inherent tones has been largely eclipsed by narrative and connotation" (15questions, n.d.).

This push to expose the 'inherent' qualities of an instrument is echoed by American composer Holly Herndon, albeit focusing on the laptop as her instrument. Herndon's work asks what forms unique to the laptop can emerge, typically a dizzying array of self-programmed signal processing, mangled voice, and hard-hitting beats (Herndon, 2012, 2015). "I really think it's a fallacy the way people cast technology in this [cold, clinical] light and then cast acoustic or even analogue instruments in this warm, human light," Herndon says, "because I don't understand what would be more human between a block of wood and something that was also created by humans, for humans" (Cliff, 2012). By questioning ubiquitous cultural assumptions about technology, Herndon lays the groundwork for a critical appraisal of the laptop's possibilities, and this forms a critical part of her broader political motivations of techno-utopianism. Despite Herndon's practice undoubtedly being mediated heavily by the DAW, her experimental practices focus on the laptop as a broad category rather than the software it utilises.

This materialist, exploratory attitude is particularly prominent in the work of British sound artist Mark Fell, one of very few artists actively and explicitly critiquing DAWs in their electronic music practice. Working primarily with and against dance music idioms, Fell is known for his deconstructive, austere, and often whimsical approaches. A pertinent example of this approach comes from his album *Manitutshu* (2011), the genesis of which began with an invitation to make presets for Native Instruments' software synthesiser Razor.* When Native Instruments refused all forty of Fell's presets, he created the album *Manitutshu* exclusively using those presets (Fell, n.d.).

Two interviews particularly articulate his understanding of the DAW as a hegemonic, normative medium. In an interview for the Quietus, Fell says:

* https://www.native-instruments.com/en/products/komplete/synths/razor/

> "Western musical frameworks, I would argue, imply an understanding of time that is ideologically related to first person linear perspective. This model has been shown to be connected to specific beliefs about the world and ourselves. In the Western tradition music is thought of as events moving from future to past through an infinitely narrow now point. This now point is where 'we' are at. We could contrast this, however, by referring to anthropological studies of different cultures and musical traditions. For example, Australian aboriginal [sic] society has a very different view of time and space, and of the relationship between self and the world. Studies have shown a preference for a spatial over temporal view of the self and the world. Here time is seen as an infinite now. Similarly, aboriginal [sic] musics can be seen to sustain and constitute this worldview. My specific interest is in how timeline-based audio and MIDI editing environments imply a linear view of time with an infinitely narrow now point, whereas programming structures and the paradigm implicit in Max/MSP (for example) offers different temporal frameworks" (Doran, 2013).

Another of Fell's approaches to interrogating the DAW are concerned with compositional structure. In a 2015 cover feature for The Wire, Fell describes his side project Sensate Focus, exploring the deep house idiom using Digital Performer, a DAW of which Fell was unaccustomed. His use of a DAW "forces consideration of the temporal arc of a track, something Fell flipped by turning it into inescapable, lingering moments, meditations on 'the texture of the experience, as opposed to the overall journey and the conclusion.'" Fell also remarks of the pencil, a prominent symbol of the DAW that features in all Sensate Focus record sleeves, "the idea that the pencil was the tool, which was where all the activity happened. The pencil obviously recalls the phallic symbol—the word's the same!" (Barrow, 2015, p. 32). Fell's observations are central provocations for this thesis, and an important precedent for using the methods unique to experimental electronic music to interrogate the material conditions, practices, and politics of the DAW.

As Fell demonstrates, experimental electronic *dance* music, an admittedly loose term I use to describe dance music practices that 'deconstruct' its tropes (Baines, 2018) or otherwise employ an experimental and counter-hegemonic ethos, is increasingly incorporating techniques unique to the DAW in a less self-conscious way. British artist Sophie Xeon, performing and producing under the moniker SOPHIE, emphasises both a saccharine artifice and a caustic sound design aesthetic in her music. Her album *Oil of Every Pearl's Un-Insides* (2018) is unabashedly digital, "an instantly identifiable musical

vernacular based on synthesized bubble sounds, brash treble, deep bass, and distended, anonymous vocals" (Geffen, 2018). The vast majority of the album is synthesised "from scratch" (Ravens, 2018), employing digital techniques such as physical modelling, additive synthesis, vocoding, and an extremely crisp approach to drum production that makes no pretensions towards analogue synthesis. Another act approaching DAW-based practice in a unique manner is Second Woman, the American duo of Turk Dietrich and Joshua Eustis. Grounded in dance music, Second Woman's tracks feature fluctuating tempi, a parameter that can be automated in the DAW. Describing tempo "as an instrument," their compositions ebb and flow while retaining much of the ethos and timbral palette of electronic dance music. The opening track "100407jd7" from their self-titled debut album (2016), makes this particularly overt. Describing this practice, Dietrich says that "getting off the grid and working in the DAW without lines, without a grid, and having tempo be malleable, for me leads to a more interesting experience as a listener" (Wilson, 2017). Here, conventional DAW practice is seen to be synonymous with working to 'the grid,' a visual guide enabling users to easily synchronise sound placement to a defined tempo. In turn, this is seen to be restrictive, and performing tempo as an instrument is seen to liberate those restrictions.

Thus far I haven't discussed a genre of practice sharing much in common with experimental electronic music and its tradition of foregrounding the material conditions of its origin. Glitch was a popular aesthetic in experimental traditions from the 1990s to the early 2000s, making prominent the incidental or accidental sounds unique to digital-based sound practices. In a canonical paper on the subject, Cascone writes that "the technique of exposing the minutiae of DSP errors and artifacts for their own sonic value has helped further blur the boundaries of what is to be considered music" (Cascone, 2000). This shares much in common with my mission statement to foreground the material conditions of the DAW. But times change, and glitch has lost some of the fervour and urgency it once had. My rationale for not incorporating an overtly digital, 'glitchy' aesthetic in my compositional practice is mostly in the interest of keeping up with the times rather than an overt rejection of the methods and ethos it pioneered.

1.4 Methodology

1.4.1 Practice-led research strategy

I have described experimental electronic music as music driven by an ethos of counter-hegemony and resisting perceived status quos in music practice, using experimental methods to create new forms. With caveats, this may be formalised as practice-led research, described by Gray as "research which is initiated in practice, where questions, problems, challenges are identified and formed by the needs of practice and practitioners … [and] the research strategy is carried out through practice, using predominantly methodologies and specific methods familiar to us as practitioners" (Gray, 1996). As a DAW practitioner for about ten years with an artistic interest in critiquing the materials and processes of music-making, this methodology involves the composition of new works employing DAW-specific processes, and all the complex machinations that creating new artwork involves. Practice-led research is characterised by its privileging of subjectivity and reflexivity as the research unfolds, in which research questions emerge from the chaotic flux of making and reflexivity, and are answered through the creation of art, and reflection on both the artwork and the work of art.

The object of research, the grain of the DAW, is a phenomenon difficult to quantify, explore in isolation, or approach through traditional positivist scientific enquiry. Practice-led research enables the researcher to reflexively and intuitively shift their practice as appropriate, approaching the object of research from different angles. These multi-threaded and dynamic approaches are "complex, adaptive systems on the edge of chaos," embracing "messiness, randomness, non-linearity, adaptivity, feedback, and so on" (Gray & Pirie, 1995).

Practice-led research acknowledges the researcher's identity and their embeddedness in the social milieu of the current moment. Artists and artist-researchers inevitably make creative decisions that are informed by their environment and influenced by their responses to it. Artists also have preferences for certain styles and genres over others for many reasons. My practice is grounded in the stylistic tradition of experimental electronic music, a diffuse collection of practices whose aesthetic prerogatives are multivalent and always in flux, but disposed to asking certain kinds of artistic questions over others. A project such as mine, which investigates the material and sonic intricacies of a medium, is typical in experimental electronic music practice, however exploring the DAW in such a way is substantially rarer. I also acknowledge my identity as a young, cisgendered, able-

bodied white male, brought up in an upper-middle-class household and residing in an Australian inner-city locale. As I have pointed out earlier, these identifications have been privileged in DAW-based practice since its inception, to the exclusion of women and gender-diverse people, people of colour, Indigenous people, and people with disabilities (Bell, 2015b; de Carvalho, 2011). While I don't consciously navigate my identity and privilege in this research, it may be coded in my actions and responses to certain artistic problems and questions.

I understand the act of working with materials as *inherently* productive, that is, material intervention produces knowledge. Bolt describes the particular forms of knowledge artists can access through direct handling and interaction with their materials as "material productivity." Bolt suggests that "the materials [of art] are not just passive objects to be used instrumentally by the artist, but rather, the materials and processes of production have their own intelligence that come into play in interaction with the artist's creative intelligence" (Bolt, 2010, pp. 29-30). Materials are not inert but possess agency to influence or 'suggest' new directions for artistic practice to emerge. Material productivity acknowledges the distributed agency of artist-researcher and material, while also deflecting notions that the artist-subject or material-object are unified wholes or binary categories in creative practice. As a material production of knowledge, practice-led research thus concerns itself with "articulating what has emerged or what has been realised through the process of handling materials and ideas, and what this emergent knowledge brings to bear on the discipline" (p. 34). This material productivity is central to my research methodology. The knowledge imparted from material productivity can be difficult to describe in words, but they are nonetheless only accessible through a practice-led research methodology.

The importance of serendipity cannot be understated in this research project. Serendipity has traditionally played an important role in experimental electronic music, historically encouraging open-ended experimentation and improvisation at times when such practices were not common in Western art music. Many of the most important breakthroughs in this research came about through such open-ended exploration, prompting various shifts in my approach. Practice-led research enables setting up the conditions for creating serendipitous experiences and for unexpected outcomes to emerge, which in my practice usually means improvising with a software synthesiser, tweaking its parameters until an unusual or provocative sound emerges.

Reflection is an important component of any practice-led research project, and is often considered in two parts: reflection-*in*-action and reflection-*on*-action (Haseman, 2010). Reflection-in-action can instigate shifts in method or prompt new avenues to explore. During my immersion in composition, I wrote a journal on my laptop to reflect on the work I was doing at that moment. This auto-ethnographic journaling took place in a number of text editing apps, with additional pen-and-paper notes, organised by immediately timestamping every entry. They refer to particular sounds that I had saved with unique names, often nonsensical but organised by version number (e.g. "*wdtyjo v02.aif*"). As my work is mostly conducted on a laptop with internet connection, thus just a few clicks from social media and other time-sinks, this journaling did not withdraw myself from immersion in practice any more than usual.

Reflection-*on*-action takes place after immersion in practice, whether that is day-to-day or after the project has finished. It enables reflection "in a more distanced way, on how practice operates as knowledge production, and how the outcomes of studio enquiry emerge in relation to established knowledge and broader institutional discourses" (Barrett, 2010). The combined journals made during immersion in practice, some 30,000 words in total, were then analysed some months afterward, comfortably removed from the creative process, in preparation for this exegesis.

The journal also serves to document my experiments, trials and errors of composition that led to the finished work. In order to be explicit and transparent about my processes, I was very diligent with saving versions-in-progress, 'scrap' DAW files, recordings, and other data and ephemera generated through practice. Approximately 85 gigabytes of such files were amassed over the composition period.

1.4.2 "Opening the black box"

I approach this research from a social constructivist perspective, the notion that technologies and their constituent practices can be interpreted as embodying social and cultural practices. This approach is advocated by Sterne, whose definition of technology is one I acknowledge in this research:

> At a basic level, a technology is a repeatable social, cultural and material process (which is to say that it is all three at once) crystallized into a mechanism or set of related mechanisms.… They are structured by human practices so that they may in turn structure human practices. They embody

> in physical form particular dispositions and tendencies – particular ways of doing things (Sterne, 2003b, pp. 376–377).

Sterne suggests that "sound technologies are social all the way down," and that "to understand even the simplest sonic or musical practice, we have to open it out into the social and material world from which it comes" (Sterne, 2003a, pp. 337–338).

These understandings are preceded by a movement in the social sciences loosely grouped under the 'social construction of technology' (SCOT) moniker (Bijker, Hughes, & Pinch, 2012). One metaphor prominently used in SCOT studies is the *black box*. The term is used in scientific and computing fields to refer to a system that can be conceptually reduced to something that transforms an input to generate an output. The manner by which the system in the black box works is not necessary for the broader system to be understood—all that matters is that a transformation takes place. The black box signifies an opaque boundary between the means and practices of production of some thing or action, and the people and things that receive or scrutinise said things or actions. "Opening the black box" became one of the goals of SCOT studies, investigating how supposedly-neglected systems work and how they are rendered opaque, particularly in terms of the social practices that are essential to their operation.

Several methods are proposed that go some way towards opening these systems. A technique for opening the black box is Clifford Geertz's *thick description* (Geertz, 1973). A thick description of a phenomenon goes beyond its material and ontological circumstances and instead involves considering all manner of social practices. A tendency in ethnographic studies, Geertz claims, is for the ethnographer to obscure or omit their own field notes from their formal studies, despite them maybe pertaining and describing complex social practices. In this research, I aim to be comprehensive in my thick descriptions of my actions and situating them in some sort of context.

Another technique for opening the black box is historical analysis (Pinch, 2008). Situating some system or technology as descendent from various historical epochs dispels any suggestion that technologies emerge *ex nihilo*, outside of culture or society. Histories of music technology written by practitioners have often resorted to rattling off of a laundry list of technologies released in chronological order, with emphasis on their increasing technical capacities. The four-track, then the eight-track, then the 24-track, and so on. Such histories valorise the expansion of technology as inevitable, and inevitably good. Little is said about how practices adapt, let alone what kinds of people and cultures are

promoted through such practices. Historicising technology without historicising its constituent practices perpetuates the convenient but erroneous myth that technologies develop in a bubble outside of society—a black box. Although my situating of DAW-based compositional practice in historical context does make a point of saying when certain DAW technologies were released, I emphasise the social factors that underpin their emergence.

1.5 Thesis overview

After this introduction, I describe in detail the locus of my inquiry, a theoretical framework I term *the grain of the* DAW. I define this as *the sonic effects in a recorded musical work that infer the material conditions and practices pertaining to the DAW*. This framework draws from several thinkers, but particularly from Roland Barthes' essay *The Grain of the Voice* (1977), in which he privileges an embodied relation to an original sound source—"the body in the voice as it sings." Pierre Schaeffer and Michel Chion's notion of the grain is decidedly more objective, denoting a sonic quality that refers to either metaphors of coarseness, or sounds introduced in the recording that are extrinsic or exterior to the original sound source. I also invoke Alexander Galloway's notions of interfaces and *intrafaces*, which suggests an interpretation of media and artwork as the intersection of an internal, material logic; and an external, social and cultural logic. I argue that the grain of the DAW is not simply audible as noise exterior to the music, such as the grain of a record (surface noise) or the grain of tape (wow and flutter, tape hiss, and saturation). Rather, the grain of the DAW emerges through understanding the intricacies of practice associated with the DAW, and these can be foregrounded or concealed through compositional techniques.

Chapter 3 situates the practice of composing music in the DAW through historical analysis. I approach this from a social constructivist perspective, articulating the evolving forms of labour associated with creating recorded music. The DAW is understood to be an historical accumulation of practices associated with synthesis, sampling, recording studio practice, live performance, as well as political movements such as neoliberalism. Throughout its development and emergence, DAWs have been understood through metaphors that are not necessarily *a priori* assumptions, such as the metaphor of the DAW as a musical instrument. I examine these metaphors in closer depth, and suggest that these, along with renewed interest in analogue electronic instruments, contribute to a presiding aesthetic of concealing the grain of the DAW.

Chapter 4 turns toward my own compositional practice, outlining the various experiments I conducted with the intent of foregrounding the grain of the DAW. I describe a three-phase process of composition and experimentation: sound design, arrangement, and acousmatic listening. These experiments ranged from exaggerated explorations of automation, unconventional uses of send and return tracks, negotiating spatiality, and foregrounding the DAW through autobiographical narratives. The experiments involved negotiations between material intervention and aesthetic concerns, often emphasising the former and failing to find use in the context of making the album.

Chapter 5 describes and explores the making of my album *Thru*, the creative component of this thesis, with regard to these experiments and other techniques that I argue foreground the grain of the DAW. I dissect each of the six tracks individually, referring to my journaling and previous DAW sessions as data to establish these techniques. I conclude the thesis by summarising the theoretical framework of the grain of the DAW, the compositional techniques that foreground them, and suggesting avenues for further research.

2 Theoretical Framework

I have previously described the primary research question underpinning this thesis as *What compositional techniques can foreground the grain of the DAW*? This chapter seeks to clarify this theory of the grain of the DAW. Through synthesising the work of Roland Barthes, Pierre Schaeffer, Michel Chion, and Alexander Galloway, I define the grain here as *the sonic effects in a recorded musical work that infer the material conditions, practices, and idioms associated with its creation and transmission*. Applied to the DAW then, the grain of the DAW is an analytical framework for locating elements of DAW-based music that are unique or idiomatic to the DAW. This definition is differentiated from a conventional understanding of the grain as noises associated with the transmission of sound, such as the hiss of a tape or the surface noise of a vinyl record. I describe a tendency in sound studies to valorise noise as a marker of sonic difference, which thus posits perceptually noise-less media like the DAW as indifferent or homogenous. I suggest that a better way of perceiving the grain of the DAW is through a better understanding of the practices associated with DAWs. In the context of electronic music composition, DAW practices are informed by production techniques utilised via 'prior' technologies multitrack tape machines, hardware synthesis, outboard effects, recording studio practice, and others. I will argue that these inherited tropes and practices take on new forms in their realisation in the DAW and DAW-based practices, and that these forms are audible as such.

2.1 The grain

The term *grain* has been described variously across sound and music studies, but two definitions are especially influential: one from Roland Barthes' influential essay *The Grain of the Voice* (Barthes, 1977), the other as described by Pierre Schaeffer and Michel Chion (Chion, 2009; Schaeffer, 1966).

Barthes introduces the concept of the grain in an attempt to rescue musical criticism from "the poorest of musical categories: the adjective" (p. 179). To describe music in such a subjective manner is to reduce it "to the dilemma of either the predicable or the ineffable," and to prescribe music an economic function and a "natural or magical" mode of signification (p. 180). Rather than simply rehashing standard musical criticism sans adjectives, Barthes suggests "it would be better to change the musical object itself, as it presents itself to discourse, better to alter its level of perception of intellection" (pp. 180-181). This new object is the grain, "the very friction between the music and something

else, which something else is the particular language (and nowise the message)" (p. 185), and it in this friction that "the materiality of the body speaking its mother tongue" (p. 182) is revealed. In Barthes' words:

> The 'grain' is the body in the voice as it sings, the hand as it writes, the limb as it performs. If I perceive the 'grain' in a piece of music and accord this 'grain' a theoretical value (the emergence of the text in the work), I inevitably set up a new scheme of evaluation which will certainly be individual—I am determined to listen to my relation with the body of the man or woman singing or playing and that relation is erotic—but in no way 'subjective' (it is not the psychological 'subject' in me who is listening; the climactic pleasure hoped for is not going to reinforce—to express—that subject but, on the contrary, to lose it). The evaluation will be made outside of any law, outplaying not only the law of culture but equally that of anticulture, developing beyond the subject all the value hidden behind 'I like' or 'I don't like' (Barthes, 1977, p. 188).

Barthes deploys this term to compare two singers, Charles Panzéra and Dietrich Fischer-Dieskau, the former exhibiting the grain of the voice, the latter subjugating it. Notably, Barthes' appraisal of these singers is through their recordings, not live performance. Panzéra's only recordings were in the 1920s and 30s, before the LP, "leaving a void that for the present generation is filled, unjustifiably, by Fischer-Dieskau," as Barthes says (cited in Dunsby, 2009, p. 113). Despite the lower fidelity of Panzéra's recordings—a different kind of grain to which I will return—Barthes can hear perfectly the grain of Panzéra's voice, "the tongue, the glottis, the teeth, the mucous membranes, the nose," seemingly lacking in Fischer-Dieskau.

While Barthes' essay has profoundly influenced the fields of sound and music studies, a hard and fast definition of the grain is elusive, "couched in synesthetic metaphor and in the rhetoric of adulation" (Boutin, 2016, p. 164). "It is an idea," Dunsby writes, "that many people apparently feel they can understand instinctively, regardless of its original meaning. It seems to make intuitive sense" (Dunsby, 2009, p. 113). Its association with embodiment and erotics, its ineffability, no doubt fuels its allure. The grain in this sense is a sonic quality that enables an embodied relation to a sounding body, even when that body is not present, only recorded.

Barthes' grain points specifically to the human body, not the technological apparatus that is the focus of my inquiry. To make this transposition, I will consider Pierre Schaeffer and Michel Chion's definition of the grain. Schaeffer and Chion define the grain as a

timbral characteristic of sound objects. Under the rubric of *musique concrète*, a genre preceding electroacoustic and acousmatic musics that Schaeffer was instrumental in composing and theorising, recorded sounds need not be comprehended by the sources of the sounds they insinuate.

Pierre Schaeffer introduces the concept of the sound object as a constitutive component of *musique concrète*, an early predecessor of electroacoustic and acousmatic musics. Sound objects are not heard as "indices of objects and events in the world" (Kane, 2012, p. 440)—presumed to be the "natural" mode of listening (what Schaeffer calls *écouter*)—rather for the qualities of the sounds as such, separately from any other significations. This listening-without-signification, reduced listening (what Schaeffer calls *entendre*, or *écouter reduite*), is the means of access to sound objects. The sound object as an organisational unit of music forced a re-imagining of how music ought to be structured, prompting Schaeffer's *Traité des objets musiceaux* (1966), a vast text taxonimising the many possible characteristics of sounds themselves in great detail. One of these characteristics is the grain, described by Michel Chion in his companion text *Guide to Sonic Objects* as "a microstructure of the matter of sound, which is more or less fine or coarse and which evokes by analogy the tactile texture of a cloth or a mineral, or the visible grain in a photograph or a surface" (Chion, 2009, p. 171). Schaeffer defines it as the "overall qualitative perception of a large number of small irregularities of detail affecting the 'surface' of the [sound] object" (cited in Chion, 2009, p. 171).

In Schaeffer's taxonomy of sounds, the grain is a criterion of any sustaining sound object, although this should be qualified further to be useful in this project. The sound object and its obligation of reduced listening have drawn sharp criticism. "By positing the sound object as the ontological grounding of musical experience," Brian Kane writes, "Schaeffer commits himself to an ahistorical view about the nature of musical material." This involves making "essentialist" claims about recording technology, as producing "little more than an abstract glimpse into an ancient originary experience" (Kane, 2014, pp. 37-40). For Schaeffer, this is the point—sound objects are at least an attempt at objective descriptions of sounds as such—but by negating the practices and histories of technologies that enable this perception to emerge, "the 'voice' of technological things is silenced" (p. 40). Given this project is concerned with exactly this "voice," the criterion of reduced listening can be discarded, although I use it as a technique for assessment of my compositions, explored further in Chapter 4.

One example of grain that may seem obvious to today's listeners and musicians is *transductional noise* (Link, 2001), the noises introduced by recording media and playback formats such as the pops and clicks of a vinyl record, the hiss and frequency roll-off of an old cassette tape, or the distortion artefacts ambiguously described as 'warmth' of a vacuum tube amplifier. Chion alludes to this via the analogy of "the visible grain in a photograph or a surface," but says nothing of its analogue in music. This omission supports Kane's claim that sound objects erase their technological origins, although Schaeffer and Chion's invocation of "surface" suggests an awareness of the sonic artefacts that may be unintentional but are nonetheless intrinsic to it. Emmerson makes the connection between transduction noise, surface, and grain—between Schaeffer and Barthes—explicit: "Distortion, tape hiss, vinyl surface noise, low bit rates—all in their time were considered transitional to something 'better'. But they are also 'the grain of the system', a signifier (a signature) of its idiosyncrasy and character, but also its 'time stamp' (its timbre)" (Emmerson, 2007, p. 84). This sentiment, conflating transduction noise with character and difference, is a common one associated with "analog fetishism" (Stuhl, 2014), and is a pertinent issue for this project since DAWs may be characterised by their lack of perceptible, intrinsic transduction noise. As I will argue, this does not presuppose that the DAW does not have a grain, only that the grain is enacted elsewhere and is emergent through understanding the practices of DAW-based composition.

Before synthesising these definitions of grain fully, I look to the work of cultural theorist Alexander Galloway. The grain metaphor implies a friction or roughness between two things or processes—between music and language for Barthes, between sound object and surface for Schaeffer and Chion. Another word for this is *interface*, or better yet, *intraface*. Galloway, in the book *The Interface Effect* (2012), describes the conventional understanding of the interface as "an 'agitation' or generative friction between formats" (p. 31). But this convention, descendent from Marshall McLuhan's famous dictum that "the content of a medium is always another medium," does not tell the whole story of interfaces. This logic renders interface and medium as one and the same. The interface has "its own autonomy, its own ability to generate new results and consequences" (pp. 31-32). More markedly, interfaces are not things or media, but always an effect, more an event than a locale; "it is that *moment* [emphasis added] where one significant material is understood as distinct from another" (p. 32).

To describe the complexities and frictions inside media, Galloway uses the term *intraface*, an interface internal to the medium. In artworks, a primary intraface is between

what Galloway calls the *edge* and the *centre* of the artwork, sloganising that "the edges of art always make reference to the medium itself" (p. 32). "The existence of the internal interface within the medium is important," Galloway writes, "because it indicates the implicit presence of the outside within the inside. And, again to be unambiguous, 'outside' means something quite specific: the social" (p. 42). This opens media and artwork up to new forms of critique and analysis, as explicitly of the world and never acting in isolation.

Galloway uses this shorthand binary of *edge* and *centre* to understand artworks in terms of their engagement with the medium they incorporate. Artworks that gesture towards their centre are those that perpetuate an internal logic that makes little overt reference to its medium. Stated differently, centre-facing artworks do not exhibit self-awareness of their status as artworks. One example of this is recorded music premised on what Brown calls the "transparency perspective," in which "a sound recording is understood on the model of a transparent windowpane" (Brown, 2000, p. 361). Brøvig-Hanssen also makes a similar observation, in which the mediating effects of sonic technologies of music can be understood by varying degrees of 'transparency' or 'opacity' . In this perspective, a musical performance is documented with a degree of objectivity, and presented *as* a musical performance—the listener then expects to treat the performance as such, and any sonic effects of the recording medium itself are considered flaws that detract from the immersion in the hypothetical performance space. Artworks that gesture towards their edge, by comparison, draw distinct attention to their medium, rejecting representation or documentarian approaches in favour of forms and expressions that are unique to that medium. *Musique concrète* is one example of early artwork that foregrounds the media and technologies of music recording, and rock music is often touted as an early musical genre whose primary artefact is the record and not the performance (Zak, 2001, pp. 12-13). Whether artworks gesture towards their edge or centre is a matter of artistic and compositional technique. More specific to the DAW, artists like Mark Fell, as I have described in Chapter 1.3.2, gesture towards the edges in particularly prominent fashion.

I propose that *the grain is the edge of the intraface*, the material and social conditions of the artwork, conceptually differentiated from its internal coherence. This grain is an audible "sonic effect," what Kane calls "the result of the interaction of a source and a cause. Without this interaction, there is no emission of sound" (Kane, 2014, p. 8). To summarise and synthesise, in Barthes we hear the grain as an affect derived from the sonic identifier of an originary body. In Schaeffer and Chion, we hear the grain as a surface teeming with difference, a "signature of matter" and materiality. And in Galloway, we hear the grain at

the edges of the artwork, an invocation of the medium's status as such. A working definition of the grain can be reached: *the grain is the sonic effects in a recorded musical work that infer the material conditions and practices associated with a sonic medium*.

This definition does not refer to transductive noise, or any of the definitional limitations of recording media often described as fidelity. This is intentional, and I will argue that extricating the audible artefacts of the transmission of recorded sound from the grain is necessary to understand the grain of the DAW.

2.2 The grain after noise

The conventional definition of fidelity is the degree to which a reproduction of some artefact or phenomenon is verisimilar to its original (Guberman, 2011). High-fidelity sound equipment is more verisimilar to its original, and low-fidelity sound equipment less so. The term *fidelity*, synonymous with faithfulness, assigns a moral value to sound reproduction—to be faithful to a piece of music is to act virtuously, to be unfaithful signifies transgression. Technology companies and hi-fi salespeople exploit this in the way they frame their new audio technologies as one step closer to perfect fidelity, a virtuous immersion in the music (Milner, 2010; Newton, 2016). Also coded in this definition is the notion that there is an original artefact that can be replicated. For music recordings, this has traditionally been the live performance. Returning to Brown's notion of the "transparency perspective," for much of recorded music history, live performance has been regarded as a more authentic, more 'real' evocation of music (Bolter & Gromala, 2006; Brøvig-Hanssen, 2013; Glasgow, 2007), and recorded music need only capture the live performance with as little overt mediation as possible.

This notion has been problematised because for as long as recordings have existed, performers have adapted their performance techniques for the recording apparatus (Sterne, 2003a). The limitations of early recording equipment meant that these adaptations to be adequately captured by the recording, for the sake of sounding like a live performance, were often severe and alienating (Horning, 2013). The conventional notion of fidelity is complicated further by recording conventions that have developed over the decades, in which "current practice dictates that a sound recording should have more treble than would be heard in the real situation" (Chion, 1994, pp. 98-99), or the loudness war and the widespread acceptance of dynamic range compression as a 'natural' sound processor (Katz, 2004). Recordings are always-already constructions.

Despite the general pretence towards 'transparency' in recordings, the sonic effects introduced by earlier recording technologies have since come to be valorised in an era of digital formats with negligible surface noise. Wallach describes "the grain of the record" as "a 'space of encounter' between music and 'noise'—embodied and disembodied sounds—whereby the latter can become aestheticized as a valued component of the listening experience" (Wallach, 2003, p. 43). To illustrate the point, he evokes Simon Frith's critique of the compact disc (CD). For Frith, CDs draw the listener "to the surface of the track, the moment of musical production, with no reference to its context or surrounding noise" (Frith, 1988). "According to Frith," Wallach writes, CD-based music is "devoid of sonic traces of the playback medium itself—there is no 'distraction', hence no grain," and this is experienced by Frith as a "musical deficit" (Wallach, 2003, p. 43).

Under the definition of the grain that I am suggesting, Frith's statement fails to historicise and understand fidelity as a socially contingent phenomenon, placing high-fidelity sound at the end of history from which it cannot be recovered or expanded. This inclination abounds even today, thirty years after Frith's critique, as a vinyl and cassette resurgence continues to grow (see Harvey, 2017; Hendricks, 2016). An understanding of the grain needs to extend beyond noise.

Noise is not just valorised amongst record collectors, but in academic contexts as well. Where once noise was seen as wholly negative, particularly in Schafer's landmark text *The Soundscape* (1977), it is now often considered a site of difference and heterogeneity. Sterne critiques Schafer's pessimism around noise as "a distinctly authoritarian preference for the voice of the one over the noise of the many" (Sterne, 2003a, p. 343), while McCartney and Thompson describe it as erasing sound practices where noise is an affirmation or silence is lethal (McCartney, 2010; Thompson, 2014). "Noise might be said to truly make us visible," writes LaBelle (2010 p. 62), "a dramatically important platform for renewing political subjectivity and community today" (p. 82).

I am cautious of this close coupling of noise and difference in the context of studying the DAW, because it implies that silence, a lack of noise, is coupled with homogeneity, authoritarianism, or indifference. I believe this notion stems from the equation of noise, the material sonic effect; with noise, the term that figuratively denotes 'extraneous' information or stimulus. Neither of these definitions sit well as a way to describe the grain of the DAW. The little noise that is generated in DAW-based composition is negligible, and in most cases barely perceptible. DAW practice can be characterised by a unique

sense of intentionality, where if there are extraneous or serendipitous sounds, these are accepted as nonetheless part of the composition.

This is not to say that DAWs are noise-less in the literal or figurative senses. Bit-rate dithering and sample rate conversion introduce noise, albeit at barely perceptible levels, and different DAWs perform additive maths differently, such as when calculating the amplitude of the two channels when the panorama is engaged (Leonard, Levine, & Buttner-Schnirer, 2012). The possibilities for generative music, improvisation, serendipity, and other chaotic methods of working in the DAW may also lend themselves towards this figurative understanding of noise. My suggestion is that focusing on the comparative noise and silence of DAWs doesn't have the scope to contain the forms of difference and diversity that makes DAW-based compositional practice unique. As Guberman writes, we live in a post-fidelity world, where sound quality "is no longer the primary focus of products and consumers, but one concern among many" (Guberman, 2011, p. 431).

2.3 Listening to the grain

If we are listening for the grain of the DAW, which adds virtually no extraneous sound, then what are we listening for? It is not enough to define the grain of the DAW by what it lacks. I would like to suggest that a way to listen for the grain of the DAW is through a better understanding of the practices associated with DAW-based composition and production.

The aesthetic value of transductional noise derived from analogue recording media, Wallach suggests, may come from a place of nostalgia, in which older recordings may prompt an affective response, evoking "memories of pleasure derived from the 'grain of the record'" (2003, p. 33). Profound experiences with recorded music are not necessarily detracted by trasnductional noise—they may signify a time and place as much as the material conditions of a recording, as Emmerson suggests when he considered timbre to be a "time stamp" (Emmerson, 2007, p. 84). They also recall experiences supposedly external to the listening experience—placing the stylus on the record, rewinding the tape, cleaning the CD. These practices are broadly understood to be integral to the experience of listening to recorded music on those media. These practices are not necessarily limited to 'physical' media however, and intimate listening experiences may certainly be had with MP3 players and streaming platforms.

The process of making those recorded works, however, are conventionally obscured. As I will describe in the next chapter, the recording studio and its practices are typically concealed and hidden from listeners. The creative decision-making in in-studio composition, recording, and mixing are seldom communicated, and if they were, then their subjective and aesthetic complexity makes such communication difficult. Nonetheless, inferences can be made as to how a recording was made, and what kinds of processes were enacted. These inferences will always be at least partially speculative, and reliant on context established outside of the recorded music itself. These speculations become more well-informed when the practices around recorded music are better understood and experienced. This places the audio engineer-researcher in a privileged position, where they may make inferences that untrained listeners cannot.

DAW-based compositional practices are also conventionally concealed from the listener, but arguably less broadly understood. They comprise many disciplines, including sound design, mixing, arrangement, and data management. Within each of these disciplines are highly complex, subjective, and aesthetically-motivated activities, such as manipulating plug-ins, automating parameters over time, editing, managing and creating MIDI information, bouncing and exporting tracks, and many others. This is complicated further by the fact that often, they are all enacted by one person. Speculating on how these practices are enacted in a given musical work is difficult and tenuous, but as a composer whose practice is exclusively mediated by the DAW, I can draw from this experience to make inferences about DAW-based compositions that I believe make them unique from their analogue predecessors. Thus, I suggest that the grain of the DAW may be better articulated and perceptible with a broader understanding and experience of the practices involved in DAW-based compositional practice.

This is not to suggest that the grain of the DAW is equally apparent in all DAW-based compositions. In describing Galloway's notion of the intraface, I have suggested that such compositions may gesture towards their centre, its interior compositional logic; or its edges, its exterior social, political, and mediatic associations. Recorded works that enact the latter include those in which the recording enacts the "transparency perspective," where any overt mediation of the representation of the live performance is minimised. This perspective remains dominant in many genres of music, such as classical, folk, and jazz, all of which centre live performance as its primary mode of expression. That said, recordings that are more overtly mediated by the recording apparatus may also gesture towards their centre. The notion of the *soundstage*, for example, is a mixing convention that

suggests that each sound or instrument in a recording is 'placed' in a three-dimensional acoustic space (Dockwray & Moore, 2010). The listener is ostensibly placed front of stage. This quasi-representational convention is common throughout recorded music (Zagorski-Thomas, 2010). Another example is the use of plug-ins that emulate the processing characteristics of tape, vinyl, vacuum tube amplifiers, and other media (Bennett, 2012; Sterne & Rodgers, 2011). In the DAW, I regard these as *compositional techniques*. Because DAW-based compositional practice comprises many disciplines including audio engineering and production, the decision to mix a work with lo-fi emulation, or to represent a hypothetical space using reverb, is a compositional one, insofar as a usually singular music-maker is exercising authorship over all of the tasks associated with making recorded music.

2.4 Summary

The purpose of this theoretical framework I term *the grain of the DAW* is to clarify the condition that this thesis primarily explores. I am drawn to clarify this framework for a few reasons. There is a lack of perspectives which centre the sonics of DAW-based compositional practices that do not simply describe them by what they lack, that is, transductional noise. In order to articulate this, I have offered an expanded definition of the terms on which *grain*, and to an extent *fidelity* and *noise*, differentiated from how they are typically understood. This re-definition attenuates the idea that the grain is an objective sonic effect prior to perception, and amplifies the practices associated with sound media. I have suggested that one method of interpreting artworks is via Galloway's notion of the intraface, the interaction between an artwork's centre, the internal logic and coherence of an artwork; and its edge, its engagement with external politics, sociality, and the the medium's material condition. Although no artwork can be situated exclusively at either end of this binary—how can an artwork not have an edge or a centre?—they can be interpreted as gesturing one way or another. I suggest that recorded music that gestures towards its centre *conceals* the grain of the DAW, while recorded music that articulates the medium's unique conditions and politics *foregrounds* the grain of the DAW. This thesis is primarily concerned with articulating compositional techniques that perform the latter. To situate this practice in context, in the next chapter I historicise DAW-based compositional practice and its techniques for concealing the grain of the DAW.

3 Situating DAW-based compositional practice

This chapter historically narrativises and overviews the emergence of DAW-based practice as a near-universal condition of recorded music. Approached from a social constructivist perspective, I understand its emergence primarily in terms of labour, the forms of work performed in the creation of a recorded music composition, and the way work is redistributed as the cultural and technological milieu evolved. Traditionally, in popular music, this comprised a schism between the recording technician and the musicians they were recording. The technician approached an aesthetic of 'transparency,' of recording performances with a sense of realism. In other forms, such as experimental music and amongst certain popular musicians, a condition of "phonographic auteurism" emerged that eroded the technician-musician dichotomy and opened up all aspects of recording practice to artistic intervention. Electronic music instrument designers increasingly consolidated around the notion of an 'all-in-one' instrument for recorded music creation, first with the MIDI protocol, and then with MIDI sequencing software; while in professional recording studios, hard-disk digital recorders were utilised for the promise of greater control for the audio engineer (Leyshon, 2009).

Around 1990, digital audio recording and MIDI sequencing software began to converge in the home computer, and recorded music composition became increasingly centralised in the home. The traditional recording studio, once the locus of recorded music creation, became an increasingly untenable business model, while smaller-scale 'project studios' multiplied. I understand these developments as 'atomisation,' an effect of neoliberalism which encourages labour forms in which individuals work by themselves on an increasing number of tasks (Boykoff, 2011). Recently, this has taken forms such as incorporating technologies external to the DAW to both consolidate and delegate compositional control, with movements such as *controllerism* and the recent popularity of modular synthesis contributing to these developments.

At various points in the DAW's emergence, metaphors have been deployed to articulate various aspects of DAW practice that are not necessarily *a priori* assumptions. Metaphors I explore in closer depth include the DAW as a musical instrument, the DAW as a word processor, and the DAW as a tape machine. I suggest that these metaphors, and the atomised status of DAW-based practitioners, contribute to a condition whereby DAW practices are often highly idiosyncratic and concealed, affecting perceptions of the grain of the DAW.

3.1 Technician, musician, auteurism

The recorded music industry emerged around 1890 in North America, coinciding with the invention of phonographs and gramophones. From then until approximately 1925, the technique of recording was acoustic, in which performers gathered around a horn, amplifying their sound waves and etching directly onto a rotating wax cylinder or shellac disc. There was no capacity for editing a recording after its inscription into a rotating shellac disc or wax cylinder. The sound recordist managing these devices, often with little understanding of acoustics, developed idiosyncratic and ad hoc techniques to experiment with greater fidelity and definition: "by necessity and inclination, [acoustic sound recordists] could best be described as systematic tinkerers" (Horning, 2013, p. 12). Sound recordists typically worked alone, and due to the fierce competition between labels and the assumption that higher fidelity yielded higher sales, they were protective of their approaches. This precipitated the erection of barriers between their equipment and the space for the musicians. While this served the more technical purpose of isolating the sound of the recording apparatus from the recording, it also isolated the techniques of sound recordists from the musicians, lest they divulge the tools and techniques of one recordist/label to a rival. This physical and metaphoric binary—technician and musician—continues to resonate through much of recorded music history.

Although technical acumen played its role in sound recordist practice, it also involved affective labours such as diplomacy, astute people skills, and an ability to navigate through artistic egos to turn over a good recording. Sound recordists were low in the hierarchy of the recording industry, so despite a singer being paid handsomely for their labour, a sound recordist received considerably less. Recordists would direct musicians' performance techniques, such as where to stand, to move backwards when playing or singing louder, and other movements unnatural in a live performance setting—directives that many musicians were uncomfortable performing. Despite their low place on the hierarchy, recordists were the ones blamed for poor quality recordings, even if the artist's obstinacy was a more appropriate reason. This was the source of "a major tension between art and technology that defined acoustical recording" (Horning, 2013, p. 16). For this reason, many musicians approached recording studios with apprehension, comparing them to a clinical laboratory that rendered in stark relief all the imperfections that would go unnoticed in a live performance. Other musicians, however, grew confident with the recording process, such as singers who would intuitively learn when to move further from

the horn depending on their loudness and pitch. Katz (2004) suggests that those performers who adapted to the idiosyncrasies of recording were generally more commercially successful, and even had large-scale impact on performance practice, both in and beyond the recording studio. Katz uses the example of Fritz Kreisler, whose deep vibrato would have been considered garish and gaudy, but given the relative instability of phonographs and gramophones in the early 20th century, this vibrato masked the 'wobble' of the disc, and the deep vibrato became standard performance practice for strings players.

With the onset of electrical amplification and recording from the mid-1920s, the divisions between recordist and musician deepened, both in terms of the required knowledge of electronics and their spatial separation. Sound recordists in the electric era increasingly had electrical engineering backgrounds, maintaining and modifying their recording apparatus. Moreover, the rooms used for recording began to favour acoustical dryness, a precedent that would enable the development of artificial reverb as a way of controlling the perception of space as an aesthetic technique (Sterne, 2015).

With the golden age of radio in the 1930s, and the emergence of sound in film, sound recording practices and their apparatuses became increasingly complex and idiosyncratic. This may have fuelled the collective organisation of American recordists into the Audio Engineering Society in 1948, that established protocols and conventions for technological development in the industry. It also began to specify distinctions in labour to accommodate the growing demands of sound recording, especially with the onset of electromagnetic tape in the late 1940s, with its capacities for editing and higher definition. As recording technology expanded in complexity, distinct aspects of the record production process were distributed across several specialisations:

> By the 1960s, in fact, the individual who controlled the console during a recording was no longer necessarily a 'recording engineer', and was more likely referred to as a 'mixer', the term used in the film industry. Soon the titles of 'mixer', 'recording engineer', and 'technician' had become almost interchangeable, at least to those outside the industry. But each had a distinct function, and in major record label studios where union rules prevailed, they represented different jobs. Yet they were all aspects of what was once the solo recordist's job, a job that had expanded and diversified along with the industry as well as the technology (Horning, 2004, p. 715)

This unionised mode of production is described by Kealy as the "craft-union mode" of recording (Kealy, 1979). Aesthetically, audio engineers in the craft-union mode were principally concerned with maintaining "concert hall realism," rather than recording techniques that may be perceived as unrealistic or overtly mediated. An authentic and faithful representation of the musician being recorded, as if it were a live performance, was the preference. This coincides with Brown's notion, as discussed in the previous chapter, in which privileged "the transparency perspective," in which the recording medium's grain was to be concealed as much as possible. In this model, recordings are considered to be *documentary*, even *immersive*, as if they function as re-enactments of a musical performance and the listener positions themselves within the representation of space that the recording captures. Of course, as Brown and others have pointed out, this perspective is a chimera, because music recording employs techniques that are very distinct from the live performance they claim to reproduce, thus recordings are always-already mediated. However, "the art of engineering an illusion" of a live performance (Horning, 2013, p. 33) remained an important aesthetic, and this continues to the present day in many genres of practice that privilege performance, such as classical music. Technological developments in recording media, and techniques associated with them, developed along with these lines of maximising this illusion of 'perfect sound' (Milner, 2010).

Contrasting with Kealy's idea of the "craft-union mode" of recording is the "art mode," in which audio engineers forwent the stability of unionised labour for more thorough, collaborative artistic co-creation of recorded music. In this mode, techniques unique to recording are used to create effects impossible or impractical in a live performance, breaking from the tradition of transparently representing the concert hall experience. Those who could enact this kind of recording practice were typically wealthy or enjoyed institutional backing. "The success with which an artist-craftsman moves from his craft world to an art world," Kealy writes, "depends to a large degree on whether it is possible for him to abandon the established institutions and rewards of the craft world and successfully finesse the career contingencies of the art world" (Kealy, 1979, p. 23). Raymond Scott (Holmes, 2008, pp. 161–164); Les Paul and Mary Ford; Bebe and Louis Barron; Halim El-Dabh; Delia Derbyshire; and avant-garde *musique concrète* and *elektronische Musik* composers such as Pierre Schaeffer, Karlheinz Stockhausen, and Vladimir Ussachevsky, are all regarded for their early pioneering of compositional techniques vis-á-vis recording in the 1950s and beyond.

The 1960s was a turbulent time for recorded music aesthetics. The long-playing (LP) vinyl record gained traction, becoming the "*de facto* formal structure for creativity in rock music" (Zagorski-Thomas, 2010, p. 206), and famous acts like The Beatles and Glenn Gould swore off live performance in favour of studio-based practices. "Phonographic auteurs"—musicians who had full authorial and technical control over all aspects of recorded music composition while seldom performing live despite earning their reputation through live performance (Hammons, 2013)—emerged as mythologised popular-cultural icons, the likes of which included The Beatles, Brian Wilson, Scott Walker, Frank Zappa, and many others.

The artistic treatment of the recording studio or electronic music studio, uniquely from composing for live performance, is described by Morton Subotnick as "music as a studio art" (Subotnick, 2008), and by Brian Eno as "in-studio composition" (Eno, 1983). In these practices, the studio is a laboratory for innovative, recording-specific practices to emerge. In Subotnick's case, the 'studio' is not much more than a tape machine, microphones, and a synthesiser, while for Eno a studio more akin to commercial music production is the locus of his practice, with its mixing console, multitrack tape machine, recording room and control room. Eno uses the metaphor of the studio composer as a painter or sculptor to propose a studio-led practice where "you're working directly with the sound, and there's no transmission loss between you and the sound—you handle it." This allowed the composer to "infinitely extend the timbre of any instrument." These circumstances inform his innovations in the ambient music of *Ambient 1: Music for Airports* (Eno, 1978) and others. Eno's ambient music was instrumental in shifting studio-based music practice away from simply representing live performance. A technique Eno uses for this is emphasising sounds' artificiality, pushing their timbres beyond comprehension through overt signal processing. As Tamm writes, "the total sound [of *Music for Airports*] is profoundly 'artificial,' in the sense that it has been created by artifice, by the systematic application of human intelligence to a set of sounding materials" (Tamm, 1989, p. 148).

While Subotnick's and Eno's impressions of studio-based practice tended to be collaborative, they were mostly celebrated as the work of an individual *artist-prophet*, a term used by Osborne (1999) to describe the tendency to valorise singular artists, thereby erasing the communities that nurtured them. This dynamic has antecedence in the organisation of the symphony orchestra. Osborne suggests that the symphony orchestra is "culturally isomorphic," deriving its activities in part from the cultural imperatives of the day. The emergence of the symphony orchestra in the 19th century coincided with an

intellectual movement of "transcendental idealism that emphasised the primacy of the spiritual and intuitive over the material and empirical" (Osborne, 1999, p. 71), contributing to the emergence of the archetype of the "artist-prophet," the valorised individual composer or conductor for whom musicians were objectified as subjects of total control. Technologies and instruments have crystallised around this ideal throughout the centuries. Diduck, for example, suggests that one instantiation of this is what he describes as *claviocentrism*, a cultural logic that centres the keyboard as the foundation on which Western music's organisation and comprehension is built upon. At the keyboard, the individual was the locus of artistic expression, a notion confirmed by the fact that many of the 'great composers' of European history, particularly in the Romantic era, were prodigious keyboard players (Diduck, 2018, pp. 33-63).

The archetype of the autonomous, individual artist-prophet as an idealised form of artistic production was prominent in technological development throughout the late 1970s and 1980s. 'All-in-one' musical devices employing then-nascent digital technologies promised maximal individual expression, an ideal appealing to wealthy artists. Milner suggests that the first DAW was the Synclavier I of 1977–8, a computer capable of synthesis, sequencing 16 tracks of additional synthesised sounds simultaneously, and generating print-out scores from its terminal, "the first [sequencer] to use multiple tracks so that a piece of music with several 'instruments' could be replayed at will" (Milner, 2010, p. 311). This was followed in 1979 by the Australian-developed Fairlight CMI, with similar functionality. Both instruments were extremely expensive and comparatively rare—the Synclavier II retailed at the time for £120,000 (over AU$1 million as of 2019) and only about 70 were made—but their impact on music creation was disproportionately significant. Many 'phonographic auteurs' including Herbie Hancock, Stevie Wonder, Kate Bush, and Peter Gabriel all touted the sampling capacity of these instruments and contributed to the timbral palette that established several sonic tropes of recorded popular music in the 1980s (Fink, 2005; Lavengood, 2017). In the documentary *Bring on the Night* (Manson & Apted, 1985), Gordon Sumner, better known by the alias Sting, re-enacts the process of writing the track "We Work the Black Seam" (Manson & Apted, 1985) using a Synclavier. Beginning by punching a rudimentary drum beat into the front panel, he layers seemingly improvised synthesiser melodies on top. He reaches over to the Synclavier's terminal, edits a sequence of notes that appear as traditional Western notation, before printing off the compositions presumably for his band to perform. Although this excerpt is obviously staged, it can be considered a performance of

what would become tenets of DAW-based compositional practice: sequencing, synthesising, arranging, all enacted *in the box*, in real-time, and by an individual.

Throughout the 1980s, the electronic music instrument market flooded with digital synthesisers, samplers, and MIDI sequencing software. The 1983 advent of the MIDI protocol, and its subsequent implementation in popular instruments like the Yamaha DX7 synthesiser and the E-mu SP-1200 sampler, had the capacity to bring these instruments into alignment and synchronisation, albeit hampered by uneven implementations of the protocol and a steep learning curve for amateur users (Diduck, 2018). MIDI was enthusiastically taken up by the emergent home computing market, especially Apple's Macintosh computers introduced in 1984 and the Atari ST introduced in 1985. MIDI sequencing software, such as Mark of the Unicorn's Performer and Professional Composer, Steinberg's Pro-16, and C-Lab's Creator (a predecessor of Emagic and later Apple's Logic) among the earliest adopters whose products later evolved into fully-fledged DAWs by the early 1990s.

3.2 Controlling, conjuring, and manipulating sound

At the professional and commercial end of the music-making spectrum, hard-disk recorders were developed from the early 1980s for recording studios and film sound design, operated by a computer terminal. Watson (2016) writes that when DAWs started to infiltrate recording studios, they were generally seen positively, "giving greater ability to professional engineers and producers to manipulate sound creatively." Early renditions of the technology included Synclavier's Post Pro; custom-made systems for film such as Lucasfilm's SoundDroid; and various idiosyncratic recording systems at academic institutions (Milner, 2010, p. 329).

The proprietary and often custom-made nature of these early DAWs make it difficult to historicise the practices associated with them. However, there are other factors at play in the relative lack of information around them. Early DAWs were prestige tools, sold on the premise of speed, accuracy, efficiency, and control, all of which propelled the digitalisation of many industries from the 1980s onward. As prestige objects that required specialist knowledge, they also suggested a mystique or aura, one that Meintjes documents in her ethnography of recording studio practices in South Africa. She writes that the recording studio can be understood as a "fetish," which Chun understands as an object to which some event or practice is falsely attributed to it, often imbued with mystical notions

(Chun, 2011, pp. 49-54). Meintjes, approaching the studio with little knowledge of the processes of audio engineering, is told by the resident audio engineer, "I reckon that however much you watched [me], you'd never know what's *really* going on. You could never know what's in my head when I make adjustments on the desk" (Meintjes, 2012, p. 275). While this could be put down to an expression of experiential and "tacit knowledge" required of audio engineers (Horning, 2013), or even an ontological condition of sound, Meintjes interprets this as an unwillingness to break the carefully-constructed mystique of the recording studio space:

> The lure of the studio, like that of the fetish, lies in the coupling of the promise of the revelation of its secrets with the knowledge of their infinite unknowability. Within the material body of the studio and of the bodies within it—its technology, its artists, and its sound—there is a wealth of ever-discoverable pathways. The boundaries of the creative possibilities in the studio are unfixed, unknown, and unending. There is always another possible way to change the sound. This is both a physical and metaphysical condition (Meintjes, 2012, p. 278).

The same construction of the studio as fetish—mythologised as a form of magic by institutions such as Abbey Road Studios (Bennett, 2016)—may also be applied to the DAW. This is alluded to by Digidesign co-founder Evan Brooks who, reflecting on the impact of DAWs on the music industry, says that "it used to be all about capturing a moment. Now, you can *build* a moment" (Selvin, 2001, emphasis added). DAWs construct and maintain this mysterious "metaphysical condition" of sound being endlessly pliable in a number of ways. One is through a condition called *suspended inscription* that Kirschenbaum explores in relation to word processing. Word processors are frequently used as explanatory metaphors to describe the possibilities of DAWs (Bell, 2015a, p. 46; Burgess, 2014, p. 134; Prior, 2009, p. 86; Strachan, 2017), most of which revolve around this condition, in which the act of writing is separated from the act of inscribing or printing onto a palpable object, such as paper or an MP3. With the typewriter, writing and inscribing are one in the same—if one wanted to make a change to the manuscript, they would have to re-type the document, or get creative with scissors and correction fluid, thus exposing the 'flaws' or the history of the manuscript in its process of editing. Word processing software breaks this relationship. Editing and rearranging, once difficult to achieve meaningfully on a typewriter, could be enacted almost instantly and with significantly less labour:

> Word processing thus emerges as a combination of the indefinite suspension of inscription *and* the allure of realtime editorial intervention—in stark contrast to the typewriter, where writing and editing were of necessity mechanically separate operations. In effect, the writing surface becomes a Möbius strip, with the writer both writing and not-writing at the same time—which is to say, writing in multiple locations simultaneously, one text made of light and another stored indefinitely prior to printing onto yet another (even more durable) surface. Word processing was thus the simulation *and* the suspension of writing—"writing" and "not-writing"—instantaneously manifest and yet potentially endlessly postponed (Kirschenbaum, 2016, pp. 47–48).

Leaving aside the question of whether recording sound is an act of *writing* or *inscription* (a problematic proposed in Bohlman & McMurray, 2017), in the contemporary DAW, a similar condition exists under a different name: *in the box*. The term originated simply to describe work performed 'in' a computer, which in the 1980s may have been little more than editing one audio track, but over the next decades it would come to incorporate many more practices associated with recorded music.

It is towards this totalising condition of suspended inscription, towards the *in the box*, that the DAW developed throughout the 1990s. Although Digidesign advertised Sound Tools, their first fully in the box audio editor, as "the first tapeless recording studio" in 1989 (Milner, 2010, p. 337), personal computers lacked the capacity to stream and edit multiple audio tracks simultaneously. Pro Tools, released in 1991, used hardware digital signal processing to enable four tracks of simultaneous digital audio. Opcode's Studio Vision, released in 1990, was the first software to incorporate both audio editing and MIDI sequencing, and comprising arguably the first interface similar to what is found on modern DAWs (Ludwig, 2016; Sound on Sound, 2010). Many MIDI sequencing and audio editing software companies, following the lead of Opcode, combined the two throughout the 1990s. Many of the DAWs consolidating in this manner, such as Cubase, Logic, Digital Performer, and later Pro Tools, remain popular today.

Many of these sequencer designs, and indeed the MIDI protocol itself, were informed by a tendency to valorise real-time 'performance' and immediate audition as part of the compositional process. Many samplers and synthesisers were as much devised as performance instruments than strictly studio-based tools—the Linn 9000, an early hardware MIDI sequencer, featured pressure-sensitive pads for 'finger-drumming,' a lineage continued on Akai's MPC line of sampler-sequencers introduced in 1988. This

valorisation of real-time feedback became especially prominent as development of digital signal processing increased. Peter Gotcher and Alan Brooks, while developing new presets for an early E-mu sampler, noted that when they applied digital EQ (of their own design) to a sample they had recorded, they had to wait for the calculations to complete before hearing the result. Brooks calls this a "modified listening cycle":

> If you're working in an analog recording studio, you listen to a sound in real time—if you want to add high end you grab the EQ knob for 'high,' and turn it up … You tweak and you keep on tweaking until your brain tells you to stop. It's a cyclical process between your hands and your brain" (Gotcher, cited in Milner, 2010, p. 329).

Digital signal processing, at least in its early iterations which precluded real-time feedback, severed this immediate connection. Real-time control, or "tweakability" (Perlman, 2003), was regarded as essential to audio engineering, granting the DAW the status of a musical instrument, a metaphor I will discuss later. Digidesign's early implementation of real-time audio effects may have arguably helped Pro Tools become an industry leader, although Steinberg's Virtual Studio Technology (VST), released for development in 1996, had the most cross-platform compatibility and enabled the emergence of the third-party plug-in industry.

Somewhat contrasting with Meintjes' perception of studio practice as an "infinite unknowability," DAWs brought graphs, tables, and real-time visualisations of sound to recorded music creation. DAWs are inherently visual despite their constructions as a site for conjuring and controlling sound. Sterne writes that visuality has traditionally been understood as a more objective or rational sensory perception, compared to sound and aurality, which is subjective and prone to bias (2003a, p. 15). He suggests that this stems from a tendency in the sciences to understand that "sound had … to be seen in order to be quantified, measured, and recorded" (p. 45). Visualisation of sound, be it the 'piano roll' metaphor commonly found in MIDI sequencers, the 'timeline' arrangement of a composition, waveforms, or spectrographs, played into the promise of the digital to offer unsurpassed accuracy.

Magazine advertisements of DAWs in the 1990s provide a clear example of this fetishisation of visuality. Figure 1 shows an advertisement in *Mix* for Emagic's Logic Audio 2.0, circa 1994. A dizzyingly busy screenshot highlights many ways one can control sound through its visualisation. A video frame at the top right suggests that this DAW

Figure 1: Advertisement for Emagic's Logic Audio 2.0 in MIX Magazine, September 1994, p. 155.

enables film scoring, affirming its intended audience to professional musicians and composers. The overwhelming narrative here, to return to Brooks' sculpture metaphor, is that one can 'see' sound from multiple perspectives, using many metrics and graphs.

Another convention of control is the deployment of the metaphor that *the DAW is an instrument* (Bell, 2018). Alperson writes that musical instruments are "musically, culturally, and conceptually situated objects" (2008, p. 42) in which "the idea of the musical instrument seems central to our understanding of the musical art" (2008, p. 37). One common interpretation of musical instruments is that they are "extensions of [musicians'] bodies … [and] embodied entities" (2008, p. 40), intimate technologies of aesthetic self-expression. This stems from a classical understanding that instruments are "entirely passive," ideal instruments being ones that "perfectly respond to the impulses of performers" (Tresch & Dolan, 2013, p. 290). Musical instruments such as the piano have

long been associated with individual expression, a particular and imitate relation between human and tool.

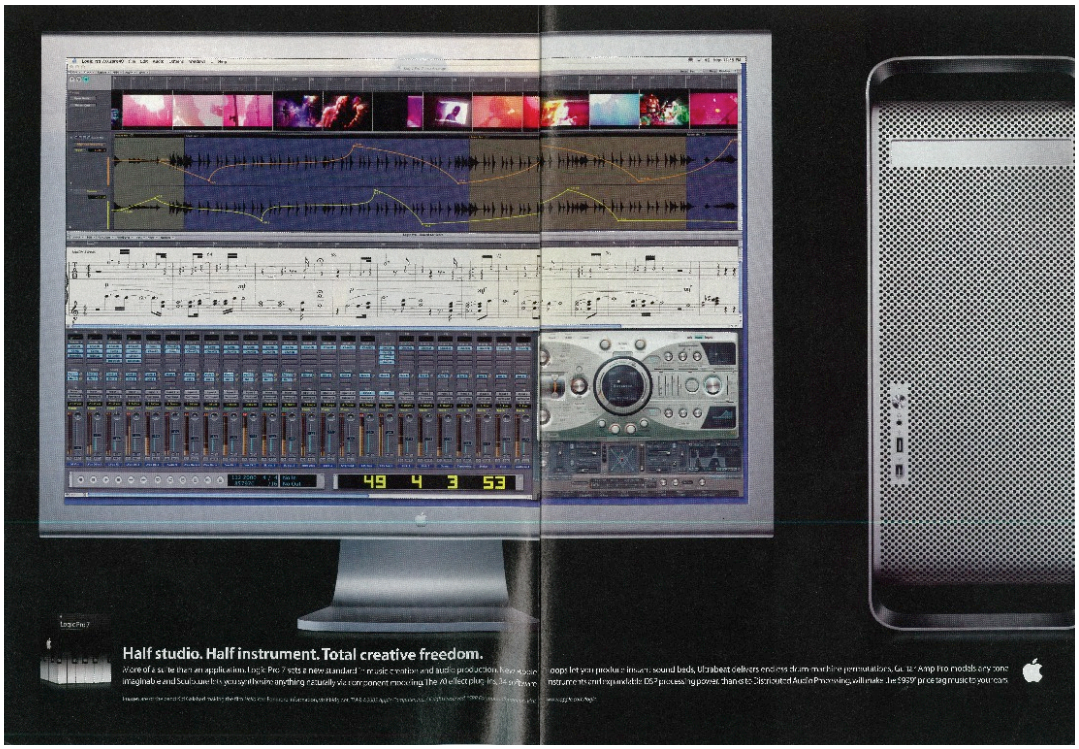

Figure 2: Advertisement for Apple's Logic Pro 7 in MIX Magazine, May 2005, pp. 3–4.

Drumming this idea home, so to speak, is an advertisement also in *Mix* for Logic Pro 7, now developed by Apple (Figure 2). Its tagline—"Half studio. Half instrument. Total creative freedom."—employs the instrument metaphor to suggest autonomy and individual artistic expression. In this version, software synthesisers have been introduced, and DAW developers shipped their own synthesisers, functioning as a selling point in this advertisement. This advertisement also reflects shifting demographics of DAW users—less commercial applicability, more individual expressivity. Its language borrows from Brian Eno's assertion that the recording studio is a 'compositional tool' (1983), in which the studio has more instrumental agency in creative practice than typical practices in which the music is written prior to entering the studio. The advertisement culminates in imagery which suggests the capacity to create recorded music exclusively in the computer: the transition of recorded music composition into the box was complete.

3.3 Atomising a compositional practice

It is necessary to take a detour to reflect on the economic and political milieu coinciding with the consolidation of recorded music practice into the box. It is a widely-

acknowledged truism that the music industry has undergone vast, tumultuous upheaval in the last twenty years (Anderton, Dubber, & James, 2013; Rogers, 2013). The 'music industry,' a nebulous catch-all term for the economic activity concerned with producing and distributing music-related commodities (Wikström, 2009), has had its traditionally primary commodity, music recordings, rapidly lose monetary value. An indicative statistic is the United States trade value of so-called 'physical' recorded music plummeting from $27.3 billion in 1999, to $6.8 billion in 2014, a 75% drop in 15 years (Klein, Meier, & Powers, 2017).

The causes of this cataclysm are widely attributed to *digitalisation*, "a series of cultural and economic changes resultant from the collective adoption of digital technologies within a particular social group" (Strachan, 2017). Digitalisation in the music industry can be described in three overlapping fields: consumption, distribution, and music creation (Wikström, 2009). I will briefly describe the former two before exploring the latter more deeply.

The digitalisation of music consumption is generally seen as the primary driver and culprit for the music industry's current tumultuous state, and consumption practices have variously fallen into and out of step with the industry's distribution practices over the decades. One example is piracy facilitated by internet-based peer-to-peer file sharing. Its immediate precedent, bootlegging, was the ire of the music industry for decades, with substantial resources committed eliminating the practice, from the infamous "home taping is killing music" campaign to lobbying politicians for legislative action. Despite these campaigns, the economic costs of bootlegging to record labels are minimal, and Marshall argues that the campaign is a largely symbolic gesture to resist "challenges [to] the authorship and ownership of popular music" (Marshall, 2005, p. 155).

By the 1990s, with the emergence of DAT, CD players and burners, and increasing internet activity in households, the emphasis shifted from anti-bootlegging to anti-piracy. Digital compression techniques such as the MP3 format (Sterne, 2012a) enabled the recorded music corpus to become readily and freely available to a public with access to peer-to-peer file sharing technologies (David, 2009). Despite the many protestations by high-profile musicians and lobbying by record companies, and despite the success of some forms of legislation against piracy (Adermona & Liang, 2014), peer-to-peer file sharing continued relatively unabated, undercutting music economy revenues significantly, "[causing] the entire decline in record sales …and [impairing] what otherwise would have been growth in the industry (Liebowitz, 2008).

The main beneficiaries of this digitalisation, compression, and illicit distribution of recorded music were consumer technology companies, particularly those making MP3 players, most famously Apple with its iPod (Sterne, 2012a). Apple's 2003 opening of iTunes as a platform for the legal sale of digital music downloads stemmed the bleeding to an extent, with digital downloads occupying a third of all recorded music sales in 2010 (Waldfogel, 2010). The latest in these developments are streaming platforms such as Spotify or Apple Music, who sell listeners the right to stream music over the internet, relegating the need to possess an audio file at all for a monthly fee (or freely through an advertisement-based model). These ventures are widely perceived to result in significantly less revenue for musicians than individual album or track sales (Krukowski, 2012). This also impacts record labels, particularly indie and non-major labels, which Pelly blames on Spotify's opaque algorithms that sort tracks into playlists with overwhelmingly major label representation (Pelly, 2017). Rather than a supposed 'dematerialisation' of music that this suggests however, the materiality of music consumption is mostly dictated by the technology companies who gain financially from the sale of smartphones and the monopolisation of platforms (Magaudda, 2011).

Amongst these dramatic changes in music consumption, music distribution conventions have changed too after digitalisation. Most overtly, musicians, not necessarily bound by the cultural and material gatekeeping of major labels, increasingly release music themselves, through platforms like Bandcamp at a price (or lack thereof) of their own choosing (Kribs, 2016), and self-promoting their work through social media (Baym, 2012). Bandcamp also facilitates the proliferation of independent and esoteric labels, retaining the traditional business model of selling individual albums or songs for a flat fee. Despite the do-it-yourself (DIY) ethos of distributing music through such platforms, they nonetheless prompt questions about the true autonomy and independence of counter-hegemonic labels and artists. "Far from a haven for a type of musical independence freed from commercial constraints," Klein et al suggest, "we have seen the emergence of new forms of dependence, especially those tied to music's new gatekeepers: Silicon Valley and Madison Avenue" (Klein et al., 2017, p. 227).

Music creation, as I have suggested, has adapted to digitalisation in several ways, but one prominent trend aims towards consolidating recorded music practice into fewer components, eventually culminating in the DAW, a single ecosystem which folds many practices into one software operated by one person. DAW-based compositional practice is largely an individual, solitary affair, much like the Western experience of music listening

today (Gracyk, 1997). The privileging of individual practice is legible in the DAW interface, such as the QWERTY-keyboard-as-piano-keyboard metaphor—it necessitates "a division of labor whereby only one person at a time can enact [musical] ideas" (Brooker & Sharrock, 2016, p. 466). Live performance, once so quintessential to the perceived authenticity of a musical recording (Auslander, 1999), becomes relegated in favour of bestowing maximal control and centralised authorship on the individual, the composer/arranger/ performer/sound designer/audio engineer. These disciplines, once relatively distinct, are enacted all at once in non-realtime, through a medium which permits endless mistakes and their endless corrections. DAW-based compositional practice blurs these distinctions beyond comprehension, often becoming subsumed into one term: the *producer*.

The creative practices of the contemporary producer have been extensively discussed (Howlett, 2009; Moorefield, 2005; J. A. Williams, 2006; Wright, 2017), however the term is apt for describing how labour-forms of music creation are distributed. Boykoff understands this in terms of *atomisation*, "whereby collective units (e.g. families, unions, classes) are reduced to individualized units consisting of one person rather than many" (Boykoff, 2011, p. 105). In the atomisation process, "we're encouraged to view ourselves as active, atomized subjects 'going it alone' and 'maximizing our utility' to improve our lives" (p. 107). Under a political and legal environment tending towards neoliberalism, atomised and individual labour forms are increasingly the norm across all forms of media production (Curtin & Sanson, 2017; S. Taylor, 2015). In electronic music composition specifically, this has been observed by Diduck, who attributes it to the emergence of MIDI:

> Because entire orchestras could be created with a single keyboard, the majority of popular forms of music produced electronically … are most likely to be the work of a solo artist. MIDI is arguably in large part responsible for today's over-abundance of lone (and usually male) electronic music producers … [and has] contributed to a recent culture of auteurist electronica artists.… In many ways, the solo artist has become the whole equation of digital music, and its solution (Diduck, 2015, p. 60)

That the rise of neoliberalism and atomisation, with increasing workloads and expectations placed on atomised professional composers and sound designers (Beer, 2013), coincides with the convergence of virtually all the skillsets required to compose

recorded music into one piece of software, is likely not a coincidence. It suggests that the DAW is complicit in, or even perpetuates, the atomised status of recorded music makers.

One prominent narrative of this atomised compositional practice is that the portability of the laptop opens up manifold possibilities for making recorded music, encouraging new forms of networking and collaboration. Prior (2008, 2009) suggests that:

> The laptop, in particular, is the archetypal nomadic device: quick, portable and powerful, but flexible enough to be used as an all-in-one mobile production studio. For musicians, the key attribute of the laptop is the way it makes creativity possible in myriad spaces, so that productivity can continue beyond the physical confines of the home or studio (Prior, 2009, p. 90).

Despite the miniaturisation of DAW-based compositional practice, the majority of its practitioners are not working on music "anywhere, anytime," or even in radically mediated networks and collaborative settings (Théberge, 2004), but rather in their own home, particularly in the bedroom. The bedroom is increasingly the *only* site of musical composition for many DAW-based practitioners, particularly amateurs. (Groenningsaeter, 2017). This turn towards more private spaces have fostered the archetype of the *bedroom producer* (Walzer, 2017), a young musician making electronic or popular music in their bedroom using a DAW. Toop, in a 1994 article on 'bedroom music,' writes that these musicians are "young obsessives who record prodigious quantities of electronic music en route to the bathroom," their bedroom "a monastic cell devoted to solitary music-making" (Toop, 1994). The artists Toop associates with bedroom music are Aphex Twin (Richard James), µ-Ziq (Michael Paradinas) and Daniel Pemberton, the latter of whom was 16 at the time and had already released an album entitled *Bedroom* (Pemberton, 1994). That these artists were associated with IDM, with its seemingly un-danceable and deeply ornate style, perhaps fuels this stereotype of the bedroom musician as a reclusive male obsessive whose compositional process is a mystery bordering on alchemy. In the 21st century however, the bedroom musician does not pose such a strikingly particular figure, and it is not unusual that music made in such locales gain significant popularity (Walzer, 2017).

As DAW-based compositional practice recedes into bedrooms around the world, the occupation of audio engineer becomes increasingly precarious. Audio engineers faced greater job precarity, taking on more roles in the recording and compositional process (Beer, 2013; Watson, 2013). As recorded music plummeted in revenue, so too did

recording budgets, and recording studios became a less tenable enterprise. From the 2000s on, many prestigious studios shut their doors, while others adapted to varying success. In a study on the demise of the recording studio, Leyshon (2009) writes that one of several causes for its decline was the increased quality of home recording, enabling "considerable prestudio preparation work, which signals a further fragmentation of project work to incorporate the space of the home or at least the home studio" (Leyshon, 2009, p. 1326). He also writes that the main way studios have adapted to this restricted industry is to emphasise "congeniality," "compliance," and "translucence" among its hired staff and in the presentation of the studio. Leyshon describes this as one outcome of contemporary capitalism:

> in much the same way that Thrift (2005) has argued that the affective turn within capitalism more generally is really driven by a hard-edged concern for competitiveness and profitability, so the cultivation of congeniality within studios is a response to the fact that many of the other barriers to competition within the sector have been progressively lowered and eroded (Leyshon, 2009, p. 1317).

A similar argument, that the 'affective turn' of capitalism is driving the redistribution of the labour of making a music recording is alluded to by James (2014). DAWs, according to James have enabled timbre, once a qualitative and wholly affective trait of sonic experience, to be manipulated in a quantitative, specific, and standardised fashion. This, she says, mirrors the affective turn in capitalism, in which "new musical technologies take the affective dimensions of musical performance—such as timbral 'sound' and feel'—and make them work as one of the central engines" of the popular music canon, and thus, the music economy (James, 2014). The use of timbre is preceded by a tendency in alternative and indie musics to incorporate lo-fi timbres that evoke the materiality of pre-digital media as a site of differentiation from the sheen of popular music recordings (Bennett, 2012; Blake, 2012).

A middle-ground between the bedroom and the commercial recording studio is the 'project studio,' a catch-all term describing what is essentially a workspace somewhere between an amateur bedroom studio and a professional recording studio. Project studios are used by one or slightly more musicians or audio engineers, and are equipped with mid-range recording technology. Today, performing recording or audio engineering work in project studios is an increasingly viable alternative to doing the same in professional recording studios, as the gap in audio quality and the economic outlay decreases.

"Computer technology," writes Cole, "was vital for positioning the project studio as a viable economical alternative to traditional commercial studios" (Cole, 2011, p. 450).

3.4 Analogue fantasies

Thus far, I have discussed the consolidation of control and authorship to the individual musician, operating a DAW in increasingly intimate spaces. In the last decade, however, electronic music practices have partly diverted away from the DAW and in-the-box practices, towards increasingly incorporating analogue and modular synthesisers, sequencers, and other audio hardware. This notion is captured in a promotional image on Ableton's webpage (Figure 3), as Live 10 is advertised in a project studio complete with many hardware electronic music instruments. The space is clearly a personal, intimate space, the cellophane awkwardly placed in front of the light suggesting it is not a studio for professional audio engineering. The laptop, running Live, takes up very little space in the image compared to the analogue instruments, synthesisers, and so on. It suggests that the DAW plays a secondary role to the analogue equipment.

Here, I re-invoke the theoretical framework of the grain of the DAW. The image is indicative of a tendency in the last few years for the grain of the DAW to be concealed—its material condition diminished, its unique practices obscured—in favour of foregrounding the grain of the analogue despite being mediated by the DAW. This shift is influenced by several aspects, but I will focus here on analogue metaphors in the DAW interface, "technostalgia," and the delegating of compositional labour.

The design of the DAW and its constituent practices reference analogue practices in many ways, such as the interface's allusion to the multitrack tape console (Bell, Hein, & Ratcliffe, 2015; Walther-Hansen, 2017). It encompasses linear 'strips' akin to a mixing console or the individual channels of a multitrack tape, send/return tracks, and a plug-in interface. The term *skeuomorph* denotes this kind of design, explicitly referencing practices and trends that the software (Bell et al., 2015).

Many human-computer interaction theorists have considered the DAW within this paradigm of referring to analogue practices in the DAW interface. Duignan extensively explores the visual metaphor of the multitrack tape console in the DAW, and offers some critiques of the disjunction between the multitrack tape metaphor and DAW-based practice:

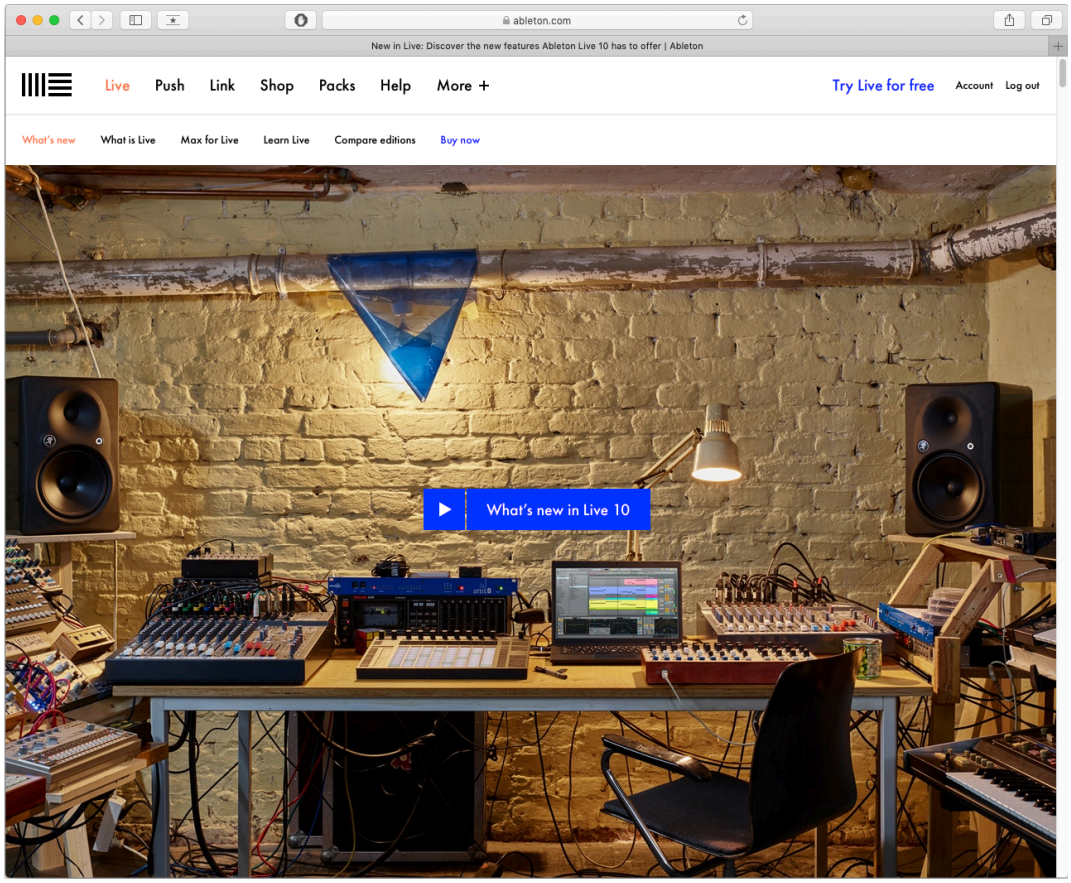

Figure 3: Screenshot of https://www.ableton.com/en/live/, circa February 2019

> [Firstly,] the requirement of tracks lasting the duration of the entire piece is the result of unquestioned assumptions carried forward to the very nature of multitrack tape. Secondly, multitrack-mixing systems have been developed to suit traditional groups of musicians. The mapping of instrument parts to channels and tracks is a natural one. However, in digital production environments there can be an unlimited numbers of virtual instruments, arbitrary audio sampling of sound-bites, and often no musicians to demand they appear for the duration of a whole track. Finally, the uniform reliance on this model raises the question of what other yet unexplored conceptual models and abstractions could make possible (Duignan, 2008, p. 65)

Referencing analogue media makes up a significant aesthetic in user-interface design in DAWs, deploying conceptual metaphors (Lakoff & Johnson, 1980) to encourage the user to make certain associations with the software's functionality. This is suggested when audio engineer Tom Lord-Alge calls Pro Tools "a tape machine on steroids" (Milner, 2010, p. 298). DAW practices enact fantasies often born in analogue practices.

This notion is reprised all throughout the design of third-party plug-ins. Companies like Waves,* Universal Audio,† and u-he,‡ create plug-ins that emulate analogue components or synthesisers, utilising design aesthetics strikingly similar to their 'real' counterparts, replete with wooden panelling, VU meters, and scuffed steel surfaces.

One way to understand the rationale for these design choices is what Pinch & Reinecke call *technostalgia*, a cultural logic that privileges the technologies and practices associated with older media over newer software-based technologies and their unique potential (Pinch & Reinecke, 2009; T. Taylor, 2001). This is not necessarily informed by a nostalgia for the past, rather it is a "movement toward both new sounds and new interactions, whether aural, social, or physical, made concrete through combinations of the past and present" (Pinch & Reinecke, 2009, p. 166). Bennett observes similar sentiments in recording engineers and their employment of vintage consoles or technologies that integrate multitrack tape machines with the DAW timeline (Bennett, 2012). Software-based emulators of analogue components are not completely shunned from the processes of technostalgic musicians, but the very fact that they are emulators, quantifying what might otherwise be a non-linear and imprecise signal path, that draws these musicians to such gear. The idiosyncrasies and serendipitous exploration of interacting with hardware, as opposed to software, drive the compositional process.

This may be understood as a delegation of control of some aspects of the compositional process away from the DAW, towards an increasing number of electronic instruments physically separable from the DAW interface. Richard Devine, a leading proponent of modular synthesis, suggests in an interview that his turn towards modular synthesis came as a result of burnout from meticulous DAW-based editing. In the DAW, Devine says, "everything's calculated, everything's perfect, everything's coded. If there's any sort of deviation or randomness you have to actually program that randomness into the computer yourself, whereas on the modular it's kind of an open game" (Future Music, 2013). The modular synthesiser generates compositional material through serendipity and open-ended play, characteristics that the DAW does not afford. By opening up certain compositional characteristics to serendipity and chance, Devine is able to compose in an intuitive way, without getting bogged down in the minutiae of automation that DAW practice enables.

* https://www.waves.com
† https://www.uaudio.com/uad-plugins.html
‡ https://u-he.com

Delegating and redistributing labour in ways such as this is a vital part of DAW-based compositional practice. Software synthesisers often come loaded with hundreds of thousands of presets, the work of sound design performed by synthesiser designers instead of the home electronic musician (Goldmann, 2015). DAWs, especially GarageBand, often come pre-packaged with a large library of loops and samples, a famous example including Rihanna's employment of "Vintage Funk Kit 02" in her hit song *Umbrella* (Rosen, 2007) a loop found in GarageBand's loop library (Stewart, Nash, Harrell, & Carter, 2007). The redistribution of labour arising from DAWs is perhaps most apparent in the rise of orchestral sample libraries, vast samplers often comprising several hundred gigabytes of recordings of individual orchestral instruments, effectively supplanting orchestral musicians in scores for film and media (Terren, forthcoming). The recent rise of algorithmic mixing platforms, such as iZotope's Neutron suite,* suggest that even the highly tacit and subjective practices of mixing may be (relatively cheaply) delegated to machines.

Musicians interpret these positively or negatively, an example of the latter being the *controllerism* movement of electronic music performance. This movement prioritises or even fetishises tactility in composition and performance, mapping the DAW's parameters to MIDI controllers and other devices, such as those associated with the new interfaces for musical expression (NIME) community. Bringing tactility to DAW-based compositional practice, Lin suggests, is "a cathartic release that reinscribes our mastery over 'our' machines" (Lin, 2017). It is a microcosm of the widespread anxiety over whether automation will threaten workers' jobs, assigning aesthetic value to the wresting of musical expression from DAWs (fortuitously, also denoted as automation). This aspect is one of several instances of technostalgia—as Pinch & Reinecke write, "it is the tactile nature of real gear as opposed to simulations of gear [that are] fun and stimulating" for technostalgic musicians (Pinch & Reinecke, 2009).

Controllerism is also emblematic of the aforementioned perception towards treating the DAW as a musical instrument. Of course, the DAW is and remains a tactile medium, insofar as the computer keyboard and the mouse are tactile objects, but these are considered poor devices for musical expressivity. This may be associated with their mundanity, and their usage in everyday computing tasks. As part of the "information-technological transformation of music," Grossmann suggests, laptops with music software

* https://www.izotope.com/en/products/mix/neutron.html

such as DAWs "mediate between the information-technological architecture of the universal office machine and the aims and options of musical play," and this includes negotiating between the use of banal and traditionally musical technologies.

The above examples indicate that the atomisation of musical expression takes many forms, many of which are in response to the emergent ubiquity of the DAW. The metaphoric richness of the DAW, in terms of its interface and its cultural positioning, suggests a complex referentiality with other musical media, digital labour, and musical aesthetics. Sterne calls this *mediality*, a "complex web of practice and reference" pertaining to peoples' dealings with media (Sterne, 2012a, pp. 7–9; Terren, 2014). Practices formulated with analogue technology are implicit in the grain of the DAW, and clarifying these in historical context can help negotiating the more radical potential of the unique material conditions of DAW-based compositional practice.

3.5 Summary

I have described here the cultural shifts and labour redistributions that have articulated the material condition and practices of the DAW. It has been suggested that DAW-based music making has antecedence in audio engineering, traditionally a collaborative and craft-based discipline; and phonographic auteurism, the assumption of control over the entire recording process. The emergence of DAWs, particularly in home computing settings, allowed the latter to flourish while the former became increasingly precarious. Today, home recording and composition is a popular and perhaps dominant form of music creation, often mediated heavily by the DAW. DAWs are heavily informed by practices developed during an era when analogue recording technologies dominated, and a recent trend towards employing analogue or modular synthesis in electronic music production foregrounds these practices. This, I have suggested, is often at the expense of foregrounding the more radical potential of the DAW as its own, unique mode of compositional practice. The rest of this thesis will explore the process through which I develop compositional techniques that explore this potential, the grain of the DAW.

4 Artistic experimentation

This chapter describes the compositional experiments I made from 2015–2017 exploring new techniques for foregrounding the grain of the DAW. These experiments are largely unfinished compositions, individual sound designs, or seedlings of ideas that I elected not to explore further. They informed the development of the album *Thru* to various extents, although not all of them were explicitly used in the final work. This experimentation involved negotiating between creating techniques that distinctly foregrounded the grain of the DAW, and aesthetic concerns particular to the music I wanted to make. Described in another way, this process involved mediating between the *edge* and *centre* (as per Galloway) of the music I was trying to write. Many experiments tended towards the former, denigrating the poetic potential of the latter.

The experiments described here are arranged in a loosely chronological order. Not all experiments that I undertook as part of this research are recounted here, only the ones that dealt most overtly with the grain of the DAW. I begin by describing the compositional process I enacted, devised as a three-phase model comprising sound design, arrangement, and acousmatic listening. Experiments around automation, layering, and several other concepts and techniques promoted in DAW-based compositional practice are described, and I explore their relationships to the grain of the DAW.

4.1 Compositional process

Composing in the DAW is a messy process. In my day-to-day practice, I prefer not to work on one piece or idea from inception to completion—I flit between ideas rapidly, and somewhere in the dizzying rush, work gets done in a very piecemeal fashion. This is similar to Eno's "studio as compositional tool" practice, but the non-linear workflow I privilege is best described by American electronic musician Bee Mask:

> I try to think of my studio like any artist's studio; I'm always developing a handful of things in parallel, looking for connections between them, connections to things I've already done, and connections to ideas I'm currently fixated on, trying to organize them and build series, doing "research and development"-type work with new tools and materials, and stockpiling scraps that might be useful later. Writing, tracking, editing, and mixing are constantly doubling back and blurring into each other and working quickly is basically out of the question. As anyone to whom I've

> ever owed a master will tell you, everything of mine is "50% complete" for 90% of the time it takes to make (Lynch, 2012).

This process speaks to the messiness of studio-based creative practice, a messiness I relish. However, I felt this could be formalised for the purposes of clarifying this research, and have thus identified three phases in the compositional process that each mobilised different characteristics of the grain of the DAW and DAW-based practice.

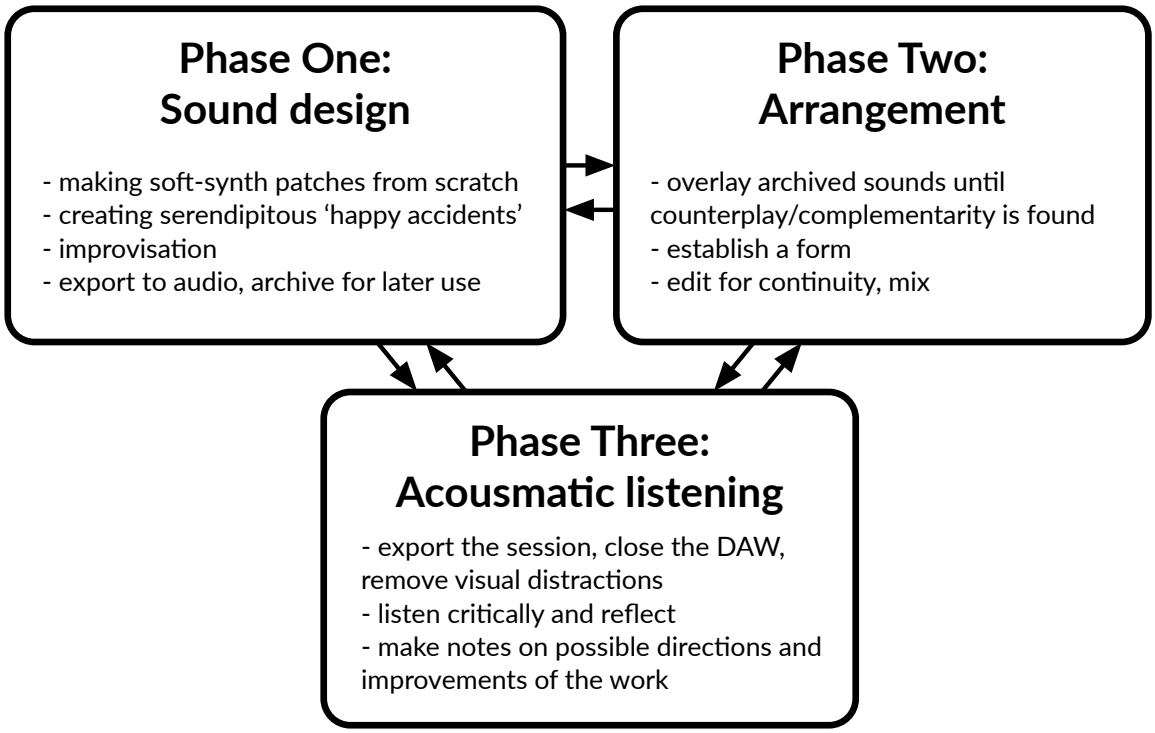

Figure 4: The three-phase compositional process

The compositional process I enacted in this research had three phases: sound design, arrangement, and acousmatic listening (Figure 4). In the "sound design" phase, I focused on creating synthesis patches from scratch, and generating MIDI data to drive this synthesis through a mixture of methods. The "arrangement" phase involves putting sound designs together, arranging them in time and virtual space towards creating a piece of music. The "acousmatic listening" phase involves exporting my DAW session to an audio file, closing the DAW, and listening to the audio file without distraction, while I would make notes on how it could be improved. These phases prescribe no particular order, and in practice I rapidly switched between them.

I arrived at this three-phase process for two reasons. Firstly, trying to manage the sound design, arrangement, and any modicum of objective appraisal of the work simultaneously, was psychologically and computationally demanding. I would feel overwhelmed with possibilities and get nothing substantial done. The temptation to

manipulate synth parameters *ad infinitum* could both waste time and distract from appraising the composition as a whole. As Kirschenbaum suggests in his description of "suspended inscription" (2016, pp. 47-48), any compositional activity can happen at any time, enabling the endless postponement of finishing a work. Duignan sums up this phenomenon as "conceptual burden," a sense of overwhelm that is stifling for producers and reduces productivity. One way to reduce conceptual burden is to bounce, or commit, several tracks together. Rather than constantly being exposed to all of the parameters of a synth part and fighting the urge to tweak a sound incessantly, committing or bouncing forced the producer to move on. This comes with the inevitable risk of not being able to edit a sound after it is bounced, but as Duignan writes, "abstracting away the complexity of large numbers of tracks is so important that producers are willing to forgo the flexibility that keeping them as independent tracks would allow" (Duignan, 2008, p. 167). Nonetheless, the "resulting loss of provisionality" (p. 132) also introduces conceptual burden, particularly if the producer changes their mind about a particular production choice, as it is difficult or impossible to change sounds back after the act of committing. In my project, I found that foregoing flexibility gave the project forward momentum, and the encouraging feeling that the work was progressing. I will explore conceptual burden as an aspect of the grain of the DAW further in the Chapter 5.1.5.

The second reason I used this three-phase model of composition is its opportunity to explore what has been described by Milner as a specificity unique to the DAW. In the introduction of this thesis I described Milner's suggestion that the DAW reconfigured recorded music to emphasise arrangement and curation over performance and 'capturing a moment.' In this "Pro Tooled world," digital forms such as DAWs enable any sound to be used as recorded musical material. This has, obviously, informed sampling practices from *musique concrète* to hip hop and electronic dance music. But this formulation makes an implicit assumption that all sound is ontologically equal, reducible to some primordial essence or "universal code." The DAW, for Milner, makes this clearer than any prior medium. And since any sound *can* be used, any sound *will* be used, thus the artfulness of DAW practice lies primarily in the curation and arrangement of sounds, not performance or other conventional musicalities. It is important to note that Milner's analysis of the DAW does not consider in-the-box synthesis, which I understand as the sound design phase of composition, which complicates the curation-creation binary and the distinctions between my three phases of composition. The provocation, however, remains potent. What is it about DAWs that make compositions made with them *about* "arrangements,

orchestrations, [and] the mix," especially in the context of my own practice which rarely uses samples that I have not myself made? This project suggests that the grain is only partly enacted here.

By focusing on sound design, arrangement, and acousmatic listening as individually as possible, negotiating the nuances of this question becomes more controllable. I will now describe these three phases in greater depth.

4.1.1 Phase One: Sound design

In the sound design phase, the aim is to create interesting individual sounds using DAW-based processes. The definition of 'interesting' shifts day-to-day and can be influenced by my mood or what music I listened to recently, and the definition of 'individual' implies that the sounds I design are made knowing that they are not complete pieces unto themselves—they won't stand alone in the final product. They are made with the assumption that later, in the arrangement phase, I will find connections between them and other sounds, and arrange a composition accordingly. Approximately 200 such sounds were designed over the research period, ranging from finely-wrought transients less than a second long, to sprawling 20-minute improvisations. These were placed in a folder and arranged similarly to a mind map, using the 'icon view' function in macOS's Finder (Figure 5). Sound designs that I thought had some association would be placed in proximity to each other. This novel approach to organising sound designs was highly useful during the acousmatic listening phase, and often fun.

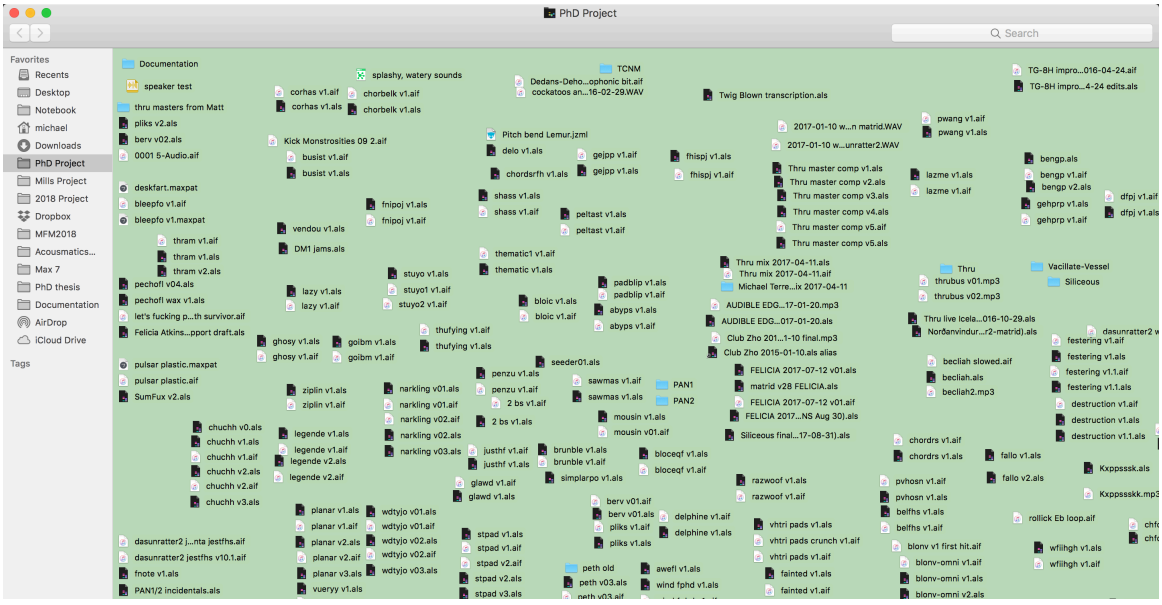

Figure 5: Section of the 'PhD Project' folder in macOS Finder, with all research-related sound designs and DAW sessions

DAW-based sound design can be described as comprising three stages: MIDI generation, sound generation, and signal processing. These stages are inevitably in dialogue simultaneously, and the exploration of each of them is intuitive and reflexive. These three stages are reflected in DAW interface design. Each track in the DAW can have plug-ins placed on them to generate or manipulate sound. In Ableton Live, these are divided into three types: Instrument, Audio Effect, and MIDI Effect. Moreover, my use of Ableton Live over any other DAW is partly due to its compatibility with Cycling '74's graphical programming software Max, via the bridging software Max for Live.* Through this software, Max patches can be converted into Instruments, Audio Effects, or MIDI Effects, automated and controlled like any other plug-in. I will now describe my approach to each of these three stages, and how their combination led to interesting sound designs.

MIDI generation refers to the processes in which MIDI information is collected, sequenced, edited, and processed in the DAW. Generation of MIDI often begins with MIDI controller. Conventional MIDI controllers often have a piano keyboard; several encoders such as rotary encoders, also known as dials or pots; linear encoders, also known as faders; and/or drum pads. I collect MIDI information through one of five mechanisms: an Ableton Push 1,† a monome,‡ an iPad running the app Lemur,§ generating it from scratch using Max, or using the mouse. The Push incorporates rotary encoders, 64 drum pads that can be set to conventional diatonic scales, and features that integrate well with Ableton Live. The monome is a boutique controller with 128 lit buttons arranged in a grid (see the lower left of Figure 6). There is no built-in functionality *per se*, and its users must make their own interfaces for it using Max. My use for it is rather pedestrian, mapping its 128 buttons to the 128 MIDI note values, which I find works effectively in creating note combinations I wouldn't think to play on a conventional piano keyboard. The iPad running Lemur is used mostly for generating MIDI CC (continuous control) data, to automate parameters in the DAW. Generating MIDI from scratch in Max is used rarely and often in ways that are wildly different from a more pianistic, hands-on MIDI performance. Finally, during recording it is possible to record the movement of parameters by manipulating them with the mouse, a mechanism I employed often, especially when I didn't have access to the aforementioned MIDI controllers. These

* https://cycling74.com
† https://www.ableton.com/en/push/
‡ https://monome.org/docs/grid/
§ https://liine.net/en/products/lemur/

Figure 6: The author's typical set-up for DAW-based compositional practice

sources are recorded into a MIDI track in the DAW, where I can manipulate them using the DAW's MIDI editing functionality. From here, the MIDI sequence can undergo further processing using MIDI Effects, which may include arpeggiation, randomisation, and harmonisation.

Sound generation refers to software synthesisers, samplers, or combinations thereof, and are the primary method of creating sound in the box. Most DAWs come with several proprietary software synthesisers and samplers, but many third-party vendors build plug-ins of all kinds, usually in the Virtual Studio Technology (VST) format or the Audio Unit (AU) format. The plug-ins I mostly use are Spectrasonics' Omnisphere;* Madrona Labs' Aalto and Kaivo;† Native Instruments' Absynth, FM8, and Reaktor;‡ and various self-made Max for Live Instruments.

I aim to record interesting sounds quickly after finding them. The temptation to keep tweaking a sound *ad infinitum* is ever present in sound design, and a moderately interesting sound can quickly become an uninteresting sound. Many plug-ins do not have the

* https://www.spectrasonics.net/products/omnisphere/index.php
† https://madronalabs.com
‡ https://www.native-instruments.com/en/products/komplete/

capacity to undo parameter changes, and even so, there may be dozens of undo actions needed to return, with no guarantee that the earlier parameter setting will sound as it did before. Software synthesisers, like their hardware siblings, are often ephemeral and temperamental.

As the research unfolded I realised that spending too much time in the sound design phase could become an exploration of the grain of the *synthesiser*, a standard practice in experimental electronic music, instead of the grain of the *DAW*. To stay focused on the research question, I tried to emphasise that my sound designs were *individual* and thus soon to be combined and arranged together, and it is in this act that the grain of the DAW is experienced.

Signal processing refers to plug-ins that perform an operation on an incoming signal in real-time. These are often described as *effects*, and in Ableton Live, the term "Audio Effect" is used. Signal processing plug-ins process the sound generated by the "Instrument" plug-in, or audio arranged in the timeline. Audio Effects can vary from practical devices like equalisation (EQ) and dynamic-range compression, to traditional creative effects like reverb and delay, to more idiosyncratic plug-ins such as spectral filtering, smearing, and waveshaping. In conjunction with Instruments, unique and interesting sounds can be found, although my use of Audio Effect plug-ins tended to be more pragmatic in practice, more applicable to mixing in the arrangement phase than the sound design phase. This is partly due to my aesthetic preference for 'clean' sounds that are not filtered to sound as if they were analogue.

Combining MIDI generation, sound generation, and signal processing can lead to serendipitous experiences, which can in turn yield interesting individual sound designs. Once enough sound designs are created, the process of arrangement can begin.

4.1.2 Phase Two: Arrangement

The arrangement phase is concerned with fashioning sound designs into a finished composition. It involves combining and editing sound designs, structuring them in the timeline and creating effective transitions between them, and mixing the composition appropriately.

Experimental electronic music typically doesn't employ classical forms and structures. It often utilises improvisatory or found structures, and even work that is meticulously constructed and intentional can, at first blush, seem formless (Priest, 2013). This is part of its privileging of 'vertical' aspects of composition such as timbre, as opposed to

'horizontal' structures, a geometric metaphor I will explore further in the next chapter. Experimental electronic music's employment of tension and resolution varies substantially. While some practices rooted in electronic dance music employ its compositional techniques like build-ups, breakdowns, and all the conventions therein, some practices more in common with ambient music avoid the tension-resolution paradigm entirely. My practice operates somewhere between these. I generate tensions through long crescendos or increasing densities of sound, or by dropping out particular frequency bands (for example, the bass), to be resolved by bringing them in again, or by subverting expectations by moving suddenly to a different kind of texture.

In combining sound designs, I try to find combinations in which the constituent sounds complement each other somehow. This can happen in a number of ways. The frequency bands each of the sounds are most active in informs the complementarity of sound design combinations—if they clash then it is unlikely to sound interesting. The sound's approaches to rhythm, melody and harmony, noisiness, all play a role here. As in the sound design phase, in combining sound designs, serendipity is often key, as what sounds seem interesting when combined can seldom be predicted ahead of time.

Mixing, as Milner implies, plays a more prominent role in DAW-based composition than virtually all other compositional paradigms. In my practice, I mix progressively as the composition takes place, rather than a more traditional recording process of mixing once composition and recording are complete. I use reference tracks, the work of artists whose mixes I appreciate and aspire to, throughout the mixing process, a practice explored further in Chapter 5.1.2.

4.1.3 Phase Three: Acousmatic Listening

The "acousmatic listening" phase attempts to replicate the conditions of the audience who will listen to the work. This phase is premised on the observation that critically listening to a composition while using the DAW is different from that of listening through audio-playing software like iTunes. Acousmatic listening temporarily removes conceptual burden, enabling a more holistic appraisal of the music *as music*, not as information on a screen. From this clearer perspective, I take notes on what ways the work can improve. This becomes a to-do list for when I move back into the arrangement phase, giving the work forward momentum.

This practice is comparable with, for example, a writer printing off their work and editing with a red pen, instead of editing fully in the word processor. This breaks the

condition of *suspended inscription*, as described in Chapter 3. It means a writer or DAW practitioner can procrastinate finishing a text or piece indefinitely until the moment of printing or bouncing down. While immersion in this state of suspended inscription is largely beneficial, exiting this state in order to appraise the work is also highly beneficial. No prior musical medium enables the movement in and out of this state of suspended inscription as easily and cheaply as the DAW.

Creating acousmatic listening conditions simply involves exporting or bouncing a DAW session as an audio file, and with the DAW closed, listening to the audio file via audio playback software, such as iTunes, macOS Finder's Quick Look feature, or an audio editor like iZotope RX. The audio can then be played on various playback systems, such as through laptop speakers, studio monitors, different pairs of headphones of varying quality, a car stereo, or a smartphone speaker. Each type of playback setting reveals different characteristics of the sound, which may or may not be beneficial, and with this information I can thus return to the arrangement phase and mix or re-compose accordingly.

The term "acousmatic listening" invokes Pierre Schaeffer's use of the term, analogous to "reduced listening" (Chion, 1994, pp. 29-34). In this mode of listening, sound is attended to *sans* signification, without acknowledgement of the sound's source and all the meanings and connotations therein. Reduced listening is a technique for bracketing off these significations so that the listener may more objectively appraise the sound itself. Historically, Schaeffer developed this practice to instigate his project of reimagining the organisational principles of art music, away from harmony and chromaticism and towards the totality of sound itself.

My use of reduced listening as a compositional tool is less ascetic in its phenomenological purity. The primary signification that I bracket off is my memory of making the sound, dissociating my DAW-based labour from the sound itself as much as possible. I have already described the importance of serendipity in my practice, but sometimes a sound I make serendipitously is not interesting under acousmatic listening conditions. This enables me to better appraise that sound, and either improve it by taking notes on what can be improved, or returning to it later.

I employ a highly iterative process, in which exporting the DAW session and acousmatic listening are the final tasks per iteration. There are two benefits of such a process: firstly, it makes for pragmatic and simplified data for analysis, and secondly, it helps me feel a sense of progression as the work gets made. Figure 7 shows the kind of

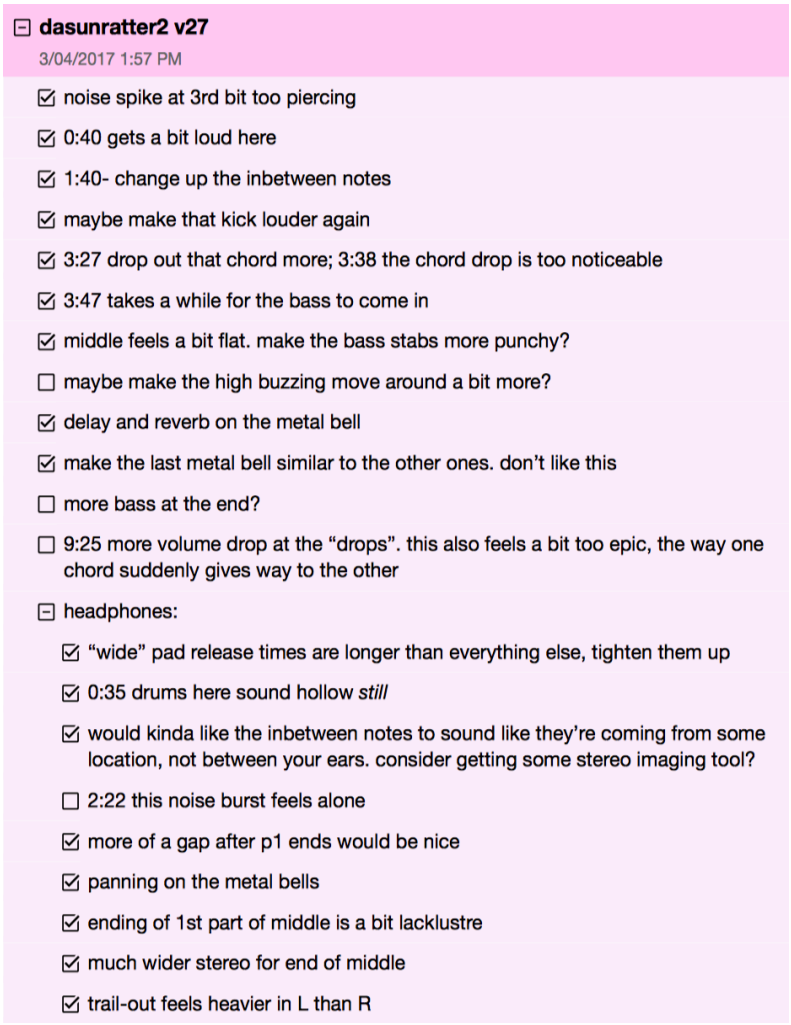

Figure 7: Notes made while listening to a late version of 'Vacillate'

notes I take during acousmatic listening sessions. The notes are particularly involved here, as this was one of the last few versions (the 27th of 33) of the piece that would become *Vacillate*, its structure more or less finalised but small mix adjustments requiring work. Earlier note-taking sessions are broader and vague, with suggestions such as "something is missing here" or "try a sharp LFO sound here."

This three-phase compositional process was strictly adhered to throughout the research, despite their tendency to blur together. I will now describe compositional techniques explored in this experimentation process.

4.2 Foregrounding automation

Automation is a primary way of literally taking the continuous control of parameters out of one's hands. The extent to which automation can be used in the process of composition makes it one of the most important aspects of the DAW that make it unique as a site of

composition. It is arguably the technique which brings DAW-based compositional practice most closely to Evan Brooks' analogy of sculpture or construction instead of just capturing sound. Although automation was achievable on certain recording consoles from the 1980s onwards, in the modern DAW, the resolution, speed, and interface of DAW-based automation suggests new forms of engagement.

There are three main methods for generating automation in the DAW, shown in Figure 8. The first is through the recording of performances from MIDI controllers (top), converting the adjustment of a MIDI dial or fader into automation. This method is most aligned with live performance, but is limited by the dexterity of the musician adjusting the MIDI controller. It is also limited by the MIDI protocol, only enabling integer values between 0 and 127. This method also applies to MIDI-generating software such as Max, but this is less usual. The second is by clicking in a breakpoint function by creating 'points' between which straight or curved lines extend between (middle). This can circumvent the resolution limitations of MIDI, depending on whether the parameter supports automation at finer resolutions, and enables making more unusual shapes. Finally, automation can be 'drawn in' using what most DAWs denote as a 'pencil' tool (bottom). Clicking and holding the mouse enables the mouse to become a pencil, drawing

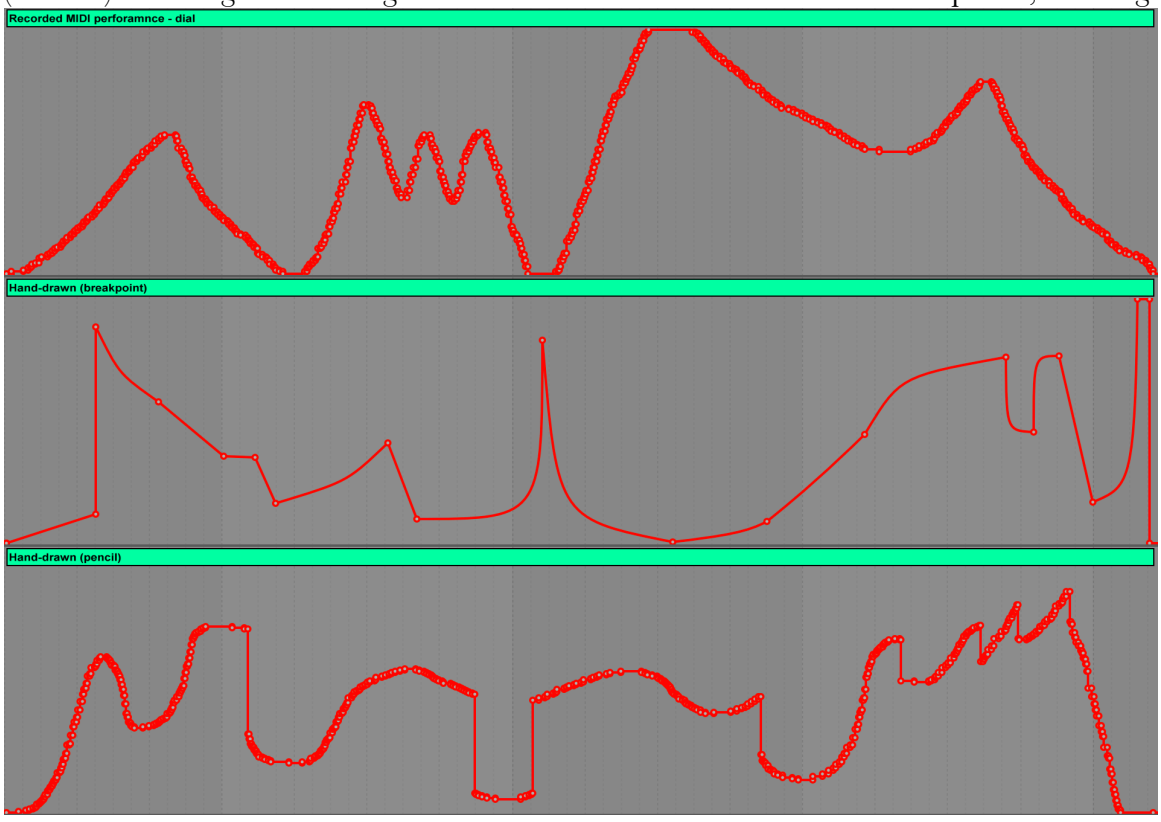

Figure 8: Three kinds of automation; MIDI controller recording (top), breakpoint function (middle) and hand-drawn (bottom)

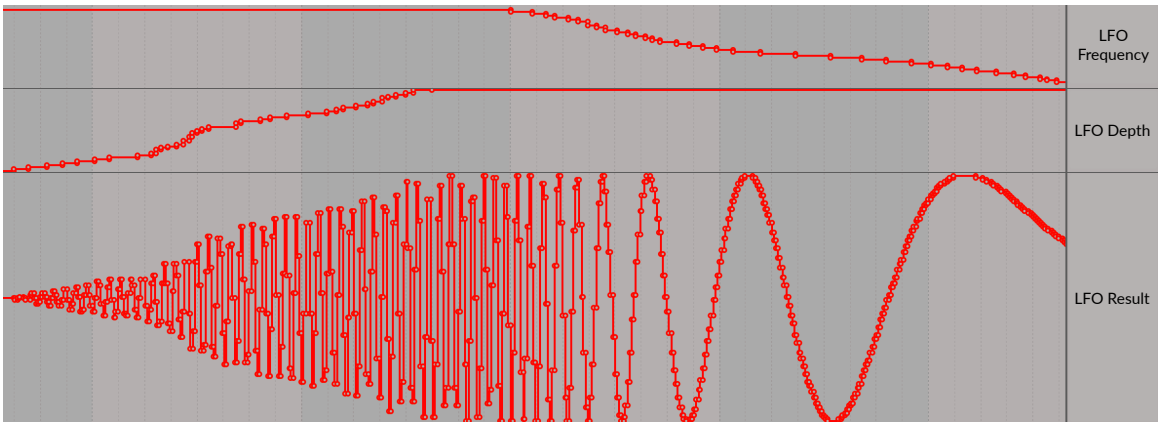

Figure 9: An example of CV-style automation (bottom), its frequency (top) and depth (middle) controlled by hand

automation shapes into the DAW. Jagged shapes can be drawn in this way, but the resolution of the drawing depends on how close one is zoomed in.

Prior to this research, I had noticed that my use of automation rarely explored the bold, jagged shapes that were possible in this form. I was interested in exploring these kinds of shapes, differentiating them from conventional ways of using DAW automation. I suggest three ways in which automation in the DAW is most conventionally used, in ways that conceal the unique potential of DAW automation:

1. *MIDI controller automation*: A conventional approach to using automation is to record or imitate gestures that are made by human hand, such as sweeping a filter by holding a dial and rotating it, or using a volume fader on a mixing console. Hand-style automation as a compositional and performance technique is prominent in styles such as popular electronic dance music and DJ performances, where the 'build-up,' an important structural component that increases intensity and tension prior to a 'drop,' is partly achieved by increasing the frequency of a filter (Solberg, 2014). Hand-style automation in practice often consists of very simple shapes, such as a ramp up or down.

2. *CV-style automation*: Control voltage (CV) is a primary mode of control in modular and analogue synthesisers. It is common in modular synthesisers to incorporate a module that enables manipulating a parameter over time, such as a low-frequency oscillator (LFO) or envelope generator. The complexity of the shapes generated with these tools can far surpass that possible with hand-style automation, but this doesn't necessarily preclude that CV-style automation is legible as a live, hand-made performance. LFOs generally have quite simple control mechanisms, such as the LFO frequency; its 'depth', or how high and low the value goes; or the shape of the LFO, such as a sine wave, triangle wave, sawtooth wave, and so on. Manipulating these parameters with the same kinds of simple

movements emblematic of hand-style automation mean that CV-style automation can be understood as hand-made, only with another layer of mediation between the human hand and the parameter being manipulated (Figure 9).

3. *Edit-style automation*: Edit-style automation is more contextual than prescriptive, in that it is typically used to 'polish' audio sources. This is usually enacted in DAW-based engineering that privileges (the illusion of) live performance, such as classical music, vocal-based popular music, and rock, maintaining what Brown called "the transparency perspective" as explored in Chapters 2 and 3. Automation of volume, EQ settings, and effects send levels may be automated meticulously such that each transient of a recording may have different automation settings. I have not worked on a project that required automation to this extent, but it is not uncommon in professional/commercial audio engineering contexts.

Using automation in ways that could not have been made 'live' by human hands, using LFO-style control, or automation that reinforces a representation of a 'polished' live performance, can be techniques for foregrounding the grain of the DAW. I experimented with this in a number of ways throughout the research. An early experiment, *bloceqf* (Figure 10, Audio Example 1) plays two drones, and on each note, the resonance and frequency of a bell curve in an EQ plug-in are automated by a MIDI controller recording, with an emphasis on short ramps towards seemingly random points. This is an atypical use of an EQ, which is usually used in a functional way for mixing several sounds or instruments rather than as a creative tool in its own right (see Chapter 5.4.3).

A second experiment in automation is the switching on and off of a 'chorus' plug-in, introducing a swirling effect (the top automation lane of Figure 10). This jarring effect is also rarely explored as a compositional technique. I felt this drew into stark relief the sequential, discrete nature of the plug-in, while surprising the listener who may have otherwise felt 'immersed' in the sound world therein.

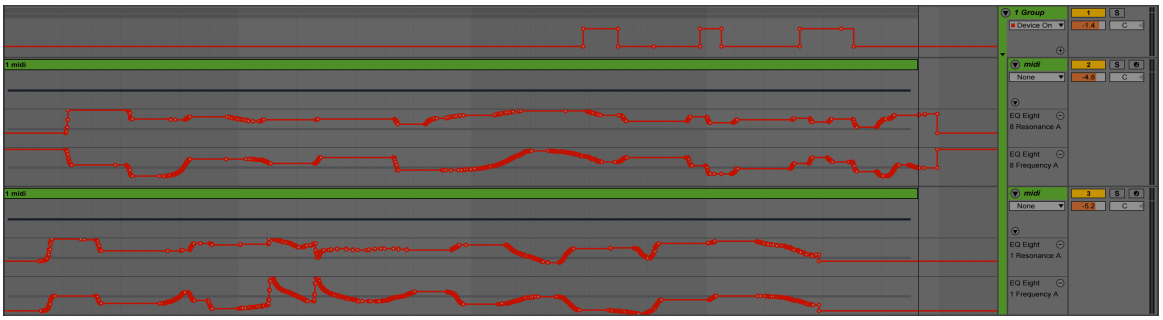

Figure 10: Exaggerated automation in *bloceqf*

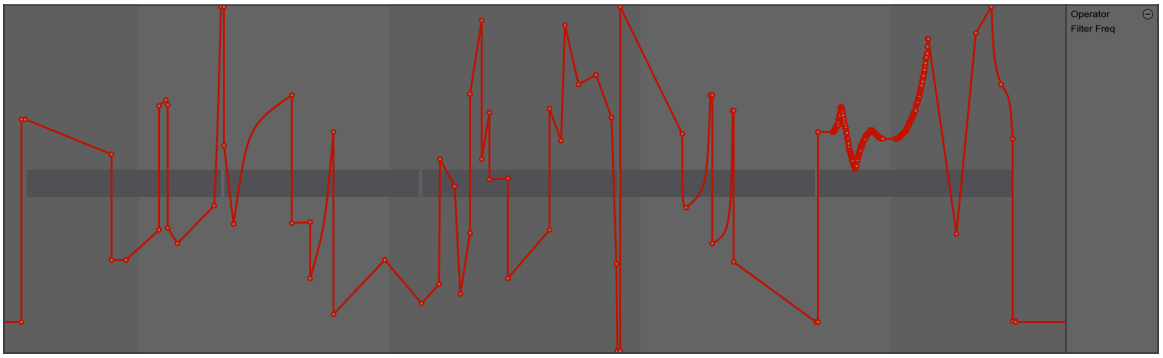

Figure 11: Angular automation shapes in *narkling*

This notion is a recurring theme throughout this experimentation process, creating scenarios that discourage a listening experience that immerses the listener in a sound world, a compositional logic akin to Galloway's notion of the *centre* of an artwork (Chapter 2.1), and instead drawing the listener's attention to the medium itself, the *edges*.

I explored more angular, DAW-specific automation shapes through synthesis parameters such as a filter cutoff. In *narkling* (Figure 11, Audio Example 2), these stark shapes are used to control a low-pass filter on a white noise source. The resultant sounds are, I feel, too random to draw attention to the DAW as a device that enables explicit and intentionally-placed automation—it sounds more like a randomised mode of control like sample-and-hold modulators similar to those found in modular synthesisers or in Max patches.

4.2.1 Pitch automation

Pitch automation was investigated early on in this research, continuing my interest in glissandi in the DAW. Conventionally, glissandi in software synthesisers are achieved through sequencing the "pitch bend" MIDI parameter, and setting a parameter common in software synthesisers for adjusting the range of a pitch bend. In Ableton Live, automation and MIDI sequencing are enacted in separate interfaces, and MIDI pitch bending is often limited to one or two octaves. I explored the idea of visualising pitch with automation by creating a Max for Live patch with a simple sine wave, its pitch controlled by an automatable parameter. *simplauto* (Figure 12, Audio Example 3) and *huppo* (Figure 13, Audio Example 4) show unusual pitch automation data drawn manually with the mouse. The former takes place over several seconds, while the latter happens in just three seconds, which mostly sounds like a smattering of digital noise.

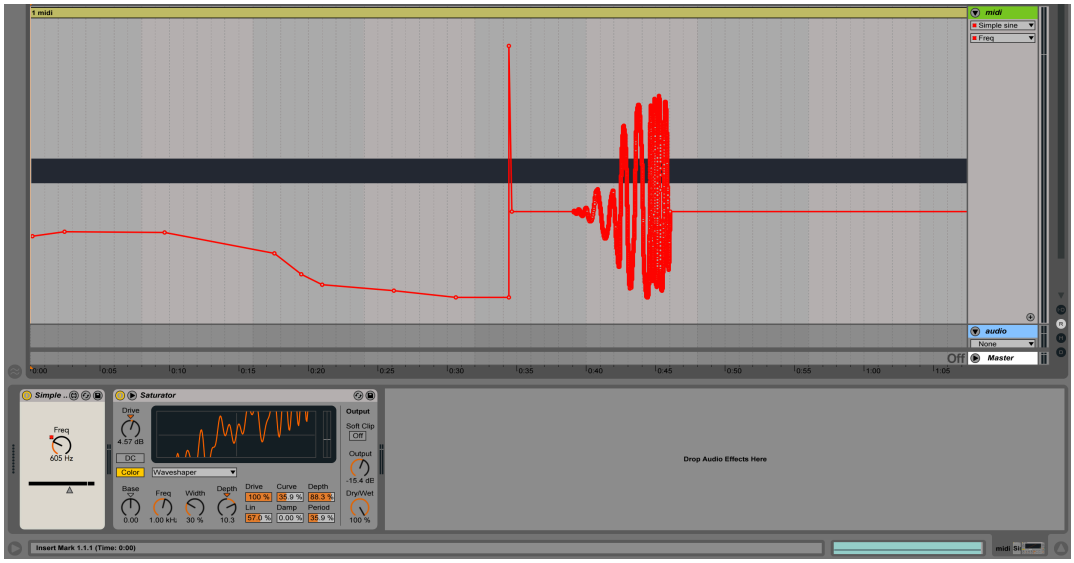

Figure 12: Pitch automation in *simplauto*

These experiments in pitch automation revealed for me the paradox in which given many choices for a particular action—especially when the differences in choice are basically negligible—indecision and anxiety can ensue. In these experiments, automating pitch to one setting may not necessarily be 'better' than another. What I experienced here was something that other experimental musicians alleviated by incorporating modular synthesisers into their practices, delegating these choices to instruments that are not so easily editable in the DAW environment. Removing the choice of editing and selecting pitches, in cases like this, can instigate progress.

These experiments in automation also prompted questions around style and aesthetic preference. The experimental electronic music I found most rewarding privileged timbral exploration rather than pitch, an arguably more central concern in Western art music. I felt such pitch explorations did not have an obvious place in my compositional vocabulary, although I do not preclude its validity as a compositional technique for foregrounding the grain of the DAW.

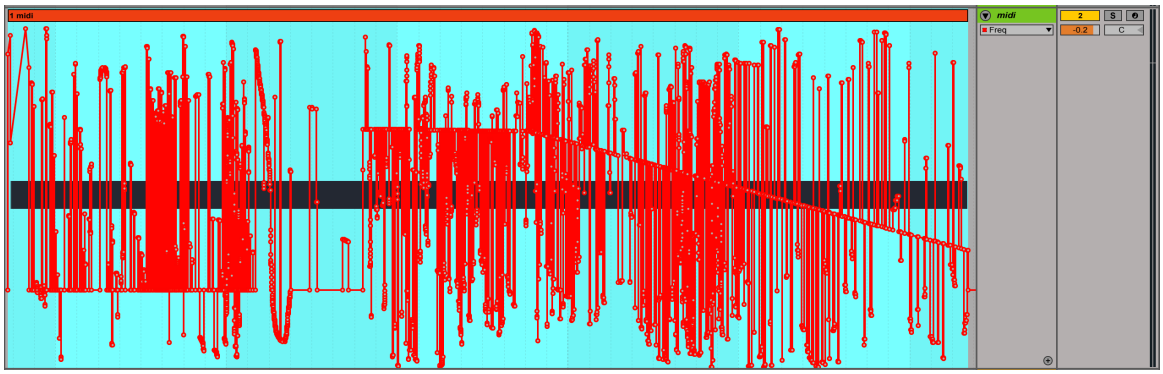

Figure 13: Pitch automation in *huppo*

4.3 Layering

A common term for instrumentation in electronic music production parlance is *layering*. The metaphor evokes visual ideas of DAW-based music as a painting, collage, or palimpsest, or more explicitly, the layer functionality in graphics editing software like Adobe Photoshop.* The DAW workspace becomes a canvas on which colours and materials are placed, often meticulously. As explored in Chapter 3, the allusion between visual arts practice and recording practice is not new, evoked by Eno's *The Studio as Compositional Tool*, in which the composer is in an "identical position of the painter—he's working directly with a material, working directly onto a substance, and he always retains the options to chop and change, to paint a bit out, [and] add a piece," (Eno, 1983). Eno describes this as an *additive* model of composition, popular in rock music after the emergence of the 24-track console, where musicians felt an obligation to fill all 24 tracks of tape with *something*. Later, he describes reggae music production as working backwards, akin to the work of sculpture, in which "the thing they played, which you can regard as a kind of cube of music, is hacked away at—things are taken out, for long periods."

The metaphor that operates at the heart of the layering metaphor is *timbre is vertical*. Eric Tamm, in his study of Brian Eno, writes that his music is "constructed on a vertical basis: to a great extent, it is music concerned with the sheer color of sound, rather than with the linear (horizontal) growth of melodies" (Tamm, 1989, p. 42). This supposes a second conceptual metaphor: *time is horizontal*. While I acknowledge that this binary metaphor begins to break down at smaller time intervals—at what point do very short loops become either a vertical timbre or a horizontal form?—it remains a useful way to

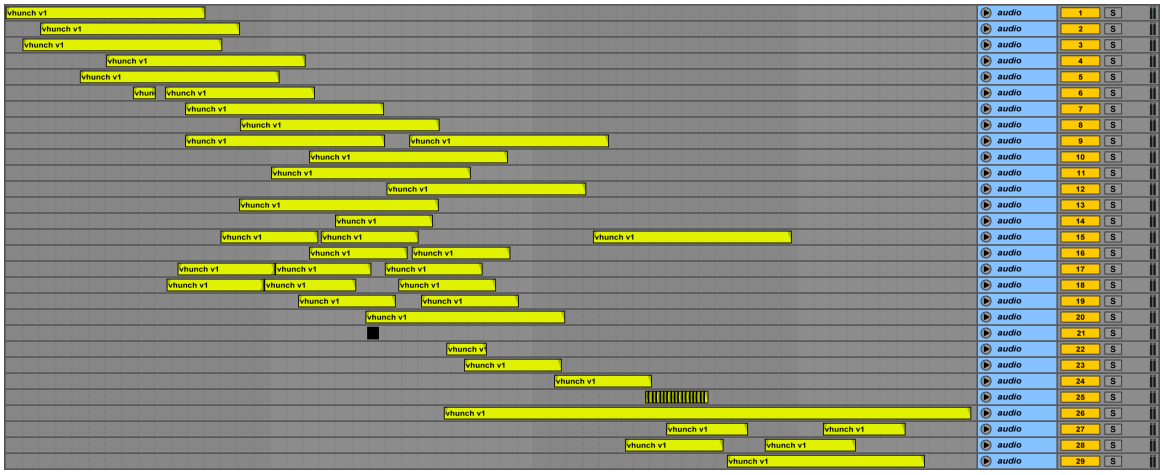

Figure 14: Layering multiple instances of a single recording in *vhunch multitrack v1*

* https://www.adobe.com/products/photoshop.html

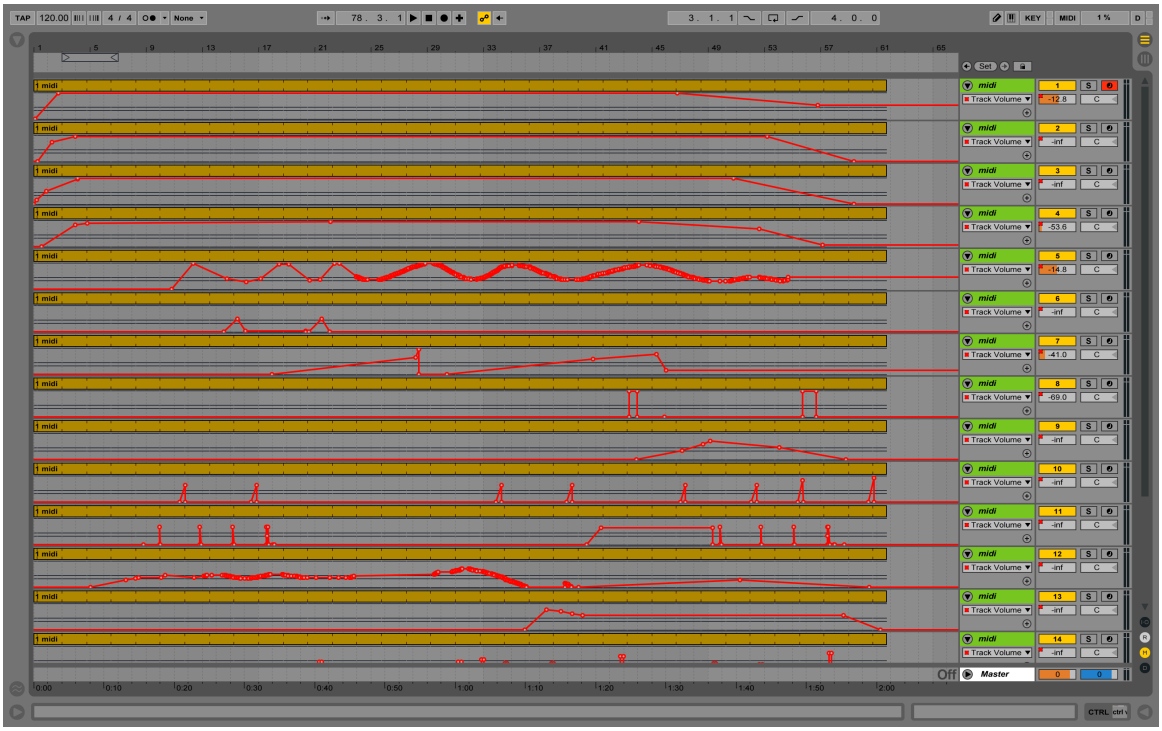

Figure 15: Layering multiple drones with different filter settings in *traxman*

think through the grain of the DAW because the metaphor is thoroughly embedded in the DAW interface. Tracks or channels are stacked vertically, and the form of the piece is organised from left to right across the screen, or as I increasingly found, diagonally from top left to bottom right, of which I shall explore further later.

The paradigm of layering is interrogated in two experiments, in which the 'content' of each layer is virtually negligible or indifferent. One experiment, *vhunch multitrack* (Figure 14, Audio Example 5), takes a 30-second sequence of synthesised sound, *vhunch* (Audio Example 6), as the sole source material. It was duplicated many times, with relatively minor processes applied to them such as reversing the audio or changing their speed of playback. There was little consideration for form at this stage, but I had hoped that ideas for formal considerations to emerge in the acousmatic listening phase. Another experiment, *traxman* (Figure 15, Audio Example 7), involves a simple chord played on a synthesiser, duplicated eighteen times, and each one set to a different low-pass filter setting. Using automation, I changed the volume of each track, again without much consideration of form.

These experiments, like the Automation experiments, placed aesthetic concerns aside in favour of rigorous, if clinical, explorations that attempt to expose fundamental practices associated with layering. While they suggest new and interesting forms, these were not explored in further depth in *Thru*.

4.3.1 Monophony

From the start of the project I was interested in the metaphor of layering and ways to subvert it. I observed that much of the experimental electronic music I was interested in was more concerned with this action, or "the vertical color of sound" as Tamm would say, than the horizontal sequence of sounds. Latartara writes that the DAW affords this vertical approach to sound well, providing "an easy visual format for layering different sounds or tracks and mixing them together. The ability to layer tracks in DAW technology … can be related conceptually to the concept of staves in Western musical notation" (Latartara, 2010, p. 111). Many artists even actively resist coding their music as events on a timeline. This view is epitomised by Oneohtrix Point Never, who says in a 2010 interview "I tend towards static arrangements. Event-based experimental arrangements bother the fuck out of me. I feel like I'm listening to a musical. It's too disruptive. I like long sexy arcs. I like vistas" (Finlayson, 2010). Notably, their music has steered far more toward "event-based experimental arrangements" than their earlier work, but this attitude is still prominent today. It is considered virtuosic production if the producer can layer many sounds and instruments simultaneously while still retaining a sense of clarity that allows the listener to aurally distinguish each instrument in the mix.

I hypothesised a way to subvert this layering metaphor was to make music that was decidedly monophonic, music that only sounded one layer at a time. However, I wanted to differentiate this work from that of the cold minimalism of musicians like Mark Fell, whose work is provocative but perhaps too austere to be used as a blueprint in my own practice. I listened to several works written for solo instrument invested in timbral, post-tonal explorations: Kaija Saariaho's *Papillons* (2000), Helmut Lachenmann's *Pression*

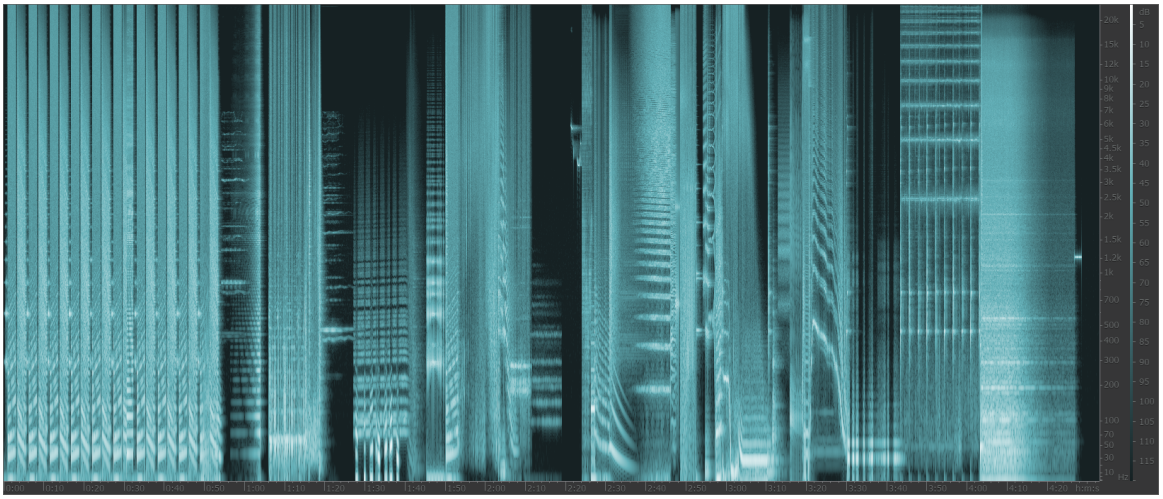

Figure 16: Spectrogram for *crh*, 0:00–4:33

(1969), Luciano Berio's *Sequenzas*, and more. These were not helpful, as I struggled to make any interesting connections between these styles and my own—they felt too *horizontal* despite their timbral emphasis. With several interesting and discrete sound designs accumulated, I arranged them in a block-like manner, revising transitions over several iterations of the three-phase compositional process. The work, titled *crh* (Figure 16–Figure 17, Audio Example 8) moves rapidly between sound designs, with the possible exception of the first 54 seconds. Sounds were organised with disjunction and contrast in mind, to highlight the block-like structure, and these are readily visible on the spectrogram of the work.*

After about 19 iterations, I decided to abandon the piece. Aesthetically, I felt the piece's structure resembled early *musique concrète*, or even early *Elektronische* serialism, only

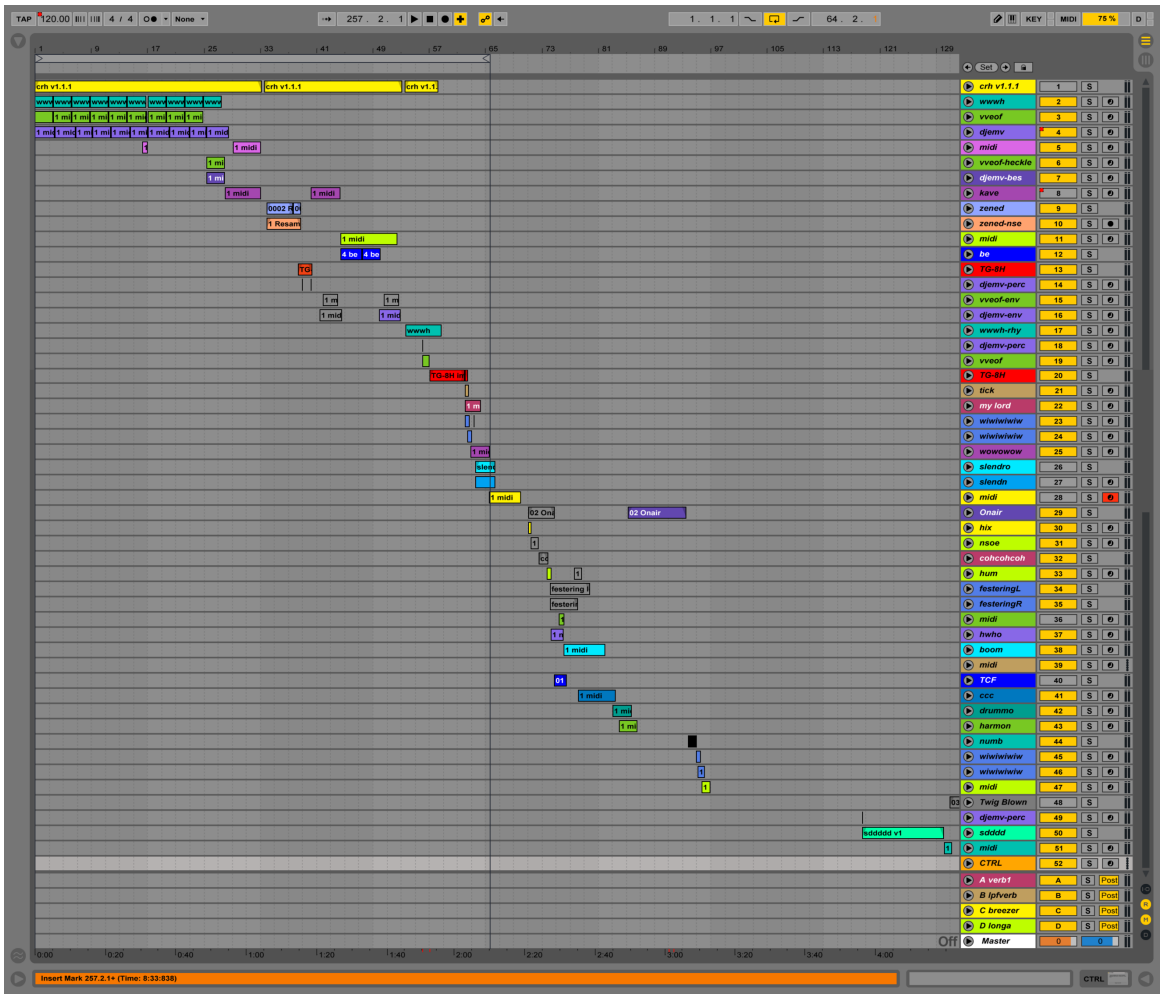

Figure 17: Composite screenshot of the DAW session for *crh*

* All spectrograms throughout this thesis are created using iZotope's RX5. The frequency scale is logarithmic, from 0Hz-24kHz, unless otherwise noted. The amplitude range is from -120dB (low) to 0dB (high). The window is set to Hanning. All spectrogram examples start from the beginning (0:00) of the piece or audio example.

with more contemporary sounds. I perceived this as old-fashioned, and out of step with the experimental electronic music I wanted to make. Although *crh* did not hit the mark aesthetically, it helped me re-evaluate the project and ask what it was specifically about layering that I felt carried some notion of the grain of the DAW.

4.4 Sound design as performance

The sound design phase takes up considerable time in my practice. It relies on an open-ended sense of experimentation and play, combining MIDI, sound generation and signal processing in ways that yield serendipitous experiences with sound. In *mousin*, (Audio Example 9), I simulate this process to an extent, recording the sound of me designing a sound. It begins with the default preset that loads when initialising Ableton's 'Analog' plug-in, an analogue-emulating synthesiser. In a piecemeal fashion, playing chords and individual notes using the computer keyboard as a MIDI input, a sound slightly more interesting than its original sawtooth sound emerges. Changes in the sound are sudden, and interspersed with silences. It has little in the way of tension or resolution, as I work through different possible tonalities, filter settings, and other parameter settings. As a piece of sound design, it is mildly interesting, but under acousmatic listening conditions, in which I bracket off my knowledge of the process that made it, it is not an interesting piece of music at this time. It may be an interesting structural idea for future compositions.

4.4.1 The Occultation of Production

Two experiments that deviated from the three-phase compositional process took place after *Thru* was finished, taking the form of an installation and a performance respectively. These works dealt with sound design in unusual ways, visually expressing the grain of the DAW in much more literal ways than may be possible in a sonic medium. *The Occultation of Production* is an audiovisual work installed at Mills College in December 2017 (Figure 19, Figure 18). Hiding musical performances from the sight of their auditors has been a prominent aesthetic for millennia, from liturgical choirs singing from behind curtains, to Wagner's design of an orchestral 'pit' beneath the operatic stage, to the mysterious sound design of science fiction films (Kane, 2014). Commodities gain mystique and aura when the labours of their production are not known to the consumer, a phenomenon Adorno called the "occultation of production" (Adorno, 1985, p. 74). DAW practice and field recording practice also participate in this cultural trajectory of the occultation of

Figure 19: Installation view of *The Occultation of Production*

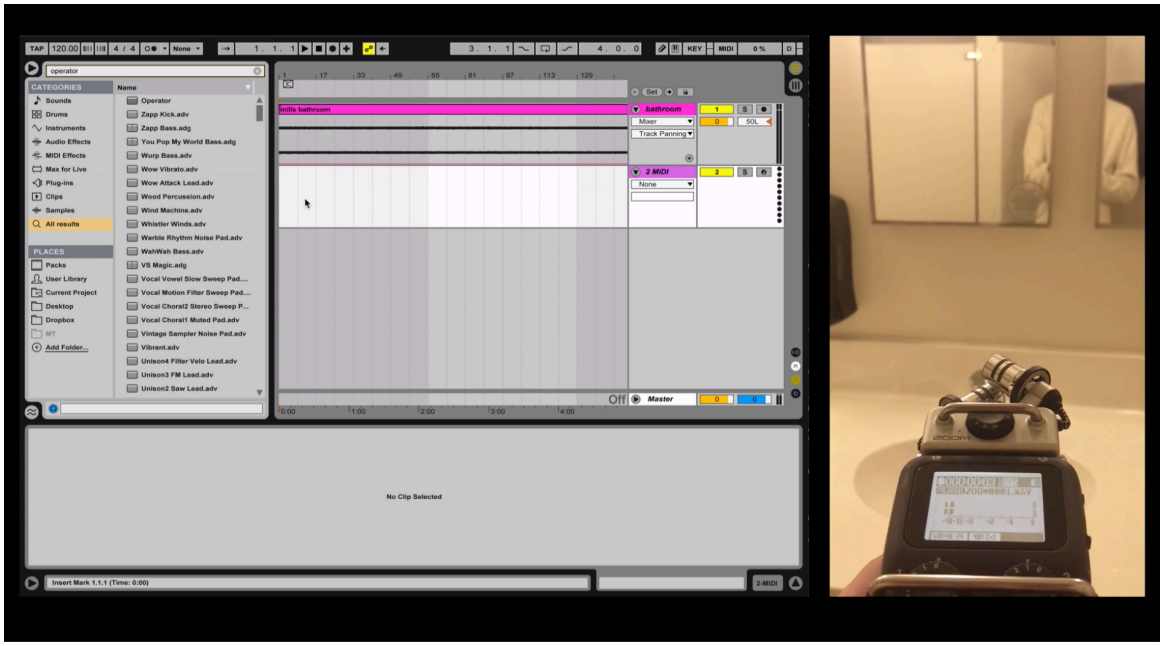

Figure 18: Video still from *The Occultation of Production*

production. While record production practice has always typically been concealed, DAW practice enacts a unique concealment in that it is predominantly done by individual musicians, who approach their DAW-based practice in self-educated and idiosyncratic

ways. Here, these processes are revealed to an extent, making transparent the construction of plausibly "real" sound, the reduction of the self, and the ambiguity in identifying the means of sound production.

The work is a projection with speakers on either side. The projection is presented as a diptych, the pane on the left a screen capture of myself working in the DAW, on the right a video of myself making a field recording with a Zoom recorder of the ventilation ducts and piping in a bathroom. In the video, I have concealed my face and worn cream-coloured clothes similar to the walls, a reference to techniques of concealment often enacted in DAW-based compositional practice. The audio from the DAW video is played from the left speaker, the audio of the field recording is played from the right. The trajectory of the work involves using the DAW to emulate as closely as possible the field recording. Using noise generators, sine tones, and ring modulation to create a soundscape similar to the timbrally rich and detailed soundscape of a heated and ventilated bathroom, an impression of the artificial and 'real' soundscapes coming together is reached towards the end of the video.

4.4.2 No Scrubs

In 2018, I had been commissioned to write a piece for the Western Australian Laptop Orchestra (WALO), a group comprising undergraduate composition and music technology students. I was interested in exploring DAW practices that were not conventionally used in recorded music, and that could be performed and be legible as such. All DAWs have a feature called 'scrubbing' or a variation thereof, which allows the user to 'grab' the playhead and move it across the timeline, playing the sound that corresponds to that point in the timeline. The technique has more relevance for tape-based editing, in which one needed to 'rock' the tapehead back and forth—a motion akin to scrubbing a surface—in order to find the onset of a sound they wanted to edit, as this information isn't readily visible on tape. I was fascinated by how the DAW had inherited this practice, despite it having little practical use in the DAW interface that visualises many aspects of sound.

DAWs implement scrubbing in different ways. A common way, used by Ableton Live and others, loops a small, approximately 200-millisecond phrase in front of the playhead; while others, such as Reaper and Logic (if changed in its settings), have a more tape-based implementation, in which scrubbing backward will play the audio backwards.

The title of the piece is derived from the 1999 feminist anthem "No Scrubs" by American R&B group TLC (Briggs, Burruss, Cottle, & Lopes, 1999), and has a very convenient and rather poetic story. The song, having topped the United States Billboard 100 popular music chart, was immediately followed by Ricky Martin's *Livin' la Vida Loca* (Rosa, Child, & Escolar, 1999), the first chart-topping song to have been entirely recorded and mixed in the DAW (Daley, 1999). *No Scrubs*, then, symbolises the end of an era of analogue hegemony, yet analogue practices continue to be felt throughout recorded music and audio technologies today.

I used Decibel's ScorePlayer iPad app (Hope & Vickery, 2015) to create an animated graphic score (Figure 20) notating the position of the playhead at various points in the piece, with the bottom of the score being the start of the performers' DAW sessions, and

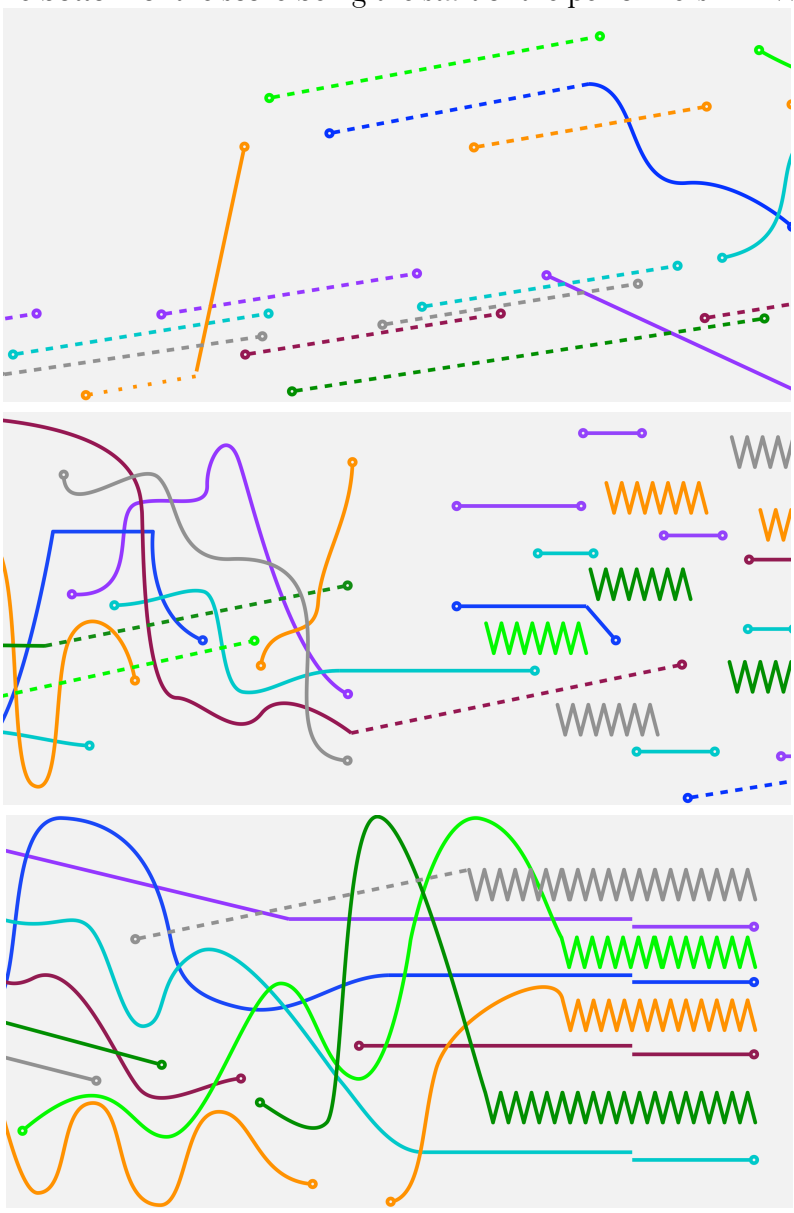

Figure 20: Three excerpts of the *No Scrubs* animated score

the top being the end. Each colour represents a different performer, and the performance lasts 8 minutes. I asked the performers to load their sessions with a DAW-based composition they were working on, or a hip hop or R&B track, with one of them being the original TLC track.

The work was light-hearted and fun. It evoked for me the sense of playfulness in a piece like John Cage's *Imaginary Landscapes No. 5*, updated for the digital era, and saturated with analogue references. Sonically, the piece was a mess (unfortunately a recording of the performance was not made), but this felt secondary to the ethos of subverting and exteriorising elements of DAW-based compositional practice that were traditionally obscured.

4.5 Feedback systems

Creating feedback loops in mixing consoles by feeding the inputs and outputs of a channel into each other is a technique used in musical works since Jamaican dub producers like King Tubby pioneered the technique (Milner, 2010, pp. 302-308), and has been used in experimental music practice for many decades. In the DAW, feedback through its send-return matrix can interacts with software effects to create sounds unique to the DAW. A former faculty member devised a system using the DAW's return tracks, also known as

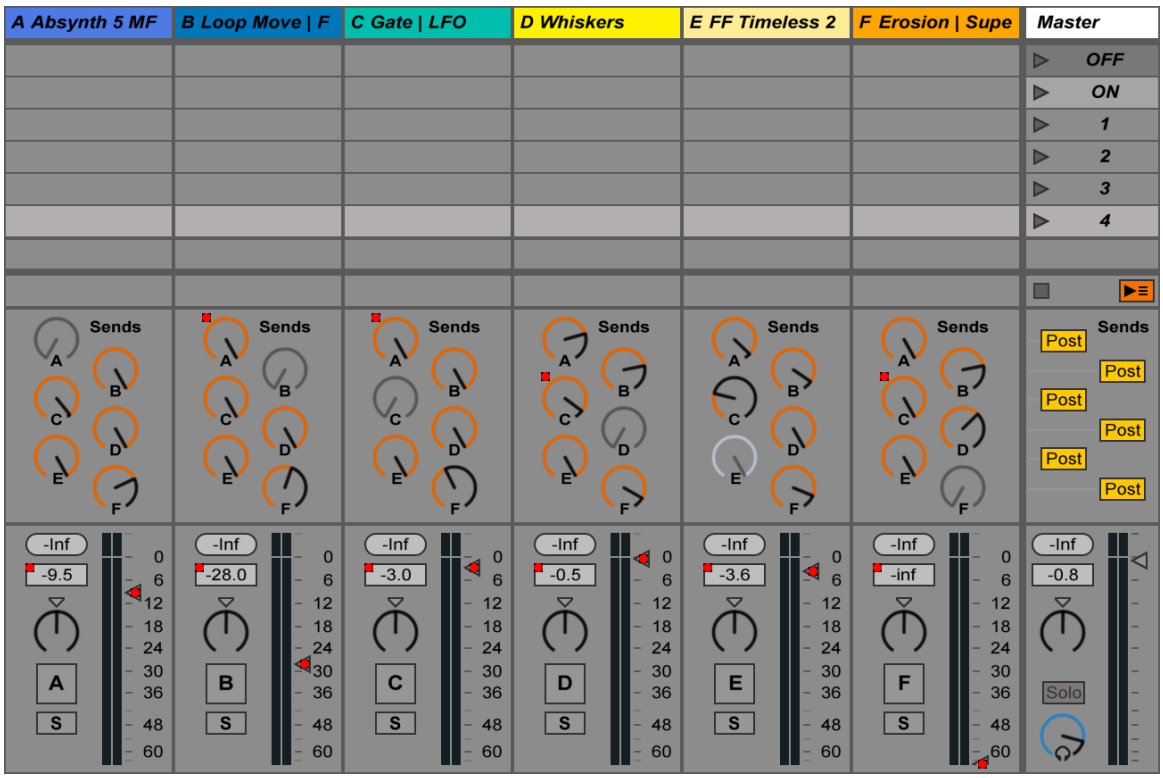

Figure 21: Complex feedback systems using send/return tracks in *sender3*

auxiliary tracks, each loaded with effects and feeding back into each other through a matrix of send busses (Riddoch, 2010). The approach subverts traditional DAW approaches and outcomes, completely negating the traditional timeline, and most conventional notions of intentionality in electronic music composition—the sounds of such a system in operation are very unpredictable, indeterminate, and non-replicable. I recorded several improvisations using systems like this (Figure 21, Audio Example 10). While these improvisations were pleasing, they were less useful as *individual* sounds. They took up all of the sound spectrum, with particularly prominent bass and treble presence. The recordings did not blend or layer well with others, and I could not work out how best to approach cutting up the recording, where such 'splices' should be made, and how it could be used in a composition. While this approach was helpful in articulating the possibilities of chaotic 'unintentional' DAW-based compositional practice, it was not employed in the development of *Thru*.

4.6 Sample libraries

As I suggest in Chapter 2, following Galloway, the grain is located at the edge of the artwork, which represents engagement with its own medium and its social positionality, while the centre represents the work's internal logic and coherence. One sonic form that complicates this binary is the use of orchestral sample libraries. I bought Native Instruments' *Komplete 9* bundle in 2011, primarily for its software synthesisers, which included Massive, Absynth, FM8, and Reaktor, all popular instruments in electronic music composition. The bundle also came with Kontakt, a software sampler, and a collection of sample libraries by default. These default sample libraries include all orchestral instruments, choirs, hardware synthesiser samples, non-Western instruments, and several keyboard instruments. Despite taking up tens of gigabytes on my hard drive, I had never used these in compositions until this project, which prompted an interest in the social construction of sample libraries and subversions of its traditional practice of emulating a 'real' performance.

Figure 22: The "soprano [a]" Kontakt patch used in *chorid*

The unfinished idea *chorid* (Figure 23) demonstrates one of these experiments on the materiality of sample libraries. A patch entitled “soprano [a]” (Figure 22, Audio Example 11) in which soprano voices sing a tonic and a fifth, is played with a three-note chord, with a slight upward bend in pitch. A cathedral-style reverb gives the note a sense of authenticity, but surrounded by digital-sounding synthesiser ramblings and processed field recordings, it is coded as ‘fake,’ and not a sound that the producer recorded themselves.

I stopped development of this piece for much the same reason as *crh*, in that the blocky form was useful for revealing the material condition of audio in the DAW, but sounded old-fashioned. The feedback I received from peers was also universally negative, which contributed to this decision.

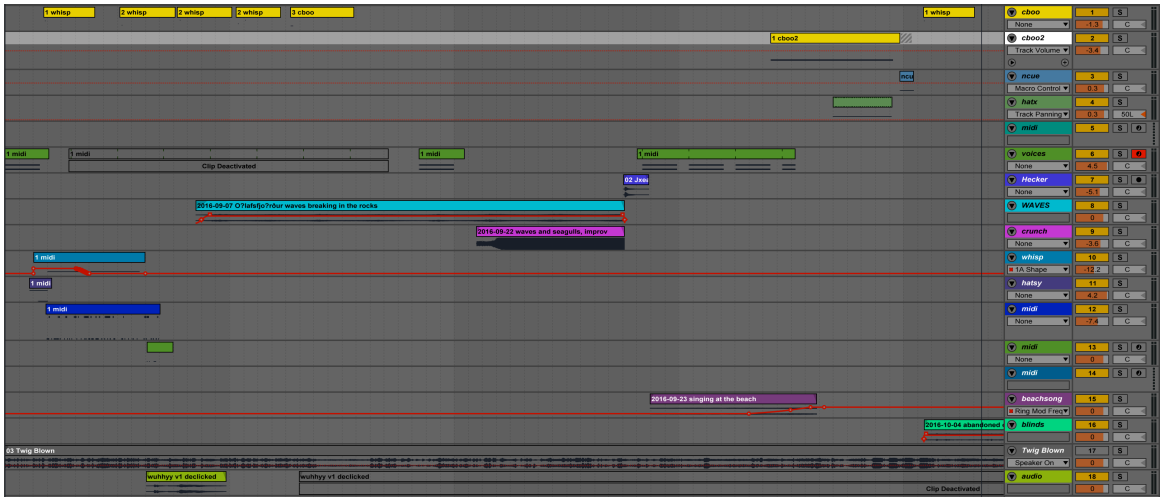

Figure 23: DAW screenshot of *chorid*

4.7 The indifference of audio and the case of field recordings

chorid also utilises field recordings that I had made while I was in Iceland, with quite abrupt and jarring transitions unusual in traditional presentations of field recordings. Making field recordings is a pastime that I get some satisfaction from, however I have struggled to incorporate them into my practice in a meaningful way. My observation is that throughout experimental electronic, dance, and ambient musical practices, field recordings are most conventionally used to add some nondescript 'sense of space' or 'randomness' to otherwise meticulous DAW-based productions. I feel this does a disservice to the potential of field recording as an autonomous art form to use them in this reductive way, devaluing the tradition of deep listening (Oliveros, 1984) that I value highly. Field recording, for English, involves critical and affective auditory engagement between the recordist, time, place, and technology (English, 2017). Constructing or collecting a field recording in English's sense requires an understanding that the field recordist's listening experience while making the recording is transmissible to the listener, meaning that the recording is immersive and representational to an extent. However, I also wanted to acknowledge the DAW as a common mediator of field recordings, and that this fact is routinely glossed over by field recordists, including by English. Field recordings are almost always edited and mixed, and this process is enacted in the DAW—in my experience, field recording is about 50% field work and 50% studio work.

Field recordings are given the same treatment as any other audio recording in the DAW: they are placed on an audio track and represented by a waveform. Field recordings are often quiet, meaning their waveforms may seem 'uneventful.' These

representations do not adequately represent the kinds of listening engagement that are undertaken during field recording. Moreover, as suggested in Chapter 4.3, the DAW particularly affords layering and additive composition, encouraging the user to place sounds concurrently with field recordings. I was interested in exploring field recordings in such a way that gave DAWs as much agency as possible, as one 'object' or 'region' among several. The experiments in this regard perform an "alien phenomenology" (Bogost, 2012) of the DAW, compositionally enacting the way that DAWs reduce listening experiences and cultural milieus associated with field recordings.

My primary techniques for exploring this include overlaying field recordings with synthesised sound or other field recordings, cutting them off abruptly, applying harsh or unusual signal processing to the recording, or using 'uneventful' sections of a field recording. In *chorid*, a recording of a tractor in which I slowly increased the microphone gain far beyond clipping point, laid over a recording of waves crashing, becomes overdriven and distorted, suddenly juxtaposing it with a synthesised squiggle (1:07–1:29).

The experiment *awefl v2* (Figure 24, Audio Example 12) explores field recordings in a similar way. The three field recordings utilised here explore wind sounds, the crushing of ice flakes on a frozen lake, and a plastic bag flapping in the wind, overlaid by (admittedly nauseating) faux-vocal synthesised sounds. Their entrances are sudden and unremarkable, as I tried to reflect the relative ease with which audio objects 'off the grid' are placed in the linear timeline. A similar experiment, *peth* (Figure 25, Audio Example 13), utilised a recording of myself spinning pint glasses on a table, with sporadic and sudden manipulations and interjections, such as synth washes and different distortion/saturation effects on the recording. Again, the results were middling, as I couldn't articulate a structure that I was happy to continue pursuing.

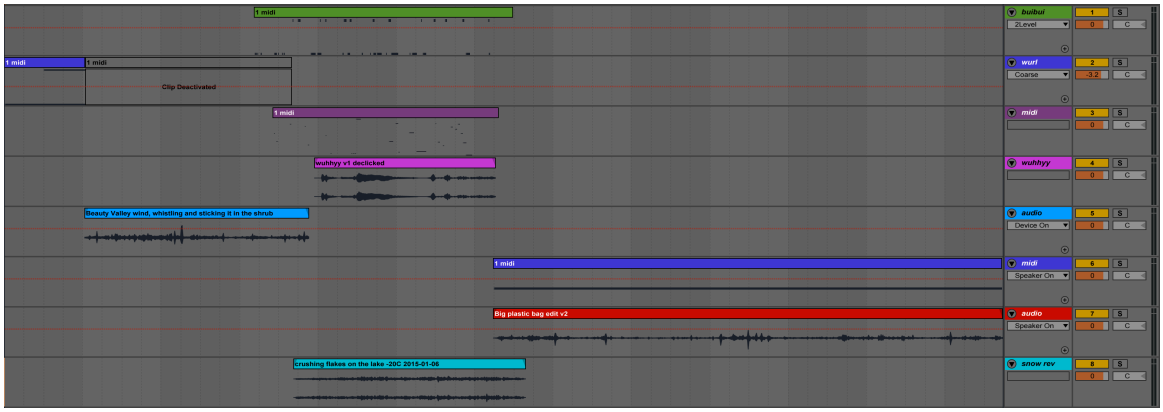

Figure 24: DAW screenshot for *awefl*

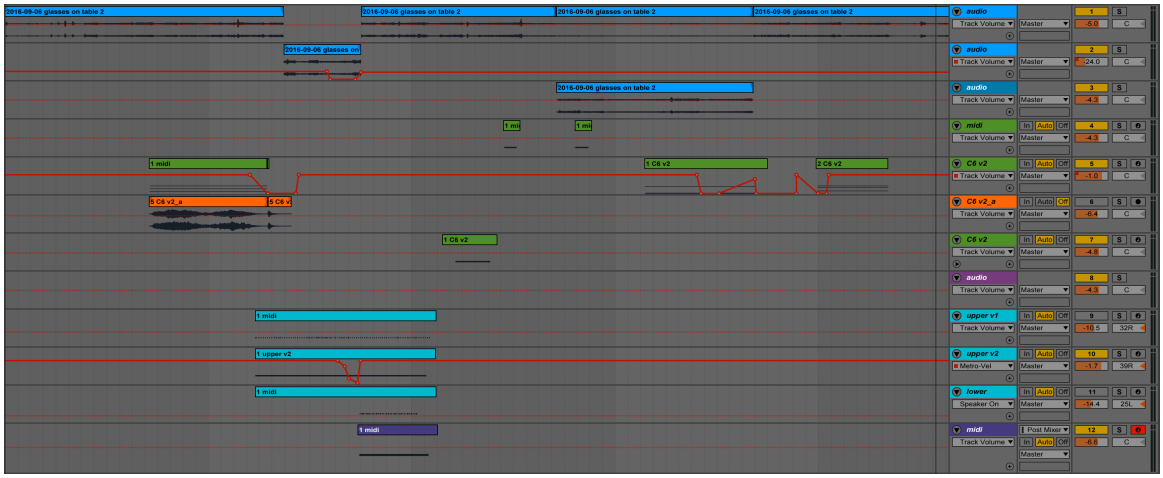

Figure 25: DAW screenshot for *peth v3*

4.8 Inconsistent spatiality

Electronically-generated sounds has a different relationship to air and space than acoustic instruments. While it is inevitable that electronic sounds will propagate through air towards the listeners' ears, manipulation of its parameters and characteristics takes place at the software or hardware level, the firing of electrons around metal circuits rather than pressure waves through an elastic medium like air. Reverberation occurs when an acoustic sound reflects from several inelastic surfaces, such as a wall, reaching the listener's ear at slightly delayed times from the first or incident sound wave. As recording technology was refined throughout the early twentieth centuries, recording aesthetics shifted toward privileging acoustically damp rooms over traditionally cavernous spaces. With the introduction of artificial reverb devices like the EMT-140 plate reverberation unit released in 1957, "engineers, artists, and musicians treated it as aesthetic raw material: sonic space itself became the object of an artistic palette" (Sterne, 2015, p. 112). Recording sounds in the supposedly space-less environment of the studio also served the more pragmatic purpose of enabling greater clarity of individual sounds in the mix, a condition which Sterne suggests detaches the space from its sound, a paradox. "Because identical or harmonically related notes in two musical layers would typically fuse if not spatially separated," write Blesser and Salter, "spatial separation afforded the composer greater musical flexibility by permitting increased complexity without concern for unintended confusion" (Blesser & Salter, 2007, p. 169).

Figure 26: Multiple representations of space using two reverb plug-ins in *berv*

The DAW enables access to diverse reverb plug-ins, its parameters changed to create a diverse range of reverberations, from extremely short to cavernous cathedrals to infinite drones. I was interested in experimenting with the possibilities of layering sounds with contrasting reverberation characteristics. I hypothesised that this disjunction between different spaces might draw attention to the mediations of the DAW and its ability to layer several recordings together without loss in fidelity. *berv* (Figure 26, Audio Example 14) is a short experiment in using percussive sounds to highlight two slightly contrasting reverberation settings. I opted for only two tracks of reverb because it very quickly sounded muddy. A gentle, bright synthesiser line with no reverb plays towards the end.

Another experiment in spatiality involved a reverberant sound source, faded out with the master volume (Figure 27, Audio Example 15). The effect is subtle, but on closer listening, the decay of each reverb tail is faded down somewhat unnaturally.

These experiments proved to be false leads, not quite as disjunctive as I had anticipated. Although there is promise in treating artificial reverb as a musical instrument in its own right, overlapping them is not an interesting enough technique on its own for foregrounding the grain of the DAW. Sterne makes a similar point: "In a world defined by detachable echoes and speaker culture, to hear things at once from multiple perspectives and in multiple spaces is a banal experience" (Sterne, 2015, p. 126). While

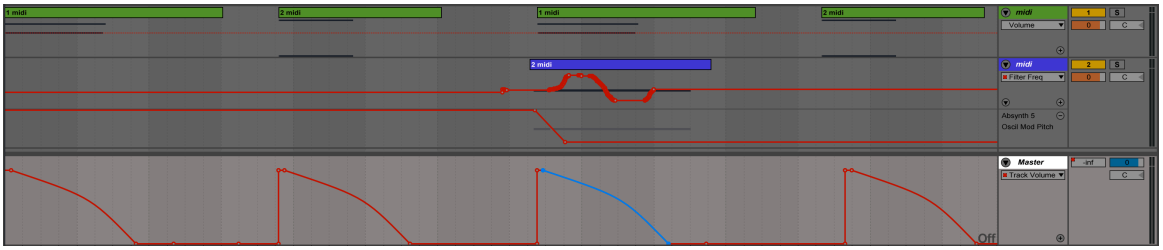

Figure 27: Using the master fader compositionally in *sawmas*

the DAW arguably plays a role in creating this banal experience, I did not find useful compositional techniques in this way.

4.9 Biographical metaphors of the DAW

In a blog post at the end of 2016,* I wrote about one of my favourite albums of recent years, an album by Minneapolis-based artist Meyers entitled *Negative Space (1981–2014)* (2016). The album is about Meyers' experience of his onset and recovery from a life-threatening condition and the chronic illness that followed, exclusively using bright digital synthesis and close-miked field recordings. *Negative Space* seemed to deploy the practices associated with making computer-based music as a biographical metaphor. One feels like Meyers was barely able to move when making the album. It was a work that constantly gestured toward its own medium, suggesting the techniques Meyers used—recordings of small sounds and computer-based synthesis—drew attention to the claustrophobic condition of the fallible body. I felt this was a moving deployment of what might be considered in other contexts a clinical sound palette, to invoke a meditation on near-death experience and recovery.

The laptop is the primary physical medium through which my entire DAW practice is enacted. Despite the mobility made possible with a laptop, I rarely make use of it in interesting locales. I mostly make music in my bedroom or a university studio. The possibilities of mobility were particularly felt while I was travelling from Iceland to Australia, during a six-hour layover in Copenhagen. I was bored, tired, uncomfortable, and hoped to alleviate my unease by writing some music, limited only to my laptop and my least favourite headphones. I dialled up a quick monophonic synthesiser patch in Aalto, and to generate note material I used the musical keyboard function in Ableton Live, making a fast and messy arpeggio on a C♯ pentatonic scale by pressing the keys W, D, T, Y, J, and O, inspiring the title *wdtyjo* (Figure 28, Audio Example 16). Having generated plenty of MIDI material through this action, I drew in automation afterward. One parameter I felt was profound in this context was automating the reverb plug-in's 'Dry/Wet' parameter, giving a sense of the sound being sucked in and pushed away. I likened this to the unusually claustrophobic "non-space" character of airport terminals, invariably large buildings with high roofs, but their homogeneity and sterility offer little comfort, a constant and unsettling reminder that you cannot leave until your flight leaves

* https://medium.com/@michaelterren/negative-space-7556a8d7996d

Figure 28: Exploring DAW-based composition as a biographical metaphor in *wdtyjo*

(Augé, 1995). Creating your own cocoon, immersing yourself in your laptop, becomes a defence mechanism against the unsettling mediocrity of these spaces. I feel this experiment goes some way in capturing this sentiment.

I found *wdtyjo* difficult to work on outside of the airport terminal, thus it remains unfinished. I am fond of the way it evokes an image of unsettled isolation and a kind of reverse-claustrophobia, however I felt this couldn't be easily communicated without being any more overt and literal about it, such as employing field recordings of airport terminals I was more interested in evoking these themes without having to describe in words how I am evoking them with respect to DAW practices, which I believe this piece does to an extent.

4.10 Conclusion

The experimentation process was useful in defining the trajectory of what would become *Thru*, articulating several aspects where the grain of the DAW might emerge through compositional techniques. The process highlighted the struggle between maintaining an aesthetic character closer to that of current experimental electronic music, and utilising techniques that foregrounded the grain of the DAW in jarring, attention-grabbing ways as this experimentation process has done. In *Thru*, I give more consideration to the former. As the techniques I have discussed here often run counter to conventions of good DAW-

based practice—insofar as conventions of 'good' DAW-based practice are often those that conceal the grain of the DAW—utilising them effectively in my practice was difficult. I still believe that these techniques developed here have merit and have a capacity for innovative music. Perhaps when I have developed my practice until I am confident and less self-conscious about my technical 'credentials,' I will feel more comfortable discarding these conventions wholesale. This is not to suggest, however, that such conventions cannot foreground the grain of the DAW. In the next chapter, I explore these conventions, and other non-conventional techniques, that perform this foregrounding.

5 *Thru*

Figure 29: Album artwork for *Thru*

Thru, the creative component of this thesis, is a 37-minute, 44-second album released on cassette and as a digital download with the Irish publisher Fallow Media.* It was publicly released on October 3, 2017 and included an audio-visual web-based installation of the track *Siliceous* published on the Fallow Media website.† *Thru* was mastered by Matt Mclean at The Soundfield Studio‡ in Bayswater, Western Australia, and the album art and tapes were designed by Ian Maleney (Figure 29, Figure 30).

Comprising six tracks, I understand it as an album in three parts. The first three tracks, *Thru* (9:58), *Fwd* (3:53), and *In2* (5:00), comprise the first part. They explore several techniques ranging from mixing strategies, aspects of sound design, and managing data and conceptual burden.§

The second part comprises two tracks, *Vacillate* (6:22), and *Vessel* (4:05), and are made exclusively for the album. Not constricted by deadlines like the other tracks, or even by other concepts, they took the longest time to make, and were both re-worked

* https://fallowmedia.com
† https://fallowmedia.com/2017/sept/siliceous/
‡ https://www.soundfieldstudio.com
§ https://fbiradio.com/945fm/programs/ears-have-ears/

Figure 30: Cassette version of *Thru*

substantially, several times over. In particular, they explore techniques that foreground intentionality, meticulous editing, and the limitations of sound design in a DAW.

The final part is the final track, *Siliceous* (8:26). Created during an immersive artist residency in Iceland, *Siliceous* explores the novel technique of *speculative mimesis* to create a sonic speculation on a fantastical, underground ecosystem, and how this intersects with the grain of the DAW

Thru was made primarily in three places: my bedroom in the Perth suburb of Maylands, a small mixing studio at WAAPA, and a bedroom in the artist residence in Ólafsfjörður (see Figure 5, p. 59). I used a 2012 MacBook Pro* with Ableton Live 9 as my DAW. Very few self-recorded samples were used in the album, excluding one recording of myself playing with a Rubik's cube at the beginning of *Fwd*; a doctored recording of myself throwing rocks at the end of *Vessel*; and me rubbing my finger on my laptop's microphone in *Siliceous*. All other sounds were made in-the-box. Composition took place in the early mornings, mostly on headphones. As well as running my DAW, I would also have a text editor open to journal my process, and regrettably, an internet browser to which I would intermittently look at social media.

* https://support.apple.com/kb/SP653?locale=en_US

Despite being in three parts with disparate themes, I consider *Thru* to be a singular work listened through in one sitting, preferably in a hi-fi listening situation or on good quality headphones. I worked on each track simultaneously, discarding many experiments that are nonetheless of significance to the research.

5.1 Track One: Thru

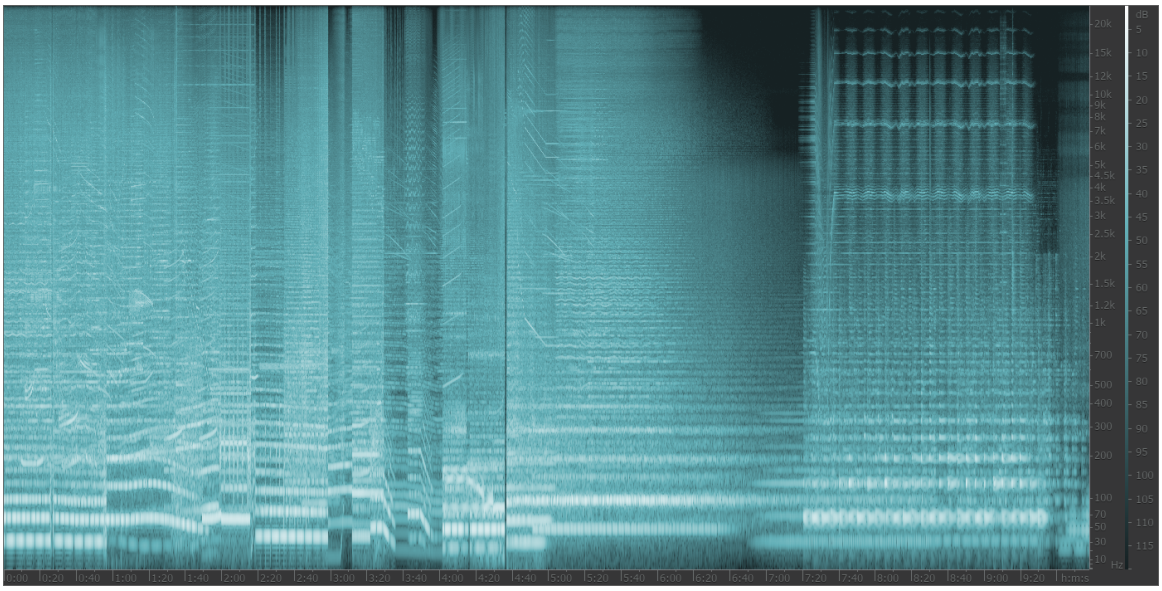

Figure 31: Spectrogram for *Thru* (9:58)

The first three tracks—*Thru*, *Fwd*, and *In2*—were created for a commission by the radio program Ears Have Ears, an experimental music show on the Sydney community radio station FBi. The show invites Australian and international artists to create "soundtracks" of 15 to 20 minutes, which can take the form of a mix, a live performance, or a composition. I was invited to make a soundtrack for the May 31, 2015 program. I considered it an opportunity to reflect on my own experiences presenting Difficult Listening, an experimental music show for the Perth community radio station RTRFM.* As a radio presenter, I am interested in fostering experiences that immerse listeners in musical settings they might otherwise not be exposed to, promoting unusual or reflective experiences and mind-states. Most radio listeners are listening in the car, and Sunday evenings, when Difficult Listening is broadcast, are in my experience a particularly receptive period within the rhythm of the working week. This involved understanding the car as what LaBelle calls "a generative space that affords the listening body a private

* https://rtrfm.com.au

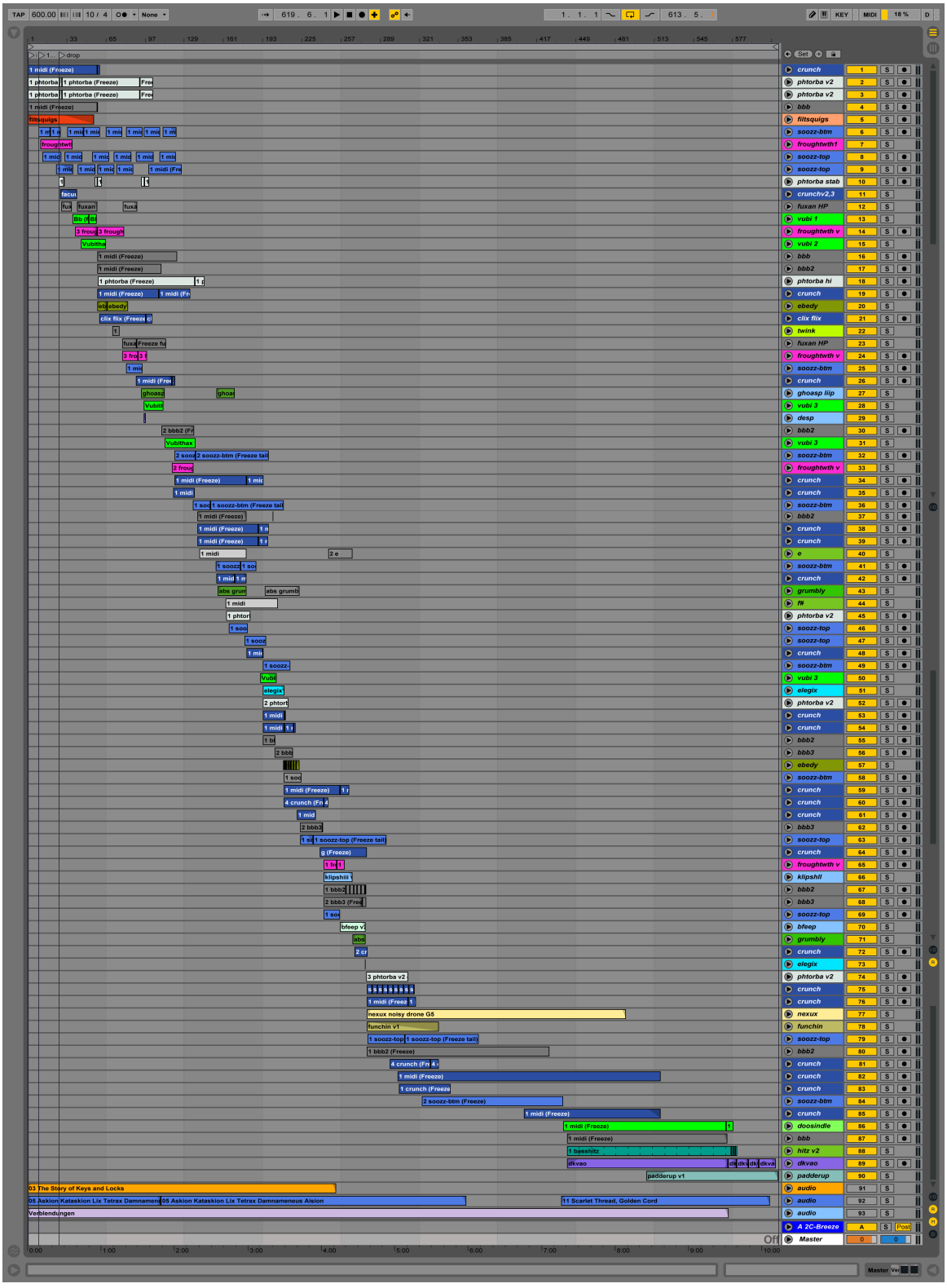

Figure 32: Composite screenshot of the DAW session of *Thru*

relation to music" (2010, p. 142). The track titles are a nod to a vocabulary employed by some writers around electronic dance music and experimental electronic music. The

British record distributor Boomkat* is renowned for its 'reviews' of the records it sells (Fact Magazine, 2015), laden with oblique superlatives and using words like 'thru' and 'fwd' in its lexicon. The word 'thru' also doubles as a reference to DAW and MIDI terminology, as a term denoting a protocol through which MIDI data is both used by the receiving device and passed through to another device.

Thru, a 9-minute 58-second track, focused on how form, automation, layering, and approaches to spatiality can foreground the grain of the DAW through composition. It also explores the use of reference tracks, negating notions of representing live performance, and novel approaches to in-the-box sound design.

5.1.1 Linear, event-based structure

Thru embodies a linear formal structure, conventional in the art-music sense that it incorporates thematic and motivic development, and a dynamic of tension and resolution Experimental electronic music today typically does not rely on the tension-resolution model of musical structure, in no small part *because* of its status as conventional. Much of the practice is concerned with systems, setting systems running and negating narrative or form—recall Oneohtrix Point Never advocating for "static arrangements" over "event-based experimental arrangements" (Chapter 4.3.1).

One factor in experimental electronic music's tendency towards "static arrangements" is the difficulty of making event-based musical structures in live performance. Especially with analogue and modular synthesisers, switching patches is not usually possible to do instantly or even quickly, thus live performances tend towards incremental changes over time rather than sudden dramatic shifts. My employment of a linear formal structure thus tries to negate liveness as a necessary compositional paradigm by virtue of it being essentially impossible to perform live. I aimed for a degree of complexity, movement, and careful development of thematic material.

Thru can be understood as comprising four sections. The first section, 0:00–2:18, is loud and brash, introducing the main synthesised sounds that act as through-lines throughout the piece. Several incidental sound designs intersperse and generate tension, and usually these sounds do not return. The flippancy with which these sounds are employed only once without any further development draws attention to the 'constructed-ness,' or 'non-liveness' of the piece. The next section, 2:19–4:36, shifts the key and

* https://boomkat.com

introduces a repeated motif, a figure with exaggerated and repeated panning. More embellishing sounds fill out the soundscape, punctuating the several crescendos and decrescendos. The third section, 4:36–7:20, begins with a loud explosion that reprises the first section, gradually simmering down over a long decrescendo. In very classical form, the primary note shifts to the dominant, G, setting up a resolution to C in the final section, 7:20–9:57. Softer than the other sections, it is relatively sparse and placid in comparison to the first two sections.

While I do not rule out that this work could not have each of its parameters performed by one individual, the density of different sound designs, their careful automation, and their arrangement in a linear form, all suggest that it is a meticulous DAW-based construction. Approaching composition by foregrounding this sense of anti-liveness is a technique for foregrounding the grain of the DAW reprised throughout the pieces in this album.

5.1.2 Reference tracks

Reference tracks are finished tracks, usually by other artists and producers, that are used as a guide for mixing. By directly and immediately comparing one's own mix with a commercially-released track, one will in theory achieve a better mix more quickly and accurately. It is considered standard practice, especially amongst early-career audio engineers, to use reference tracks diligently.

In the DAW, I employ reference tracks by placing them at the bottom of the screen (the bottom three tracks of Figure 32), out of the way, and setting a keyboard shortcut to toggle the 'solo' track setting on and off. Several reference tracks may be used, and I use different reference tracks for different sections of the work.

Picking reference tracks can be humbling, especially in DAW-based compositional practice where distinctions between composition and mixing are blurred. I pick tracks I already like and have listened to many times, and these are typically works of experimental electronic music. I elected not to refer to tracks that employed distortion and tape-like effects. The work of Bee Mask (2011, 2012) was used extensively, with works by Valerio Tricoli (2014), Chris Abrahams (2013), and Matt Carlson (2016) also employed throughout the album. I privileged Bee Mask's work because their mixes are very clear and precise, making no pretence towards analogue 'warmth' despite their largely analogue palette, and their use of effects like reverb and delay in refined ways.

In the context of music with instruments such as rock or folk, reference tracks might be used as a guide for how instruments should sound individually and collectively. In experimental electronic music, instruments are less materially or conceptually separable, so my use of reference tracks is more holistic. My principal technique for using reference tracks is by viewing spectrographs of each track. I load one plug-in which has a spectrographic viewing feature such as Fabfilter's Pro-Q 2 (Figure 33), and another onto the reference track. By placing the windows next to each other, I can see the relative differences between each, and adjust the mix accordingly.

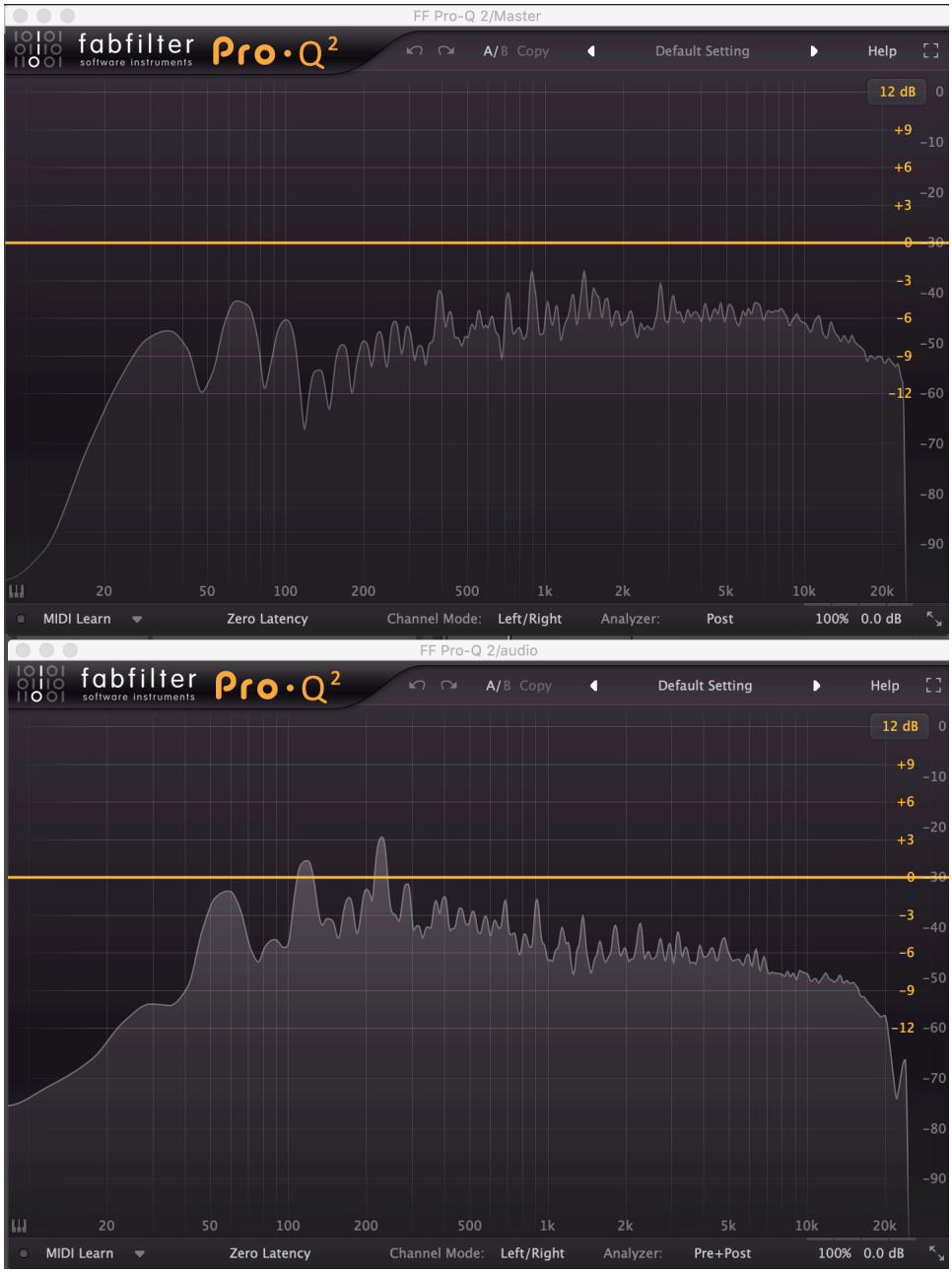

Figure 33: Spectrograph of *Thru* (top) and spectrograph of a reference track (bottom)

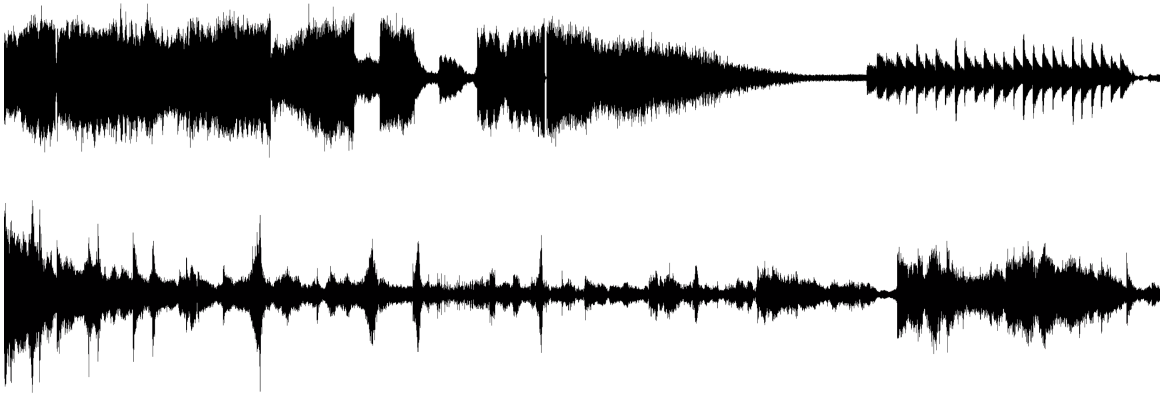

Figure 34: The waveforms of *Thru* (top) and Saariaho's *Verblendungen* (bottom)

In DAW-based compositional practice, reference tracks are likely to be influential to more aspects of the composition than just mixing. To help me structure the work, I found a recording of Kaija Saariaho's *Verblendungen* for tape and orchestra (Saariaho, 1984), placed it at the bottom of the DAW session, and used the waveform of the recording as a structural guide (Figure 34). Although the alignments are not exact, it shows distinct events in the latter are associated with changes in amplitude in the former, especially with the return to loudness towards the end of each piece. In a sense, I approached the waveform for *Verblendungen* like an instructional score.

I am ambivalent about what this process implies. On the one hand, it demonstrates the way that DAWs can prioritise certain types of information over others, specifically the waveform as an influential paradigm in composition. On the other hand, I more or less copied—sampled—the structure of Saariaho's piece without attribution. This experiment evoked what Milner called "the Pro Tooling of the world," in which all sounds are "[reduced] to a universal code that can be recombined at will" (Milner, 2010, p. 301). The use of waveforms as instructions may be one such combination that is specific to the DAW.

5.1.3 Automation

The limitations of automation become apparent when it is used to automate pitch. These limitations vary between software synthesisers. In Omnisphere, for example, all parameter values are reduced to an integer between 0 and 127, much like the MIDI protocol. This can make smooth glissandi difficult to achieve, as the pitch inelegantly quantises and steps between frequencies. Others, such as Aalto, enable automating parameters that aren't confined to this protocol, thus smooth glissandi are more readily achievable. There are

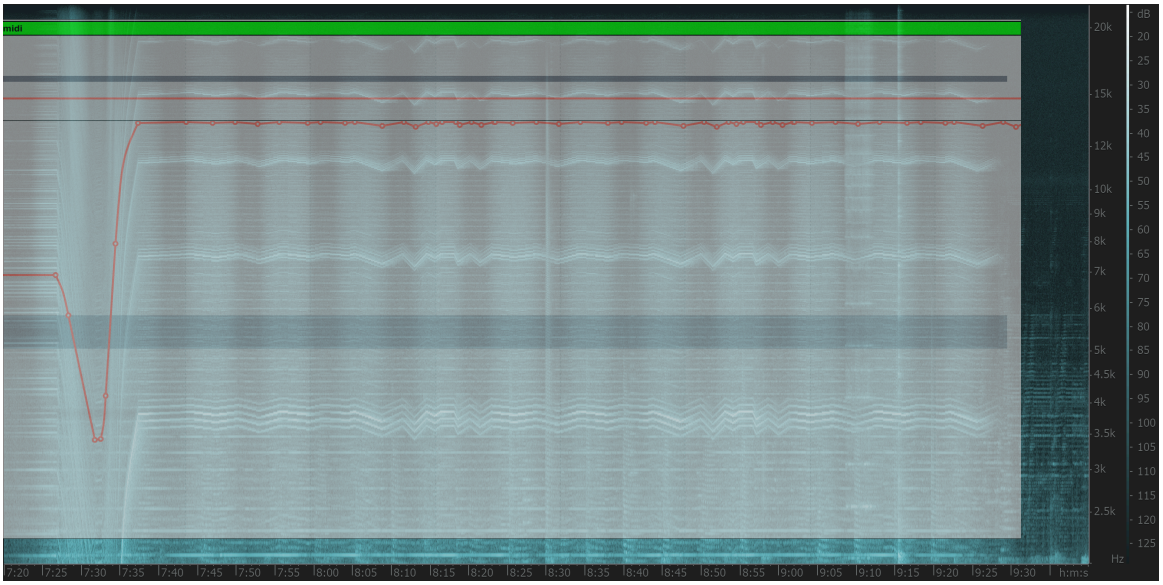

Figure 35: Pitch automation from 7:20–9:30 overlaid on a spectrogram, 2kHz ≤ y ≤ 24kHz

limitations to this though, and pitch quantisation and stepping is noticeable at times. In the final section of *Thru*, a high note synthesised in Aalto drifts in and out of the s. The stepping is noticeable, albeit concealed somewhat by reverb. Looking at the sound on a spectrogram (Figure 35), it is very noticeable that not only does the pitch of that sound *look* like the automation I made for that instrument, but it reveals some laziness on my part in that I copied and pasted the automation so as not to keep creating new automation. The limitations of automation are shown here by how small the changes in the (red) automation line are, in comparison to the relatively steep changes in pitch revealed by the spectrogram.

5.1.4 Flattening the soundstage

The *soundstage*, also known as the stereo image, is a term broadly concerning the representation of perceived width and depth of a mix (Dockwray & Moore, 2010). The term suggests that sounds are placed on a stage, like actors on a theatre stage, with the listener perceiving where sounds are coming from in this theoretical space. It need not be considered a form of "concert hall realism," as Kealy says—a wide and deep soundstage is often considered good mixing practice in electronic music as well as acoustically-based work. I discuss depth more specifically in Chapters 5.2 and 5.6.5, and width in Chapter 5.3.

In *Thru*, I was interested in subverting representational notions of the soundstage by creating work that was 'flat,' or radically lacking in perceptual depth. 'Flatness' is a

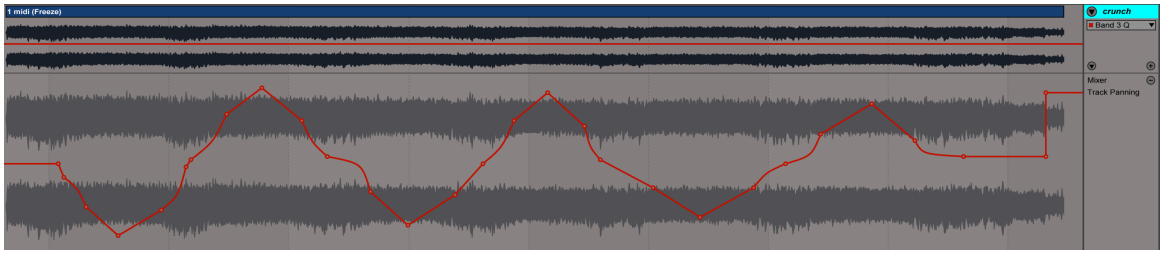

Figure 36: Panning automation data from 2:00–2:13 in *Thru*

qualitative term that is difficult to describe, although Morton Feldman explored the notion throughout his career. In a 1969 essay *Between Categories*, Feldman suggests that music has a *surface* and a *subject*, somewhat akin to Galloway's *edge* and *centre* dichotomy, and this has precedence in painting, as the renaissance-born illusion of perspective gave way to abstract expressionism in the 20th century. "My compositions are not really 'compositions' at all," Feldman writes; "one might call them time canvases in which I more or less prime the canvas with an overall hue of the music" (Feldman, 2000, p. 88). The 'flatness' of Feldman's work is suggested by his use of limited dynamic range and muted timbres, thus limiting the perception of space and foregrounding the temporal aspects of sound.

Although Feldman's work is stylistically and technically at odds with mine, I sought to approach this notion of flatness in *Thru*. I primarily enacted this in two ways. Perhaps the most obvious is a sparing use of reverb and delay. I only use reverb to create a sense of a soundstage notably at two points: at the sudden drop-out 4:35, and in the final 'movement' from 7:20–9:58. Without reverb, the different synthesised sounds do not coalesce as much as they would in a live room, thus perceptually differentiating between sounds is easier. I also exaggerated panning at several moments, for example from 2:00–2:15, 2:40–2:58, and 3:40–3:51. These motifs do not move across the stereo image in a natural way, which would have required more diligent use of reverb. Rather, the panorama simply moves from hard left to hard right and back, dwelling at each end for a little while (Figure 36).

Subverting the soundstage, the representation of a hypothetical three-dimensional space amongst which all sounds are localised, can foreground the grain of the DAW. Although the approach of 'flattening' music towards its 'surface' à la Feldman is as much an ethos as a demonstrable sonic effect, the practice suggests new engagements with the DAW's material conditions that contrast with conventions of spatial representation in audio engineering.

5.1.5 Conceptual burden and data management

In Chapter 4.1, I describe Duignan's idea of "conceptual burden," in which user interfaces that present the user with (the perception of) too much information can be paralysing or otherwise influence the user's decision-making. This may result in a sense of overwhelm, which slows the process down. Bouncing a track or several tracks, despite the "resulting loss of provisionality," is a simple way to reduce conceptual burden, and concealing other kinds of information, such as compilations of tracks (also known 'comp tracks'), and automated parameters not currently in use, are also crucial tasks in reducing this. Maintaining a clean and conceptually burden-free DAW environment is an action I privilege in my practice, because conceptual burden influences my perceptions of my own work. This motivates my three-phase compositional process—acousmatic listening effectively wipes the slate clean. However, it is impractical to export the DAW session after every change I make, therefore steps need to be taken to minimise informational overload.

Conceptual burden arises from a number of conditions, not just excessive visual information in the DAW interface. Ableton's interface prominently displays a CPU usage meter at the top right, which can inform the user's choice to add more material to a composition. Throughout the making of *Thru*, in my journal I repeatedly questioned whether the work I was making was too complex simply because the CPU usage meter had a consistently high reading. My response to this was to bounce out several tracks, or work on one sound design individually outside of the 'main' *Thru* session (explored further in Chapter 5.4.2). In turn, this introduced other aspects of conceptual burden. The solid-state drive on my laptop was 256 gigabytes, a relatively small amount of space that I repeatedly filled up with bounces of old DAW sessions.

In a journal entry around the beginning of the compositional process, I reflect on this condition:

> the set is getting huge, it's got 50 tracks at the moment and that's just the first half. it's taking 10 minutes to do a single bounce … times like these i wish i had a desktop that could crunch this stuff harder, and let me go further with more cpu, ram etc, but the laptop is better in many ways. i think there's a closeness to the laptop, and almost an individuality in remaining firm with my choice of keeping my productions on a laptop and not buying a desktop computer. part of that is bc [because] i like that i can make music anywhere, perform music, compose, consume, all on the same device (that's what my hons [honours] thesis is about i think?) and, well, i'm

> close to the laptop. it's set out how i want it. the mouse is the right sensitivity. i have access to everything i need, everything is orderly and searchable and i know all the keyboard shortcuts i've made to get to things quickly. incidentally there is a mac pro sitting one meter from my laptop, here in the MA [music auditorium] control room at waapa, but it'd be a massive bummer to use a computer which didn't have my software, my synths, my keyboard shortcuts (personal journal, April 21, 2015).

This entry also suggests that managing conceptual burden also invites considerations of the circumstances of the user, typically the kind of computer they can afford to use. In the entry, I acknowledge that a desktop computer would be more powerful, thus potentially reducing conceptual burden, but this is not enough for me to warrant losing the mobility, intimacy, and familiarity of my laptop.

Organising the DAW session to seem cleaner and more intuitive thus became an important aspect of my DAW-based compositional practice. I arranged all tracks from top to bottom in terms of their chronological order, resulting in a diagonal arrangement of sounds from top-left to bottom-right. Colour-coding tracks also became a useful technique for quickly understanding the function of a track in the context of the piece. In Figure 32, the deep blue tracks (labelled "crunch") use similar software synthesiser patches, as do the grey tracks labelled "bbb." During the practice, I would have every track 'minimised' (as shown in Figure 32) and would only 'open' the tracks that I was currently working on. I also hid various views that were unneeded at any time, such as plug-in windows, the DAW file browser, and the piano roll. Eventually, these practices became habitual, and likely helped my compositional process move along.

As a technique for foregrounding the grain of the DAW, reducing conceptual burden is arguably not audible in the final work, despite its importance in DAW-based compositional practice. Perhaps—and I suggest this facetiously—the fact that *Thru* got finished *at all*, and not bogged down in the morass of overwhelm and anxiety, is where the audibility of managing conceptual burden lies.

5.2 Track Two: Fwd

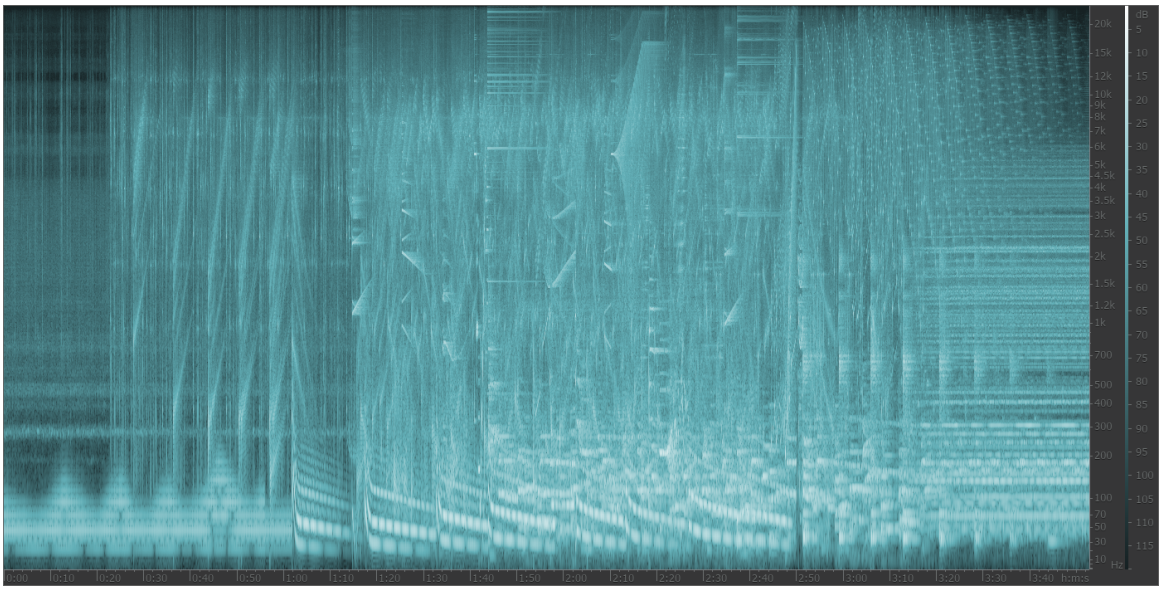

Figure 37: Spectrogram for *Fwd*

Fwd, a 3-minute and 53-second track, was composed very quickly in about one day in 2015, and adjusted only slightly over the next two years. It came together at a time when I was interested in the idea that timbres unique to synthesis could be considered as motifs, performing some of the functions of a leading melody despite not being beholden to conventional harmony. *Fwd* foregrounds these motifs, drawing attention to automation and the unique controls that digital synthesis in a DAW provides. Other aspects of the

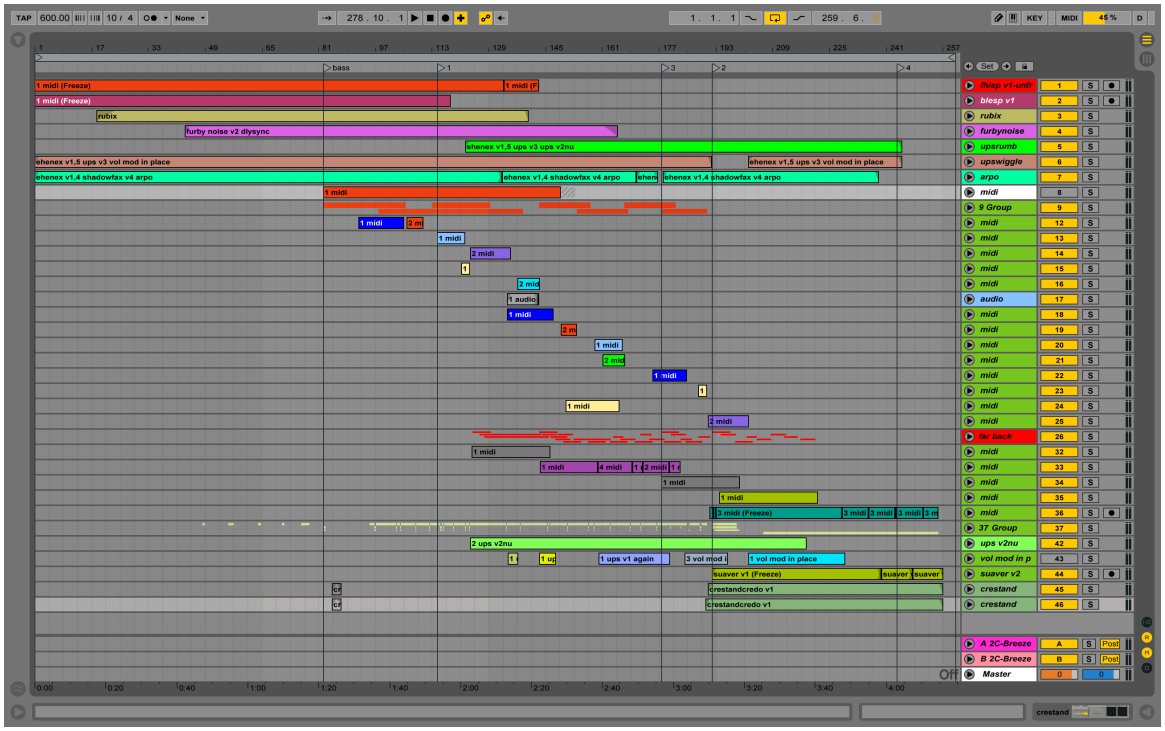

Figure 38: DAW screeshot of *Fwd*

composition of *Fwd* that foreground the grain of the DAW include the liberal use of polyphony, and a stark separation between foreground and background.

5.2.1 Synthesised motifs

My practice has privileged using unusual synthesised sounds as leading 'motifs' since at least 2014, inspired by work such as Chris Abrahams' solo records, (Abrahams, 2013) and Rashad Becker's oeuvre (Becker, 2013). In these artists' work, short sounds that do not conform to conventional harmony interlock and weave through one another, occupying a foregrounded position in the sonic field, accompanied by a 'backing' that doesn't overwhelm the leading sounds (I discuss this foreground/background distinction further in Chapter 5.2.3). The motifs are carefully arranged to give the impression of a vaguely chaotic, loosely structured soundscape despite its probably meticulous arrangement. When I listen to these artists, I am often surprised that these motifs can be *earworms* (Priest, 2018)—they get stuck in my head like the melodies of a pop song. It's an unusual and fascinating experience, one that I have explored here and in earlier works of mine.

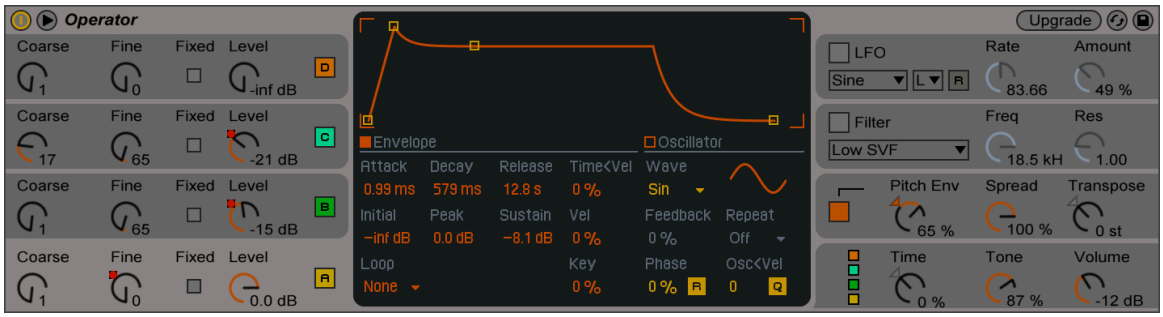

Figure 39: GUI of the software synthesiser Operator, by Ableton

Figure 40: GUI of the software reverb plug-in Breeze 1, by 2C-Audio

In *Fwd*, I created a 'melody' of nine discrete, non-tonal synthesised motifs, using automation to control parameters of software synthesisers. Each motif in the 'melody,' except the first two motifs, is arranged on a separate track in the DAW, with the software synthesiser (Ableton's Operator, Figure 39) patched slightly differently in each. A shimmering, unrealistic reverb (2C-Audio's Breeze 1, Figure 40) was also applied to these sounds, and some of its parameters were also automated.

Figure 41 (Audio Example 17) shows the automation data of the first four motifs in *Fwd*, starting from about 1:12. Making these motifs was a trial-and-error process, with no overt goal in mind other than to ensure a sense of continuity between each motif. The continuity emerged largely from the use of glissandi in each motif, slight variations of software synthesiser patches, and a consistently sized gap between each motif. The motifs are short, and this can be attributed in part to a feature of DAW-based practice that makes long, timbre-centric motifs more difficult to produce. In most DAWs, starting playback from the middle of a sequenced MIDI note will not trigger that note—the user needs to start playback before the start of the sequenced MIDI note. This means that, for example, if one were editing a section of automation near the end of a 30-second-long MIDI note and wanted to hear how it sounded, one would need to play it back from the start to hear it, and could thus wait several seconds to hear the section they were working

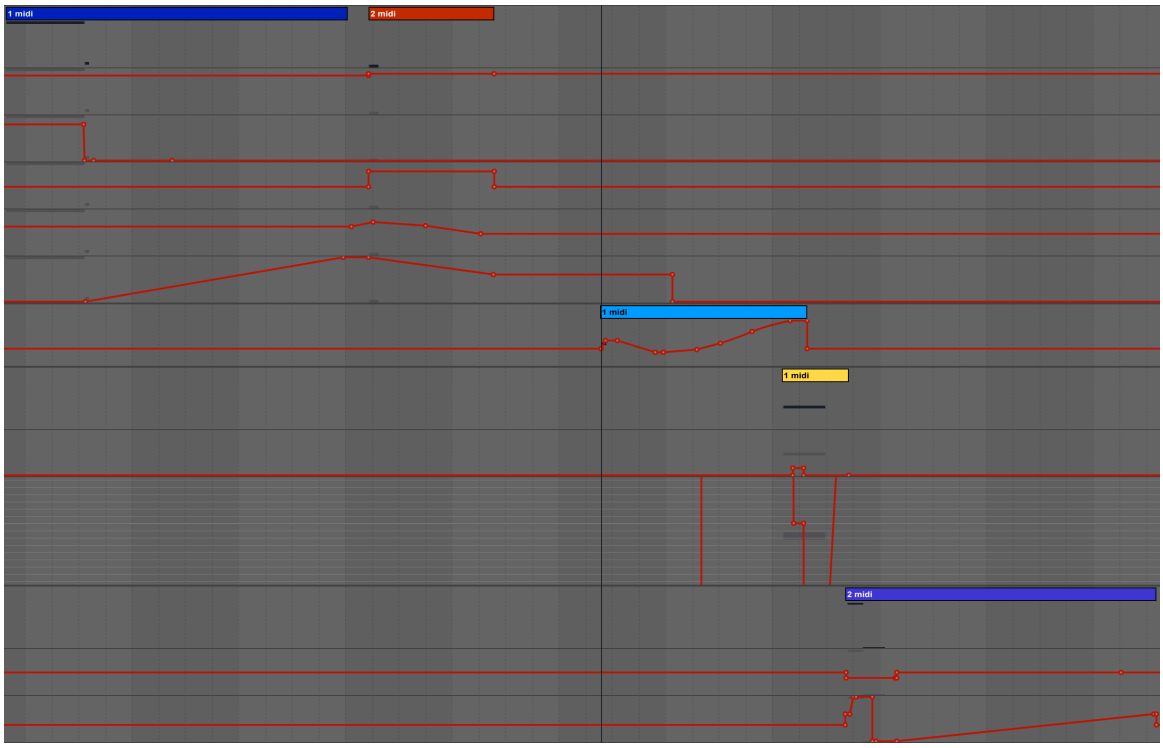

Figure 41: Automation data in the first 'motifs' in *Fwd*, 1:12–1:53

on. Short motifs provide the most immediate feedback in the compositional process.

Compensating for this, many DAWs have a feature called MIDI Chase that will trigger any notes held when playback begins during a note. This may not be desirable as the attack envelope may be quite different to the sustained timbre of the note. As far as complex automation of notes or motifs is concerned, short sounds are easiest and most clearly encouraged by the DAW interface if immediate and controlled feedback is importance for the user. The short motifs of *Fwd* make this clear. This tendency can thus be interpreted as highlights practices of control, and the practice maintaining immediate and consistent feedback, rendered as a compositional technique.

5.2.2 Polyphony by default

Fwd incorporates a dense, polyphonic background of bubbling glissandi throughout most of the track. This bedding fills out the soundscape and creates movement in the long gaps between the main motifs. The sound was generated with Native Instruments' *Massive*, a popular software synthesiser especially in electronic dance music.

The capacity for dense polyphony is a characteristic of digital and software synthesis, and the number of possible simultaneous notes that can be generated continues to increase with computing power. Historically, this tendency to privilege polyphony has

Figure 42: GUI of the software synthesiser Massive, by Native Instruments

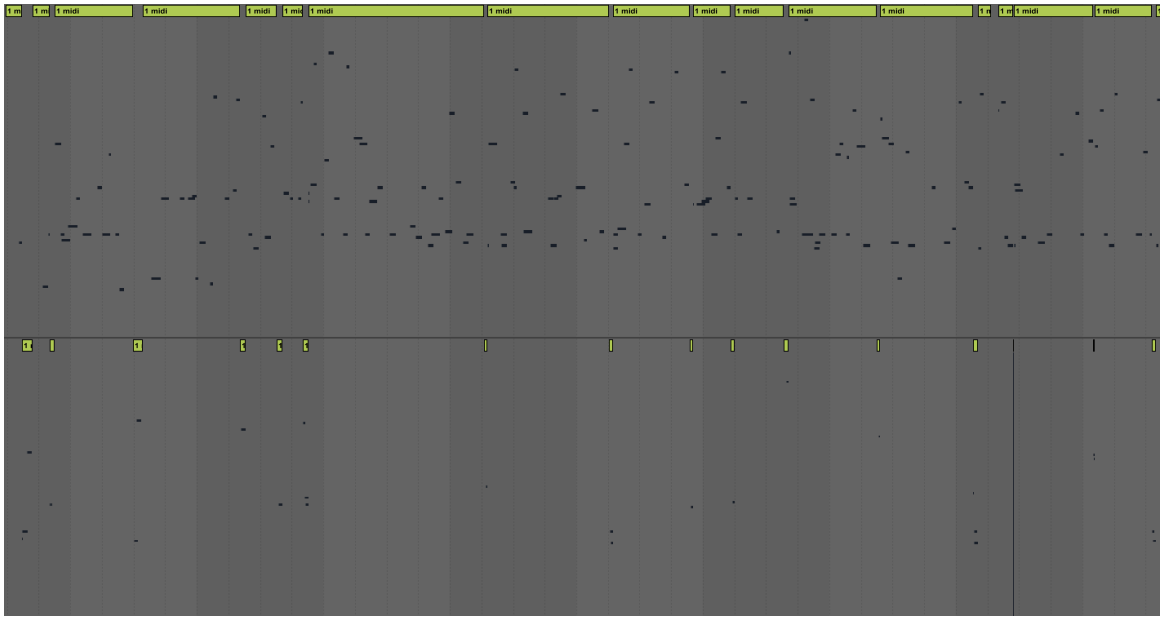

Figure 43: Excerpt of the MIDI information for the polyphonic "bubbling" sound in *Fwd*

been documented by Diduck in his history of MIDI, specifically as a way to both approach the individualistic condition of the piano keyboard and to give greater control to the individual musician (Diduck, 2018). While polyphony is certainly possible with analogue synthesis, it is often exercised more carefully than in the digital domain, as is the case in *Fwd*. Figure 42 shows the GUI and default setting for Massive when it is loaded into the DAW. Next to the title in the top left, there is a "Voices" section that shows "0/16," meaning that it is automatically set up for 16-voice polyphony. This default polyphony is ubiquitous among software synthesisers.

During the sound design phase, I had made the patch and improvised a MIDI performance using the monome. Being a 'non-claviocentric' MIDI controller, the monome enables a less discriminating approach to tonality, which was already tenuous given the prominent glissandi that the bubbling sound exhibits. Afterward, I made another synthesiser patch in Massive that was identical except for its pitch moving downward instead of upward. Figure 43 (Audio Example 18) shows the MIDI information for this bubbling sound, with the upward glissandi at the top and the downward glissandi at the bottom. Also applied to these sounds is a filtered delay, reverb, an EQ boosting the low-mids, and a limiter to compress some of the more 'popping' transients. This sound is accompanied by another Massive synthesiser sound, similar to

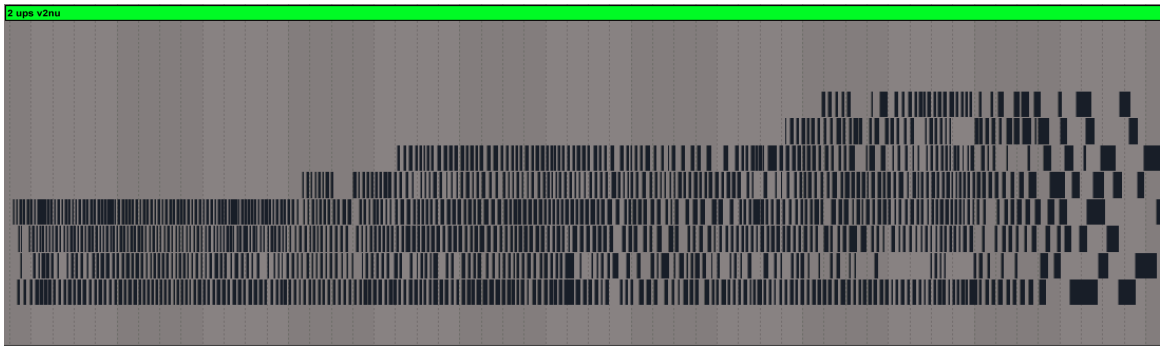

Figure 44: A second MIDI performance of a "bubbling" sound in *Fwd*

the first but with significantly more reverb and a denser MIDI performance (Figure 44, Audio Example 19).

In DAW-based practice, polyphony is standard, if not encouraged. The DAW's antecedence in MIDI, itself designed specifically for polyphonic note sequencing, contributes to this normalisation. Emphasising highly dense polyphonic sound design can thus be a compositional technique for foregrounding the grain of the DAW.

5.2.3 Foreground and background

In Chapter 5.1.4, I described ideas of flatness and non-spatiality as being one way to highlight the grain of the DAW. This is not a totalising aesthetic though, and in *Fwd* I explored a more vivid distinction between foreground and background. This distinction is also realised in the terminology for electronic music sound design—it is common to differentiate between a 'lead' synthesiser sound, often loud and attention-grabbing; and a 'pad' synthesiser sound, softer and usually relegated to the background.

In a Sound on Sound article called "Creating a Sense of Depth In Your Mix," White describes depth as "the sense of front-to-back space," meaning the distinction between sounds that seem close to the listener and sounds that seem further away. As Dockwray & Moore observe, this evocation of the soundstage is an almost universal condition of popular music since at least the 1960s (Dockwray & Moore, 2010), but its evocations in electronic music are less well understood. Techniques for creating a sense of depth in the DAW include using reverb, using EQ to reduce high frequencies, adding delay, and considering the arrangement of the work such that sounds with similarly high or low frequency content aren't clashing (White, 2009). The capacity for depth to be manipulated as a compositional technique becomes easier and more sought-after in DAW-based practice.

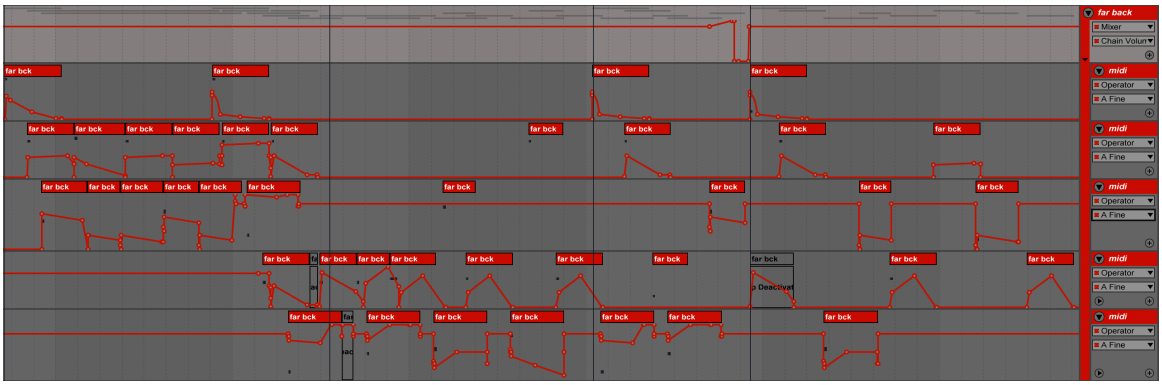

Figure 45: The "far bck" sounds in *Fwd*, 2:15 to 3:40

In *Fwd*, certain sounds create depth by using the above techniques. The sound I've entitled "far bck" (Figure 45, Audio Example 20) uses a similar Operator synthesiser patch to the main motifs, but the reverb has been substantially deepened, completely "wet" and with a decay time of 6 seconds. They have a slower attack and a total attenuation of treble content. The pitch of each sound is also carefully automated, suggesting a downward motion.

The illusion of depth will be unlikely to truly fool the listener unless the listener is under extremely controlled conditions, like a wave field synthesis system or a high-end mastering studio. As Sterne notes, this is beside the point—the use of reverb as a compositional tool involves seeking "to produce sonic effects, not actual places. These effects are judged according to the nebulous aesthetic of satisfactory impressions rather than accuracy" (Sterne, 2015, p. 123). The fictional spatiality of *Fwd* only alludes to a cavernous space, not provide a realistic capturing of a space. As the illusion of depth comes into its own as a compositional technique in DAW-based practice, realism becomes less necessary, and it is this technique of eschewing realism that I have exploited here.

5.3 Track Three: In2

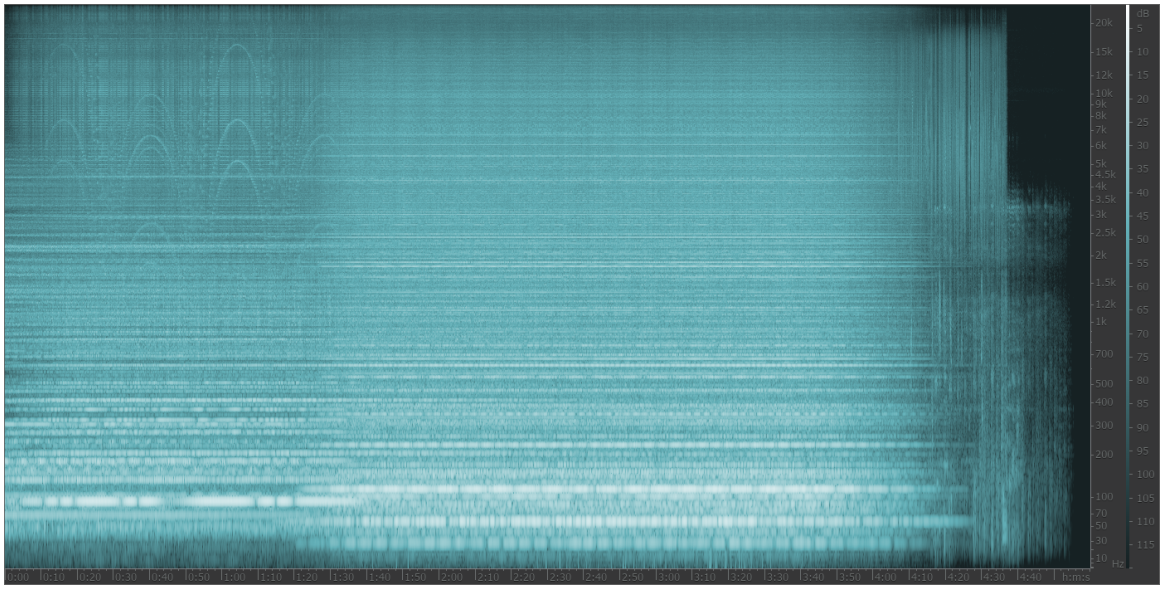

Figure 46: Spectrogram for *In2*

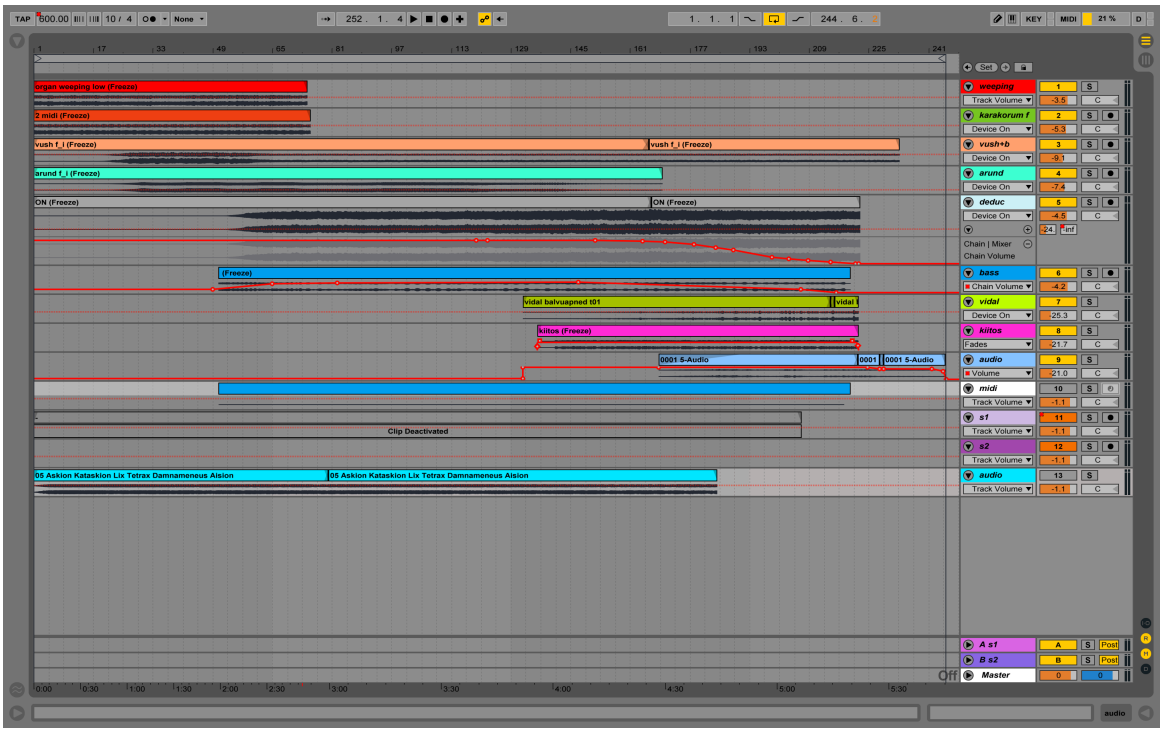

Figure 47: DAW screenshot for *In2*

In2 is a 5-minute track that was predominantly composed in 2013, adapted in 2015, and finished in 2017. More than any other track in the album, *In2* explores a structure and tonality found in drone music, essentially comprising a chord of texturally dense synthesised notes, and maintaining a consistent and at times overbearing intensity. The grain of the DAW is foregrounded here through this emphasis on timbral density enabled

by software synthesis, and surgical equalisation techniques enabled by detailed visualisation.

5.3.1 Blending between tracks

Before describing how *In2* negotiates the grain of the DAW, I will describe the process of transitioning between *Fwd* and *In2*. While almost every track in *Thru* has some degree of crossfading or blending between tracks, the transition between *Fwd* and *In2* required the most finessing. At the very end of the process of making *Thru*, I compiled all the tracks of *Thru* into one DAW session (Figure 48) and arranged them according to the space or overlap between tracks. This is a delicate task that is not easily described—it involves negotiating the trajectory and momentum of an album's constituent tracks in terms that are tacit and intuitive. Here, the duration of each track is defined, and they don't necessarily conform to the duration of each bounce.

To create the transition between *Fwd* and *In2*, I used a reverb plug-in and automated its 'wet' setting, an EQ setting (how much high- or low-frequency content is reverberated) and the track volume. The impression I was trying to achieve here was for the sounds at the end of *Fwd*, brisk arpeggios punctuated by heavy bass hits, to appear to recede into the background, as the drone at the start of *In2* emerges seamlessly. A conventional

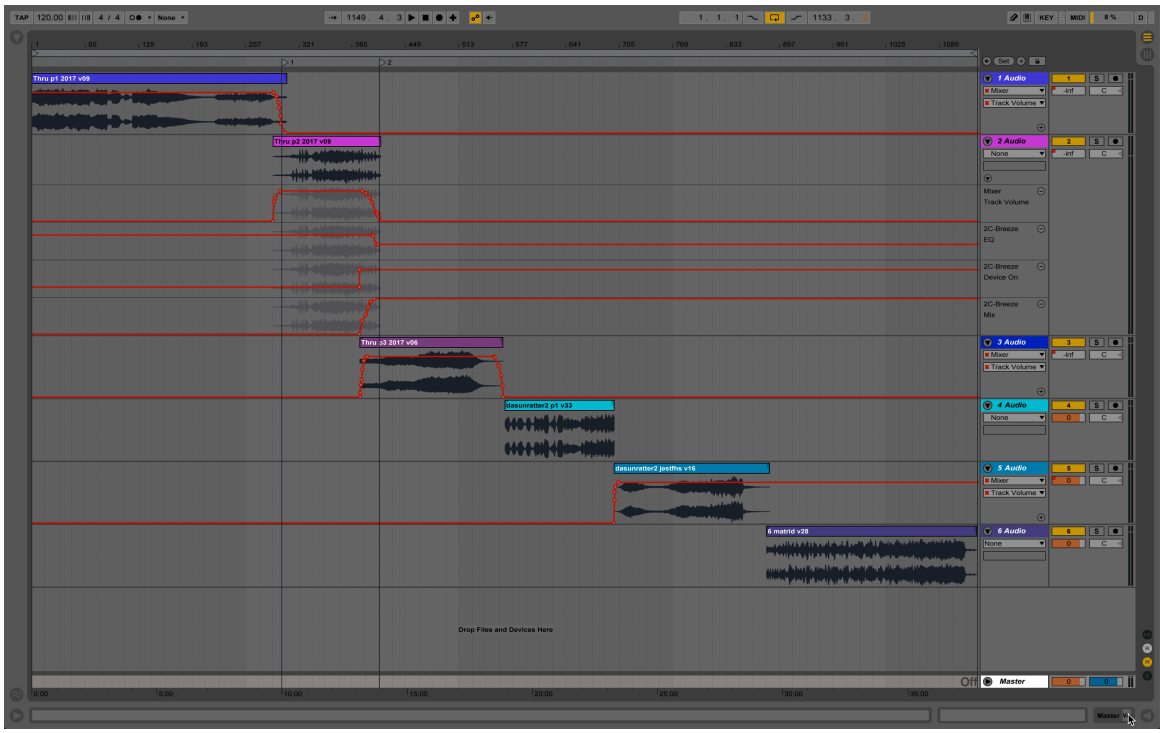

Figure 48: The DAW session for the full arrangement of *Thru*

crossfade or a low-pass filter sweep was not effective because the high notes didn't blend

well with the start of *In2*, and the way they faded out seemed abrupt no matter how long the fade-out was.

Crossfades and low-pass filter sweeps are common ways for DJs to transition between tracks. The manipulation of several parameters of a reverb, however, is only practical in the DAW, without the pressure of enacting those changes in real-time. DAWs enable the possibility for intricate blending between tracks, although whether this technique is widespread among DAW-based composers is debatable and not easily audible.

5.3.2 Mixing strategies: stereo width and treble boosting

A term I'm perhaps reluctant to associate a piece like *In2* with is *power ambient*. A tongue-in-cheek genre title, power ambient incorporates the free-flowing structure of ambient music while utilising aggressive electronic timbres at loud volumes. The style was particularly prominent in 2014, typified by artists such as Lawrence English, Ben Frost, and others (Kalev, 2014). Power ambient is typically well produced, highly automated, and intentional, in a way that isn't free-wheeling or improvisatory. It also maintains a clear and consistent mix, despite its typically heavy use of distortion and saturation, typically with a high bass and low-mid presence. This leads me to suggest that it is typically a DAW-based practice.

There were four versions of *In2*, made between 2013 and 2017, and each mixed slightly differently. The fourth version is the final, mastered version. Comparing them is instructive of how mixing strategies that highlight the grain of the DAW can emerge. I am specifically referring to a section corresponding between 2:00 and 3:40, the loudest and most consistent section of the piece. Excerpts from each of these four versions are collated in Audio Example 21. Figure 49 through Figure 52 show a sound field meter at left, and a spectrum at the right, set to an 'infinite' time setting, meaning the spectrum reading is an average of the entire section. For these readings, each version of the track had its volume adjusted to be equal with the others for these measurements. Although these sonic visualisation methods do not entirely represent the differences between each mix, they partially articulate the subtle evolution of *In2* and the centrality of mixing in foregrounding the grain of the DAW. These mixing strategies are idiomatic to DAW-based practice, and not necessarily unique to it—many of these strategies are inherited from popular music record production (Zak, 2001).

I composed *In2* mostly in 2013. I was considerably less experienced with digital audio production then, and had less audio production tools I use today, such as studio monitor

Figure 49: Sound field and spectrum of *In2*, circa 2013

speakers and third-party plug-ins. Compositionally, the first version differs from the others as it has a regular sub-bass note. In this first version, the mix more prominently centres the ascending and descending synth line. It has a greater presence in the low-mid region of 200–300Hz, shown in Figure 49, and the main drone lacks the brighter presence of the other mixes. The stereo field is also narrow, meaning the mix primarily tends towards a mono signal.

The second version (Figure 50) was edited and mixed in 2015 for the Ears Have Ears broadcast of *Thru*. The mix is noticeably brighter in the range above 10kHz. The ascending and descending synth line is still very present, and the stereo field is even narrower than the first.

Figure 50: Sound field and spectrum for *In2*, circa 2015

Figure 51: Sound field and spectrum for the final mix of *In2*

The third version (Figure 51) was edited and mixed slightly from the end of 2016 to mid-2017 when I submitted the mix to the mastering engineer. The bass note of B♭ is more prominent than the first two iterations, and the ascending and descending bass line has nearly disappeared. The stereo field is wider than both previous versions.

The final version (Figure 52) is the version mastered by Matt Mclean at The Soundfield Studio. The low-mid range of 200Hz–1kHz has been attenuated slightly, while the range between 1.5kHz–20kHz has been boosted slightly. More notably, the stereo field is significantly wider.

Figure 52: Sound field and spectrum for the final master of *In2*

Two aspects of the grain of the DAW emerge here: firstly, stereo width has taken a precedence. A 'wide' stereo image is a sought-after and favourable trait of contemporary production aesthetics. Stereo width contributes to a sense of three-dimensionality, a

spaciousness that is less present in a mono or 'narrow' mix. Stereo width is achieved through a number of techniques, such as delaying one of the stereo channels by a few milliseconds, introducing reverb, or performing mid-side processing and amplifying the 'side' signal. The inevitable trade-off of a wide stereo image is that its mono compatibility—its capacity to sound similar to the stereo version when played on just one speaker—is compromised due to the phase cancellations that occur when the stereo channels are summed together. Despite this, wide stereo imaging is pervasive in electronic music production, which I speculate may be attributed to the popularity of headphone-based listening in the 21st century. A wide stereo image benefits a piece like *In2* because the intent is to foster a more visceral, less cerebral experience, in which the sound is all-encompassing, and the listener is smothered.

A second aspect of the grain of the DAW that emerges here is that across the four versions of *In2*, the treble content above approximately 1kHz has been boosted. Michel Chion writes that it is a standard convention in mixing sound for film to boost the treble frequencies of recorded sounds, even if doing so does not present an 'accurate' presentation of the original sound (Chion, 1994, pp. 98–99). There may be many factors contributing to the emergence of this convention. There is a tendency to conflate 'high fidelity' or 'high definition' with high treble content, proof for Sterne that the relationship between the definition of a recording and 'the real thing' is "largely metaphoric, since it has as much to do with aesthetic conventions of sound mixing as it does with how something might sound in a room to the 'naked ear'" (Sterne, 2006, p. 343). Boosted treble frequencies also exploit the Fletcher-Munson effect, whereby the perception of loudness changes with the frequency of a sound. The human ear is most sensitive to a frequency band between approximately 2–5kHz, thus boosting that frequency band will increase the perception of loudness more than any other band (I explore loudness further in the next section). The terminology used to describe the treble content in recorded sounds, terms like 'presence,' 'brightness,' and 'brilliance,' further illustrate the positive associations that such mixing conventions mobilise.

Figure 53: Graphical user interface for the software synthesiser *FM8* by Native Instruments

Mixing treble to be louder is not unique to DAW-based practice, but software synthesisers can have significantly more treble content than many traditional or acoustic instruments. Frequency modulation (FM) synthesis, the main technique used in the Native Instruments *FM8* synthesiser used in *In2* (Figure 53), can be especially piercing in the higher frequencies. This differs from traditional analogue techniques such as subtractive synthesis, in which low-pass filters are frequently used to taper off treble frequencies. *In2* uses several software synthesisers with a high amount of treble content, a condition made possible by the DAW. It can be suggested that the use of synthesisers that incorporate this technique, despite its antecedence in pre-digital modes of recorded music creation, highlights the DAW's capacity for creating mixes with high treble content. This applies to all the pieces in *Thru*, although *In2* and its four versions demonstrate this evolution succinctly.

5.3.3 Loudness

The 'loudness wars' is a term coined to describe a tendency, beginning in the 1980s with the advent of digital audio, for recorded music to have increasingly high amplitude and decreasing dynamic range. The impetus of this logic stems from the assumption that 'louder' recordings are more attractive than quieter ones, particularly in radio broadcast (Milner, 2010, pp. 237–254). Eventually, around the mid 2000s, recordings in pop and

Figure 54: Waveform statistics for *In2*

rock music were so loud that they were clipping frequently, their squashed dynamic range leading to several audio engineers protesting how 'unlistenable' such music was. Despite its apparent waning in the 2010s with streaming platforms incorporating loudness normalisation technology (Robjohns, 2014), the effects of the loudness wars on DAW-based practice continue to resonate.

With today's ubiquity of DAW-based production, particularly in electronic dance music, loudness is still perceived as a vital component to making a track or composition sound 'professional,' eligible for being played alongside other tracks on radio or in a DJ set. The loudness wars comprise an ethos of practice that privileges certain tools and techniques over others, and DAWs have accommodated or even promoted these developments. Third-party plug-ins like Waves' *L3 Multimaximizer*[*] and iZotope's *Ozone*[†] have a notoriety for being used (and abused) for achieving maximum possible loudness. The signal processing techniques used in these plug-ins include limiting compression, a form of dynamic range compression with a high ratio of compression. When used inappropriately, limiting can result in a fatiguing or flat mix.

In2 has the highest average loudness of all tracks on *Thru*, mostly because it is compositionally the least dynamic piece. Figure 54 shows statistics relating to loudness and amplitude of *In2*, generated by iZotope RX. The "Total RMS level" statistic is an average reading of the RMS level across the entire track (−11.52dB on the left channel; −

[*] https://www.waves.com/plugins/l3-multimaximizer
[†] https://www.izotope.com/en/products/master-and-deliver/ozone.html

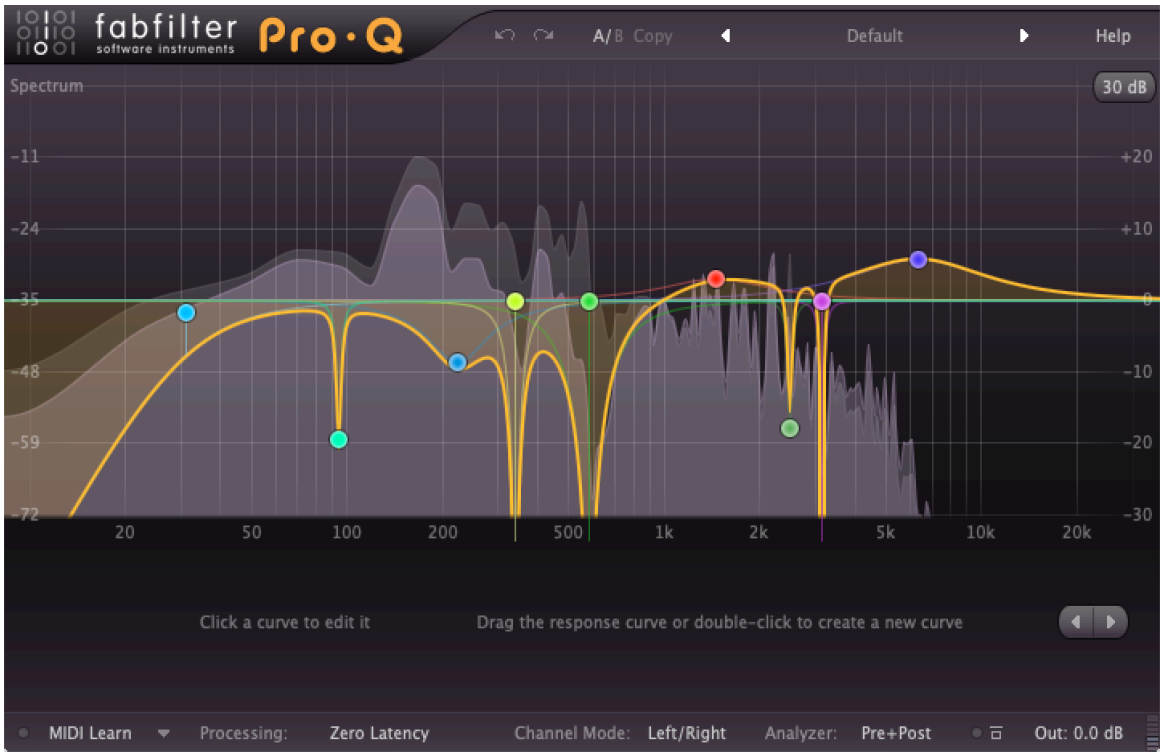

Figure 56: Equalisation curve of one of the drones that open *In2*

11.33dB on the right), including the long decrescendo at the end. During the loudest section in the middle, the "Max. RMS level" is reached, approximately −6.5dB. This is quite loud, but not as loud as some popular music, which can have a maximum RMS level exceeding 0dB and an average RMS level of −4dB or more.

To clarify, the high average amplitude of *In2* is mostly attributed to mastering, and is not strictly my work. It is a standard mixing convention that the pre-master mix should be quieter by several decibels, and should not employ a limiting compressor on the master channel. Figure 55 shows these differences in amplitude between mix and master.

To mix a track for maximum loudness, it would be necessary to apply dynamic range compression to most or all channels in the mix. However, loudness can also be achieved through careful equalisation, attenuating frequency bands that intersect with other instruments, thereby avoiding phase cancellation and allowing higher gain to be applied

Figure 55: Waveforms of *In2* before mastering (top) and after (bottom)

to each. The grain of the DAW can also be foregrounded through layering many sounds, and using equalisation to ensure that they are all clear and can be boosted. The drone that opens *In2* comprises two parts: a pitched-down recording of a harmonium, and a drone made using the software synthesiser Kaivo by Madrona Labs. The latter was heavily equalised to integrate well with the drones that would follow (Figure 56). Notches and sharp attenuations at frequencies around 95Hz, 350Hz and 600Hz allow fundamental frequencies from other drones to sound more prominent, while a broader attenuation at about 220Hz reduces low-mid frequencies that the harmonium recording occupied (this approach to mixing is discussed in more depth in Chapter 5.4.3). Such aggressive equalisation strategies are only feasible in a DAW environment, enabling a greater density of sounds and instruments to be heard clearly in the mix. These approaches contribute to an overwhelming sound, foregrounding the grain of the DAW primarily through mixing techniques.

5.4 Track Four: Vacillate

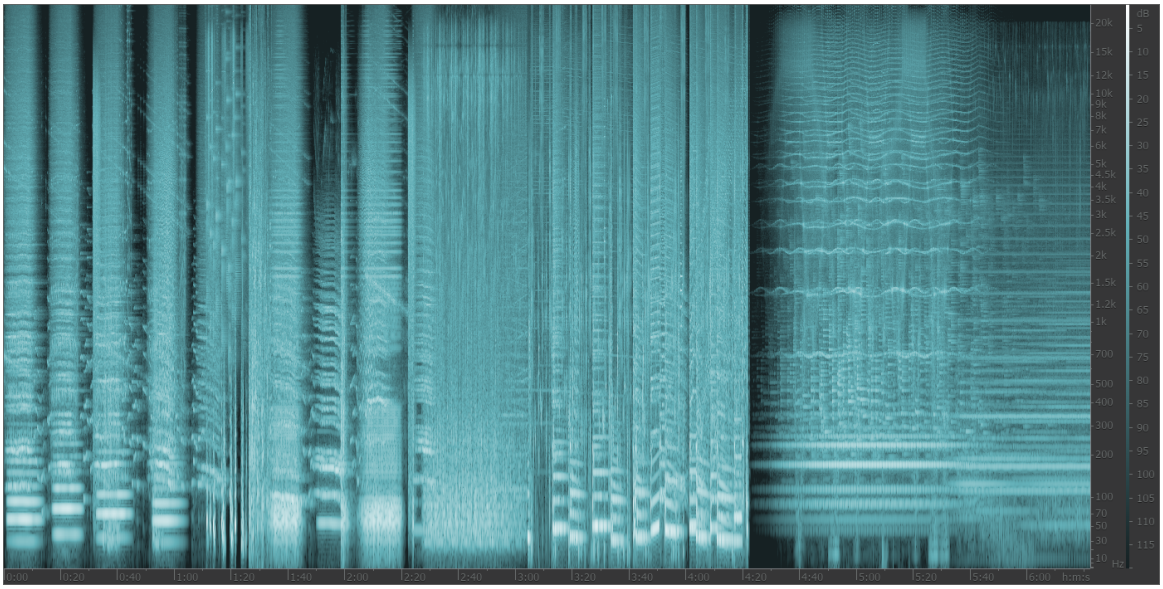

Figure 58: Spectrogram for *Vacillate*

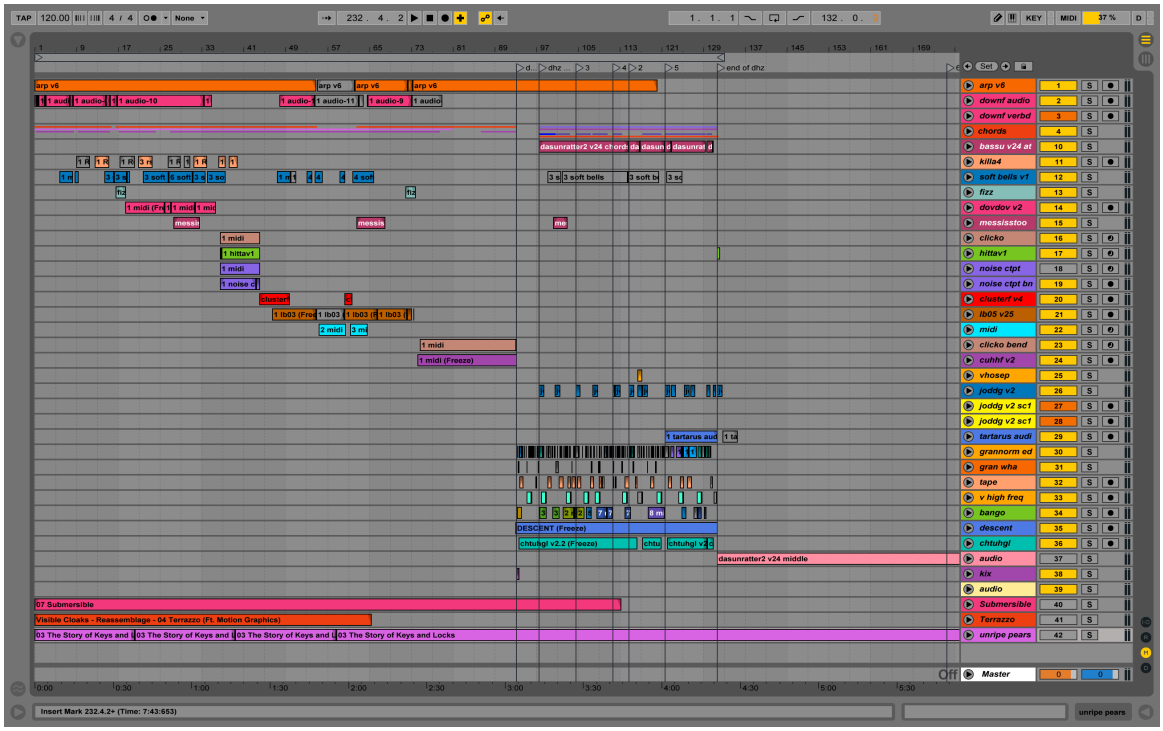

Figure 57: DAW screenshot for *Vacillate*

Vacillate, a 6-minute 22-second work, developed in tandem with *Vessel*, and throughout their creation, their themes and sound designs were interchangeable. The iterations *Vacillate* underwent, of which there were about 33, involved radical changes. The final version utilises a sonic palette more conventional to popular electronic music than the other pieces, at times recalling the timbres of electronic dance music or noise music in

equal measure. These sounds are arranged in a block form, with short transitions between different sonic worlds, exposing the multiplicity of sounds DAW-based compositional practice enables. *Vacillate* also explores novel editing strategies, and raised questions around virtuosity and intentionality in DAW-based compositional practice.

The initial stages of *Vacillate* and *Vessel* were two tracks called *dhz v2.5* (Audio Example 22), and *dasunratter* (Audio Example 23), created for a performance in January of 2016. The forms of these versions are largely linear, increasing in intensity and complexity over the tracks' durations. Their mixes are muddy and remain unfinished. Some ten months after the performances, during an artist residency in Iceland (described in further depth in Chapter 5.6), I developed these pieces further and they took on forms similar to the final versions (Figure 59, Audio Example 24). At this time, *Vacillate* had a very 'blocky' form, with sudden and contrasting shifts between sonic environments. Still unhappy with the piece, the edges of these transitions softened over the next several months of refinement, and had more of a through-line due to the recurring synthesised chords throughout. At least in its early iterations, *Vacillate* privileged diverse and erratic DAW-based sound design to an extent unsurpassed by the other tracks on *Thru*.

5.4.1 Block form

Block form is characterised by Vickery as involving "sequential and nondevelopmental substructures comprising parametrically divergent musical materials" (Vickery, 2011, p. 25). Used to describe works as early as those of Igor Stravinsky, block form trades in contrasts and juxtapositions, jumping between different motifs or textures in a jagged, discontinuous manner. In my experience, one psychological effect of listening to a work in

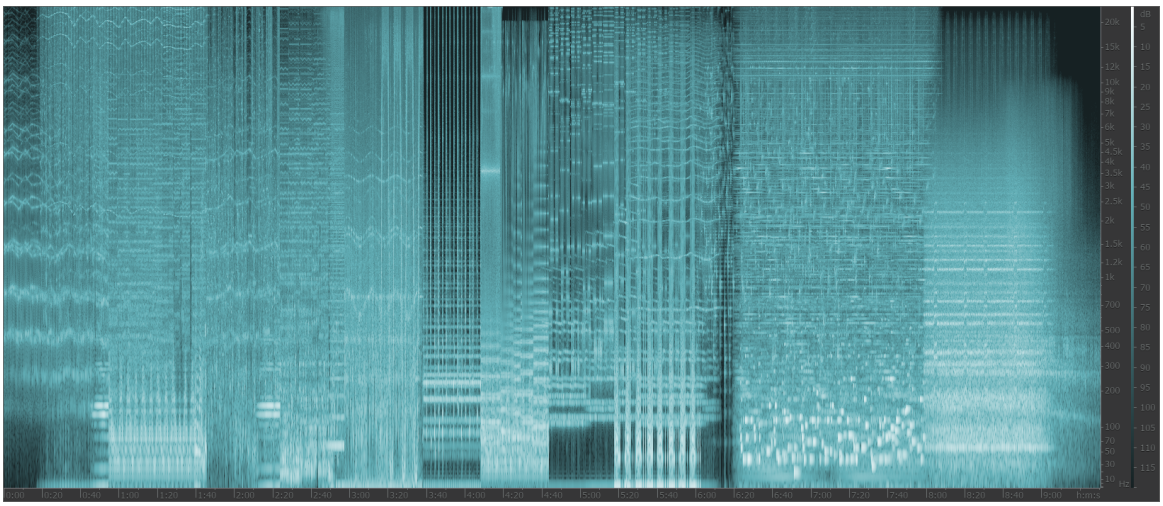

Figure 59: Spectrogram for *dasunratter2 v05*

block form is that it resists a sense of immersion in the internal logic of the work, gesturing towards the work's edges as opposed to its centre. By eschewing narrative or linear development—that is, the internal logic or its centre—block form encourages thinking about the materiality of a musical work, such as its instruments and physical properties. It is a form that dances around the edges, so to speak.

At the early stages of the research, I hypothesised that blocky, non-linear forms could draw attention to the DAW's editing capabilities. The way the DAW makes light work of precise 'splicing,' automating, and other simple tasks seemed like it could form the basis of a useful compositional technique for foregrounding the grain of the DAW. This hypothesis drove the creation of *crh* (Chapter 4.3.1) and an earlier version of both *Vacillate* and *Vessel* (Figure 59, Audio Example 24). The disjunctive contrasts are clear in the spectrogram.

For much the same reason I ended up rejecting *crh*, I found this structure unsatisfactory, a little too on-the-nose. It still evoked *Elektronische* serialism. However, where it highlights the grain of the DAW is in the kinds of timbres and software synthesisers used, privileging bright sounds and heavily multilayered, dance music-oriented textures. In subsequent versions, I softened the edges of these transitions, and the focus shifted towards highlighting *vertical* rather than *horizontal* composition, to borrow Tamm's metaphors (explored in Chapter 4.3).

Vacillate comprises seven discrete blocks, which I will label $A_1BA_2CA_3D$. The 'A' sections are linked through their use of bright synthesised chords. The 'A_1' section, from 0:00 to about 1:11, involves five bending chords, peppered with other synthesised sounds and chirps. The 'B' section begins with distorted kick-drum-like sounds at 1:11, before a messy, granular noise begins suddenly. This gives way to the 'A_2' section at about 1:34, similar in structure to the first but with different chords and different incidental sounds. At 2:27, the 'C' section enters with a looping noise motif and other percussive synthesised sounds, and at 3:04 the 'A_3' section enters with another kick-drum-like sound. The 'A_3' section utilises chords similar to the first two 'A' sections, but they are more percussive, and accompanied by granular voice-like sounds and other percussive sounds. This section carries on until 4:22, when it ends abruptly and the 'D' section fades in, sustaining a series of wavering drones until the track *Vessel* enters.

While block form in itself doesn't necessarily highlight the grain of the DAW, it can be used as a technique to introduce a diversity and density of timbres. This diversity, and the fickleness of its transitions between different timbres, are a driving force of *Vacillate*, and

exhibit the DAW's unique material capabilities. I will return to this idea of density and diversity of sound design in Chapter 5.4.3.

5.4.2 Editing strategies

Since *Vacillate* changed substantially over its many iterations, the process involved managing a lot of sound designs and other musical information that came and went. Despite the relative slimness of the final DAW session (in comparison to the first track of *Thru*, for example), the DAW session for *Vacillate* was dense and complex at various points in the process, before being gradually simplified towards the end of the process.

As described in Chapter 5.1.5, the simplest and most immediately effective way to reduce conceptual burden is to 'bounce' software synthesiser-based tracks to one audio track. Audio has a different set of affordances for editing than a MIDI track, and synthesis parameters cannot be changed after bouncing. Despite the restriction that this implies, it opens up space—CPU usage, visual space, and psychological space—to experiment more freely with other aspects of the composition.

In situations which require meticulous automation editing before bouncing, I found it useful to perform these edits in an entirely new DAW session. Figure 60 shows part of the DAW session for "dasunratter2 v23," which still included all of *Vessel* in the session at this point. It has 65 tracks (not shown).

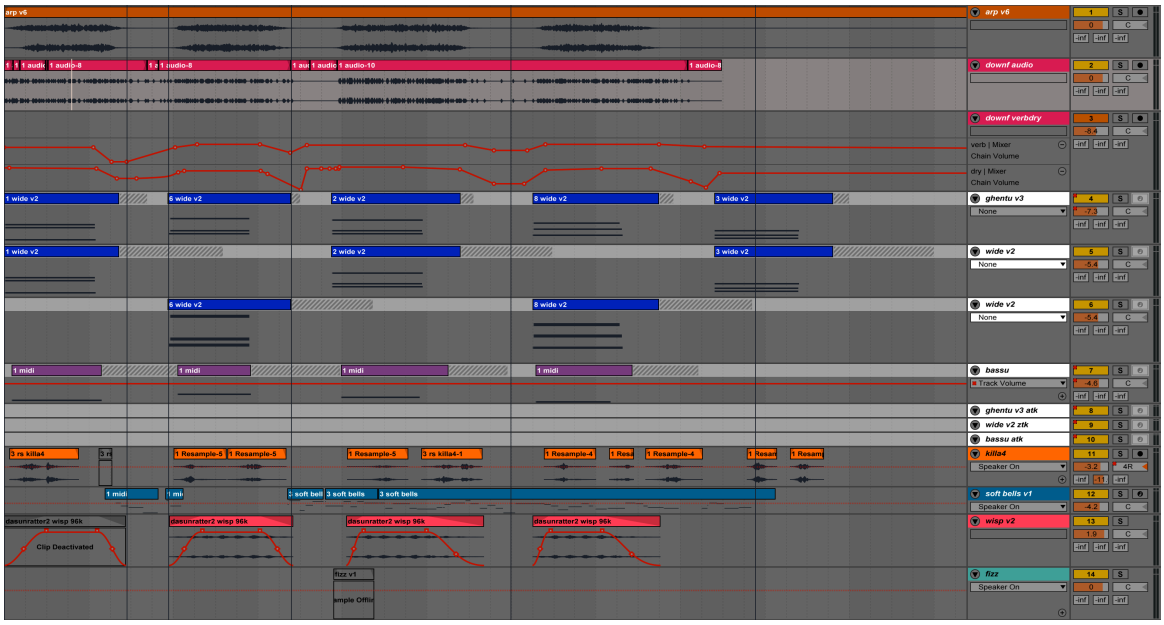

Figure 60: Partial DAW screenshot for *dasunratter2 v23*

I was unhappy with how the synthesised chords and bass sounded (the highlighted white tracks in Figure 60) and wanted to refine and experiment with them further.

Despite them being "frozen," an action similar to bouncing where MIDI tracks retain and display all the MIDI information but are in fact bounced audio versions of those tracks, they were still visually cluttering the DAW session, giving me a sense of conceptual burden arising from visual complexity.

To alleviate this, I exported the entire DAW session except for the chords and bass. I began a new session entitled "dasunratter2 v24 chords bass" (Figure 61), imported the "dasunratter2 v23" session minus the chords and bass (the brown track at the top), and imported the individual chord sounds into the session. Figure 61 shows this session when I was finished with it. Having edited and refined the chords and bass, including making new patches and changing the pitch-bend automation (not shown in the image), I bounced down each instrument into individual stems (the second, third, and fourth tracks from the top). These tracks were imported into the next session, "dasunratter2 v24" (Figure 62).

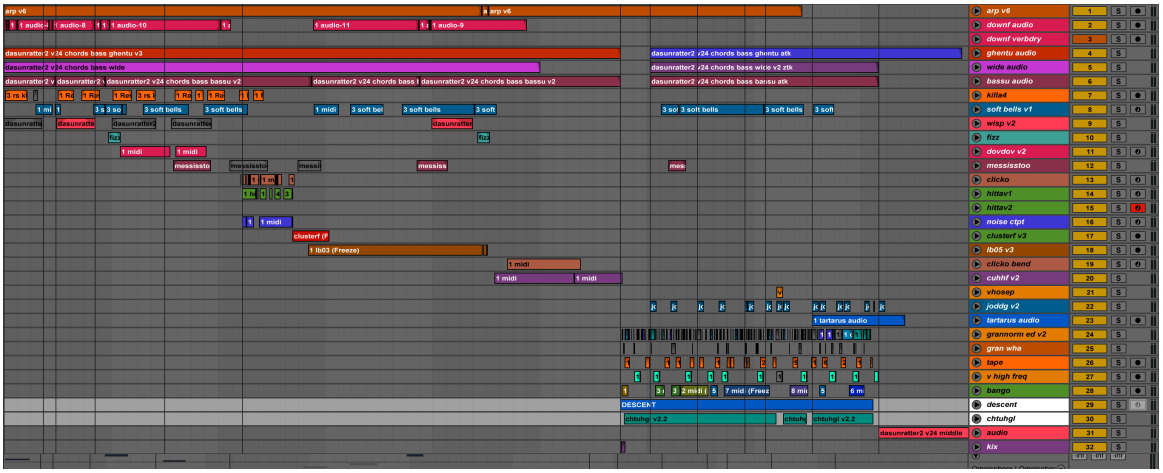

Figure 62: DAW screenshot of *dasunratter2 v24*

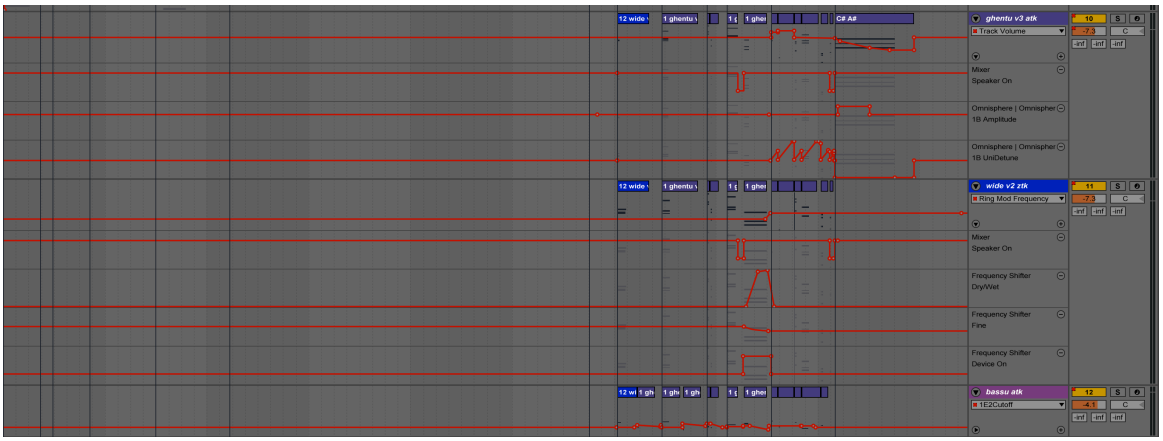

Figure 61: Composite DAW screenshot of "dasunratter2 v24 chords bass"

The visual complexity and conceptual burden in the making of *Vacillate* was thus reduced. Another benefit of this process concerns with productivity—creating an

environment where I could only work on making one set of sounds (the chords and bass) sound as good as possible led to a satisfactory result that remained nearly unchanged by the final version. Although there would've been no material difference had I made these changes in the original DAW session, CPU issues notwithstanding, I felt more comfortable to experiment and add new sounds in this additional DAW session. The "dasunratter2 v24" DAW session also involved separating *Vacillate* and *Vessel* into new sessions, again reducing visual and conceptual clutter, resulting in a DAW session with only 33 tracks instead of 65.

Another editing strategy employed in *Vacillate* occurred in the early phase of creating *dhz*. In the sound design phase I had serendipitously made a granular synthesis patch that obliquely evoked a cadence somewhere between animal vocalisations or human voices. Granular synthesisers typically work with varying degrees of randomness, thus each time one plays back a MIDI sequence that is triggering a granular synthesiser, it will be heard differently every time. Because this granular synthesiser patch only hit the 'sweet spot' sporadically, each playthrough varied in quality, and made it difficult to conceptualise the arc or trajectory of the composition. To counteract this, I recorded several takes of this granular patch, and edited the best sounds from each into a single audio channel (Figure 63). This took approximately three hours to edit 1-minute and 20-seconds of this sound.

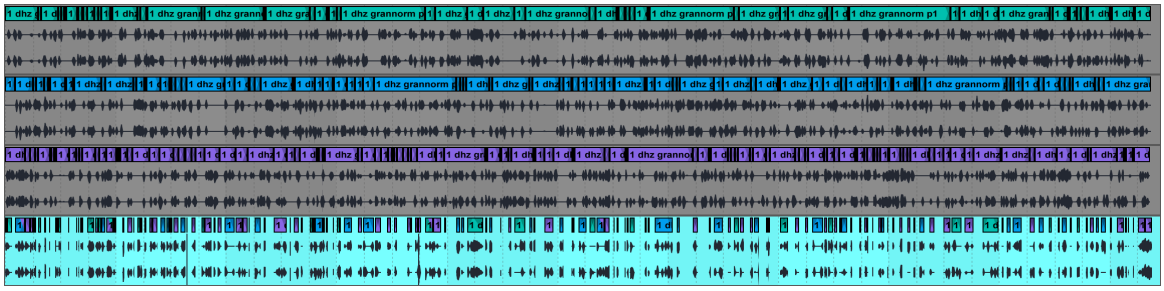

Figure 63: Three 'takes' of a granular synthesis patch, and the final edited version (highlighted)

As *dhz* transformed into *Vacillate*, and it became increasingly clear how this granular sound would be used in the final work, I edited it again. This time, my main concern was for the granular sounds to integrate with the chords and stabs that punctuate this 'D' section of the piece without seeming overcrowded. I also separated the lower granular 'voices' from the higher ones, and mixed them slightly differently (Figure 64).

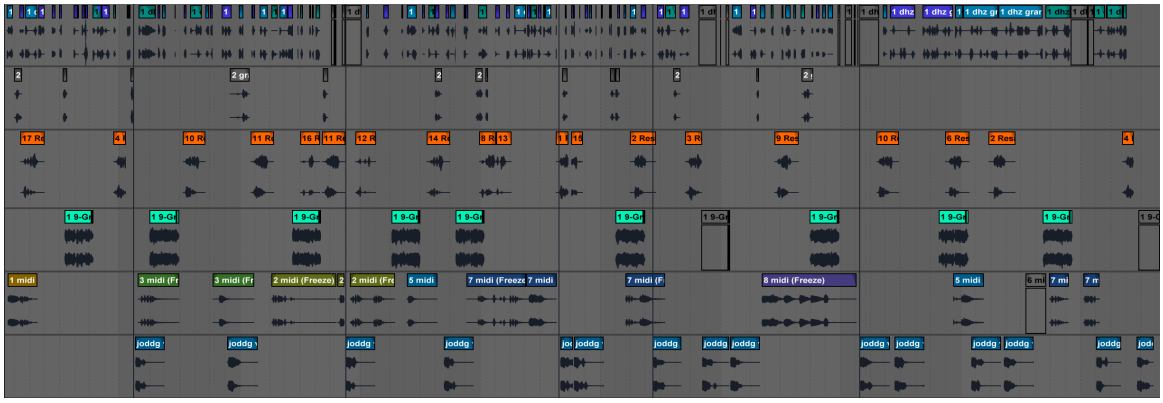

Figure 64: Detail of the *dhz* sound (top), with other 'granular' sounds, in the final *Vacillate* DAW session

The making of the *dhz* granular sound raises a compositional technique for dealing with randomness: repeatedly listening as a way of making new senses of some sound. This technique derives from Brian Eno who, recounting to David Toop, devised an experiment whereby he made a field recording in a London park, put a fade-in and fade-out on the recording, and then looped the three-and-a-half-minute recording, repeatedly listening to it over several days. "This was an extremely interesting exercise to do," says Eno, "first of all because I found that you can learn it. Something that is as completely arbitrary and disconnected as [a field recording], with sufficient listenings, becomes highly connected" (Toop, 1995, p. 129). Having listened to *dhz* several times, the internal logic of this edited 'performance' became apparent, and informed my compositional choices, such as where I put the chord and stab sounds in section 'D' of *Vacillate*. This can inform new compositional moves that work with and against this recording at very small time-scales.

5.4.3 Intentionality, virtuosity, and their audibility

The extent to which the above examples are audible evocations of the grain of the DAW requires some unpacking. My aim here is to describe the tacit knowledges that make this meticulousness or intentionality an audible evocation of the grain of the DAW.

Intentionality in musical composition can be described as characteristics that suggest that the composition could not possibly have been created 'off-the-cuff,' or in a real-time setting such as live performance. The meticulousness of its construction is on full display, employing a diversity of sounds and using processing techniques that maximise the impact of sounds. A degree of complexity is a prerequisite in such compositions. The artful balancing of complexity with clarity here can be considered a virtuosic display of DAW-based production.

The virtuosity exhibited in DAW-based practice relies on characteristics pertinent to particular styles of music. In electronic dance music, these may include mixing characteristics described in terms such as "punchiness," depth (see Chapter 5.3.2), and more stylistic notions such as grittiness, warmth, or clarity. In more traditionally compositional characteristics (as opposed to mixing), this may include timbral qualities of synthesisers or drums, the variations in patterns or sequences, or the way intensity builds and releases. In experimental electronic music, the terms by which virtuosity is judged are arguably broader and rely on other contexts—they may even actively resist notions of virtuosity. In the case of artists such as Objekt or SOPHIE (described in Chapter 1.3.2), whose practices are often described as experimental but are strongly informed by electronic dance music idioms, they exhibit virtuosity mostly in terms of electronic dance music, particularly in mixing and sound design.

As uncomfortable as I am describing my work as exhibiting virtuosity, *Vacillate* aims towards it—the success of which I perhaps cannot determine objectively. This is partly informed by electronic dance music production aesthetics, and sound design in experimental electronic music. One example of this is the way heavy, transient sounds are created and mixed. At 3:13, the first chord of the 'D' section hits with a substantial sense of weight, mixed in such a way to heighten dramatic effect. This took some effort to mix properly so that this 'weightiness' was apparent.

In order to create this sense of 'weightiness,' a variety of mixing strategies can be applied. Precise equalisation and compression are important strategies here. If multiple tracks occupy similar frequency bands to each other, they may interfere with each other, cancelling out or amplifying in uneven ways and resulting in a 'flatter' sound. Equalisation in these situations must attenuate frequency bands in instruments and software synthesisers that are less important and may interfere with other instruments. Figure 65 shows the EQ plug-in, Fabfilter Pro-Q 2*. Its GUI comprises the EQ curve (yellow), and two spectrographs: one (light grey) describing the sound as it goes into the plug-in, one (dark grey) describing the sound as it goes out. This provides a clear visual representation of exactly how the EQ is changing the sound. When multiple instances of this plug-in are

* https://www.fabfilter.com/products/pro-q-2-equalizer-plug-in

Figure 65: GUI for Fabfilter's Pro-Q 2 equaliser plug-in

open and viewable at the same time, the overlapping frequency bands of simultaneous sounds can be identified quickly and easily.

The audibility of this mixing technique may be represented in the spectrograph of the final mix. Figure 66 shows an average spectrographic representation from 3:13 to 3:18 of *Vacillate*. The spectrograph remains relatively linear, with a smooth and steady decline as the frequencies increase. This is relatively standard practice, particularly in electronic dance musics that aim for maximal loudness, audibility, and impact. The smoothness of this linear decrease in frequency amplitude is not necessarily given in other genres of recorded music such as rock or folk, as production aesthetics may aim for making all (acoustic) instruments sound natural and unmediated, qualities which aggressive and surgical EQ may hinder. Electronic music production does not necessarily share this aesthetic as many of the sounds are synthesised.

Another aspect of this audibility comes from the quantity and diversity of simultaneous sounds. Such aggressive EQ techniques as described above would not be necessary if there weren't several simultaneous sounds that the user wanted to be heard. The quantity of simultaneous sounds used and the precision of EQ techniques open up a mutual relationship—the more sounds used simultaneously, the more surgical EQ techniques need to be to accommodate them, and as EQ technologies become more advanced and precise, more sounds can be employed without muddying the mix. This

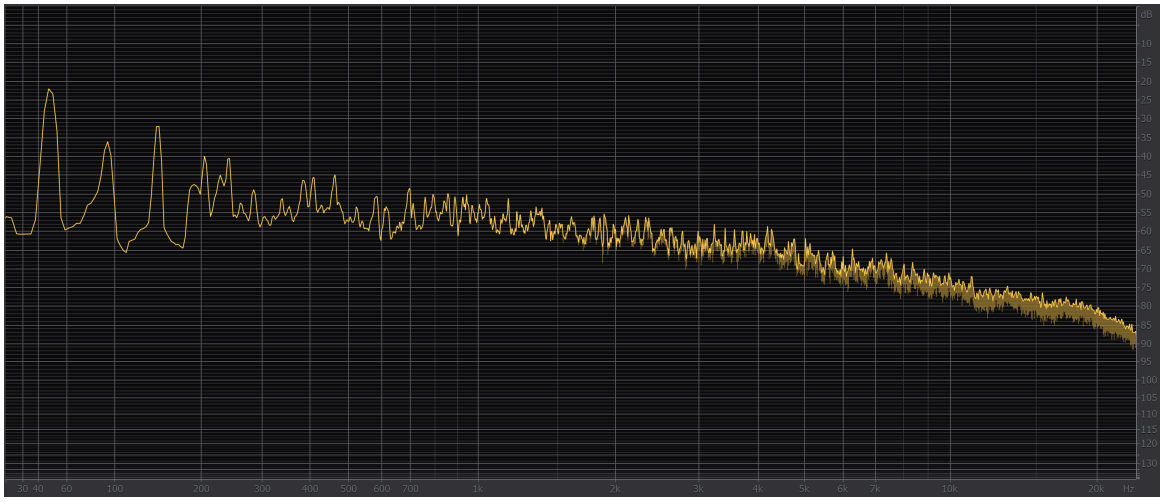

Figure 66: Average spectrograph from 3:13 to 3:18 of *Vacillate*

can be seen in contemporary EQ technologies. Fabfilter's Pro-Q 2 has an option to filter with 96dB/octave slope, unheard of in the analogue domain (although four 24dB/oct filters in parallel would achieve a similar effect, I have not heard of this used in practice). iZotope's Neutron suite of plug-ins enables cross-plug-in communication, showing the energy levels of the frequency bands of another track inside the GUI in an EQ plug-in of another track, making the above technique of having several EQ plug-ins open at once clearer. They also have brickwall filters, a digital-only technique with no slope whatsoever, removing all frequencies below the cutoff frequency entirely.

In DAW-based practice this doesn't typically lead to a vast quantity of simultaneous sounds used, which may introduce conceptual burden as discussed elsewhere. It does however encourage the combination of simultaneous sounds such that together they may make a mix that has a linear, gently sloping downward spectrograph. This convention is made possible and audible by the visualisation tools employed in DAW-based compositional practice.

5.5 Track Five: Vessel

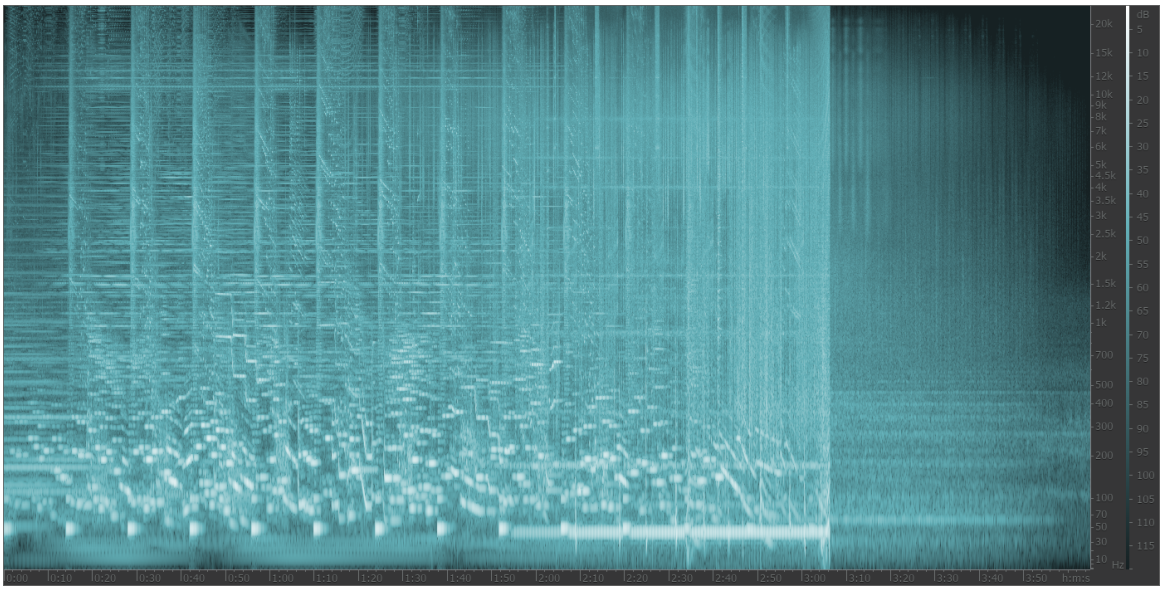

Figure 67: Spectrogram for *Vessel*

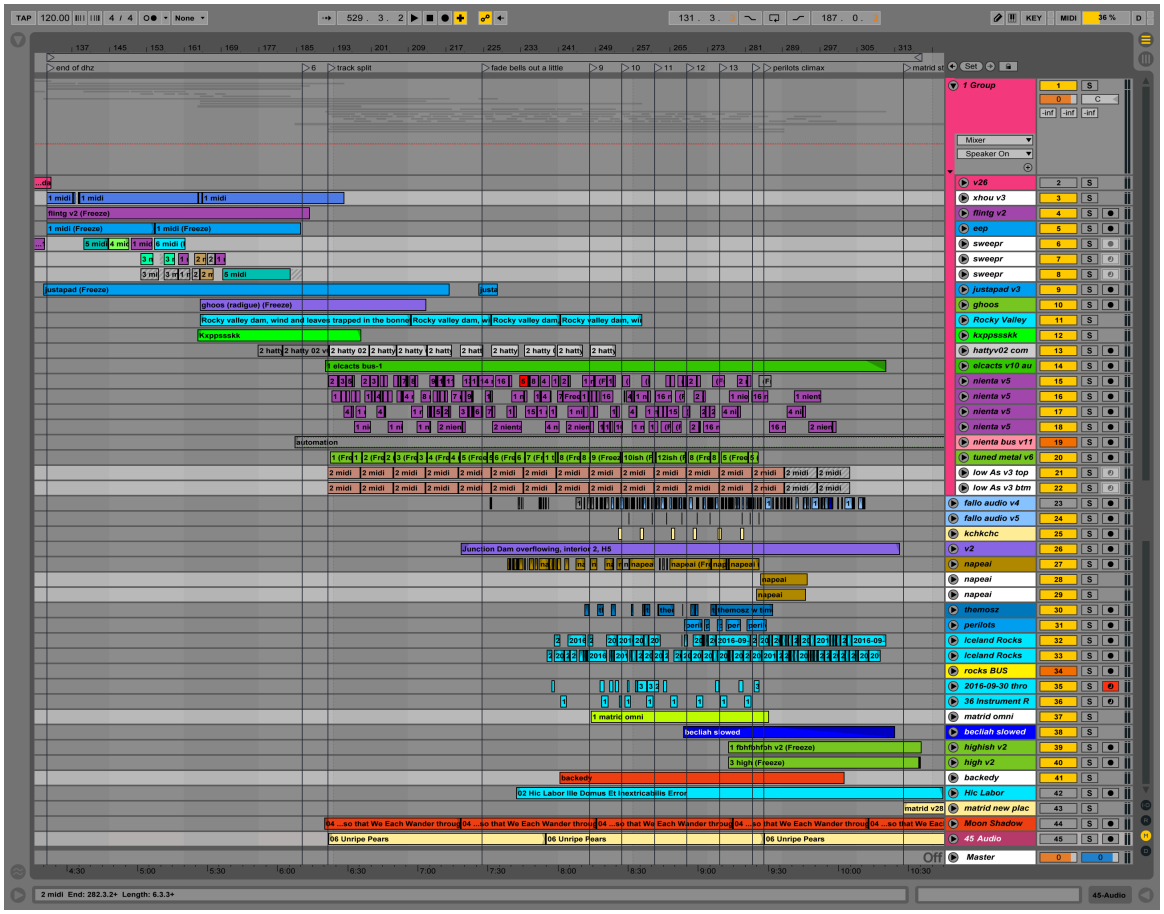

Figure 68: Composite DAW screenshot for *Vessel*

Vessel, a 4-minute, 5-second track, explores the grain of the DAW especially through its sound sources and its looping structure. Its most prominent features are a recurring bass

pulse, followed by a descending bell-like figure, accompanied by an understated melody in the low-mid range. As *Vessel* unfolds, prickly noises accumulate and culminate in a sudden dropout, revealing a gentle bed of noise. Its looping structure is the only piece in *Thru* where I work in a metrically rhythmic capacity, albeit not quite 'on the grid.' *Vessel* also investigates editing techniques and sound design strategies that foreground the 'claviocentrism' of the DAW interface.

5.5.1 Repetition and looping

It is often said that the DAW affords looping and duplication of sounds more than any other compositional medium, and this is a pervasive technique in DAW-based practice. "Repeating and looping sounds," Latartara writes, "is one of the most common compositional techniques coded within music software programs today … [and is] intrinsic to the software interface" (2010, p. 110). This is reprised by Magnusson, derisively, when he suggests that "the digital audio workstation, through its affordances of copying, pasting and looping, assures us that it is perfectly normal to repeat the same short performance over and over in the same track" (2009, p. 171). Magnusson's language seems to suggest that the DAW is a kind of mendacious influence on composition, and he possibly overstates the influence of software's affordances while understating the influence of cultural practices and genre-specific techniques.

It goes without saying that repetition is an essential component of almost all musical practices worldwide. This is especially true of music for dancing and other similarly communal activities. Analogue sequencing for electronic music creation emerged as early as the 1940s, but made popular by Bob Moog and Don Buchla's step sequencer modules in the late 1960s (Arar & Kapur, 2013). Looping a sequence of 'steps' became simple, albeit only accessible to the academic institutions which housed these synthesisers. This coincided with compositional interests among the American avant-garde towards looping, process, and an emphasis on timbre and its manipulation (Lucier, 2012). Donna Summer and Giorgio Moroder's "I Feel Love" (Summer & Moroder, 1977), often credited as the first piece of electronic dance music, introduced repetitive arpeggios deriving from step sequencers, and quickly became a standard convention of disco and other electronic dance musics. The introduction of drum machines, and MIDI sequencers like the Akai MPC, also ingrained repetition and looping into the canon of dance music and hip hop. This lineage continues today, and informs the interfaces of DAWs today, especially Ableton Live.

The entirety of *Thru* does not have many loops or (exact) repetitions, partly because I am interested in DAWs enabling a highly granular, 'off the grid' sequencing unavailable to preceding sequencers. At the same time, I am interested in acknowledging this lineage as a ubiquitous technique in DAW-based practice, which *Vessel*'s understated loop pays homage to this lineage in an oblique way. The components of the loop—a bass note, a distorted noise deriving from the bass note, and a series of descending bell-like passages—form the structural basis of the piece, a motif for the listener to latch onto. The loop itself is unremarkable and understated. Unlike most electronic dance music, it is a long loop without any otherwise sense of metric rhythm beyond its 14-second length. Coincidentally, the loop repeats 14 times in the piece.

The extent to which DAWs 'encourage' looping, especially in this genre-specific context, is debatable, and not as clear-cut as Magnusson or Latartara suggest. While there are many situations while working in the DAW where looping becomes an option (in Ableton Live, looping is often switched on automatically after recording a MIDI sequence), it doesn't presuppose that the user will actually follow through and take on the compositional technique looping. For novice DAW practitioners, this may occur more frequently. In my own practice, I am often switching off looping functionality without thinking about it, having ingrained this repetitive process into my practice. It does not inconvenience me. Because the DAW's apparent insistence that looping techniques must be used in a composition does not affect my day-to-day musical practice, I err towards a social constructivist interpretation. Looping is a technique developed across centuries of musical practice that informs DAW design, and the latter has less of a claim to encouraging this technique than a musical culture that privileges repetition and its variations.

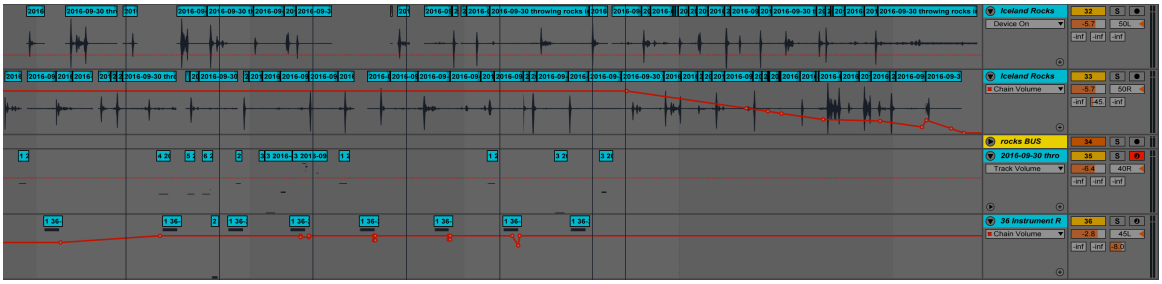

Figure 69: Rock sounds in *Vessel* from 1:33 to 3:52

That said, looping does occur often throughout *Thru*, albeit at a much smaller level, as a sound design choice. In the second half of *Vessel*, field recordings of myself interacting with rocks in a quarry in Iceland are used in different ways. Figure 69 shows four tracks of

Figure 70: Sampler plug-in using a rock sound

material that utilises these recordings. The two tracks at the top are panned hard left and hard right respectively, and the bottom two are MIDI tracks with one 'hit' of a rock loaded into a sampler (Figure 70). The brown highlight indicates that the sample is looping, and the length of the sample is approximately 60 milliseconds. The volume and the speed of playback are then manually automated, creating sounds that suggest movement and organicism. This technique is common in glitch music, in such a way that it foregrounds the digital character of audio files and new technical possibilities that only digital audio can afford. My usage is more impressionistic, evoking some vaguely naturalistic sound source while still evoking a sense of artificiality (this idea is discussed in more depth in Chapter 5.6.2).

5.5.2 Melody construction

To better understand the 'constructed-ness' of some of the materials in *Vessel*, I will describe the process through which one layer of synthesis changes over the process of composition. For most of the first three minutes of *Vessel*, an understated melodic line in the low-mid range with an unusual harmonic content, provides much of the sense of movement in that section of the composition. I called this sound *nienta* for no reason in particular. In the sound design phase, I created this sound using Native Instruments' Absynth and a reverb plug-in, improvising a simple, short line of MIDI notes (Figure 72). This sound design sat in my project folder for a few months before I found it to be a useful counterpoint to the piercing drone throughout what would become *Vessel*.

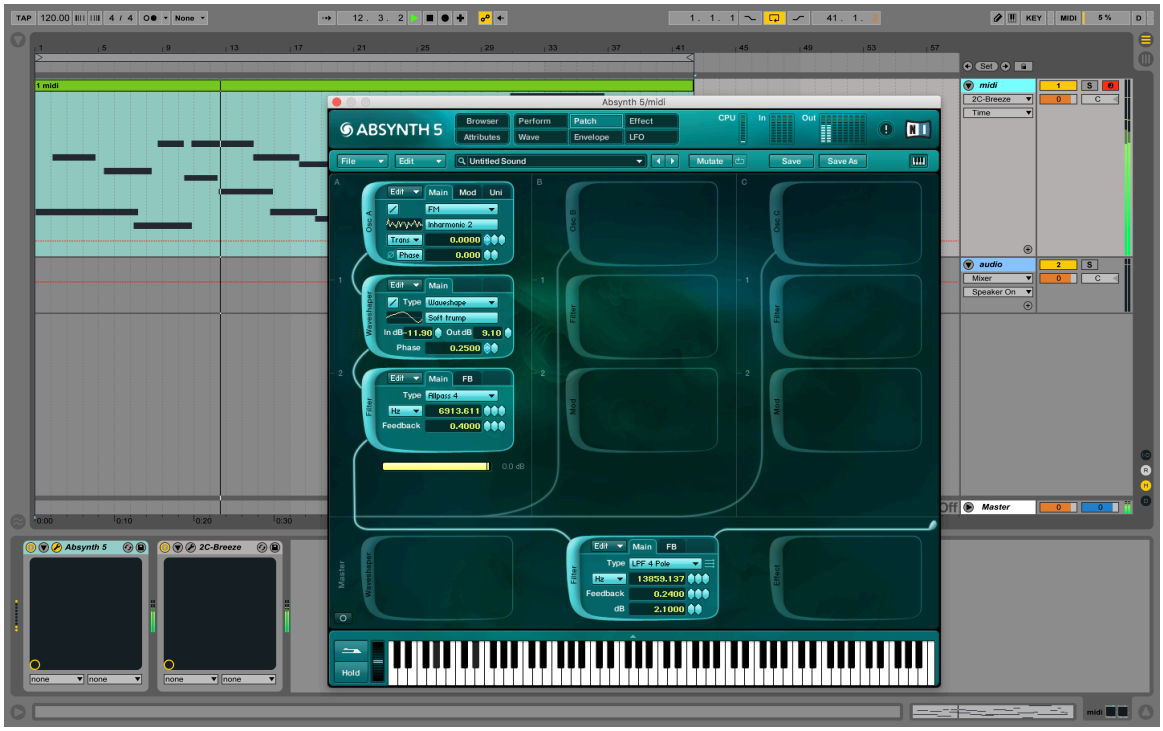

Figure 72: DAW screenshot of *nienta v1*, featuring Native Instruments' Absynth synthesiser

As I listened to *nienta* more in this context, I felt it was diffuse, vague, and meandering, with no real trajectory or clarity. The next version, *nienta v3*—my use of version numbers tends to get mixed up, hence the skipping of 'v2'—involved using four instances of the original Absynth patch, with individual notes arranged across each of them (Figure 71). Each instance had a different volume setting, which I used to conceptually divide each of the 'lines' of the melody, such as putting longer, bass-oriented notes in the bottom instance. Pitch-bending automation, not visible in the image, was also used extensively. The melody was based on the original improvisation, but new tangents and deviations emerged as a result of this careful placement of notes.

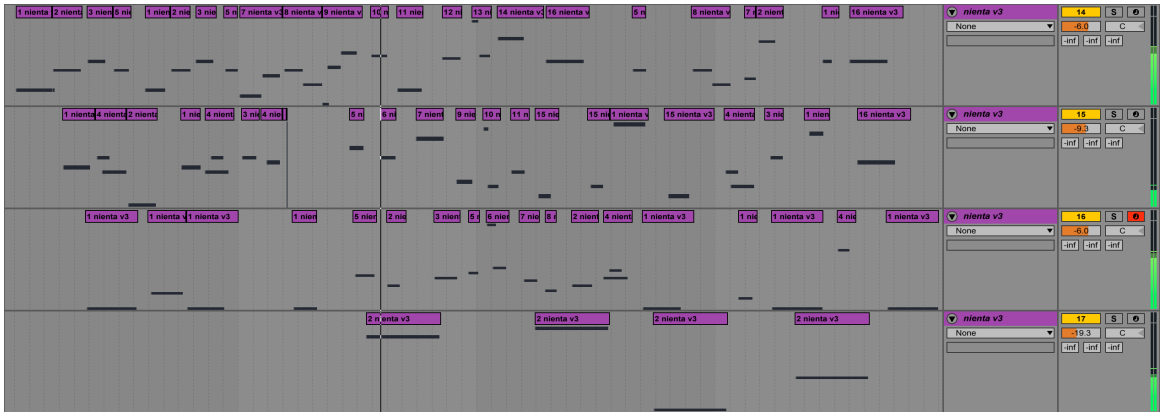

Figure 71: DAW screenshot of *nienta v3*

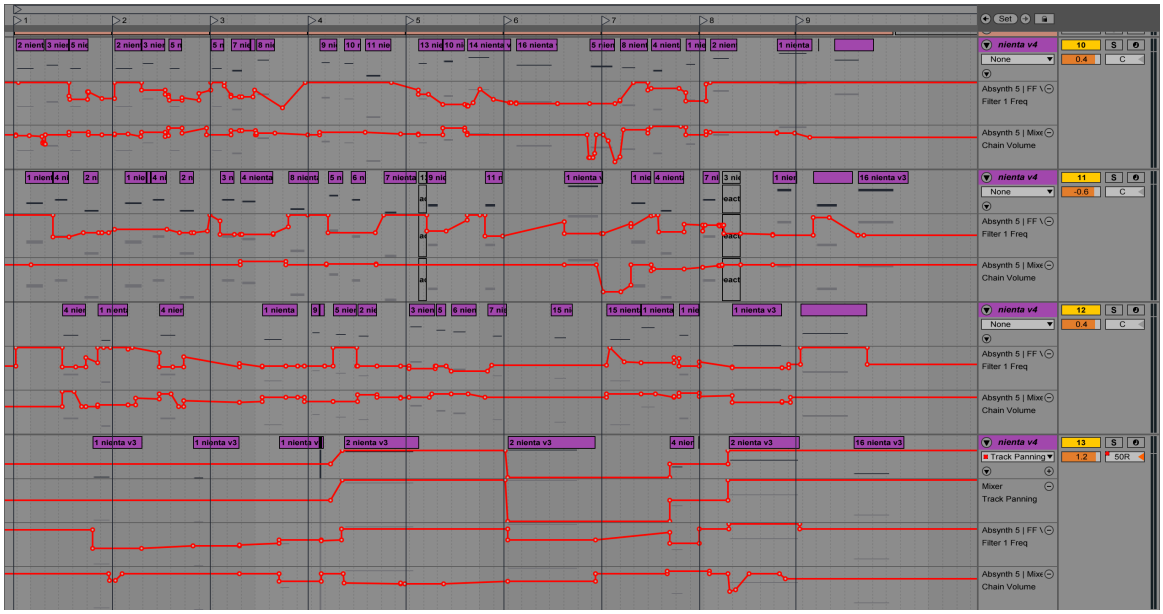

Figure 73: DAW screenshot of *nienta v4*

This work was hampered by some unusual anomalies that made work on *nienta* slow and tedious. Sometimes, the note that sounded would be wrong by an octave, which was fixed by bringing the playhead to the start of the whole line, before going wrong after a little more editing. Because the harmonic content of *nienta* is unusual, the most prominent frequencies generally didn't correspond to the MIDI note—in other words, playing a C would not sound like a C, but rather an A♭ or an E♭. Certain notes were significantly louder than others as well.

I exported this as a single audio file to my main *Vessel* session, and after a lot of listening I locates areas of improvement. *nienta v4* (Figure 73) shows a more meticulous arrangement of each note, using automation to carefully control the frequency of the filter in Absynth, and change the volume and panning of each line. Further editing of the melody was also required, and some light EQing on each track helped smooth it over.

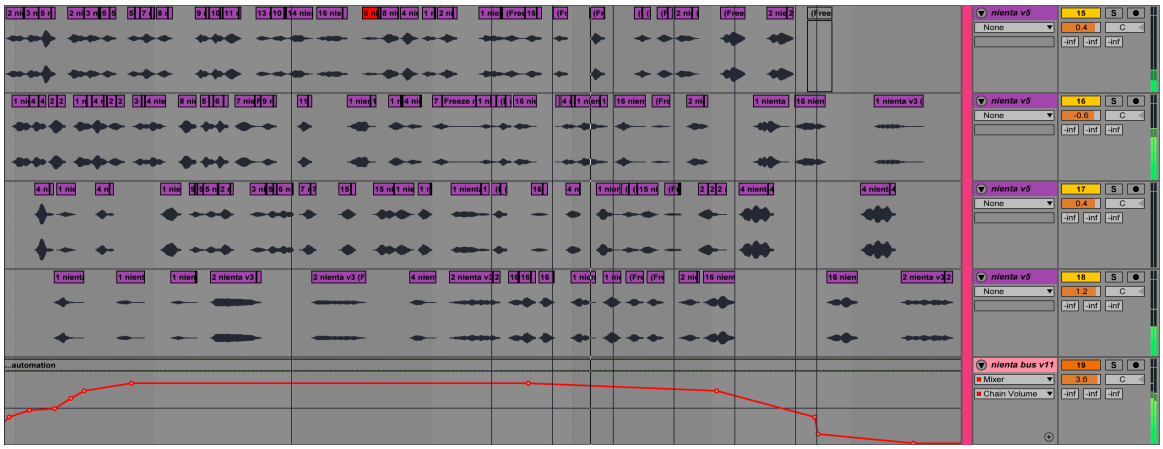

Figure 74: DAW screenshot of *nienta v5*

This process took at least a whole day of DAW editing. I used markers to provide visual aids for when *nienta* needed to work around the loud bass pulses.

The *nienta* that appears in the final version of *Vessel*, *nienta v5* (Figure 74), involves one more round of editing. Each track of version 4 was bounced to audio, and the timing and volume of each note was individually adjusted (not visible in the image). Each track was routed through a buss track (visible at bottom), which processed the sound further with a multiband compressor, an EQ, a reverb plug-in, and volume automation that gave the melody a gentler entrance and exit.

The process of refining *nienta* occurred to varying degrees across all sound designs in *Thru*. This process of refinement is perhaps not as audible or perceptible to the listener as other techniques that foreground the grain of the DAW, but it does suggest

5.5.3 Claviocentric sound design

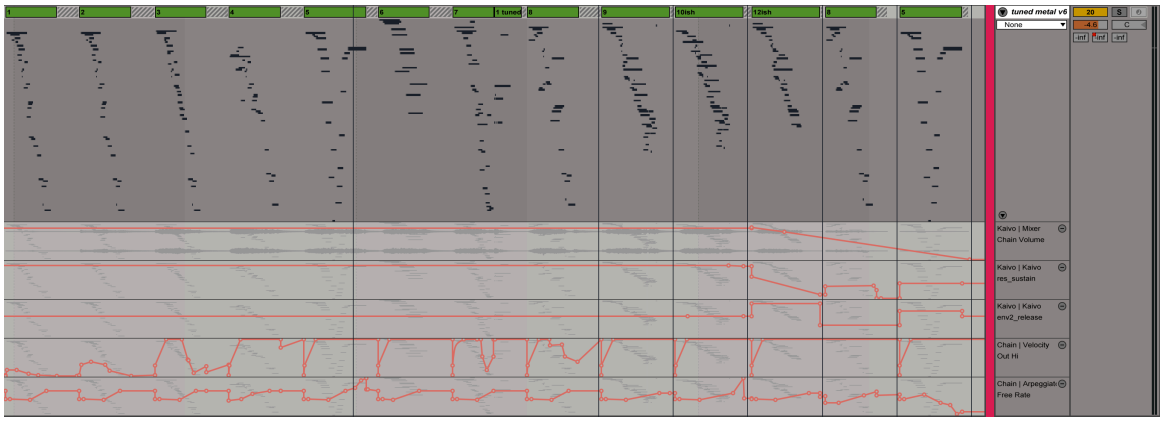

Figure 75: The "tuned metal" sounds in *Vessel*

Claviocentrism, as described in Chapter 3, is a concept coined by Ryan Diduck describing a cultural logic that privileges the piano keyboard at the centre of musical discourse (Diduck, 2018). Diduck uses the term to describe how the keyboard found its way into instruments that did not necessarily require it as a way to structure the possible sounds that instrument could make, which in turn made them legible as musical instruments. The classic example of claviocentrism is the comparison to the widespread success of the Moog synthesiser replete with a piano keyboard, compared to the more esoteric Buchla synthesiser, beloved by experimental composers (Pinch, 2008). In turn, the keyboard became a central organisational principle of MIDI, sequencing software, and finally, the DAW.

Much of my compositional practice has involved trying to escape sonics that allude to the rigid twelve-tone framework of the clavier keyboard. This is demonstrated all across

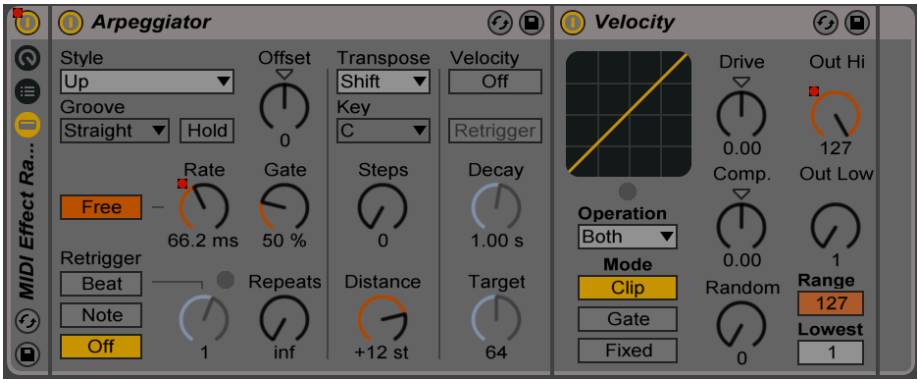

Figure 76: The "Arpeggiator" and "Velocity" MIDI effects used in *Vessel*

Thru, particularly in its heavy use of glissandi. In composing *Vacillate* and *Vessel*, however, I hoped to articulate the claviocentrism implicit in DAW-based compositional practice by embracing it to an extent. They are thus more open to utilising conventionally claviocentric (diatonic) chords and even melodies. *Vacillate*, for example, features lush chords throughout, and despite their gentle glissandi, they are functional within a diatonic system of tonality.

In *Vessel*, a downward-sliding bell-like figure repeats with each pulsing bass note. Figure 75 shows the MIDI information used to create this: a cascade of MIDI notes down the keyboard. As well as the sequenced MIDI notes shown, an "arpeggiator" MIDI effect repeats the currently-playing notes at a regular time interval, and a "velocity" effect enables changing the velocity of each note over time easier. The arpeggio rate and the velocity are automated, shown at the bottom of Figure 75, to ramp up the velocity while increasing the duration between arpeggiated notes.

I understand these bell-like figures to represent the difficulty of escaping the limitations that claviocentrism might imply in the DAW interface. Combined with the physical-modelling synthesis of the bell-like sounds, it foregrounds the grain of the DAW by foregrounding the way MIDI is virtually inextricable from the DAW and the sound designs carried out within it. It is a reminder that despite the tendency for DAWs to be situated as sites of total compositional control, this control works in some ways more than others.

5.6 Track Six: Siliceous

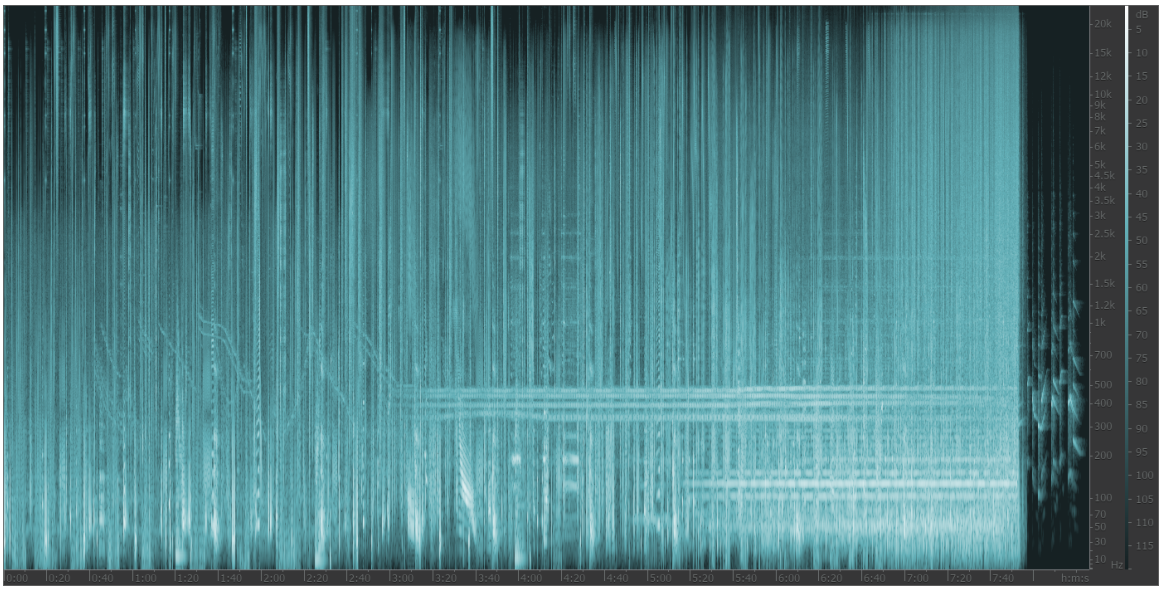

Figure 77: Spectrogram for *Siliceous*

Siliceous is somewhat of an aberration from the rest of the album in its intent and execution. Conceptually, I regard it as a speculation on the interior lives of rocks and mountains, a kind of animist meditation drawing from an artist residency I undertook in Iceland. This notion of representing a hypothetical ecosystem became a novel technique that I used to highlight the grain of the DAW. By employing sounds and mixing strategies typically found in electronic dance music, and appropriating them to articulate the earthy sonics I had in mind, *Siliceous* wavers uneasily between edge and centre, between the grain of the DAW and the imaginary ecosystem being represented.

5.6.1 Background

Siliceous was initially conceived as an exploration of themes outside of the present research. It stemmed from a persistent compositional idea I'd been wanting to explore for at least five years but didn't have the time or technical skills to commit to the idea until 2016. I was interested in creating a kind of cracked, dry, splintered electronic music derived from soundscape compositions and musical evocations of landscape (Weiss, 2008). I felt that the musical works that dealt with landscape that I loved, a prime example being Richard Skelton's *Landings* (2009), didn't reflect my own experience of landscape in occupied Nyoongar land of south-west Australia. I felt that simply transplanting European evocations of landscape into an Australian context was to replicate colonial narratives. The iconic film *Picnic at Hanging Rock* (McElroy & Weir, 1975) is an example of such depictions—it utilises the trope of the young woman lost in an apparently inhospitable

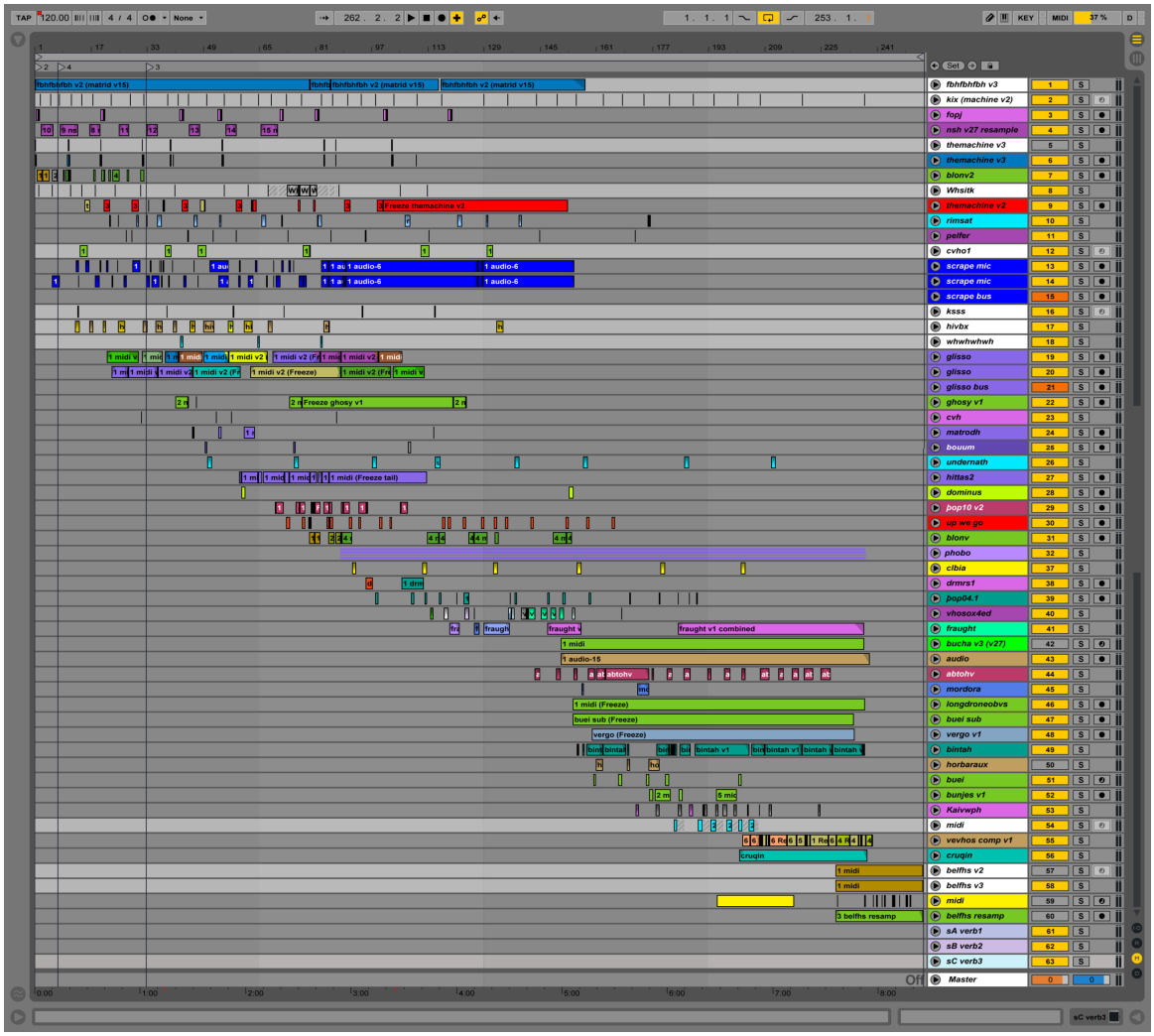

Figure 78: Composite DAW screenshot of *Siliceous*

Australian landscape, understood by Tilley to be "a marker of innocence that signals the settler as not savage and, therefore, as entitled to occupy the land" (Tilley, 2009). *Picnic at Hanging Rock* also evokes the notion that the landscape is sentient and supernatural, and this is evoked through sound design. Thick, bassy rumbles accompany panoramic images of Hanging Rock and its surrounds, the implication being that the land is stirring or awakening as the protagonist characters climb the rock. The use of bass-heavy noise to denote large or geological entities is persistent, and I was interested in exploring alternative sonic impressions that evoked the multiplicity of the landscape rather than one all-encompassing entity.

Between September and October I was involved in an artist residency with five other sound artists at Listhús í Fjallbyggð* in Ólafsfjörður, Iceland, as part of the one-off

* http://www.listhus.com/

Norðanvindur Sound Art Residency and Festival,* and the A! Performance Festival in Akureyri.† Ólafsfjörður, with a population of approximately 800, is located in a fjörd and surrounded by imposing hills. In winter, the sun does not surpass these hills, meaning the townsite does not see direct sunlight for most of winter. Landslides and avalanches occur frequently. I had many discussions with Icelanders about 'the big one,' the overdue eruption of Katla, Iceland's largest volcano. These conversations suggested a general feeling of hushed reverence for the landscape, often understanding it as a living entity. These characteristics affect the lived experience of Icelandic people in very pronounced, sometimes violent ways.

5.6.2 Speculative mimesis

While coming to terms with these understandings and depictions of landscape in both northern Iceland and the Nyoongar Nation, I was also interested in exploring techniques of mimesis in electronic music. Imitation, especially of acoustic instruments, has historically been used as a way to validate electronic sound generation as an artistic practice, from the violin-like vibrato of Clara Rockmore's theremin technique to John Chowning's emulations of brass sounds using FM synthesis in the 1960s (Chowning, 1973). Once the imitative capacities of electronic sound generation became clearer and more vivid, imaginative interpretations of fictional sound sources—sonically imitating objects or entities that don't otherwise exist—became a common aesthetic prerogative, particularly in electroacoustic music (Smalley, 1996). Using electronic instruments for what I would call *speculative mimesis* is a prominent aesthetic in electroacoustic music traditions, and can be heard in the work of several electroacoustic artists, including Denis Smalley, Jonty Harrison, and several others. In this respect, I was particularly drawn to work such as Iannis Xenakis' *La Legende d'Eer* (Xenakis, 1978), and German musician Rashad Becker's *Traditional Music of Notional Species* series (Becker, 2013, 2016).

I have been drawn to speculative mimetic techniques in music composition for several years and applied these to acoustic and electronic pieces. No sound reproduction device can perfectly imitate a sound in space, but the concerted attempt of trying can reveal aspects of the practice of using those devices. This is especially prominent in 'older' media such as analogue synthesisers, the kind of which Rashad Becker uses in the aforementioned *Notional Species* series. In its extreme, Wendy Carlos' *Switched-On Bach*

* http://www.listhus.com/special-programs/category/2016-noranvindur
† https://www.facebook.com/A.performance.festival

(1968) and its meticulous imitations and augmentations of acoustic instruments do as much to signify the limitations of the Moog synthesiser than signifying its literal capacity to imitate. In *Siliceous*, I tried to evoke a speculative ecosystem of supernatural entities underneath the surface of the earth, the interior workings of the mountains and geological formations that can inspire incredible awe and unleash powerful forces as starkly as in Iceland.

Because of the potential for speculative mimesis to foreground the material limitations of a medium, it is a useful technique for foregrounding the grain of the DAW. This technique risks becoming simply an exploration of the grain of the *synthesiser* however, thus I took care not to overly emphasise the software synthesisers used in the production of *Siliceous*. The techniques I arrived at that derive from speculative mimesis and foreground the grain of the DAW include employing tropes and conventions from electronic dance music, arrangement consistent with the *Sharawadji effect*, mixing strategies that foreground 'flatness,' and distinct spatial separation of foreground and background.

5.6.3 Electronic dance music tropes

As I was interested in creating a subterranean soundscape, I opted for sounds that were dry, 'snappy,' and had substantial bass presence, vaguely reminiscent of the way sound is conducted through the ground. My immediate points of reference were the kick drum and the rim shot, two integral components of electronic dance music percussion. I began by looping kick drum samples that came with Ableton Live, of which there are many. I often looped these sounds by loading them into a sampler, and using Live's MIDI Arpeggiator (explored in Chapter 5.5.3) to play the sample rapidly. When this is done while automating volume, panning, or a low-pass filter cutoff, it suggests movement, evoking a non-specific animal vocalisation. The original context of the sound, however, is never quite lost. It is almost always audible *as* a kick drum or a rim shot—indeed, one of the rim shot samples I use comes from the widely-used Roland TR-808 soundset.

Despite the dryness that I had initially pursued at the outset of *Siliceous*, I also explored reverb. Again, I approached this from the perspective of electronic dance music. The genres associated with dance music often employ artificial-sounding reverb, such as shimmering plate reverb. I utilise plate reverb sparingly, but particularly on sounds with mostly treble content. Prominent examples of this occur with the clicking sound at 3:00, 3:40, 4:20, et cetera.

By referring to electronic dance music, arguably a mode of practice that is more mediated by the DAW than most other genres, the DAW becomes foregrounded. In earlier attempts to electronically replicate acoustic sounds, the 'grain of the synthesiser' becomes apparent to contemporary listeners. I believe this referential technique does the same in *Siliceous*—it situates itself in historical and practical context, in which the DAW's ubiquity in electronic dance music is both highlighted and mutated.

5.6.4 The Sharawadji effect

The Sharawadji effect is a term derived from Sharawadji, an aesthetic originating in Chinese garden and landscape design in the 17th century, characterised by pleasure derived from irregularity and disorderliness in its design. Applied to the experience of listening, Augoyard defines the Sharawadji effect as "the feeling of plenitude that is sometimes created by the contemplation of a sound motif or a complex soundscape of inexplicable beauty" (Augoyard & Torgue, 2005, p. 117). The term has been used in electroacoustic and soundscape composition for decades, referring to a structure and soundset that may seem banal at first but on deeper listening may reveal itself to be a careful construction. "The sharawadji affirms itself," Augoyard writes, "in contrast with the very banality it is based on. Sharawadji sounds … become sharawadji only through decontextualization, through a rupture of meaning" (2005, p. 118).

I am drawn to this concept because I was interested in creating an ecosystem comprising a kind of structured disorderliness, using a carefully-vetted set of sounds and meticulously placing them in the timeline. When placing the sounds, I paid great attention to the gaps between sounds, ensuring there was little overlap between them and vaguely evoking some sort of conversation between organisms. This also maintained momentum throughout the work. The majority of my time working on *Siliceous* involved moving sounds around very slightly. Figure 79 shows an excerpt of notes taken during the acousmatic listening phase for a near-final version of *Siliceous*. I have located dozens of 'gaps' where the work lulls, and suggest several locations where sounds should move slightly.

The placement of sounds in the timeline was painstaking, even under the pretence of quasi-randomness. Random sequencing of sounds can certainly be done using Max or other programming languages, however the randomness that I have tried to create here is very structured. Sounds recede and are replaced with new ones, which repeat or vary sporadically over the course of the work, and sounds rarely overlap—if they do, they

occupy different areas of the spectrum. I believe this commitment to meticulous randomness is communicated to the listener.

This kind of editing is only practical in the DAW, where the perception of momentum and 'gaps' may only be legible or editable in an environment that permits endless changes. The grain of the DAW is exposed here through attentiveness to the placement of sounds in the timeline, particularly in their lack of overlap, and their careful repetition as the piece unfolds.

5.6.5 The evolving soundstage

In Chapter 5.1.4, I discussed subverting the mixing convention of the soundstage as a way of foregrounding the grain of the DAW. The relative ease with which a soundstage can be

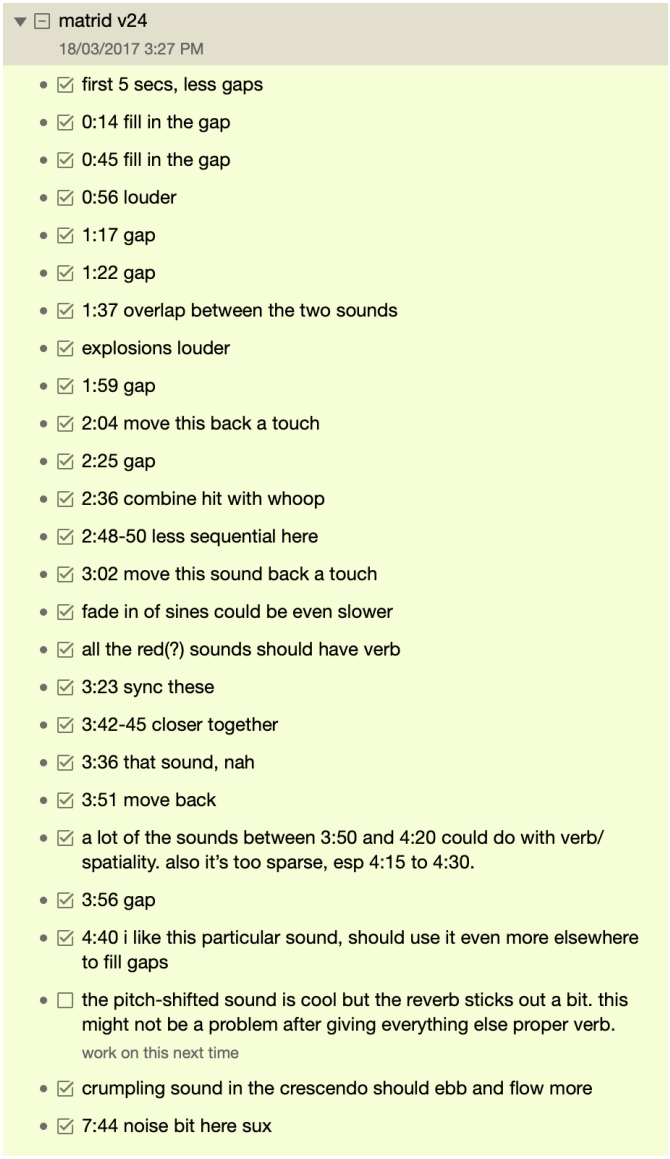

Figure 79: Excerpt of documentation during the editing of *Siliceous*

articulated or subverted is a characteristic of analogue and digital recording media—one can simply use a reverb 'incorrectly.' Rendering the soundstage 'flat,' however, unsettles the representation of a coherent spatial locale from which the sounds emerge.

The soundstage in *Siliceous* varies throughout its duration. From approximately 0:42 to 3:03, distant synthesised glissandi with prominent reverb and reduced treble and bass frequencies suggest a cavernous soundstage, while most other noises suggest close proximity. They pan across the soundstage quickly and dramatically, perhaps suggesting the sensation that a sound is flying past the listener.

From 3:03 to 7:53, four wavering sine tones in the mid-range complicate this soundstage. Sine tones have an ambiguous relationship with space. In my experience, locating the originating source of a sine wave in a space such as a reverberant room can be difficult, especially if it coincides with the room's resonant frequency. The sine tones also waver periodically in amplitude, to further suggest spatial dislocation. From approximate 5:18 to 7:53, these are joined by drones in the low-mid range. As these tones are employed in *Siliceous*, the perception of a coherent and cavernous space becomes problematised, as the sine waves seem to evoke a non-space of sorts. This effect is utilised to mesmerising effect in Italian artist Neel's track "Crater Chain Observations," from his album *Phobos* (Neel, 2014). Finally, from 6:44 to 7:57, a consistent noisy pattern evoking the sound of ripping paper swarms the soundstage, with little sense of perceptual depth. *Siliceous* concludes with a distant metallic percussive sound, in which the conventional soundstage is restored.

By shifting between various kinds of soundstage, its 'constructed-ness' is drawn into relief. It suggests that the representation of space is a convention born from the "transparency perspective" of music recording, can be disrupted easily in the DAW.

5.6.6 Mistakes

One aspect of making *Siliceous* that foregrounds the grain of the DAW arose entirely due to carelessness. There is one particular sound that I labelled "þop10 v2" (the burgundy-coloured track in Figure 78) characterised by a noise burst with high-speed panning modulation, evoking a splash or an explosion. This sound occurs eight times between 2:16 and 3:27. All sounds are panned hard to the left. This panning is unintentional—I had planned for them to be placed in the centre of the panorama. I believe the problem occurred because the action of offline bouncing, or exporting a DAW session to an audio file and not simply recording it all in real-time, sometimes introduces unpredictable

anomalies. The "þop10 v2" sounds are processed with a third-party delay plug-in, and I believe that there was an error that caused only the left channel to be processed. This was an oversight because towards the end of the compositional process of *Siliceous*, I had listened to it so many times that I didn't bother to listen intently on the final version, as this had not been an issue in previous renders. It was only after receiving the masters that I realised the problem was there. At first, I was frustrated by this oversight, but I have come to hear it with some affection, as if it were a small acknowledgement of the fragility and fickleness of the DAW.

5.7 Conclusion

The making of *Thru* articulated several techniques through which the grain of the DAW becomes foregrounded. Negotiating between these techniques and making aesthetically-pleasing compositions—the push-pull dynamic towards the edge or centre of the work—informed much of the development of *Thru*. I have suggested that negotiating sound design, arrangement, mixing, acousmatic listening, and data management comprise DAW-based compositional practice, and each of these practices can be reconsidered through new or novel means. While these techniques are not necessarily all applicable at once, and sometimes even contradict each other, they articulate various aspects of the material condition of the DAW, refer to its practices, and do so in a way that is less applicable to other musical media. I will summarise and reflect on the techniques I have explored in the next chapter.

Thru was well received on its release. American record distributor Experimedia put the album on their "Best of 2017" list, describing it in a tweet as "one of the best thing [sic] we've heard this year."* Madrona Labs, who made the software synthesisers Aalto and Kaivo, described it as "delightful aural hedonism."† The 50-cassette run of *Thru* sold out within a year, and as of February 2019 the download was purchased 37 times through my personal Bandcamp page, and less through the Fallow Media Bandcamp page. Mat Dryhurst, best known as the creative partner of Holly Herndon, tweeted a positive response to it,‡ and Australian sound artist Kate Carr put *Thru* in her 'top 10 records of

* Experimedia have since, sadly, ended their operations and closed their social media accounts.
† https://twitter.com/michaelterren/status/944679911989510145
‡ https://twitter.com/matdryhurst/status/913802064676970501

2017' list compiled by Boomkat.* Ryan Diduck, author of *Mad Skills: MIDI and Music Technology in the 20th Century*, gave a humorous and positive review on his personal blog, in what will likely be the only time my music is compared with the TV show *Pawn Stars*.†

* https://boomkat.com/charts/2017/516?fbclid=IwAR1SCv-duuFFlYPWmYgEp7h_bx5JeEBasiIIj4Kt_lei8-jV2VxKDTOs4l4

† https://lunarlodge.wordpress.com/2017/10/05/i-want-it-what-is-it/

6 Summary and conclusion

In this thesis, I have explored compositional techniques that foreground the material conditions and practices pertaining to the DAW. Through a practice-led research methodology involving processes unique to experimental electronic music, these techniques emerged at the intersection of compositional activities such as sound design, arrangement, mixing, listening, reflection, managing data, and managing conceptual burden. I have suggested that despite the DAW's current ubiquity in the recorded music creation of today, it has received relatively little scrutiny as a compositional tool or a socio-historical artefact.

6.1 Towards the grain of the DAW

To summarise and clarify the findings of this thesis, I will first describe the theoretical framework I have developed to isolate the locus of my inquiry. The grain is a concept that describes the sonic effects in a recorded musical work that infers the material conditions and practices of its making. It synthesises several mobilisations of the term, from Roland Barthes' essay *The Grain of the Voice*, in which he posits the grain as a sonic effect that facilitates a particular (embodied, erotic) relationship between listener and vocalist; to Pierre Schaeffer and Michel Chion's definition, as a more objective inference of the material origins of a sound. I place the grain closer to what Alexander Galloway calls the "edge" of music, a conceptual binary describing artistic effects that either enforce an internal compositional or representational logic (the artwork's "centre"); or refer to the material and practical conditions of its medium (the "edge").

This definition of the grain differs from a conventional understanding of the grain as transductional noise, such as the hiss of tape or the crackle of vinyl. I have made this differentiation because the DAW seems to lack such noise. This has led to suggestions the DAW lacks a grain at all and thus is illegible as a medium of musical activity. I interpret this as a misunderstanding as to what DAW-based practitioners actually do, and in fact recorded music originating in a DAW may be audible as such—all artworks have an "edge" that refers to their medium, and listening practices simply need to adjust to negotiate where the edges are and what they sound like. I suggest that compositional techniques can be utilised to either conceal or foreground the grain of the DAW, and that the former is arguably more common.

To articulate the compositional techniques that foreground the grain of the DAW, I devised and enacted a three-phase model of composition. The first phase, sound design, involves the creation of interesting sounds using software synthesisers, MIDI generation, and signal processing. The second phase, arrangement, pertains to the arrangement of sound designs and mixing them into a composition. The third phase, acousmatic listening, involves reflecting on and assessing the work outside of the DAW environment. This compositional process was almost exlusively 'in the box,' a condition which blurs these phases into each other, a condition similar to what Kirschenbaum calls the suspension of inscription.

The compositional techniques explored through this process have thus far been listed in vaguely chronological order as I encountered them in the making of *Thru*. Here, I will summarise them in terms of this three-phase model.

6.1.1 Sound design

Parameter automation (see Chapters 4.1, 5.1.2)

Automation is one of the central tools that makes the DAW stand apart from previous analogue recording technologies. It facilitates meticulous editing of data that is realised in audio in many ways. Here, the automation I have tended to use has been very complex, drawing shapes that subvert conventional devices for changing the value of a parameter, such as an LFO. I also experimented with automating pitch, which may be useful for future compositions.

Motif creation (see Chapter 5.2.1)

I have suggested that motivic development can be driven by timbral manipulation, rather than conventional, classical motifs that centre melody, harmony, and rhythm. In *Fwd*, I have emphasised this aspect of motivic development to draw attention to the linear timeline, and the 'automatability' of synthesis parameters 'in the box.'

Feedback systems (see Chapter 4.5)

The DAW's send and return tracks have the capacity to feed into themselves, creating chaotic feedback loops. These loops can expose the character of audio plug-ins while subverting the linear timeline central to the DAW's operation. I found limited use for this technique in my practice.

Subverting sample libraries (see Chapter 4.6)

Sample libraries, particularly orchestral ones, are increasingly ubiquitous tools for making music for media. Their unique and subversive possibilities for experimental music have not been well explored. Rather than try to represent a coherent soundstage akin to a concert hall, I have placed these sounds well outside that context, incorporating synthesised sounds and cutting off these sounds suddenly. I believe this is a rich area to pursue, but in the context of my own practice, felt too on-the-nose.

Polyphony and claviocentrism (see Chapters 5.5.2 and 5.5.3)

The DAW embodies the piano keyboard as an organisational principle of music in its interface. The 'claviocentrism' of the DAW also embodies the notion of polyphony as a default mode of composition, and this extends to the design of software synthesisers. I employ highly polyphonic sound design all throughout *Thru*, and often these conform to the pitch-set of the 12-tone, equal-temperament clavier keyboard.

Speculative mimesis (see Chapters 5.6.2 and 5.6.3)

This novel technique was used in *Siliceous* to evoke a hypothetical, fantastical soundscape of a subterranean ecosystem. My approach to this was to use a palette of sounds typical in electronic dance music, such as kick drums, and warping them using pitch bending and other automated parameters to suggest a sense of organicism. This technique suggested a speculative geological sound world, while always keeping its DAW-based origins audible.

Sound design as performance (see Chapter 4.9)

I conducted a few experiments and foregrounded the practice of designing sound as a performance practice. One recording of myself designing a sound did not reveal any compositional techniques worth pursuing, but rendering these actions visual through the installation *The Occultation of Production* very literally foregrounded the grain of the DAW. An additional performance piece, *No Scrubs* for eight laptops, also placed the timeline of the DAW into sharp relief, in which new sounds are made by 'scrubbing' the playhead across the timeline. These aspects of DAW-based compositional practice that are traditionally not presented to the listener/viewer make up important artistic techniques, although perhaps their value as compositional techniques are yet to be confirmed.

6.1.2 Arrangement

Layering (see Chapter 4.3)

A primary conceit of the DAW as a mediator of musical composition is that it enables different sounds to be played simultaneously and edited individually on a series of 'tracks.' This employs the metaphor of 'layering,' and virtually all DAW-based composition comprises multiple layers of sound, or what Eno calls "additive composition." I have questioned this condition through experiments such as layering and arranging several of the same sound over the top of one another, playing the same sound and automating each track individually, and making 'monophonic tracks' in which one sound plays at any one time. I found these experiments difficult to translate into aesthetically interesting compositional techniques, though I do not rule their applicability out entirely.

Foregrounding the indifference of audio (see Chapter 4.7)

In the DAW, all audio is treated equally *as* audio—aside from the number of channels and differences in format, there is little ontological difference between a field recording, a completed piece of music, or the many singular sound designs I created throughout this research. I tried to emphasise this condition by using field recordings and negating any possibility of the listener being immersed in the space and place represented in those recordings. By cutting them off rapidly, and interspersing them with synthesised sounds that are decidedly out of place, the symbolic content of each layer of audio becomes redundant, foregrounding the DAW's indifference for this symbolic content.

Musical structure: linear forms, block forms, and looping (see Chapters 5.1.1, 5.4.1, and 5.5.1)

I have explored numerous forms that foreground the grain of the DAW in one way or another. In *Thru*, I employed a linear, event-based form drawn from the orchestral work of Kaija Saariaho. The careful and liberal use of automation to punctuate certain 'events' in the work, such as slow crescendos and building of complexity, is a form where the DAW's automation capacities excel. Similarly, block forms in which several compositional ideas are presented in stark contrast against each other, are explored in *Vacillate*, subverting the notion of a consistent instrumentation. Most prominently, as far as critiques of the DAW go, looping is often seen as a technique that the DAW implicitly encourages. I pay homage to this sentiment in *Vessel*, albeit in a loose way.

Flattening and deepening the soundstage (see Chapters 4.8, 5.1.4, and 5.6.5)

The soundstage evokes the metaphor of width and depth in a mix, and virtuosic DAW-based production has tended towards having a very 'wide,' very 'deep' soundstage. The soundstage metaphor also supposes a representation of a space in which all sound sources—instruments—emanate from individual locations much as the instruments of a live performance would. Subverting this mixing convention by making a 'flat' soundstage with little perceivable depth erases its representational nature, foregrounding the DAW as a mediating device in recorded music. The metaphor of flatness also evokes the flatness of the screen, the DAW interface itself even, and is a common refrain in art that explores digitality. This style of mixing is particularly evident in the first track of *Thru*. I have also explored in the other direction, mixing and designing sounds that suggest a very deep soundstage, or a sound source a long distance away. In the case of *Vacillate*, often these are explored one after the other, alluding the ambivalence of spatial representation in DAW-based compositional practice mentioned earlier. An experiment in having overlapping soundstages (Chapter 4.8) was less successful, in which I had hypothesised a disjunctive listening experience which mostly turned out to be banal.

Mixing conventions: loudness and treble boosting (see Chapters 5.3.2 and 5.3.3)

Although the 'loudness wars' predate the DAW, new digital plug-ins have enabled severe limiting compression that can produce extreme loudness. It is a standard convention to mix for substantial loudness, especially compared to mixes made in prior decades. Moreover, it is a standard in DAW-based production to boost treble content higher than it might otherwise be perceived outside of the recorded medium. For the most part, I mostly participate in these conventions rather than critique them, but they are audible as techniques that can be understood to foreground the grain of the DAW.

6.1.3 Acousmatic listening and reflection

Biographical metaphors of the DAW (see Chapter 4.9)

Drawing on the history of the DAW as one reification of atomised musical practice, I explored the possibility of DAW-based compositions that refer to this history as a metaphor for circumstances in my personal life. In one compositional example, I explored feelings of isolation using compositional techniques that were only available on my laptop at the time, to suggest the contradictory sense of claustrophobia in the vast open space

that is the airport terminal. I believe this is a highly fertile ground for poetic negotiations of the DAW as a compositional medium, and I hope to explore this further.

Strategies for countering conceptual burden (see Chapter 5.1.5)
Managing the amount of data visible and available to the DAW user is an important yet frequently overlooked aspect of DAW-based compositional practice. If there is too much data on the screen, this can contribute to what Duignan calls conceptual burden. Although this is not particularly audible or legible in the final compositions, it has significant influence on the practice as it unfolds. The three-phase compositional process I enacted was one way of managing conceptual burden. I also worked on individual sound designs in separate DAW sessions, bouncing complex sound designs into singular audio files despite losing the ability to control them, and managed the order of tracks such that audio content appears from top-left to bottom-right of the timeline.

Listening for intentionality and virtuosity (see Chapter 5.4.3)
I have described 'intentionality' as an approach to compositional practice in which it couldn't have been made 'off-the-cuff' or in live performance. This is an ethic I employ in my music, and highlights the advanced control that DAWs provide. I have also explored the notion of 'virtuosity' in DAW-based production, especially as it is understood in dance music. One component of virtuosity is the balance of complexity with clarity, and I explore the role of EQ in enabling this balance. This enactment of virtuosity through the use of EQ, compression, and other mixing tools is an aspect I attempt to pursue in *Vacillate* and other tracks on the album.

6.2 Further studies

There are many fields relating to DAWs that require attention. One pressing avenue of inquiry would be to collect more primary source material towards historical documentation of developing DAWs. Beyond occasional press interviews, the programmers and designers behind the DAWs used today do not typically reveal their motivations, inclinations, or biases, and how these may have helped shape the DAW. Such data may be integral to understanding the DAW from a social constructivist perspective. Primary source material could also be gathered from trade magazines, trade organisations such as North American Music Merchants (NAMM), online forums, and seasoned producers of popular and electronic musics. A cultural history of the DAW

would need to cut through the rhetoric of speed, accuracy, and progress that brought the DAW into existence, and probe the systems that have helped create the ubiquitous condition of the DAW today.

This study is informed by my background as a DAW practitioner for most of my life, and my compositional practice making experimental electronic music. This genre comprises techniques that are often oppositional to a perceived status quo. The DAW today *is* the status quo, however, and this is reflected in the ubiquity of DAWs in the making of popular music and popular electronic dance music. Further studies of the DAW as a sonic mediator would need to include concentrated efforts to pursue its effect and impact on popular music practices. It could also be argued that the grain of the DAW is especially prominent in certain genres of electronic dance music, such as drum 'n' bass. This genre is especially mediated and strongly associated with aspects of craft, whose leading practitioners are often experts in music production. The DAW is central to the production of drum 'n' bass, and anecdotally speaking, the grain of the DAW is especially prominent here.

My investigation of compositional techniques that foreground the grain of the DAW is not as radical as it perhaps could have been. It is heavily informed by the current zeitgeist of experimental electronic music that privileges analogue and hardware-based synthesis traditions, which in turn may be a reversal of the zeitgeist that privileged the unique glitches and timbres of digital synthesis and music-oriented programming languages. Compositions that radically foreground the grain of the DAW may sound more like the work I described in Chapter 4. Given this thesis was largely concerned with conventions of DAW practice—and in many ways bolstering my ability to enact those practices—techniques that radically subverted DAW conventions fell by the wayside in this thesis. I also made little use of other DAWs. My decision not to use several DAWs in this research was driven by financial restraint, as most DAWs cost hundreds of dollars. While I have tried to be discreet about my preference for Ableton Live, and have offered little discussion of its unique features, I have little doubt that using multiple DAWs would enlighten new aspects of DAW-based compositional practice, particularly around ideas of pedagogy and GUI design. Comparative analyses of different DAWs would be an important step in this direction.

DAW technologies, particularly early DAWs, are at risk of being lost. As computer hardware and operating systems continue their inexorable pursuit of hypermodernity, the archival of yesteryear's computers and DAWs becomes a more difficult and costlier

proposition. The fleeting nature of cutting-edge technology is already something felt by most DAW-based practitioners, myself included, who have likely lost access to old DAW sessions simply through upgrading their hardware, software, or operating systems. These could be vital primary sources for future study. These questions are already being considered in literature studies (Kirschenbaum, 2016), and are bound to become more prominent in music studies, particularly as the methods of historically-informed music practice are applied to digital music of the last few decades. Archival work needs to ensure the accessibility of old DAW sessions, computers, hard-disk recorders, and early DAW software.

6.3 Concluding remarks

This research has helped me clarify and formalise a compositional practice I was tacitly aware of, but unable to articulate. It has also improved my ability to professionally produce recorded music and broadcasts, and teach DAW-based music production to young people and university undergraduates. I hope to have solidified my proposition that the conditions and practices pertaining to sonic media can viably be articulated through the methods unique to musical composition and analysis. In Chapter 1.1, I suggested that "art practice is best praxis in microcosm," and that this research is an attempt to re-situate my practice towards this ideal. My feeling is that this research has helped clarify my practice and its positionality more generally, offering a road map for future avenues to explore.

Many sonic media, such as vinyl, tape, and compact discs, became subject of new forms of interrogation after their popularity has peaked. Vinyl crackle, tape hiss, low bit-rate MP3s, analogue synthesis, General MIDI, and other media and instruments of yesteryear have newfound aesthetic value. The grain of these media continues to fascinate musicians and listeners. The DAW continues to grow in popularity, as does its market and competitiveness, which may contribute to the relative lack of rigorous studies around the DAW. Its ubiquity will not last forever, and as it recedes, new aesthetic values of the grain of the DAW will emerge. Advances in artificial intelligence, machine learning, and algorithmic music (and their commodification) may threaten the DAW's hegemony, or at least some of its conventions and techniques. This would be an extension of the neoliberalisation of musical practice, a trajectory that the DAW has also been instrumental in, but this cannot be written off as a foregone conclusion. It is thus

important to historicise, document, and ultimately encounter new modes of engagement and expression with these tools. For now, the DAW facilitates the creativity of millions of musicians worldwide at all skill levels, mediating an unfathomable diversity of musical practices and traditions. It is a near-universal condition of recorded music today, a condition that I hope to have provided insight into.

Appendices

Appendix A: List of publications during candidature

Terren, M., & Hope, C. (2015). *Map-Making Towards an Onto-Cartography of the Digital Audio Workstation*. Paper presented at the Australasian Computer Music Confernence, Sydney. Retrieved from http://acmc2015.net/wp-content/uploads/2015/11/Terren-and-Hope-2015-MAP-MAKING-TOWARDS-AN-ONTO-CARTOGRAPHY-OF-THE-DIGITAL-AUDIO-WORKSTATION.pdf

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Terren, M. (2018). *Siliceous: speculative mimesis and the grain of the digital audio workstation*. Paper presented at the Australasian Computer Music Conference, Perth, Australia.

Terren, M. (2019, forthcoming). *Fake it 'til you make it: the virtual orchestra in new electronic music*. Paper presented at the 2017 Totally Huge New Music Conference, Perth, Australia. Proceedings forthcoming.

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