The University Of Sheffield.

The sound was already inside:

exploring textility through sonic art installations, compositions, and performances.

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Abstract

This doctoral research explores ways in which textility, a concept popularised by anthropologist Tim Ingold, may be explored through sonic art installations, compositions and performances. The term *textility* refers to an understanding of creative practice in which form emerges through an intervention in fields of force and flow; rather than imposing form, which Ingold describes using the term *hylomorphism*, textility involves the following of lines and contours latent in materials, in anticipation of what may arise through creative acts of exploration and engagement. The exploration of textility in this research takes two forms. Firstly, it takes the form of an original portfolio of artworks, each created for the purposes of understanding how textility may be explored across a variety of different materials and media common to sound art practices. Secondly, it takes the form of a written text. The text starts by introducing the notion of textility, explaining how this notion underpins the central research motivations and research methods. It goes on to consider how an exploration of textility through the creation of sonic artworks requires the development of bespoke methods, referencing the portfolio of original artworks to illustrate key findings and observations. The research concludes by arguing that textility and hylomorphism cannot be separated; there is always an element of both in every creative work. In this context the artworks become frameworks whose aim is to foreground an ongoing reflective focus on intention, action, agency, and outcomes. Understanding of this conclusion, and the creative structures underpinning this investigation, enables one to develop purposeful strategies for best intervening in those fields of force and flow that Ingold describes, to produce creative works in which textility is aesthetically central.

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Declaration

I, the author, confirm that the Thesis is my own work. I am aware of the University's Guidance on the Use of Unfair Means (www.sheffield.ac.uk/ssid/unfair-means). This work has not previously been presented for an award at this, or any other, university.

Introduction

In *The Textility of Making*, anthropologist Tim Ingold suggests that contemporary discussions regarding art and technology mistakenly invoke a hylomorphic model, in which making things – in the broadest sense of this term – involves the imposition of a predetermined form onto (what are assumed to be) passive materials or objects (Ingold, 2010). In rejecting this idea, Ingold proposes an alternative account of making, in which form emerges through an intervention in fields of force and flow; rather than imposing form, practitioners follow the lines and contours of materials in anticipation of what might arise. To help us understand this point, Ingold suggests that: "Rather than reading creativity 'backwards', from a finished object to an initial intention in the mind of an agent, this entails reading it forwards, in an ongoing generative movement that is at once itinerant, improvisatory and rhythmic" (Ingold, 2010, p. 91).

The terms *hylomorphism* and *textility* are carefully chosen. For example, when explaining the term *hylomorphism,* Ingold refers to Aristotle, who claimed that creation always involved matter (*hyle*) that has form (*morphe*). In the history of Western thought, Ingold argues, a corruption of Aristotle's sentiment led to a hylomorphic model of creation becoming deeply embedded, leading to the point at which form came to be seen as something: "imposed by an agent with a particular design in mind, while matter, thus rendered passive and inert, became that which was imposed upon" (2010, p. 92). Believing this to be inaccurate, Ingold's choice of the opposing term, *textility*, draws from both the ancient greek term *tekhne*, used to describe the skill of a practitioner, and the Latin verb 'to weave', *texere*, with both words appearing to share the same root. This alternative term, used to describe 'how things are made', places the maker in a direct and unequivocal relationship with the materials of their art: "Practitioners, I contend, are wanderers, wayfarers, whose skill lies in their ability to find the grain of the world's becoming and to follow its course while bending it to their evolving purpose" (2010, p. 92).

Ingold's persuasive, and oft cited, polemic on 'making' implies that materials should have an elevated status in our understanding of creativity; rather than thinking that we can stamp or forge materials relative to a set of predetermined ideas, creativity is seen as a means of engaging with, understanding, following, and respecting materials, almost as if they were co-creators in the act of making. Thus, Ingold undermines the notion that we conceive of

holistic forms in advance of creative acts insisting, instead, that we necessarily happen upon such forms through our acts of doing[1]. Form is emergent rather than pre-planned.

This doctoral thesis, which embraces Ingold's notion of textility, focuses upon sound or, more specifically, art that is created from sound. It considers whether any specific strategies for making such art are more, or less, successful in terms of allowing sound to "follow its course" and asks what it would imply for artists to use sound for "their evolving purpose" without slipping into hylomorphic assumptions or actions. Although this line of questioning departs somewhat from Ingold's idea that we cannot avoid textility, it does so in context where art involving sound has, for the most part, been packaged as music, bringing with it several hundred years of hylomorphic assumptions relative to the development (or imposition) of musical form. Understandably, given this historic context, there has been very little written on the notion of textility in sound art, and although one might contend that all sound art is created in coalescence with the material itself, we do not yet know whether particular strategies for "following" particular materials will yield radically different results from those which imply an imposition of certain predetermined ideas.

With the above in mind, this thesis sets out to explore textility in the context of sound art. It combines 1) a portfolio of original artworks, and 2) a written thesis which puts those works into context while addressing specific ideas and questions relative to the central notion of textility. The artworks are interdisciplinary, blending sound art installations, compositions, and live performances (variously documented using both sonic and audio-visual media). Each of the works in the portfolio provides insights into the various ways in which textility may be explored across a variety of different materials and media common to sound art practices. The text starts by introducing the notion of textility and explains how this notion underpins the central research motivations. It goes on to set out a core research method that was necessarily adapted for each of the works in the portfolio; these adaptations become the central focus in the second half of this thesis.

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[1] Creative practitioners may well *think* that they have predetermined and pre-planned the form of their works. Ingold, however, would likely contend that it does not matter what practitioners *think* of their creative acts; making involves materials, and those materials invariably play a part in determining their own ultimate form.

The research concludes by returning to Ingold's polemic on making. Although Ingold may be correct in stating that textility is inevitable and unavoidable, differences hold between sound art that has been produced under hylomorphic assumptions and sound art that has been produced under the belief of textility. An understanding of how one may allow sound to "follow its course" allows for the development of purposeful strategies for intervening in those fields of force and flow that Ingold describes and, in doing so, produce creative works in which textility is aesthetically central. This is abundantly clear from the many ways in which the accompanying portfolio of works shape intention and agency, and in the various ways in which they require and permit acts of intervention and restraint; ultimately demonstrating that a balance between textility and hylomorphism is always at play.

Chapter 1: Towards Textility

This doctoral research emerges from my experiences as a saxophonist in Sydney, Australia, during my late teens. I began playing saxophone at the age of ten, focusing on both classical and improvisatory repertoire, and playing in a variety of ensembles while progressing through the Australian classical music examination system. At this point in time, I had never heard of the terms *textility* and *hylomorphism*. In retrospect, however, these terms neatly characterise certain key aspects of my training and thinking as a young performer, and my development as an artist thereafter. Section *1.1. Background to the Research* provides a chronological narrative starting from my formative saxophone years and leading up to the point at which I started this doctoral research. The purpose is not simply to document my personal experiences, but to explain how each may be described (albeit in retrospect) as a gradual move away from notions of hylomorphism towards notions of textility. This sets the scene for what follows in Section *1.2. Research Questions*: in an effort to understand my own practice and development, I discovered Ingold's terminology and broader conceptual arguments, and this doctoral research offered an ideal opportunity to begin exploring these concepts through practice-based research. Section *1.3. Research Methods and Methodologies* provides a broad overview of the core methods employed to produce the accompanying portfolio of creative works. This overview is substantially fleshed-out in Chapter Two where bespoke adaptations and iterative developments of the core method are presented, explained, and justified in the context of the individual artworks comprising the creative portfolio.

1.1. Background to the Research

The idea of exploring textility in sound art practice started to crystalise around the time that this doctoral research began. Prior to this time, I was unaware of the term *textility*, but I had already made numerous discoveries and observations, of both a practical and theoretical nature, that would ultimately prepare me for a study in this area. What follows is a brief introduction to those discoveries, drawing attention to some of the central terms and ideas that will subsequently recur throughout the thesis.

The Saxophone

As a young performer, I viewed analytical attention to detail and virtuosic precision as one of my most significant assets; I felt that I had the ability to mark out, identify and control discrete elements in music making; these could relate to both physical technique or artistic intention/interpretation. Articulation and intonation were major focuses; being able to play in tune over the entire range of the instrument or being able to precisely control the beginning and end of notes in various ways. Other examples might include combinations of rubato and dynamics over the course of several phrases or controlling macro sections of a movement or work.

There is an element of frustrating pleasure involved in a stop-start methodology which accompanies the marking out of fragments of material and repeating them over and over until they are brought under control. My own approach was to construct a mental image of myself sitting in a chair in the corner of a room observing myself playing. This external, critical observer would have the ability to take note of details that might otherwise pass by unobserved and, crucially, to ignore the flow of the rehearsal or performance in order to focus more specifically upon the sonic details. This approach to music making was, on reflection, highly conceptual, seeking to impose intention on the musical material. At this point in time, I believed that there must be always a 'self' that remained separate from the activity, maintaining reflection and external critique.

Psychological Silence

My approach to music-making began to shift significantly during my late teenage years. A key moment in this shift occurred during a performance workshop where I presented a transcription of Handel's *Violin Sonata Number 6* on saxophone. Since the work was written for violin,

spacing and timing to facilitate breathing were not incorporated into the work; in the faster sections of the work, filled with rapid virtuosic phrases, this resulted in extended periods of strain due to full breaths being practically impossible.

I remember starting the fast movement of the piece and, almost instantly, the movement was over. Up until this point, the performance had been progressing normally, but for this movement I went blank; I had no memory of performing, and no sense of time passing. During the movement, my ability to monitor my performance, or self-observe, completely disappeared. The performance seemed to have taken place in a kind of profound psychological silence. I asked those present for feedback on my performance and was roundly assured that it was successful, accurate and expressive.

This was rationalised as follows; exhalation had been extended, owing to those musical phrases not originally intended for wind instruments, and this had occurred in a section of the piece requiring a very high level of concentration and technical proficiency to perform. Wanting to explore this experience further, I set about finding ways to achieve and sustain such mental states during musical performance with the intention of achieving higher level musical outcomes. My aims included establishing a situation of heightened intuition and ability to respond to the moment. This equates to an ability to think less literally (mere task execution), and to be less constrained by rational ideas about musical activity (to be lost in the moment).

At this stage, my previous approach (analytic attention to detail and virtuosic precision) began to blend with a physical method aimed at immersion and psychological silence, or self-forgetting. The overall aims remained strictly musical, of course; body, mind and instrument served the production of a musical work, through performance, for an external audience.

One way of theorising the state of immersion that I experienced during the performance of Handel is the concept of ‘Flow’ developed in the 1970s by psychologist Mihaly Csíkszentmihályi (1990). Within a standard Flow paradigm, the challenge level of an activity is balanced against the skill level of an agent. When these two factors balance each other in terms of high skill required at high challenge levels, this can result in an immersive state of mind in which an individual becomes completely absorbed in activity accompanied by a diminished sense of ego and perception of passing time (Geirland, 1996).

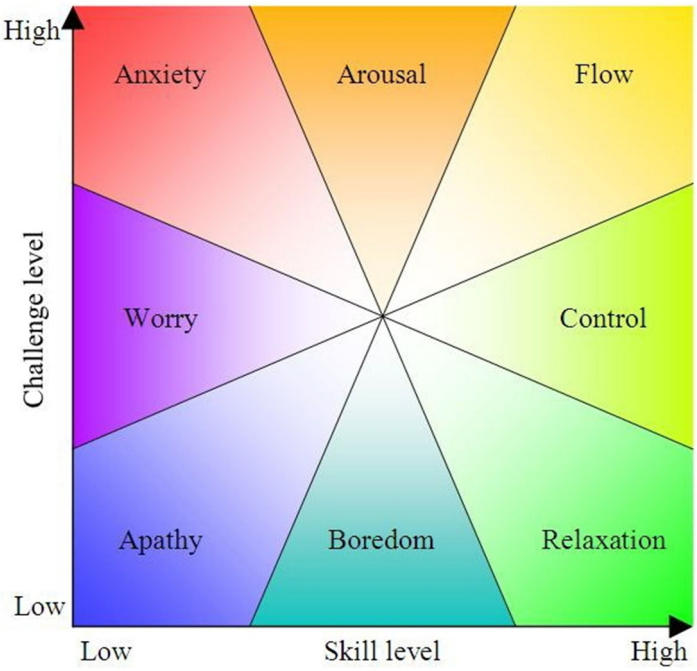

Figure 1 Flow diagramme illustrating the relationship between challenge, skill level and resultant psychological state (Csikszentmihalyi, 1994, p. 31).

Csíkszentmihályi's Flow theory offers a powerful structure through which to understand how activity can become self-forgetting and wholly immersive. Flow studies have been carried out in a wide variety of fields, such as sports performance, cultural anthropology, neurology, education studies and sociology, with a correspondingly diverse range of research methodologies applied (Csíkszentmihályi & Csíkszentmihályi, 1992). Work has also been carried out connecting flow concepts to immersive experience in meditation (Niu, 2006), (Carrington, 1977) and music performance (Parncutt & McPherson, 2002). It would seem that my experience can be described in terms of achieving an immersive state in the context of Flow; complex task execution matched against high skill level produced a psychological state akin to meditation in which a sense of self was minimised or absent.

Approaching 20th Century repertoire

In the years that followed, I began focusing on contemporary C20th classical musical repertoire written specifically for the saxophone; I found it artistically rewarding to perform works which explored the full range of sound capable of being produced by a saxophone, while reflecting the range of contemporary influences taking place around me. Principally, these were works that investigate silence, noise and space in the context of the late C20th, such as the compositions of Japanese composer Ryo Noda. Noda's works feature micro tuning,

multiphonics and altered intonation, wide variations in timbre, articulation and dynamic range. Note-to-note timings and durations are indicated using traditional western notation. However, the performer is given leeway in terms of how this may be interpreted, free from a strict pulse or meter.

Noda's *Improvisations I* (Noda, 1974)*, II* and *III* (Noda, 1975) were of particular interest. These *Improvisations*, which are heavily influenced by Japanese solo shakuhachi repertoire, alternate between rapid note-to-note movement and long sustained tones, decrescendo and pauses. Dealing with issues of timing in the context of Noda's *Improvisations* brings to the fore the notion of poise; an understanding of how to wait, and when to act. A decision about how long to wait is part of a deliberate decision-making process, and knowing how long it might be appropriate to wait was further heightened by a range of breathing strategies that I was required to explore; I would end a given sound and then wait a deliberate amount of time before inhaling so as to heighten physical focus. This change in perspective helped me to develop a body-mind somatic strategy as a central element of my own performance practice.

Improvisations felt like the ideal place to test and develop ways of using breath, physicality, and mental focus to access and deepen immersive states, or Flow states. Accordingly, engagement with these kinds of works marked the beginning of a shift away from purely musical concerns (in which the aim of performance was the production of musical sound for an external audience) towards performance as a method, or process, for accessing and exploring psychological states. Csíkszentmihályi's use of the term *autotelic* is pertinent in this regard; a Flow activity takes on a purpose in, and not apart from, itself. It becomes self-fulfilling for the participant. In a flow situation, a practitioner initially plays saxophone in order to 'play music'. A Flow state enhances immersion, pleasure and possibly intuition and of-the-moment responsiveness during such an activity but the overall aim is still the production of musical material.

The shakuhachi

In 1996 I moved to Tokyo, Japan, to pursue studies on the *shakuhachi*, a bamboo flute which between the 17th and late 19th century was played almost exclusively within the context of Zen Buddhism by itinerant monks known as *komusō*. Using the instrument as a primary part of their spiritual practice these monks performed *suizen* or 'blowing Zen', aiming to achieve *ichon jobutsu*, or 'Buddhahood in a single note'.

Surprisingly, for an instrument so strongly associated with spirituality and Zen practice (both historically and in its worldwide contemporary usage), I found there was no direct instruction within the mainstream tradition related to the idea of how 'blowing Zen' (suizen) functions, or of how to achieve this idea of 'Buddhahood in a single note'. Relationships between breath, phrasing and poise/timing were discussed in a musical and stylistic sense, but there was seldom any direct connection made between instrumental performance and any resultant effect on a performer's psychological state[2]. An exception to this is the musician Watazumi Fumon (1911-1992); one of the most significant modern proponents of the use of shakuhachi in a meditative or spiritual context. Rejecting not only the name shakuhachi itself, and terming the flute *hochiku* or (法竹, 'dharma bamboo'), he referred to the instrument's Zen repertoire not as *honkyoku* (original pieces) but *dôkyoku* (道曲, 'pieces of the Way'). In a practice that transcended conventional notions of music making, Watazumi stated, "the reason we use sounds is to get to the basis of human life, of [the] human health and strength. ("Watazumi Doso Roshi - The International Shakuhachi Society", 1981)"

A primary focus of this practice for Watazumi is breath, and the shakuhachi as a musical instrument is transformed into what he termed a 'concentrated breathing tool' or *dogu*. Performance practice using the shakuhachi becomes a way to focus on "lengthening the out breath instead of worrying about the in breath." Using the flute encourages a practitioner to move away from what Watazumi terms "unconscious breathing", which is "the simple movement of the lungs, towards conscious or mindful breathing. (1981)"

In a practice intended "to express in sound your own life force" (1981) and which is often not conceived of as being performed for an audience in any regular musical sense, Watazumi engaged in a mind-body practice prioritising somatic process over any conventional musical product or outcome. Drawing on such influences, as a graduate research student in

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[2] This was certainly not something discussed in lessons as any kind of aim in terms of musical performance practice on the instrument. In fact, certain subsections of the *shakuhachi* community which focus on meditation and attempt to reconstruct traditional Zen performance practice were reported to me as strange sounding and 'unmusical'. My conclusion was that within mainstream shakuhachi transmission in Japan the emphasis is on external musical product over any body-mind process; although there is an awareness of historical aims, my own experience suggests that these often remain generally undiscussed and highly personal.

Tokyo, I tested how to extend the ideas I had developed as a saxophonist in Australia and formulated the concept of a 'meta-physical feedback system' (Archibald, 2002), through which instrumental practice aims for a state of 'uncondition' (Powell, 1997, p. 1507), 'no-mind', 'mindfulness', 'emptiness'.

The notion of meta-physical feedback describes how instrumental performance practice can act as a somatic (body-mind) framework whose primary aim is that of accessing specific psychological states in which a sense of self is minimised or absent. Meta-physical refers to the somatic, while the notion of feedback refers to a looped or overloaded attentional state created by asking a practitioner to closely attend to demanding internal physical tasks (for example bodily musculature, breath, diaphragm, and embouchure), while at the same time monitoring fine detail in how the somatic is made manifest through external sonic outcomes. The sound sonifies the somatic.

Although I was unaware of the details of Watazumi's work at this time, and ignorant of Csíkszentmihályi's Flow theory, my ideas form an interesting combination of both approaches.

The notion of complexity, which had previously been aligned with a traditional concept of Western instrumental virtuosity, was reframed to that of attending as closely as possible to the 'very simple'. For example, of paying close attention to the details found in a single tone (nuances in dynamics, timbre, and intonation), and in how that sound is produced (the body/ somatic). Simplicity and complexity came to be viewed as the same thing: a sustained tone is as complex as the 'New Complexity' of Brian Ferneyhough if considered in a certain way. Csíkszentmihályi's notion of task-based challenge, which might be assumed to relate to rapid technical motor sensory demands, could be understood in this context as attention to minute detail and mental focus on the almost overwhelming somatic state itself.

Secondly, drawing on personal experience as a woodwind player and informed by formal Eastern meditation strategies, extended exhalation, and sustained diaphragmatic tension were viewed as key drivers in any resultant conscious state. This understanding formed the basis for a re-framing of music performance practice itself. The body and physical technique no longer merely support the production of external musical sound; performance practice

becomes a structure within which somatic process, centred around the exhalation, is given equal if not more importance than any musical outcome[3].

The traditional solo *shakuhachi honkyoku*[4] repertoire of Japan (a central focus of my studies in Tokyo) was ideal in this context as works often feature what I came call 'breath length phrasing', that is, musical ideas which can easily be extended to the full duration of an exhalation[5]. At the end of each exhalation the practitioner waits, a pause the duration of which is conceptually framed by the traditional Japanese notion of *ma*[6] (pause, space, poise), before inhaling once more. It should be noted that this pause and inhalation are not seen as being contentless or as 'empty space'; 'non-sound' is considered as important as sound, and this moment of waiting forms a key moment in the entire process in terms concentration and resultant somatic/ psychological outcomes.

The exhalation is considered to have three parts: lungs full, equilibrium, lungs emptying. Each of these stages requires specific control in terms of musculature; when the lungs are full this is a matter of controlling the release of 'over pressure'. Equilibrium is a moment of balance when internal and external forces equalise. Lungs emptying requires an increasing use of musculature to push air from the body. At any final point of rest, the practitioner must take care to be relaxed, and sit and wait. Attention is centred on in this moment on sustained diaphragmatic tension.

The development of this approach marks a significant transition in my arts practice as a whole and is of central importance to the current study. Performance practice, and the 'artistic enterprise' itself, no longer focused on delivering pre-prepared work to an external audience, but instead located a practitioner within an emergent framework focused on process which

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[3] As previously mentioned, sound is considered a sonification of the somatic. Sonic outcomes are vitally important; however, sound and music are not considered the same thing. The sound is more important than any sense of sound as music per se, yet the structure of the musical work acts as a larger framework within which this activity takes place.

[4] *Honkyoku* (本曲), "original pieces." Solo *shakuhachi* works composed anonymously within the Zen tradition.

[5] Extending these musical ideas does at some point break the musical performance practice within the modern *shakuhachi* tradition I was engaged in. For example, when learning a new work a student should internalise through repetition, the way their teacher performs a piece. Their teacher has also learnt the work in this way inside the aural traditional from their teacher. Practitioners should respect this tradition and not stray wildly from the performance practice taking place inside their particular 'lineage'.

[6] *Ma* (間) is explained in the next section of this thesis.

additionally problematised traditional notions of agency and intention, setting the stage for a later study centred on Ingold's notion of textility.

Ma (間) and Zen

During the period I studied in Japan (1996-2000), I discovered their traditional aesthetic concept for timing, termed 'ma' (間). Ma is a complex notion intertwining ideas of poise, duration, and space: it could be translated as 'the space between actions.' There is an emphasis on being in the moment and a heightened sensitivity towards the uniqueness of every action. Ma does not only mean waiting, it can relate to how an action takes place in time.

Ma (間) can act as a powerful driver in focusing sensitivity and attention and involves far more than conscious decision-making. In both Zen archery and Japanese calligraphy, for instance, actions are considered successful if they 'move beyond thought'; the idea being that the best, or perhaps most appropriate, actions are not 'decided upon'; they emerge at a level which is not concerned with conceptual, reflective logic. The practitioner is wholly immersed in their activity and attuned to the moment.

John Cage became aware of such Japanese philosophical concerns in the late 1940s and early 1950s partly due to the writings and influence of D. T. Suzuki[7] (with whom he studied for three years in New York). Cage, drawing on a Zen notion of "unimpededness and interpenetration", translated his previously oppositional, dualistic conceptions of sound and silence into intended and non-intended sounds as elements of an ever-present, continuous sound world (Pritchett, 1996, p. 74). In this way, Cage was able to conceptually develop his chance-based, procedural compositional models, thereby negotiating subjective constraints in the structuring and arrangement of compositional elements. He stated: "it is thus possible to make a musical composition the continuity of which is free from individual taste and memory (psychology)" (Cage, 2012, p. 59).

For Cage, the idea of 'no-mind' or 'nothingness' came to mean that "the mind should be alert to sounds, but empty of musical ideas" (Pritchett, 1996, p 76). If one is dealing with work that is emptied of musical ideas it can nonetheless be claimed that there is, in line with

[7] For example Suzuki's *Manual of Zen Buddhism* (1994) and *The Essentials of Zen Buddhism: Selected from the Writings of Daisetz T. Suzuki*. (1962).

the use of the shakuhachi as a tool to access this 'no-mind' state, a somatic experience that will be as critical as any musical/sonic outcomes.

Wesleyan and Alvin Lucier

Between 2000 and 2002 I was a graduate student in music composition at Wesleyan University, United States of America, supervised by Ron Kuivila and Alvin Lucier. During this time, my work transitioned away from musical sound and traditional instrumental performance towards an exploration of the sonic arts in a much wider sense. Although I had previously focused on twentieth century fine art music, my work had continued to operate within a strictly musical context. At this moment in time, I had a personal realisation that listening in fact a somatic process; paying attention is as much a physical activity as it is reflectively rational, a point made by Cage in the work Indeterminacy: *New Aspects of Form in Instrumental and Electronic Music*:

> "...it isn't useful, music isn't, unless it develops our powers of audition. But most musicians can't hear a single sound, they listen only to the relationship between two or more sounds. Music for them has nothing to do with their powers of audition, but only to do with their powers of observing relationships. In order to do this, they have to ignore all the crying babies, fire engines, telephone bells, coughs, that happen to occur during their auditions. (Cage & Tudor, 1959 LP side 3 ca. 46'00" to 47'00)"

My studies at Wesleyan University immersed me in what I would call North American Experimentalism. Underpinned by the aesthetic influence of teaching staff and collaborators, and the learning of computer and technology skills such as the Max/MSP and Supercollider programming languages, I suddenly 'had permission' for an almost totally open approach in relation to form, materials, and contexts in which to present ideas. Further to this, technical equipment, such as contact microphones, audio transducers and dynamic control devices, become aspects of my work. These aspects are crucial to the works in the portfolio accompanying this thesis.

Alvin Lucier expresses his compositional practice as an 'investigation of phenomena'; a notion that aligned extremely well with my own aesthetic, in which process and sonic outcome were equally important. We can observe how Lucier navigates this relationship from his programme notes for *Music for Gamelan Instruments, Microphones and Loudspeakers*:

> ... four players place bonangs of various sizes over microphones, creating feedback, the pitch of which is determined by the shape and size of the bowl and the resonant characteristics of the room. Three gender players strike the bars on their metallophones, searching for the pitches of the feedback strands. Since it is virtually impossible that a strand of feedback will match exactly a pitch on any fixed-pitch instruments, audible beats – bumps of sound which occur as sound waves coincide – occur. The closer the tuning, the slower the beating. When the players reach near-unison with a feedback strand they slow down or speed up their playing, creating beating patterns between the pitches of their instruments and those of the feedback. Music for Gamelan Instruments, Microphones, Amplifiers and Loudspeakers was first performed on October 18, 1994, World Music Hall, Wesleyan University by the Wesleyan University Gamelan Ensemble (Lucier, 1999).

In this example, Lucier presents a compositional approach focused on setting up an emergent situation, in which the boundaries of a work are clearly set, even though the nature of the piece springs from a wide set of possibilities in terms of sound and space. When discussing his practice with me, Lucier commented that his approach was one of 'removal'; only by removing what appeared to be unessential elements from a work may its essential nature become aesthetically central.

My Master of Arts project was divided into two sections. Firstly, I learnt the Supercollider 2 programming language with the aim of reconstructing historic electronic music compositions that were technologically defunct; this aspect of the MA dealt with the ephemerality of modern media and technology, involving the remaking and public performance of works that David Behrman had composed in the 1970s and 80s. Such 'emulation' projects required me to engage with complex computer coding languages, an understanding of historic equipment and hardware, and a clear sense of the artistic aims and aesthetic. The second part of my Master of Arts degree project involved the creation of video works which used polyrhythmic relationships to organise material. These works attempted, through juxtaposition of a looped piece of video material, to abstract and break down relationships in the subject of the piece. An example of this is the work Rhythmic Steps (2001), for three screens of looped video material.

Developing such software/hardware fluency, alongside a close personal association with and study of the creative aesthetic of both David Behrman and Alvin Lucier, had a lasting impact on my compositional and artistic development. This period of study provided the artistic and intellectual stimulus necessary for a synthesis in my artistic and compositional ideas to

take place in an open and experimental setting, free from the expectation that outcomes needed to be musical, or even considered music.

My works from this period were often based on process-driven systems which are left to unfold with minimal or no intervention. For example, a polymetric relationship 3:4:5 would be established and left to run until a full combined cycle had occurred and the three streams came back into alignment. There was an emphasis on finding a way for the materials to 'be themselves'.

Sound Gardens: design and cultivation (Germany 2011)

In 2011 I took part in a workshop session (titled Sound Gardens: design and cultivation) focused on live sound art using contact microphones and portable loudspeakers. During experimentation at this event it was realised that by creating a physical connection between microphone and speaker, using metal wire, an acoustic feedback loop could be created; the resultant sound emerged from a combination of the wire in motion and the loudspeaker, and control relied upon the balance of amplification level and placement of each element. For example, the microphone, when placed at different positions on the wire, would result in wildly differing sonic responses and volume levels. When left untouched the system would often move through a progression of states as the elements (loudspeaker and microphone) moved on the vibrating wire as a result of vibration from node to anti-node, until some form of equilibrium was established.

Such works occasionally produced confronting sound materials; unpleasant, squealing, or high volume. At other times they were very static and unchanging. In such moments, it was tempting to intervene and alter the system, with the intention of producing a 'more interesting' or rewarding sonic result. Doing so, however, removed the possibility of a transition to a new state that would eventually emerge from the materials - if left alone. Furthermore, such an intention surely springs from established aesthetic judgements and expectations about what an installation of this nature *should* provide in terms of a listening experience.

My strategy when interacting with these works was to utilise somatic techniques developed during music performance. For example, the concept of 'resting on my breath' in order to balance any over-conceptualisation or rationalisation taking place; rather than immediately intervening, I would think, "wait three breaths and if the desire is still present, act on it," perhaps altering the position of the contact microphone to search for nodes and antinodes

in the vibrating wire as a way of producing louder or softer responses from the system. I could not help but wonder whether waiting for such a relationship to emerge may, in fact, be more productive from an artistic and research perspective! These ideas mark a point at which focus on control began to transition towards a notion of negotiation.

Confronted by a situation in which no amount of skill could match challenge level, a Flow model begins to fall apart as the immersive results of agency[8] are reduced or broken completely; skill level can no longer adequately balance task challenge level over sustained periods if the task is fundamentally chaotic. As immersion is broken a participant may be seized with a desire to intervene in order to reassert their intention over materials and outcomes. In doing so, however, they risk interrupting the emergent nature of the work; regressively choosing an option already known before something wholly unexpected could emerge from the complexity of the situation.

In one idea a metal wire was used to connect a railing to a tree branch which swayed in the wind. As the tree moved, the tension in the wire was altered. On this wire was threaded a metal loudspeaker and a contact microphone was attached to the wire forming a positive feedback loop. The amplitude and overall response of the system was managed using the amplifier, in combination with exploring various speaker and microphone positions on the wire in order to achieve a stable chordal harmonic response. As the tree moved in the wind, sonic outcomes rose and fell in pitch as a result of the tension in the wire.

[8]A feeling of meaningful control and influence over the environment as a result of choices and actions.

Figure 2 Contact microphone, loudspeaker, metal wire. Düsseldorf 2011.

Figure 3 Contact microphone, thorn and branch, metal pole. Düsseldorf 2011.

Another study used a thorn which was attached to a contact microphone using an alligator clip. The thorn-contact microphone combination was hung from a tree branch using the microphone cable in such a way that the thorn rested on the surface of a metal pole. As the tree branch swayed in the breeze the thorn was scraped across or lifted off and on the surface of the pole resulting in a variety of sounds which occurred in response to natural surroundings. Pauses in sound production heightened expectation and sensitivity to both the quality of the eventual sound and the overall physical and sonic environment.

Such works were arrived at in sessions of fast paced play and experimentation. Once it was realised that feedback loops could be established using physical materials, and that these loops could then be influenced by nothing more than amplifier gain control and a tactile exploration of materials using nothing more than various positions of the microphone and loudspeaker, many variations of the idea were tried. For example, one could influence the system by muting the wire using touch, and it became apparent that very small changes in the arrangement of elements resulted in large differences in overall outcome.

This type of work was very new and a search for how to introduce variation and change over time (feedback loops can quickly reach static states, especially with only fairly gross handling of amplitude) was generally solved by employing natural elements such as wind, or by physically interacting with the materials using touch. It was not possible at these early stages to find nuanced resting points within the systems themselves which resulted in long cycles of energy fluctuation and acoustic variation that result from the system being in unstable sub-dominant states. This means, if the overall system could be held at some point below a point of maximum amplitude, a variety of modulations in frequency can be observed as the system moved up and down across sub-dominant harmonic energetical responses.

It was generally not possible to predict the outcome of ideas, and the nature of the exploration was very hands-on; a kind of ‘feeling around in a room with the lights off’. Despite having an understanding of acoustics and music technology, I had very little sense of where an idea would end up. Intuition would carry me part way, but the ideas had to be physically moved through in order for any outcomes, or points of rest, to become apparent or emerge.

1.2 Research Questions

In some respect, the ideas explored in the above workshop are similar to those explored in existing works. For example, Alvin Lucier and David Behrman have produced works focused on room and material resonance; Lucier's iconic *I am sitting in a room* (1981) deals with the harmonic resonances of architectural space, and Behrman's *Touch tones* from (2005) in which performers explore mapping the harmonic resonances of one sound onto another. As mentioned elsewhere in this thesis, Lucier's *Music for Gamelan Instruments, Microphones and Loudspeakers* (1999) asks players to create feedback tones using microphones placed inside the acoustic spaces of gamelan instruments - other players then search to reproduce these same pitches using other instruments in the gamelan ensemble. In terms of using material forms similar to those in my portfolio Lucier produced *Music on a long thin wire*, which he discusses in the album notes as follows:

> "[a] wire is extended across a large room, clamped to tables at both ends. The ends of the wire are connected to the loudspeaker terminals of a power amplifier placed under one of the tables. A sine wave oscillator is connected to the amplifier. A magnet straddles the wire at one end. Wooden bridges are inserted under the wire at both ends to which contact microphones are embedded, routed to a stereo sound system. The microphones pick up the vibrations that the wire imparts to the bridges and are sent through the playback system. By varying the frequency and loudness of the oscillator, a rich variety of slides, frequency shifts, audible beats and other sonic phenomena may be produced. (Lucier, 1980)"

Richard Lerman, a student of Lucier's, creates a wide variety of performance and installation work using contact microphones and is a considerable authority on self-made electronics, audio amplifier design suitable for piezo microphones usage, and various designs for the microphones themselves. Lerman has produced a wide oeuvre using these materials ranging from performative works such as *Travelon Gamelon* (1982) for amplified bicycles, and *Border Fences 2* (2000) in which the composer performs live, using contact microphones and high levels of amplification to transform objects such as passports, rose branches and a compass into musical-sonic objects. *8 Pieces from the Sonoran Desert* (1998) is an audio-visual work using video and highly amplified contact microphone recordings of spider's webs, ants and wasps. Video footage is an inherently disembodied indexical representation of the original; however, when paired with the highly tactile intimate diegetic sound created by a work's subject, the mismatch of levels of physical intimacy is transforming, startling and effective. Lerman's installation works such as *Fences Borders*, a series of works using the same title dating between

the early 2000s and 2020 utilise sound, objects, moving image and printed media. In a 2004 version, “an 18 Foot Coil of Bougainvillea was suspended in the center of the gallery…. wires from the ceiling drive transducers inserted into the coil making it a functional loudspeaker. (Lerman, 2004)” In this instance, the sounds being played through the coil of Bougainvillea were recorded using contact microphones attached to fences (often recorded in politically charged locations such as the USA/Mexico border).

Figure 4 Fences Borders. Richard Lerman (2004).

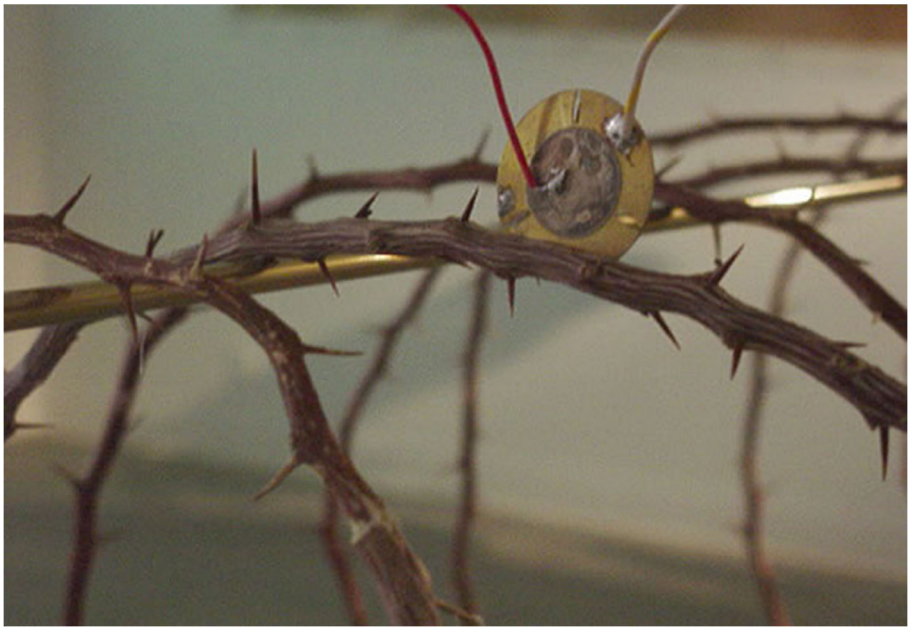

Figure 5 Fences Borders. Richard Lerman (2004).

Similar to Lerman - other artists explore ideas in a field known as phonography, defined as “capturing and transforming field recordings into a listening experience that blurs the boundary between music and everyday sounds. (DeLaurenti, 2006)” Importantly in the context surrounding my portfolio many such works are created using a combination of contact microphones and high levels of amplification in order to access ‘hidden worlds’ of sound. Australian artist Jodi Rose explores the sound of bridges in a series of works titled *Singing Bridges* (2021). American/Estonian artist John Grzinich works extensively with a variety of materials ranging from fence wire, hydrophone recordings of ice, and large physical objects such as water and radio towers (2021).

The idea of using audio transducers to transform everyday objects into audio loudspeakers has a seminal work in David Tudor’s *Rainforest IV*,

> "My piece, "Rainforest IV", was developed from ideas I had as early as 1965. The basic notion … was the idea that the loudspeaker should have a voice which was unique and not just an instrument of reproduction, but as an instrument unto itself … In 1973 I made "Rainforest IV" where the objects that ... sounds are sent through are very large so that they have their own presence in space. I mean, they actually sound locally in the space where they are hanging as well as being supplemented by a loudspeaker system. The idea is that if you send sound through materials, the resonant nodes of the materials are released and those can be picked up by contact microphones or phono cartridges and those have a different kind of sound than the object does when you listen to it very close where it's hanging. (Tudor & Hultberg, 2021)"

Rainforest IV is discussed elsewhere in the thesis as it has had a significant impact on my aesthetic and technical development.

While these works share many similarities and core aesthetic concerns with my own work, none are focused on the notion of textility -specifically on any examination of the interplay between human agent and the material world / environment in relation to artistic intention. The core concerns with these works is ultimately abstracted sound, be that in a musical or sonic arts context - whereas my work in this project uses the creation of sonic artworks as a methodology through which to examine textility and human psychology. Such an idea grew organically from my previous work and marked a fairly radical departure from ideas founded on notions of artistic authority and virtuosity (a notion based on technical control over materials) which was my starting point as a musician. I was therefore interested to explore ways in which textility, as a concept for making and organising creative practice, might be

explored through a more substantial portfolio of works. More specifically, I wanted to address the following questions:

- How might a focus on the concept of the textility inform the development of sound-based artworks?
- When might it be reasonable or most appropriate to intervene in the flow and evolution of sonic materials?
- How might one explore boundaries between the notions of textility, hylomorphism and the inevitability of human intention?
- How might one test a variety of interdisciplinary approaches in order to examine the notion of textility from different perspectives?
- Which presentation contexts might be most suitable for such works?

1.3 Research Methodology

Practice as research

This project uses a practice as research methodology in which the author's creative practice, methods, and artistic outputs act as central elements of both the project's research design and exegesis.

In their book Practice-led research, research-led practice in the creative arts, authors Hazel Smith and Roger Dean observe that PaR arises out of two main notions: "that creative work in itself is a form of research and generates detectable research outputs", and that "creative practice -- the training and specialised knowledge that creative practitioners have and the processes they engage in when they are making art -- can lead to specialised research insights which can then be generalised and written up as research (2009, p5)."

The establishment and acceptance of practice-based methodologies within academic contexts has taken place since the late 1980s (Haseman 2009, p51) and carves out a space in which experiential first-person approaches are entirely valid and recognised way of generating new perspectives and knowledges. A central motivation behind the promotion of PaR has been a push by artist researchers to shift traditional understandings of the role of an artwork[9] within academic contexts from being static outcomes (which are then 'researched'), towards viewing artworks as being the means and method/s for the research investigation itself. In the words of Australian dance researcher Kim Vincs,

> "I want to develop the idea that dancing and making dance forms a space or a substrate within which to think about dance. Rather than dances being the outcomes of thinking done previously, dances are the actual process of thinking, and this process is the core methodology of studio-based dance research (Vincs 2010, p.100)."

In the case of this project a series of creative artworks act as iterative research methods resulting in a nexus of methods and findings. Sound-based work emerging within the fragile ephemerality of an interaction between acoustic feedback a material shapes and forms acts as

[9] Alongside shifting the traditional understandings of the creative practices of researchers from which these works emerge.

Vincs' 'substrate' allowing the researcher to examine textility and hylomorphism as they relate to understandings of making, form giving, desire and intention.

Each artwork in the sequence of explorations forming the core of this project examines such notions from a different perspective and iterates on knowledge developed using methods such as studio-based testing, public presentation, writing, and image making. This strategy of *triangulation*, of getting a "'fix' on something in order to understand more fully the complexity of issues by examining them from different perspectives, and by generating data in different ways by different methods (Malins and Gray, p31)" has been central to the project's research design.

1.4 Research Methods

It follows, from what has been said above, that the central methods employed throughout this thesis relate to the concept of textility. Although not a method in itself, an attempt to explore the notion of textility is evident throughout the portfolio of creative works, and the intention to explore textility has underpinned numerous methods and decisions throughout the course of this research. Understandably, each piece within the portfolio involves a series of highly specific methods connecting different materials, media, and technologies. These are presented, in detail, in Chapter 2, where piece-specific approaches are discussed. This section gives a broad overview of methods central to the portfolio as a whole, under several subheadings:

Physical Materials:

A defining characteristic of many of works created as part of this project is the use of physical materials (other than air) to establish a direct connection between an audio loudspeaker and microphone. Within the portfolio these materials variously include steel, wire and wood, usually connected to an audio amplifier, contact microphone and audio transducer[10]. When combined with high levels of amplification this results in the creation of an acoustic feedback loop, the frequencies of which are a product of the harmonic properties of the materials themselves as opposed to a more standard context in which the feedback loop is largely the result of room acoustics. A central aim is to allow a work's materiality to 'articulate itself' in this way using acoustic feedback and, in so doing, to seek out various methods to observe and

[10] Defined as a device which converts one form of energy to another; in this case an electrical signal to physical vibration and vice versa.

develop a nuanced understanding of the notions of textility, emergence and hylomorphism. No external sonic materials are imposed: the sound is both a product of the materiality of the work and a complete expression of the materials and location at any given instant.

The body

A project investigating of notions of textility, emergence and hylomorphism is inherently concerned with issues of human action and bodily intervention. Specifically:

- When should one intervene in emergent chaotic systems?
- How should one intervene (the various methods and strategies that were developed)?
- How might intervention shape the materials and structural form of the works themselves?
- How might intervention influence the eventual presentation context of works?

The necessity for action has always been appreciated within the project. It was understood that the notion of textility does not mean a human agent cannot act in response to intention; the process of making, of bringing things into being, is not one sided in which materials are inert and pliant to human desire. In addition, action was understood as being both the decision to intervene and equally of not intervening, the act of waiting to see what might emerge. The decision to move or to remain still are both actions. This section seeks to explain such choices in the context of this project.

Intervention, while being necessary, carries the risk of being regressive; eliminating future possibilities that may emerge from the current state of the materials in favour of something the researcher has in mind. This project proceeded on an understanding that to act or intervene based on criteria weighted too strongly towards ‘what is known’ or desired removes the possibility for the emergence of something truly novel or unimagined.

The researcher must additionally allow for the fact that important emerging findings may be overlooked as they are too novel to be immediately recognised; a researcher may be too busy, the situation too complex, the outcomes aesthetically displeasing or too confronting to fully appreciate or apprehend immediately. In such situations a methodological system establishing an ability to sit with the materials, to wait, is vitally important and any urge to touch or intervene must be carefully questioned and evaluated.

It is however not possible to give an easily reducible, ‘objective’ answer to how this may be accomplished. This project is openly first-person experiential and practice based, with the

thinking rooted in practical making and doing. Each work in the portfolio acts as a cluster of questions and answers and each time a work is engaged with it will require differing inputs and offer different outcomes which over time form a substrate for realisations and understanding. At some point perhaps, responding to an intuitive urge unlocks a key finding, while on another occasion it might result in losing something almost invaluable. The key concept kept in mind by the researcher was that this project focuses on the decision-making process itself. It is an examination of how human intention meets the material work and how at that point notions of textility and hylomorphism play out in the process of creating sonic artworks.

Methods of intervening

It became clear even at the initial stages of the project that an underlying approach to interaction and intervention was that of 'exploring with hands.' The chaotic nature of the pieces, in which relationships between each element are highly amplified, confounded almost all conceptually planned approaches aimed at 'unlocking' behaviours in order to more fully be in control of them. It was necessary to continually explore, to 'feel out' the materials until something was uncovered, at which point it was important to step back, to wait, and see what emerged.

It is worth noting (particularly with works using metal wire) that even if any pleasing outcome might be reached, entropy in the form of constant sonic vibration usually resulted in both microphone and loudspeaker shifting positions, at which point sonic outcomes usually trended towards static endpoints. As such, the working method became a process of searching and exploring with hands, pausing, waiting, observing, and surrendering.

Muting and microphone attachment strategies

In addition to direct touching, various muting strategies such as attaching alligator clips to the materials were employed with the intention of influencing harmonic responses away from escalating dominant harmonic pathways towards subdominant, more unstable areas. The strategy again was to feel and touch the materials until a new energy state/sonic outcome was uncovered, an alligator clip was then applied to that position on the materials (usually used with wire).

Attaching microphone and transducer

Early in the project, consideration was given to fixing both elements to the materials in order to create a more stable set of relationships between elements and therefore to create a more 'reliable' outcome. The work was the be 'explored with hands' as previously discussed, and once suitable locations for each element were decided upon, microphone and transducer would be fixed in position with glue or solder. This approach, like that of measuring out relationships on the materials (related to ratios of distance / node antinode behaviour), was abandoned almost immediately, as even preliminary efforts demonstrated that the works were far too complex, too chaotic, for such an approach to achieve its aim. To reiterate, the fact the works are based on a positive feedback look results in relationships between every element being highly amplified. Even if in one instance a suitable set of relationships could be fixed in this way, any change to any element of the work would result in such a state being irrevocably lost. Later as the aims of the project developed and an understanding of and focus on textility came to the fore, it was apparent that this approach was also quite hylomorphic; this was an attempt to force the materials to comply with a narrow range of intention in the mind of the artist-researcher heavily based on aesthetic aims.

In terms of how the microphone and transducer should be attached, an early aesthetic aim was to have sounds in the feedback loop be as 'pure' as possible, meaning that sound extraneous to the resonant properties of the materials should be avoided. It was expected that achieving a perfect[11] attachment of microphone and transducer to materials would achieve this, however this proved to be counterproductive and uninteresting from both a research and aesthetic standpoint. It became evident that such a configuration resulted in static single frequencies, and as a result testing a variety of methods for creating 'imperfect' attachments was tested and developed. With wire this was focused on the loudspeaker and how it touched the materials; with steel sheets the way the treatment of the microphone and the way if contacted the metal surface had dramatic effects on sonic outcomes.

Various ideas such as placing matchsticks or coins between one side of the contact microphone and the materials generally resulted in a much more wide-ranging frequency response from the system overall, and it was suspected that this was due to an imperfect connection resulting in the injection of broadband noise at the point where the materials and

[11] The idea was to have the feedback loop be as 'pure' as possible by minimising or removing extraneous noise.

microphone were not regularly in contact but rapidly hit together due to vibration. In systems as chaotic as these, such relationships needed to be sought out over time, by moving materials using touch, then waiting as new energetic relationships asserted themselves and stabilised.

Figure 6 The sound was already inside. (2016)

Such configurations were almost always ephemeral, and certainly could not be established between differing versions of a work taking place at differing times and locations. Essentially as soon as any element of the work was altered (including amplification level or Max/MSP patch settings) the entire structure of the work radically shifted and it was extremely difficult if not impossible to even recapture previous states, even those taking place five or ten minutes before. Referring to notions about when to intervene and when to wait, it became clear early in the project that once a decision to intervene had been made, there was no going back. Intervention certainly came with significant risks in such a case.

Both the evolving forms, methods and ultimate public presentation contexts were highly influenced and affected by such a degree of ephemerality. The works required intervention to reach an ideal state, but ‘inappropriate’ intervention carried enormous penalties.

With a background in both musical performance and media artworks (video and media interactivity), there was an assumption by the researcher that the portfolio ideas could/would/should conform to standard models such as standalone installation sonic artworks, or public (perhaps concert) performances. In nearly all cases such aims were at best partially successful and at worst almost a complete failure. In one example, it was attempted to create in a public concert, the work Overflowing Room Tones, in which multiple loudspeakers of various sizes are connected to a single microphone. Each loudspeaker creates a unique feedback loop with the microphone, however the sound from all loops are played back by every loudspeaker. A laptop using the same dynamics control Max/MSP 'patch' as works with metal is used.

When set up and explored in a non-performative context, this idea was highly effective. It was clear how each speaker, with differing reproductive biases and frequency responses, worked to create a constantly shifting set of resonant relations as energy levels spilled from one feedback loop over into others.

Even after extended in situ testing and preparation, once the performance space was full of human bodies any resonant relationship in the room was so drastically altered that the performance fell very flat in terms of opening out a variety of frequency and timbral responses in the room.

The ultimate outcome and realisation was that the works comprising the portfolio do not fit neatly into existing boxes such as concerts or standalone gallery presentations, but instead seem to require an approach more similar to gardening. One of setting up an initial state as part of an open 'feeling with hands' exploration, then waiting with the work as outcomes present themselves before considering further actions. This seems to be more like a hybrid performance-installation idea which could take place over hours or days.

Computing technologies

As the project developed it became possible to more fully appreciate the chaotic behaviour of these systems and, as a result, the materials could be worked with so that they could exhibit a wide range of potential behaviours as opposed to immediately moving to maximum amplitude with static outcomes.

At the time the investigation moved from metal wire to steel plate (*Ten hours of drone* (2015)), the aesthetic and research methods were still pared back and relied completely on tactile

physical methods to engage with the energetic responses of the works. Although there had been several iterations in understanding and resultant methods for interaction, the fragile, ephemeral and chaotic nature of the materials still often led to static sonic/energetic outcomes at which point it was felt the work had little to offer in terms of aesthetic and research outcomes (the works need to serve both research and aesthetic objectives).

In 2016, computing technologies were applied to the project using a laptop running Max/MSP programming software. The Max/MSP 'patch' initially functioned as an audio compressor and limiter with the aim of ensuring that amplitude levels remained within specified boundaries. This change affected a dramatic shift in outcomes as it was suddenly possible to decouple input and output gain levels and work with mid-level energetic states which had previously been passed over due to rapidly rising energy levels in the positive feedback loop.

It was possible to incorporate a variety of structures into the Max/MSP patch such as randomised moving values for parameters such as overall amplification level, and compressor 'lookahead', 'knee', attack, and release timings. Most often, some of these parameters would be set to move over long durations to new random values. For example, the software may decide that over eight minutes the lookahead value (the amount of time the software 'looks ahead' to test incoming amplitude levels) should change in timing from 25 milliseconds to 5 milliseconds. At the same time, the overall level of limiting level might be lowered from -25dB to -20dB, resulting in the work becoming more energetic, potentially louder, and able to access new frequency outcomes. Note that such changes in value were not synchronised and took place independently of each other. The intention was that in combination the interaction of these elements would result in complex and unforeseen outcomes.

There was also a testing of rate of change and aesthetic ideas related to how much variation was important both aesthetically and from a research perspective. For example, if a parameter were to randomly choose a value that was distant from the current state, a marked change could be observed. If the software chose a value quite similar to the current state, the outcome might remain fairly static, or change only in very subtle ways. Testing how to 'remain' or sit with such variations in apparent newness was important for the researcher in terms of developing and testing how well 'things as they are' could be appreciated.

Changes to the Max/MSP patch (in 2017-2018) incorporated pitch shifting, with the intention of moving harmonic frequency responses to less dominant modes of vibration. This

change drew some inspiration from composer David Behrman's work *Touch tones* which is explained in the Appendix of this thesis.

It was understood that incorporating structures such as these could result in narrative or gestural results in the sonic output which were undesirable as this was felt to push materials and outcomes in a decidedly hylomorphic direction. The compositional and research aim in implementing these changes remained the establishment of an 'appropriately' boundaried space within which various energetic states could appear as the result of chaotic forces. And to repeat: the intention in interacting with the system in these ways was to establish methods appropriate to the study and understanding of the notions of textility and hylomorphism.

It should be noted that the implementation of structures such as these (computer-based dynamics control) did not 'bring the works to heel' - they remained chaotic with highly ephemeral outcomes, and the methodology for discovering or unlocking various configurations or relationships of elements was still very much one of 'feeling things out.' In other words, the works remained fundamentally resistant to control, and somewhat out of reach even with control structures implemented in the audio signal chain.

Chapter 2: Research artworks

Chapter Two deals with the practical artworks that comprise the main body of this PhD. It is important to reiterate that these works, functioning within a practice based methodological framework, are not demonstrative examples of prior thinking, but emergent structures acting to both problem setting and problem-solving methods simultaneously. As such there is an intricate intertwining of questions and outcomes, of methods and methodology, present within each work. The discussion of each work in this section will be structured as follows:

- **Overview** - a short abstract of the work, idea and intention.
- **Realisation** - the materials, location, and computing implementation.
- **Observations** - discussion of the work in terms of how things developed in practice.
- **Conclusions** - further observations and evaluation of how the work met expectations and research questions.

The works have been organised into four sections based on their structure and more specifically, the medium connecting microphone and loudspeaker. These sections are:

- Works based on metal wire,
- Works based on sheet metal,
- Works based on room architecture.

The work Wood Beetle can be found in Appendix 1 as the work sits slightly apart from the main body of the investigation due to its use of materials and the manner in which the sound was created. A loudspeaker and contact microphone are attached to a wooden post; the movements of a beetle larva inside the post create energetic impulses which trigger the formation of acoustic feedback.

Videos have been provided for each of the various works in the accompanying portfolio. The video material is not necessarily a document of a finished work per se but was chosen to illustrate both the development of a piece of work, and how the materials are being engaged with at that time; the video can only ever function as a kind of snapshot of a certain moment, since the works are durational and active over many hours. The media therefore attempts to both document points of rest in the iterative process that underpinned the

development of these works, but also to provide a viewer some insight in terms of the nature of the exploration taking place.

As an example, the issue of intervention forms a key aspect of this study of textility. To intervene too often carries a stronger hylomorphic connotation as the practitioner seeks to impose their will on materials and outcomes. Intervening inappropriately is regressive, as it removes certain future outcomes in favour of others (generally those in the mind of the artist researcher). On the other hand, waiting overly long with material that has reached some kind of end point is also only marginally useful, as the materials have little in the way of something new to show. In other words, the project is highly emergent, and situation very deliberately within ephemeral, chaotic systems. Sometimes this act of choosing *not* to intervene can be very difficult, yet crucial in terms of allowing novel or even unimaginable outcomes to appear. Yet this waiting can mean sitting with, even 'tolerating' material which can be unenjoyable, or seem to have nothing new to offer.

An example of this in the video works can be seen in the Resonant Strings and Warehouse wires documentation, in which a viewer is forced to deal with longer sections of developmental and somewhat abrasive sonic materials. The idea is to give a viewer somewhat direct access to the *feeling* of perhaps wanting to change the outcomes but then sitting with this situation to reveal what might appear on the other side.

Works based on metal wire.

Work One: Resonant Strings (2011)

Figure 7 Resonant strings. Piezo contact microphone, audio loudspeaker, metal wire attached to a rope sculpture. Düsseldorf 2011.

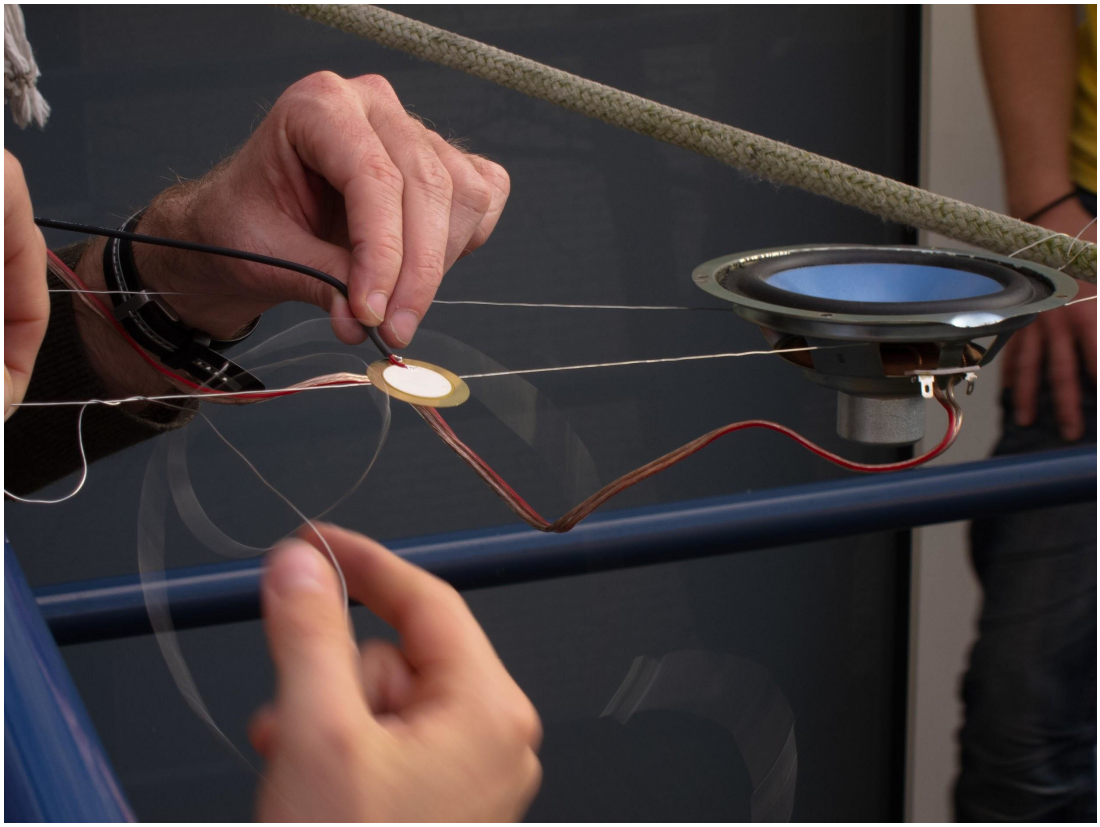

Figure 8 Resonant strings. Testing microphone attachment strategies in relation to an audio loudspeaker suspended on metal wire. Düsseldorf 2011.

Figure 9 Resonant strings. Self-made audio amplifier powered by a 9V battery. Dusseldorf 2011.

Overview

Resonant Strings was created in Dusseldorf, Germany in 2011 in collaboration with artists Phillip Schulze, Kingsley Ash and students at the Robert Schumann Hochschule. In a series of workshop sessions characterised by a rapid prototyping and testing of ideas, multiple small studies were developed exploring acoustic feedback systems in relation to both the built and natural environment. These works tested the effect of various material resonances on acoustic feedback systems and considered ways in which those systems afforded interaction.

Realisation

Most of the work was conducted in an internal courtyard at the Robert Schumann Hochschule which featured multi-level metal balconies and contained a large tree and a rope sculptural form. Using handmade 9V battery powered amplifiers, small loudspeakers and piezo contact microphones, participants began to explore this area sonically. It was quickly discovered, using sections of metal wire or rope, that acoustic feedback loops could be created using physical materials to transmit acoustic energy in place of a more standard context in which sound is transmitted using airborne vibration.

Due to the netted design of the rope sculpture, tree and metal balcony, it was possible to string sections of wire across the courtyard, on which loudspeakers could be threaded or hung. Contact microphones were then fixed to the wire using alligator clips or held against the wire by hand. Often, one end of the wire would be fixed to a static point such as the balcony railing while the other end was tied to the sculpture or tree branches. As the tree swayed in the wind this had the effect of increasing or decreasing tension on the wire which influenced the pitch of the feedback tones produced.

Observations

The primary discovery emerging from this session was the fact that a positive acoustic feedback loop could be created using solid physical materials (other than air) to transmit sound using only portable handmade equipment such as battery powered amplifiers and piezo contact microphones.

We understood, as a result of testing differing relationships on the materials (for example by sliding either microphone or loudspeaker slowly along the wire), that finding nodes or antinodes on the transmitting material could have a significant influence on the response of

the system. If a strong harmonic relationship were uncovered, the system would quickly escalate towards a static state in terms of dynamics and frequency. Conversely, if a less responsive relationship was discovered the system could remain in intermediate states in which acoustic energy was unable to continue positively reinforcing itself, resulting in harmonic responses in which timbre, dynamic levels and frequency varied and evolved over time. As a result, it was quickly identified that key factors in interacting with the sound were a combination of physical positioning (microphone and loudspeaker), touch intervention (for example muting the transmitting medium) and overall amplitude level.

Most often, in this first iteration, we could not achieve a nuanced response enabling the system to avoid static endpoints (frequency, timbre and amplitude). Ultimately, we chose to place such static frequencies in combination, or to rely on altering the tension of (tree swaying) or muting (touch intervention) the wire.

Of ongoing concern was the timbral and frequency quality of the sounds if the feedback loop reached a static, unity gain endpoint. The sound was harsh and unchanging; once at that point the system was unable to achieve another state without external intervention.

Controlling the amplitude of the system was of immediate concern in terms of avoiding harsh and static outcomes. Amplitude levels could be influenced through the gain settings of the audio amplifier and were further influenced by the positioning of the microphone and loudspeaker in relation to nodes/antinodes on the wire. Lastly, various strategies for muting vibration ranging from applying tape or alligator clips to the wire, or by direct human touch, were found to be effective in terms of keeping energy states from escalating uncontrollably towards unity gain.

Although at various points intermediate responses that varied over time were discovered, the outcome with which we were in many cases satisfied with at this stage was a static response composed of multiple frequencies with less harsh timbral responses (in essence the system could produce a static chord composed of multiple frequencies). Such responses were placed in combination when multiple systems were set up simultaneously, and these pitches were further affected by the wind in the tree or a person altering the tension of the wire.

Conclusions:

- Sonic outcomes were essentially static (in terms of timbre, dynamics, and frequency), required ongoing intervention, and musical, in terms of having one frequency placed in combination with another frequency.
- Aesthetically and from a research objective standpoint, it became important that the sound reflect multiple possibilities from within the object itself: the sound should both explore the object, drawing multiple responses from the materials, while at the same time being a 'total expression' of the state of the object at any one moment. As a result, any static outcome was felt to be unsatisfactory.
- In relation to the notion of textility, these studies were both successful and unsuccessful. The chaotic nature of the response, in combination with the newness of the ideas and the fundamentally tactile nature of the exploration, meant that practitioners had little or no way to either predict or enforce outcomes and were always in a position of negotiation, or of following emerging outcomes in rapidly changing situations. Additionally, the static endpoints these systems were quickly reached (in terms of timbral, dynamic and frequency endpoints). In combination with a musical aesthetic focused on placing one sound in relation to another, this meant that an approach focused on ongoing emergence had limited scope. Energy states in the materials emerged quickly then remained the static until some kind of intervention took place, at which point the system quickly / instantly assumed another static state.
- The notion of intervention quickly emerged as a key factor in the project. When to intervene and when to wait. Waiting allows the system time to move to states beyond what a practitioner may imagine and forces a practitioner to confront their grounds for intervening in the first place, which in some cases may be an (ultimately arbitrary) aesthetic such as "this sounds good (or bad)."
- A fundamental aim was to achieve a balance whereby the system could evolve for long periods (or ideally almost permanently) on its own, arriving at outcomes that would be almost impossible to achieve if based on practitioner psychology.
- The idea quickly became one of using chaotic systems to discover newness.
- This was partially successful at some points and the overall project provided a first glimpse at new ways of making sound and of working methodologies based on openly guiding 'emergence', rather than more standard virtuosic control-based methodologies.

Work Two: Stone Garden 02 (2013)

Figure 10 Stone Garden 02. River stones suspended on metal wire. Self-made audio amplifiers with LED lights. Piezo contact microphones, audio loudspeakers. Doi Saket, Thailand 2013.

Figure 11 Stone Garden 02. River stones suspended on metal wire. Self-made audio amplifiers with LED lights. Piezo contact microphones, audio loudspeakers. Doi Saket, Thailand 2013.

Overview

Stone Garden 02 was made while on residency in Thailand in October 2013. The objectives during the residency were to develop findings from Dusseldorf with the aim of creating a stand-alone piece of work within four weeks. The work was structured similarly: long sections of metal wire were used to transmit acoustic energy between a contact microphone and loudspeaker and portable battery powered equipment ensured the work could be both portable and take place in locations without mains electricity.

Realisation

The title, *Stone Garden*, is a reference to an earlier installation work which draws inspiration from the *Ryoanji* Zen rock garden in Kyoto, Japan. In this piece, the raked sand of the garden is taken to represent habitual thought patterns, with larger standing stones symbolising a breakpoint in everyday consciousness. This idea was carried into *Stone Garden 02*; the title is quite literal, and in addition refers to a breaking or interruption of learned understandings and relationships creating a space for new ways of seeing and understanding beyond the rational or learned/ cultural.

Observations in Dusseldorf showed that the tension of the wire transmitting sound between loudspeaker and microphone played a major role in the frequency response of the system. It was decided that weighing vertical sections of wire using large stones could provide tension to the system while also functioning as interesting sculptural forms. The eventual wire sections were about 5 metres long, hung from sections of bamboo near the ceiling, and weighted at their ends by stones weighing approximately 1 kilogram. Onto this wire was threaded a loudspeaker, and a piezo contact microphone was attached to the wire at a variable distance from the loudspeaker. An important part of the testing was an exploration of the effect of placing the microphone at varying distances from the loudspeaker and how this influenced frequency response. The entire system was powered by self-made 9v amplifiers and was therefore portable. Solar power was successfully tested at early stages of the project as a replacement for 9V battery power but not used at later stages of the project.

It was important both aesthetically and from a research standpoint that no external dynamic control be used and that what was heard be only those sounds produced as a direct, unmediated interaction of materials and location. There was a desire not to force or restrict the system into desired states through use of external controls or limits; to keep the work as pared down, simple and 'up-front' as possible without the help of 'hidden hands' in the form of computer, compressor or limiter control.

Observations

Often during the development and exploration stages of this project extremely interesting outcomes were uncovered which later could not be reproduced, or which required 'breaking' the desired aesthetic and research structure[12] in order to achieve. For example, at one point when testing a single heavy hanging stone on wire, a 'perfect' outcome was achieved (in terms of sonic outcomes matching compositional intention) in which the frequency, timbral and dynamic outcomes slowly moved between a variety of states over time. This would only occur if the stone were swinging, however, and once it had come to rest the system remained in a static state. This raised several questions about process, outcomes, and necessity of intervention and how these issues should be approached within the framework of the project. For example,

[12] I was trying to achieve a state in which the object would slowly move between differing frequencies, timbres and dynamics over time without the necessity for constant intervention.

was the project headed in a direction in which the practical works required more or less constant intervention or were in fact performed? Were there ways to facilitate states that were fairly autonomous, or would the outcome be a combination of both? There was no aesthetic issue with at this stage testing the idea of constantly 'tending' the work in the form of small interventions similar to a notion of gardening. If this were to become too pervasive, however, the nature of the interaction would become performative, which did not feel to be an appropriate direction in which to proceed. The ideal remained one in which intervention would be more occasional and that the works could sustain states in which they were able to 'explore themselves'.

As with the work in Germany, almost all outcomes were highly unstable and ephemeral due to the chaotic nature of acoustic feedback loops. In addition, as the elements were hung vertically, and were in a state of constant vibration, this resulted in objects moving and sliding downwards along the wire under the influence of gravity. In summary, any outcome needed to be accepted as temporary.

It was extremely difficult without external amplitude control, to achieve a balance that would enable the system to produce tones less than static unity gain. This resulted in relationships that would almost always lead to static outcomes. It was felt that if the materials were to be fixed (for example soldering a speaker to the wire) that this would have a detrimental effect in terms of arts research. Underpinning such a notion is the desire for a work to be artificially held in a known state at the expense of possible novel and emergent (later contextualised as *textile*) states. Such a position was felt to be regressive in the context of arts research. If an element were to be fixed (perhaps soldered) in place, or even *all* elements fixed in a particular relationship, inevitable small change, for example a very slight change in amplification level due to a battery running out of power, or small shift in the way a work rests on the ground, would render that arrangement meaningless as alterations became amplified by the feedback loop. Such a notion (that of fixing relationships) was in fact meaningless due to the design of the pieces themselves - a design which was quite deliberate but not yet fully aligned with Ingold's notion of *textility*.

Conclusions:

- It was observed that the system was extremely difficult to control and seemed to follow no discernible logic in terms of the relationships of materials and outcomes. For example, it was anticipated that using longer lengths of wire would enable the system to produce lower frequencies and so potentially produce a wider array of pitches and timbres (as the wire could oscillate over longer wavelengths). This was in nearly all cases incorrect; the frequencies produced tended towards high-pitched sounds and piercing timbres. It was also felt that keeping the wire under increased tension would facilitate greater pitch control, and this was also not found to be the case as the system would produce wildly differing frequency responses with no clearly observable correlation between either the length of the wire or the tension it was under.
- The design of this particular iteration meant that due to gravity and vibration, the system quickly passed through multiple energy states and that it was difficult to develop sustained periods of nuanced behaviour,
- The system most often took only a very short time to arrive at a static endpoint characterised by a stable single dominant frequency and timbre. As a result, the final work *Stone Garden 02* could be characterised as being more musical - the placing of one sustained frequency in relation to another. It was however possible to incorporate some feedback strands which evolved and changed over time (evidenced in video).
- In terms of the notion of *textility*, the high levels of uncertainty emerging from the system could be seen as an ideal example of the inability of human actors to assert dominance over materials. Constant intervention altering relationships which had become static in terms of frequency, time and dynamics, followed by a period of observation of any new state was not necessarily negative, yet was a less-than-ideal outcome. Another way to express this is to say that if the system immediately rises to a unity gain feedback level characterised by static frequency, timbre and dynamics, the result is not really uncertain and expresses quite limited variation and change over time (most likely only varying in terms of frequency). Additionally, if the artist must constantly intervene to prevent static outcomes, this constant intervention removes possibilities for the works to evolve in unintended ways or to pass through intermediate states that are long enough to be felt, perceived, understood.
- There was a growing recognition that core idea within these new works was that of a *negotiation* between artist and materials resulting in outcomes which are continually

coming into being. If this were to be unbalanced, a critical point of balance or space for dialogue is lost.

- At times during the development of the work the frequency range and timbral characteristics of the outcomes were felt to be quite confronting due to high frequency and strong, very dominating timbres. On reflection, however it was felt that the overall process operated as an effective piece of arts research, and that furthermore, the outcomes were entirely legitimate and acceptable in the context of contemporary sonic practice. This barrier was an internal one in which I had problems accepting certain outcomes in relation to my artistic intention. This was an important observation going forward in the project, and directly influenced the design of subsequent works in the portfolio.

Work Three: Warehouse wires (2015)

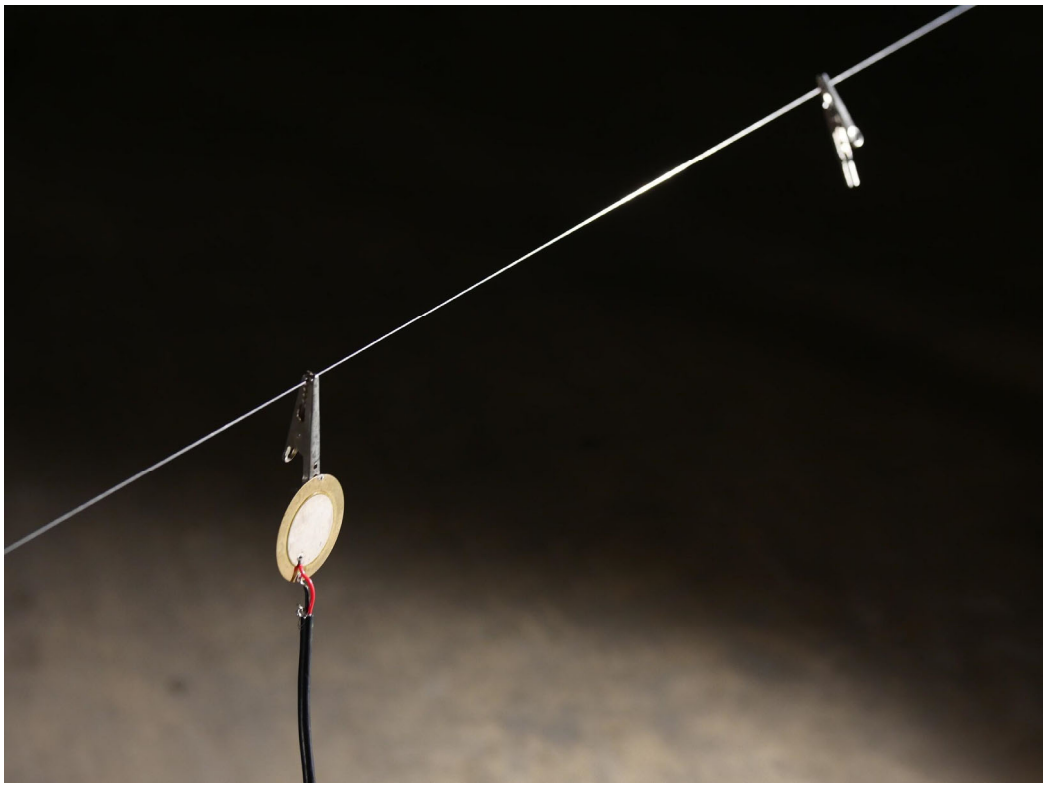

Figure 12 Warehouse wires (detail). Piezo contact microphone, metal wire, car audio amplifier, audio loudspeakers. Leeds 2015

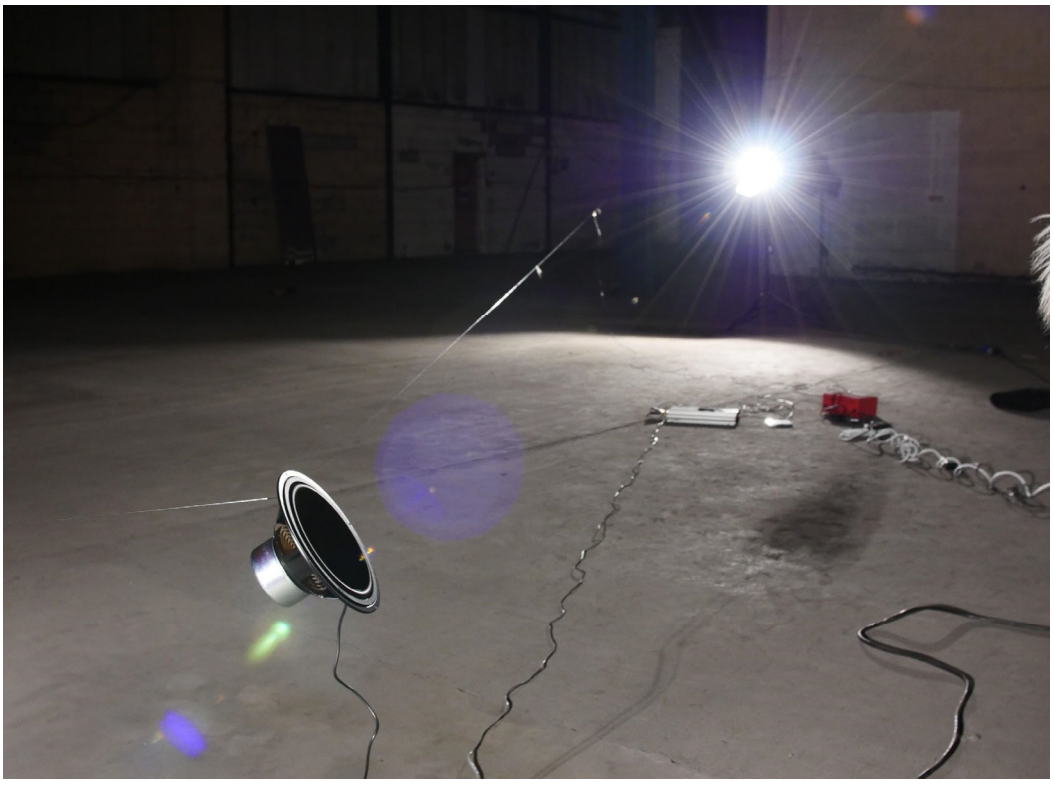

Figure 13 Warehouse wires. Piezo contact microphone, metal wire, car audio amplifier, audio loudspeakers. Leeds 2015

Figure 14 Warehouse wires (detail). Loudspeaker placed on a ruined desk acting as a sounding board. Leeds 2015.

Overview

Resonant Strings was a series of studies conducted in Leeds in 2015, which aimed to test the response of horizontally stretched lengths of wire in combination with larger loudspeakers. Testing focused on whether longer sections of wire, in combination with larger loudspeakers capable of producing stronger low frequencies, would both allow for a wider range of acoustic responses, while also facilitating additional physical control and intervention possibilities. The aim remained that of testing ways in which such a system could achieve gradually evolving energy states in terms of frequency, timbre and dynamic level while avoiding static outcomes.

Realisation

The work comprised of a series of iterative studies in which long sections of metal wire, up to 20m in length, were explored and tested using small battery powered amplifiers, a car audio amplifier powered by a car battery, piezo contact microphones, and a variety of loudspeakers of various sizes. Due to the mass/weight of the wire, and extended distances between loudspeaker and microphone, a car audio amplifier was needed to generate enough power to create an acoustic feedback loop. This type of amplifier was chosen due to its portability, and the practical benefit of using battery power in a remote location. Loudspeakers of various sizes

were threaded onto the wire in order to create a direct connection to the contact microphone. In some instances, the wire was tied at one end to the frame of the loudspeaker itself.

Observations

Longer sections of wire, in combination with larger loudspeakers, were able to produce a wide range of frequencies. The system still tended towards static responses, however, with higher frequencies and harsher timbres. In order to avoid escalation towards a static endpoint, a fine balance needed to be achieved between how the elements of the system were attached to the wire, the amplification level, the distance between elements, and various methods for muting vibration. Such configurations were inevitably quite fragile.

In order to achieve non-static frequency/amplitude responses it was important to set a base level of amplification slightly over the point where a feedback loop began to form and then arrange the loudspeaker/microphone relationship in order to slightly mute or modulate the feedback response. As a result of guiding the system away from a state of unity gain, harmonic responses do not have the power to climb through the strongest self-reinforcing harmonic frequencies that would result in a flat, static outcome. The aim was that the system gathers and dissipates energy over time and avoids static responses. Such states were difficult to establish, however, and the working process was characterised by regular ongoing intervention, and high levels of ephemerality.

Various ways of connecting the loudspeaker to the wire were tested, including attaching the wire directly to the metal speaker frame, or threading the wire through the speaker in such a way that the speaker cone directly contacted the wire (which caused the wire to vibrate strongly). It was found that a direct connection between the speaker cone and wire created a response over a much wider range of frequencies, most likely due to the fact that the speaker cone moves over greater distances, in combination with the fact the wire and cone and not directly attached and often hit other creating broad spectrum noise.

Directly touching the wire to the speaker cone was the beginning of a realisation that the sound we hear is not the sound the microphone captures, or the loudspeaker reproduces. Instead, both objects act to place an energetic impulse into the materials of the work which is then filtered by the harmonic nature of the materials themselves, much in the same way that a bell struck by a beater is hit with a kinetic impulse and then rings according to its material resonant properties.

Conclusions:

- Although difficult to achieve, it was possible to establish periods of ‘stable instability’ in the feedback system during which amplification level, placement of elements, and muting of response resulted in gradual evolution of a variety of acoustic states.
- Most often however, the system still proved too unstable to allow for the formation of states in which change was gradual; the work would quickly trend towards endpoints characterised by static timbres, dynamic levels, and frequencies.
- The work was, for the most part, highly unstable and required ongoing intervention due to the elements of the system shifting position as a result of the harmonic vibration of the system itself.
- Both a static endpoint and too-rapid change were felt to be counterproductive in terms of both aesthetic and research outcomes. It was felt that Ingold’s notion of ‘following of the world’s unfolding’ in relation to making and of textility needs to happen at a pace and manner which involves both following and leading and takes place over timescales in which changes can be usefully perceived and engaged with.
- It was felt that after these initial research works using wire that the surface area of the conducting material placed many restrictions on how the material could be interacted with and other material possibilities needed to be investigated.

Work Four: Stone Garden 03 (2017)

Figure 15 Stone Garden 03. Piezo contact microphone. Audio loudspeakers. River stone. Metal wire. Laptop running Max/MSP. Kaunas 2017

Figure 16 Stone Garden 03 (detail).

Overview

Stone Garden 03 is a sound installation made in 2017 and was shown in Kaunas, Lithuania as part of the Mind the Gap group exhibition at POST Gallery.

This work took place several years after the research focus had moved towards sheet metal as a medium connecting microphone and loudspeaker. Over that period of time, both research and aesthetic aims had shifted from previous notions of 'purity' to incorporate computer-based dynamics control in the form of audio compression and limiting. Stone Garden 03 tested how effective such technologies could be in shaping the energetic responses of metal wire, thereby extending some of the earliest physical forms explored in this project. Additionally, the work would incorporate a large loudspeaker which plays two computer-generated percussive impulses which follow a regular meter, but occur unpredictably. This idea is influenced by John Cage's *Ryoanji*, a work characterised by two sounds: a continuous glissando almost completely free of rhythm, and the other chance derived percussive sound almost completely free of pitch. The aim was to have the sustained feedback response

combined with these sonic impulses in much the same way : each heightens awareness of and sensitivity to the other.

Realisation

As in Thailand with Stone Garden 02, a long wire was hung with a stone weighing it at one end. A loudspeaker was threaded onto the wire and a contact microphone attached at a variable point higher up the wire to explore how the harmonic activity and physical motions of the wire would influence resultant acoustic feedback. A second loudspeaker playing the percussive impulses was placed on the floor next to the hanging stone

The microphone and loudspeaker were attached to a laptop running Max/MSP, which was running a patch to limit the volume of the feedback loop and control the overall amplitude of the system. The dynamics control elements of this Max/MSP patch were almost identical to patches which had developed alongside work with sheet metal. This computer was concealed near the work, an arrangement which caused many problems in the presentation of the piece.

Setting up the system involved a lengthy exploration of the materials in situ; moving the microphone and speaker to different positions in combination with different amplification settings in the Max/MSP patch would result in different energetic responses and feedback outcomes. The operation of the computer system was largely in terms of limiting spikes of volume which could tip the system towards an extreme and static energetic state,

Observations

The fundamental ideas on which the work is based, and the sounds produced were found to be worthy of ongoing investigation. Both during the preparation for the work in my studio, and during the setup preparations in the gallery the work was capable of producing a wide range of sounds, ranging from long held single tones to complex chordal structures.

The irregular rhythmic element provided by the second loudspeaker worked very effectively in combination with the feedback generated sound.

It was felt that these sounds in combination heightened attention, the percussive sound was rhythmic yet irregular (as in Ryoanji), which leads a listener’s attention: following the regular nature of the beat is easy, but the fact the sounds occur unpredictably attracts closer attention as anticipation is continually resolved or thwarted.

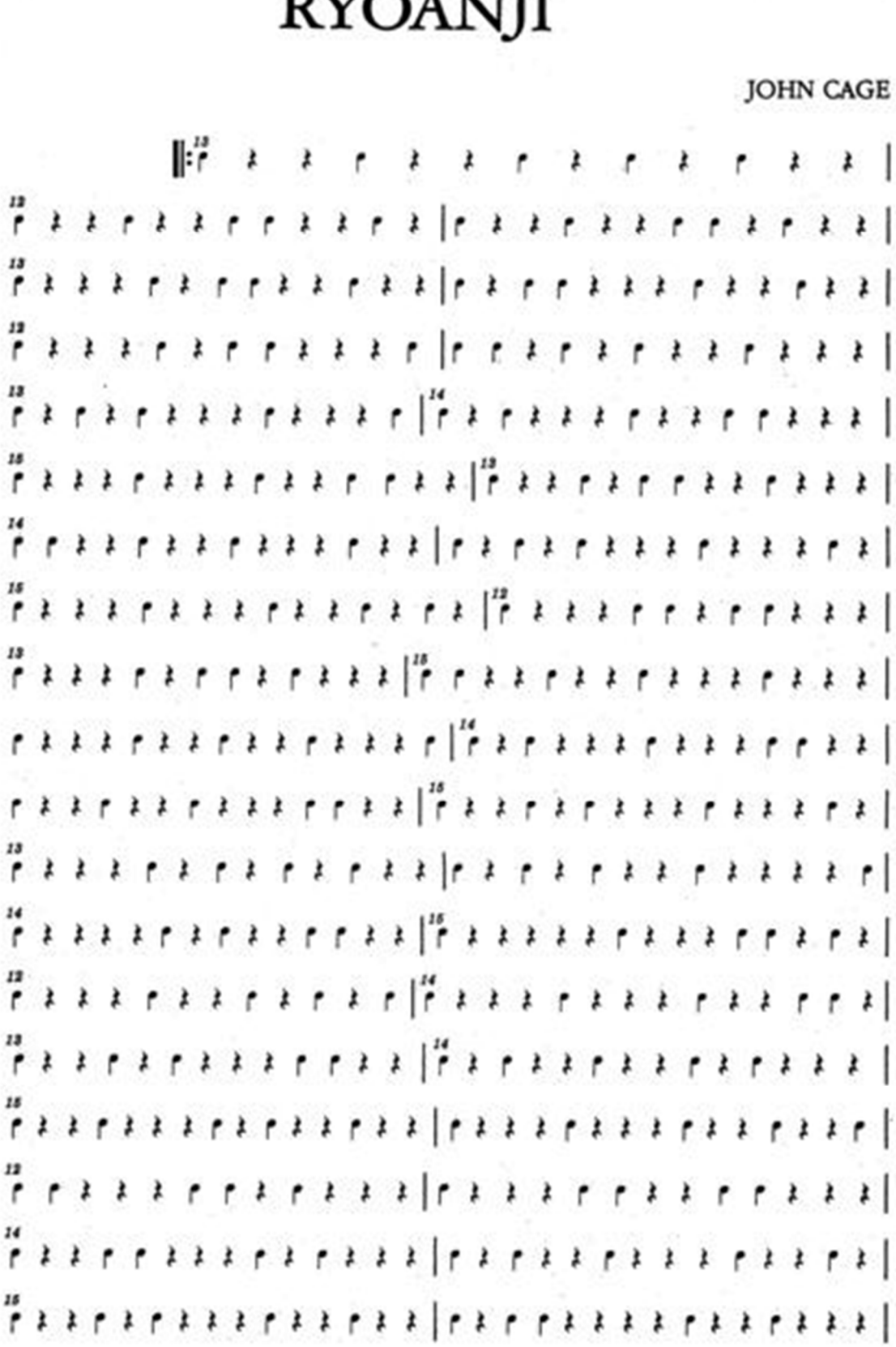

Figure 17 Ryoanji. Page 1 of the percussion score (Cage, 1983).

Even though this iteration of these ideas incorporated dynamics control using Max/MSP the fundamental nature of the work remained ephemeral and very fragile. This was an issue in preparing the work for a public showing, especially in the context of a group show which meant loss of control of the space in which the work was located, with problems such loss of power (meaning the relationships of the electronics to the physical objects was lost).

A major issue occurred as I was reliant on another person to build a covering for the computer which would provide both concealment and security. Due to external issues, this item was only delivered one hour before the opening of the event, meaning I had to disassemble the system, unplug and restart the computer, then begin a new exploration of the materials once the system was running again. This proved impossible to do in a satisfactory manner and so at the opening of the event the work was not working well at all. The fragile relationships and balances vital to how these pieces function could not be uncovered or achieved in this situation.

Conclusions

The work was felt to be successful in terms of its preparation outside its final public presentation context. In the researcher's personal studio there was time and space to fully explore how the effectiveness of computer-based dynamics control on wire based systems, and to test the added element of percussive impulses on a second loudspeaker.

Unfortunately, the final context of presentation was not at all conducive to how these works function; preparation and presentation issues led to the work failing during the public presentation. It was felt as a result that these works require much greater control of the environment, and quite possibly a different context of presentation altogether which would be somewhat more like an extended or long duration performance framework where the artist explores the piece in the presence of an audience.

Considered from the viewpoint of textility, the presentation context had pushed the overall work too far towards chaos and loss of control of elements, and so a balance between human intention, the materiality of the objects and any *textile* was difficult or impossible to establish or maintain.

Works based on plate metal.

Work Five: 10 hours of drone: live performance using steel plate (2015)

Figure 18 Ten hours of drone. Metal sheet, contact microphone, audio amplifier, audio transducer. Leeds 2015

Overview

Following several iterations of testing involving metal wire as a conductive material it was decided to explore various other objects which afforded different possibilities for interaction and acoustic response. For example, when working with wire and loudspeakers, the sound heard is mostly that of the loudspeaker. When working with audio transducers, however, the entire object becomes both resonator and loudspeaker. This work, *Ten Hours of Drone,* had its first public presentation in a performance context, during which I controlled the system by altering the amplification level, pushing the response of the metal plate between different states of vibration/sound.

Realisation

One reason to use find alternatives to wire was a desire to find new methods to interact with materials and outcomes. In previous iterations it was felt that materials were not responding to expectations in a way that was particularly satisfying; outcomes would quickly reach static states requiring ongoing intervention. Static outcomes yielded no new information in terms of the broader research aims.

Of particular interest was testing whether sonic outcomes could be controlled by placing microphone and transducer at specific positions on the material related to harmonic vibration. The centre of the sheet was marked, and lines draw on its surface diagonally to the corners and both vertically and horizontally to mid points.

The transducer and microphone were not fixed in positions but were moved, by hand, around the surface of the plate following these lines in an attempt to uncover harmonic relationships between distances and the total size of the metal sheet (much as with a vibrating string). This method served to test the system's suitability for live performance.

Based on the experience of using wire, it was clear that the manner in which both microphone and loudspeaker were attached to the material was extremely influential in terms of sonic outcomes. It was initially assumed that creating a perfect connection (attaching microphone/loudspeaker firmly to the material and with maximum surface area) would yield the best results in terms of establishing a strong feedback loop, while most accurately reinforcing the harmonics of the materials.

Different ways of placing the materials in space were tested, such as resting the metal against a wall and hanging it from the roof using wires. These were often based on sculptural aesthetic ideas but were found to have a profound impact on the sonic response of the system.

Observations

Once again, the system proved quite wild and unpredictable in terms of response. After testing various marked points on the metal sheets with microphone and transducer, it was not possible to assume that a controllable sonic outcome could be achieved using this method, meaning that the system could not be pre-figured or controlled in this way; it would require moment-to-moment exploration and interaction.

It was again difficult for the system to remain at lower frequencies and dynamic levels, and this relied on a very subtle and fragile balance of amplification level, the location and relationships of elements such as microphone and transducer, alongside the ways in which they made contact with the transmitting materials (steel sheet).

The sheet could, in the right circumstances, produce a harmonic chordal response which moved through multiple energy states. This could be influenced either by touch (hands) or by sudden shifts in amplification level. Both possibilities were developed further and form part of the media archive for this overall work.

The idea that material resonance and dynamic-energetic outcomes did not shift in a linear fashion in response to input energy level was influenced by conversations during a composition workshop with Alvin Lucier at Wesleyan University. Lucier was discussing his experience as an audience member listening to a work of James Tenney titled *Koan: Having never written a note for percussion* (1971) performed on piano (rather than more normally on tam-tam). In this piece the performer is instructed to slowly increase then decrease dynamic volume using a percussive roll. Lucier stated that he expected the dynamic level of the instrument to respond in a linear fashion as the energy level increased but was surprised to find that the instrument responded in a stepwise manner.

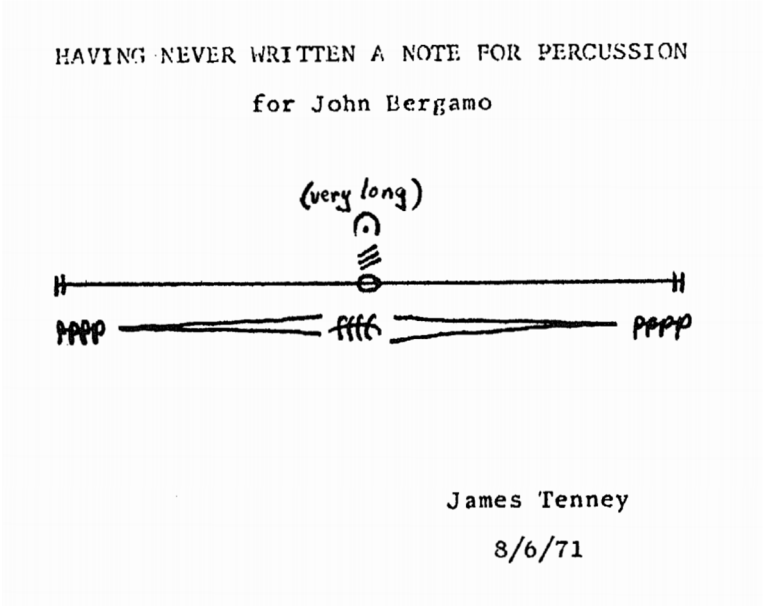

Figure 19 James Tenney. Koan: Having Never Written a Note for percussion (For John Bergamo) (Grimshaw, 2021)

During the investigation of how a steel sheet might respond to various inputs I recalled this idea and decided to test if the steel would respond in a similar fashion as I followed a similar dynamic form using the audio amplifier. In general it was found that once the steel achieved a certain energetic state, that state could be sustained with slightly less energy. In other words, the materials need a lot of energy to cross thresholds between various responses, but once within those responses seemed relatively stable.

Conclusions:

- As the transition to flat sheet large surface objects occurred there was a parallel investigation taking place in terms of how to interact with the objects and to what degree the system could be controlled.
- Attempts to predict, or enforce, any kind of outcome proved illusory, as the chaotic complexity of the overall system meant any attempt to control or commodify/standardise outcomes were unsuccessful. This line of investigation was subsequently abandoned.
- The larger surface area of the steel sheet, as opposed to a metal wire, allowed for a greater variety of possibilities in terms of how the elements (microphone, transducer and amplification level) could be organised in relation to each other.
- Once it was accepted that interaction needed to be based on a method of 'feeling things out' rather than any *hylomorphic* assumption of control[13], it became possible to 'follow the materials' into situations in which a dialogue between human action and material responses could be felt, understood and responded to. The resulting performance style was characterised by movement, then waiting as new resonant relationships in the materials reinforced themselves (or not). Often, as a performer in this context, the feeling was something like that of presenting a series of snapshots (here is this sound - the materials are responding like this right now), as opposed to creating any kind of intentional harmonic/sonic progression. Continuity could be considered intentional simply because it emerged as part of a chronology from the same set of harmonic material relationships, but there was little way to have any real control over the harmonic outcomes themselves.

[13] It was not possible in advance to have any idea of how the materials would respond sonically to touch.

- These experiences resulting in a deepening understanding of how the materials operated energetically, and how the elements of each work (microphone, transducer, amplifier) could best be arranged in order to give access to a wide variety of energetic/sonic outcomes. In terms of the larger research project these methods were no longer explored, due to several factors:
    - Such an investigation seemed to focus more on the psychology of performance and be too closely aligned to a musical/harmonic framework.
    - There was a strong internal pressure to make any performance 'make sense' in terms of structure, chordal/timbral/dynamic structure, and development / resolution. It was acknowledged, at the time, that this approach had a great deal to do with my past musical training; confronting and navigating these semiotic or musical language issues was not the main focus of the research project and consequently felt inappropriate.
    - As stated elsewhere, the main focus (emerging at this time) was to establish a set of relationships in which the 'materials could explore themselves'. This meant that while touch and other intervention methods were necessary, they should not be constant. It was felt the balance needed to be one of making some kind of intervention and then stepping back and waiting for outcomes to emerge.
    - Although it was decided that this method of interaction was unsuitable, dealing with these issues deepened an understanding of how the works operated energetically, revealing ways in which the various elements of each installation (microphone, metal, audio transducer) could be interacted with in order to most effectively focus on the project's aims.

Work Six: The sound was already inside (2016)

Figure 20 The sound was already inside. Metal sheet, piezo contact microphone, laptop running Max/MSP, audio amplifier. Kaunas 2016.

Overview

The sound was already inside was the second work made using sheet metal. This work marks a distinct moment in the evolution of the research project, as control over dynamics (using a software compressor and limiter) were used in the audio signal path for the first time. This substantial change was made in response to previous works, which afforded limited possibilities for exploring any nuanced notion of textility.

Accompanying these understandings was a relaxation of the conceptual and aesthetic desire to pare the system down as much as possible, while keeping 'hidden hands' out of the signal path. This desire for a kind of conceptual purity was leading to limited results in terms of both sonic outcomes and any exploration of the developing understanding of textility within the project overall.

Realisation

The series of test pieces that led to *The sound was already inside* (final work presented at Gallery Weekend Kaunas in 2016) used scrap metal sheets of varying thicknesses and the work was conducted as an artist in residence at Nida Art Colony in Lithuania in 2016.

A self-made dynamic control 'patch' was created using the Max/MSP programming language to control the overall volume (energy) of the work. This software acted to both reduce and limit the output of the audio transducer and if needed, to raise the gain of the input microphone. As a result, the system was able to sustain an acoustic feedback loop, but the level of sound output from the audio transducer was kept at approximately -15 to -25dB. This allowed for harmonic responses that were not previously possible.

Small magnets were used to apply the contact microphone to the metal sheet. This enabled me to avoid a fixed positioning system, allowing the microphone to be moved freely to create and explore differing relationships with the audio transducer. Match sticks and small coins were used to create a partial connection between the contact microphone and materials in order to introduce wide spectrum noise into the signal chain. My understanding of why this has a positive effect in terms of creating a wide range of frequency responses from the materials are:

- A partial connection creates a small area where the microphone and materials are striking each other as they vibrate.
- Forcing materials under the contact microphone alters the tension of the object and forces a variety of different behaviours from it (none of which were systematically tested). For example, even the weight of the microphone cable created pressure on the microphone in different ways (e.g., hanging directly down or to the side), producing widely different harmonic responses from the system.

Randomisation was used to slowly shift specific parameters of the computer system, with the aim of allowing the formation of new energetic relationships over time. These parameters were - the amount of amplification for the transducer (gain), the threshold at which the compressor and limiter became active, and the sensitivity of the microphone (gain).

Observations

Implementation of dynamic amplitude control was a very significant step forward in the overall project. Keeping the volume of the feedback system below maximum (unity) gain using the software compression/limiter systems allowed for the exploration of harmonic responses that would otherwise have been almost impossible, or far too fleeting to achieve using the previous methodology based on a very fine balance between muting, positioning and amplification level.

The establishment of nuanced feedback states which fluctuated between multiple harmonic modes still required extensive exploration of the materials *in situ* and such states were still often fleeting and ephemeral. Alteration of microphone position or amplification level would lead the system to new responses, and it was impossible to recapture previous moments and relations. As a result, each time the work was encountered it was almost always necessary to spend extensive time exploring the materials to uncover new relationships.

The working method was much the same as before, in-so-far as an amplification level needed to be set and the microphone moved to a different position on the steel plate before the system would respond. It was generally found that a partial connection between the microphone and plate resulted in the production of noise into the system:

The system was understood to operate as follows:

- A feedback loop is established which grows in volume according to the harmonic nature of the overall system. The strongest harmonic frequencies (mainly of the metal plate) are what we hear.
- The amplitude is limited (for example at -20dB), meaning only the feedback frequencies that occur most strongly at that power level will be heard.
- The sound we hear is not what the microphone is capturing or the transducer reproducing. The piezo microphone is not an accurate audiophile instrument, and the sound the microphone captures is then further ‘filtered’ by the transducer (again not an audiophile level device). Ultimately the transducer plays back an ‘energetic impulse’ into the materials which further harmonically filter any energy placed into them.
- A medium is established where these forces balance each other.
- A partial application of the microphone creates results in the creation of noise, and it is this broadband noise in combination with the core harmonic response which helps to ‘activate’ the materials more strongly. This helps in generating a wider range of harmonic responses from the materials.

- Moving the microphone to different positions creates different dominant relationships and hence different frequency responses.
- It is remained important to explore the material and work with the amplification settings in order to create dynamically changing situations which evolve over time. In order to achieve this, relationships need to be unstable and shift between different harmonic responses.

Conclusions:

- The system was restricted in volume and in some regards highly controlled through the use of compression and limiting. It was very subtle and chaotic in terms of how relationships between the elements functioned.
- Interactions with the system involved a patient search around the surface of the steel with the microphone, attempting to find a location that lay at the boundary of multiple harmonic responses.
- The manner in which the microphone was applied to the materials was vitally important. It cannot be overstated how sensitive this was in terms of impact on overall sound and output. For example, even the weight of the microphone cable pulling at different angles would dramatically affect the harmonic response.
- It might be thought that the use of dynamics control in the signal path (compression and limiting) goes against the idea of *textility*, tending towards *hylomorphism*. This did not prove to be the case, however; the implementation of gain control actually opened out a more nuanced, wider space for interactions that were more appreciable and were easier to interact and respond to.
- It was observed, during both preparations and during public exhibition, that the complexity of the system remained beyond any kind of easy control, that it could not be reproduced or easily ‘packaged’.

Work Seven: 21296 sliding (2018)

Figure 21 21296 sliding. Metal sheet, piezo contact microphones, audio amplifiers, laptop running Max/MSP. Dortmund 2018

Overview

21296 sliding builds on previous work using metal plate by incorporating pitch shifting into the Max/MSP computer patch. It uses multiple objects made from larger, thicker sections of metal. The work draws some inspiration from David Behrman's *Touch Tones*[14] in which the dominant harmonic frequencies produced by one material is mapped onto an entirely different material[15]. Some of the harmonic peaks will be common to both objects and resonate, some will not. In the same way, when the natural dominant feedback frequencies of a sheet of steel are altered in pitch, they will fall into new relationships, some of which will be resonant and others not.

Realisation

There were two main aims with this project, which was conducted whilst resident at the Künstlerhaus Dortmund in 2018. Firstly, I hoped to test very large sections of material, for example metal up to 10-15m in length, of a greater thickness (up to 1.5mm) than previous works. I believed that larger, thicker pieces of materials would be capable of producing lower frequency responses. In addition, I hoped to test the physicality of such large objects in relation to room size and thus explore how (if more than one were used) they multiple metal plates might influence each other.

Pitch shifting is fairly easy to accomplish within Max/MSP as there are standard tools designed for this purpose. Frequency shifting was set to -1000 to +1000 cents. Every eight minutes the computer would choose a new random number between -1000 / +1000 and the pitch shift would take eight minutes to arrive at that frequency. The reasoning behind slow changes is that it takes some time for the energy state of the object to reinforce itself and stabilise. Moving too quickly passes through key frequencies that become lost before they have any chance to develop resonance. If was felt that a duration of around eight minutes provides a very slow, often imperceptible, rate of change that ensures ongoing variation while allowing key resonant frequencies to expand and develop. It is important to note that this structure, which is aimed at exploring a wide range of frequencies and resultant energetic responses, may at

[14] See Appendix 1.

[15] For example, the harmonic peaks of one musical chord played by triangle wave generators are mapped onto a different musical chord using a band pass filter. Or mapped onto a noisy input such as scraping metal.

times chose a new random end point that is very close to the starting point. In such a case the material responses change very little in the ensuing eight minutes. This was not felt to be a negative outcome, should it occur.

Two large steel plates were obtained. They were both 1mm thick and 6-7 meters in length. They were tested with a variety of microphones and transducers over a two-week period, focusing on differing microphone application techniques and positioning, the effect of pitch shifting, and ways in which the two objects would interact with each other in space.

The final version of the work used the two large sections of metal in a single room. The thickness of the materials meant that they were difficult to form into specific shapes, so it was eventually decided that they would be formed into curves. It should be noted that there are various health and safety concerns which must be carefully considered when working with large sections of materials, often weighing 50-80 kilogrammes with sharp edges. Without budget, and with time constraints, I decided that it was felt best to focus on sonic harmonic responses as opposed to pursuing specific sculptural ideas. As such the materials are more or less ‘ready-mades’.

Observations

- It was possible to have the materials and overall system operating within a range which meant that it was chaotic, but never completely out of control.
- The size of the materials expanded the scope of the research in several key ways:
    - The opportunity to experience a substantial resonating object (as large or larger than a full-sized grand piano) which extended over 6-8m in length, was chest-high, and could encircle the listener. This was a novel experience for both artist and audience, in an age where sound most often is produced by much smaller discrete boxes or much smaller sized musical instruments.
    - The mass of the objects meant that if people touched them (a very common desire) the sound was not noticeably affected.
    - In some circumstances the system could produce very low frequencies that were not achievable when using smaller pieces of metal.
    - Although the objects were of much larger size, the audio transducers used throughout the rest of the project were able to set them in motion.
- The two metal plates were able to interact with each other in interesting ways. The high amplification levels, in combination with high microphone sensitivity, creates a

situation in which the metal plate becomes both a loudspeaker and microphone. In *21296 sliding* this meant that the two objects in the room were able to influence each other's behaviour as various energy states passed between them and the pitch shifting on each object would perhaps resonate with the other.

- The slow changes in pitch shifting were quite effective in terms of being able to perceive points at which the metal sheets resonated more or less strongly.

Conclusions

- By this stage of the project, issues of complete loss of control had been largely eliminated through the use of computer control systems, limiting amplitude, alongside my developed understanding of microphone placement.
- Implementing various strategies for limiting extreme responses from the system did not result in any hylomorphic shift (an assumption or strong desire for matter to be passive or inert); the system still exhibited a large variety of complex chaotic responses and remained ephemeral, unpredictable and chaotic.
- As with previous iterations, preparation and maintenance of the work involved exploring the surface of the sheet with the microphone to uncover various harmonic relationships. The use of computer-based dynamic control did not 'close down' possibilities and complex, chaotic relationships. The use of compression enabled the opening out of a space wherein notions of both textility and hylomorphism could be clearly understood.
- Larger metal plates were able to produce lower frequency responses and were unaffected by human touch in terms of their harmonic response.
- The rate of change in pitch shifting (eight-minute durations between frequency end points) and other parameters in the Max/MSP patch resulted in a work which moved through a very wide range of sonic outcomes, however during the experience of listening to the work the rate of change can be interestingly imperceptible. If, when listening back to recordings, I skip forward at five-minute intervals, the change in the system's state, and the resulting sound, are notably different. In the room, however, the rate of change meant these sonic transitions are much less apparent and gradual.

Works based on room architecture.

Work Eight a): Overflowing room tones (installation) (2018)

Overview

Developed while working as an artist in residence at the Künstlerhaus Dortmund (July-August 2018), *Overflowing room tones* is a work for multiple loudspeakers of various sizes, a laptop running Max/MAP, a single microphone, and a room.

High amplification levels create acoustic feedback loops between the microphone and each of the loudspeakers, and while each loudspeaker plays all the sound captured by the microphone and so plays back every feedback loop, only particular sounds resonate powerfully for each architecture/ microphone/ speaker combination. Additionally due to differences in reproductive quality, each loudspeaker individually shapes and colours the sound, promoting certain frequency outcomes over others or in fact being unable to produce certain outcomes due to physical size or power.

Realisation

Several loudspeakers were placed against the walls of an empty room and a microphone placed between them in one corner. The microphone and loudspeakers were connected via an audio interface to a laptop running the a Max/MSP patch based closely on patches used in later plate steel installation works (essentially a compressor/limiter with pitch shifting).

The Max/MSP patch was altered to incorporate the recording and storage of multiple pre-sets which stored all current settings in the patch. During the developmental phase of the work key moments were stored as pre-sets which could be accessed at a later point in time. Additionally, Max/MSP allows such pre-set positions to be interpolated between in a variety of ways and over differing time durations which allowed for the emergence of a variety of novel interactions and outcomes as various presets come ‘in and out of focus.’ These pre-sets were used to store ‘moments of interest’. These most often related to how the work might suddenly resonate in space as a key harmonic mode of the room was uncovered, or it might perhaps be in a moment which allowed multiple frequencies across a broad range to be expressed.

The developmental/ compositional methodology centred on a 'feeling out' of relationships between architecture and equipment using sound. In this instance the settings of the compressor and limiter used in the Max/MSP patch were altered (each speaker has an independent compressor), and various combinations of responses were saved as pre-sets.

There is a need to act, the pause and see what emerges from a new set of relationships. Additionally, any changes in the state of any of the elements, for example if a microphone was moved five centimetres on the floor, will result in a significant change in sound as new acoustic relationships reinforce themselves. This means the work is highly ephemeral, and characterised by emergent, as opposed to pre-planned, outcomes.

Observations

Given the complexity of the situation it was found that the work was in fact surprisingly easy to put together and develop:

- The work operated autonomously and required little or no ongoing intervention. It was robust when interrupted[16] and was able to return to the energetic relationships that existed before the interruption without trending towards extremes in either frequency of volume.
- It was possible to arrive at moments where the work moved between various energy states over quite long periods of time. These slowly evolving frequency/ volume relationships resulted in outcomes with a high degree of ongoing interest. Energy would accumulate then dissipate over the course of one or more minutes without trending towards extremes which was pleasing from both an aesthetic and research point of view as it validated many of the ideas that had formed the core of the project.
    - That it was possible to work together with chaotic systems to achieve a fine degree of balance. This knife edge outcome, so to speak, is necessary to have a result in which the energy states in the system are unstable within limits, never moving completely out of control yet varying in energy state over fairly long periods of time. Such moments cannot be pre planned but must be discovered by feeling out the work in any particular moment.

[16] For example, if a person interrupted relationships in the room using their body the work would return to the energetic relationships that existed before the interruption.

    - As a result of arriving at such positions through a real sense of 'collaborating' with the materials and situation, the process was felt to be highly *textile* and not inappropriately *hylomorphic*. Complex exchanges result from what is a balance in terms of human agency and intervention. Slight movements or changes in any part of the system result in large changes in outcome. The piece functions as an open framework for exploration and a feeling out of physical/ architectural space using sound.
- It was possible to keep the frequency response from becoming out of control, avoid static endpoints and to have a response which contained a wide range of frequencies.
- Nuances in the lookahead function of the Max/MSP compressor patch (which monitors the sound for sudden changes in dynamic level) would create a percussive clicking sound when the lookahead duration was pushed to extremes (1-4 milliseconds). It was unclear what caused these sonic artifacts however it was suspected this was related to an audio buffering issue. Such sounds were not viewed as being problematic and in fact became a distinctive and characteristic aspect of this work.

Conclusions

This piece functioned very effectively and produced a variety of interesting outcomes using the Max/MSP limiter and compressor created for use with steel metal. Structuring the work using multiple pre-sets to store moments of interest discovered during testing did not limit or in any way overly 'hylomorphise' outcomes; multiple loudspeakers, each operating on it's own independent audio chain, and moving between randomly selected pre-sets ensured that each overall combination of energy levels and behaviours was unique. In any case the relationships of energy in the room, being chaotic and resulting from positive feedback loops, did not exactly repeat; the ways in which energy levels rose and fell varied each time even for individual elements of the system.

Interpolating between multiple overlapping pre-sets was seen as a very productive structure which was later tested in works such as *Sho studies*.

Work Eight b): Overflowing room tones (live performance) (2018)

Overview

A concert event at the end of a period of arts residency at the Künstlerhaus Dortmund in 2018 provided an excellent opportunity to test the ideas developed in this work in the context of a live performance.

Realisation

The performance took place in the basement at the Künstlerhaus Dortmund as part of the MEX concert series. The room has a low ceiling and is about 30m long and 15m wide with multiple concrete posts supporting the roof. Seating for approximately 40 people was arranged in the middle of the room. Sound reinforcement was provided by four loudspeakers, two either side of the performance/ stage area and two at the rear edges of the audience seating block. The PA is designed for regular musical/ sonic performance and is therefore 'transparent' and designed to minimise any colouration of the sound.

The preparation phase involved spending time in the location over two or three days engaged in an exploration identical to that in which the original work had been developed. This means 'feeling out' the relationships in the location and recording pre-sets at moments of interest. These moments were points at which the energetic relationships in the room resulted in a rich variety of frequency and dynamic responses that would vary over one or more minutes. Pre-sets had been recorded at such moments during the preparation stage of the work, however the changes to the acoustics of the location due to the audience would necessarily significantly impact on relationship explored when the room was empty.

It was appreciated that adding 20-40 people to the room would significantly alter any acoustic response from the room; those issues were part of the challenge of this testing scenario and would have to be dealt with as they arose during the performance.

Observations

During the performance it was found that a variety of feedback loops could be established of differing frequencies but that these were heavily biased towards higher frequency outcomes. This limited structural/developmental possibilities in terms of how the sound might evolve and

in terms of the range of possibilities that might arise in terms of dynamic and harmonic outcomes.

The audience sitting in the middle of the room and acting as sound absorbers had a major impact on outcomes.

Using four identical loudspeakers designed for optimal sound reinforcement added to the difficulties involved in developing a range of frequency and dynamic responses. Using a variety of differing loudspeaker designs in the original proved very important in terms of promoting different feedback frequency outcomes and avoiding converging results as the feedback loops evolve over time.

Conclusions

- A conventional concert setting was less than ideal in terms of presenting the ideas the work was based on.
- There were too many unknowns involved in the presentation setting, and this combined with a concert format which assumes a fairly concise and structured work resulted in a lot of pressure to create something ‘interesting’, in a very short timeframe. In terms of *textility* the balance was shifted too far towards a situation in which a dialogue between ‘the world’s becoming’ could not be adequately developed and the work was left unbalanced.
- It seemed again that such a work would benefit best from a durational installation/performance setting which would allow for an investigation and presentation not as constrained by concert pressures/assumptions.
- It is also reasonable to conclude that this work gains nothing from being placed in a conventional music/sonic arts performance structure based on a human performer controlling the sound in real time for an audience. The work should remain closer its original realisation in which key parameters influencing the sound, such as overall amplitude and parameters of the compression system, move between randomised combinations of values in the computer system.

Work Nine: *Sho* studies (2019)

Figure 22 Sho, Rose, & Kapuscinski (2020).

Overview

Sho studies is a sound installation for laptop running Max/MSP and two or more loudspeakers. The work explores the sound of the *Sho*, a harmonium used in traditional Japanese *Gagaku* music, and is based on the thirteen frequencies and the eleven chords used by the instrument in its traditional context.

Synthesised by the computer, each individual frequency morphs between square, triangle, and sawtooth waveforms at differing speeds. This gives what is felt to be both an accurate representation of the original sound and which is further intended to create interference patterns as sounds with various harmonic spectra interact in a room.

The piece shares a common focus with the rest of the portfolio in that the nature of the work is emergent, however in order to gain a differing perspective on sonic arts and the notion of textility, the piece works with computer sound synthesis as opposed to physical objects in a room and the chaotic nature acoustic feedback.

Realisation

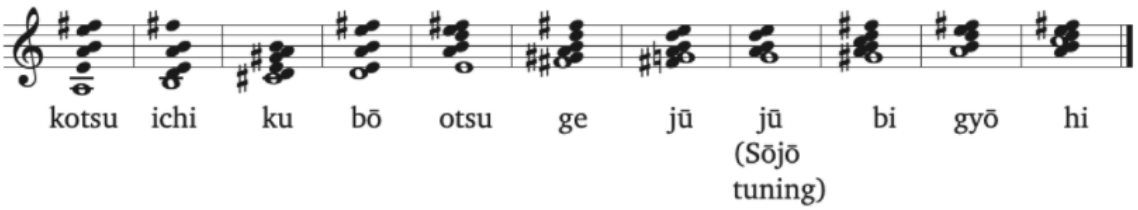

Figure 23 Sho, traditional Gagaku Chords. Rose, & Kapuscinski (2020).

The sound is structured to achieve maximum possibility for a variety of interactions between sounds in a room,

- The pitches of the original instrument morph through sawtooth, triangle and square waveforms. Each frequency moves through these waveforms at different speeds, creating complex harmonic interactions between different frequencies and room acoustics.
- Each frequency is independent in terms of volume, something not possible on the original instrument. Partial chords may be created if individual frequencies become very soft or silent. Differing dynamic relationships between frequencies result in different levels of interference and other emergent outcomes.
- Randomly triggered glissandi move individual frequencies up or down by a maximum of two octaves. This expands both the timbral and dynamic range[17].

[17] Dynamic range is affected as the register is not connected to amplitude control in the Max/MSP patch. As a result, the apparent loudness of sounds change in relation to their register.

- Multi-speaker sound diffusion creates additional possibilities for sound interaction in space. At the public presentation of this work sounds were split into two groups each of which moved independently around a four-speaker system.

The work was publicly presented at Sheffield University in 2019 at the Sound Junction concert series event. In this presentation, the work was spatialised by having two chords sounding simultaneously, randomly panning around four loudspeakers located at the corners of the room.

Observations

This work is unique within the portfolio as it tests the notion of textility in a structure not based on acoustic feedback. In place of the chaotic complexity arising from acoustic feedback loops, the work instead emerges from the interaction of multiple streams of variables such as the interaction of differing harmonic spectra, dynamics, intonation, spatial positioning within a multi speaker diffusion system, and architecture.

During its preparation the work at times seemed fairly abstract, and while it was pleasurable and quite satisfying to be able to reproduce the sound of the *sho* using computer synthesis, this in itself remained fairly dry and possibly still demonstrative.

It was not until the work took shape in the room during its presentation that there was a transition from this 'dry' state to one in which an emergent combination of sound and space resulted in an something that seemed to 'come alive'; the notion of *textility* could be observed in such moments as work was picked up and carried away in "the world's becoming (Ingold, 2010, p. 92)." These outcomes were felt particularly strongly as at first glance as they emerge from what might appear to be cold, formal-mechanical rules written in computer code. As the results of this code emerged as sound-in-space however, they in fact resulted in a very clear encounter with the notion of textility, and one which was also particularly striking as it emerges approaches the question from a perspective different to the rest of the portfolio.

Chapter 5: Conclusions

The portfolio of research artworks forming the core of this research project reflects a process characterised by Tim Ingold as an "ongoing generative movement that is at once itinerant, improvisatory and rhythmic (Ingold, 2010)." Within this process, outcomes are not demonstrative examples of a maker's initial intention in which form is simply imposed on matter but emerge and take shape as a product of the meeting and intertwining of action, and world/matter itself.

The creative works comprising the portfolio are an iterative series of experiments in which knowledge and understanding developed in previous cycles of testing and exegesis inform subsequent practical works, writings, and documentation. Each work functions a nexus encapsulating multiple research questions and solutions, while at the same time providing new points of departure as new lines of awareness, of questioning and answering, begin to appear. Stan Brakhage refers to this moment of wholeness as being when artwork becomes an 'ecology'. That "nothing should come into it that doesn't have a life in it" (Starr & Movshovitz, 1985).

Chance discoveries in a workshop setting in Germany in 2011 provided the first glimpse of how a combination of materials and methods could result in a work which seemed to 'explore itself'. The series of studies that comprised *Resonant strings* were the first efforts (at this point conducted in a wider collaborative setting) to explore prototype highly ephemeral sonic-material forms and test their responses, their boundaries, and in what context they might inhabit both sonic and physical space with each other, humans, and architecture. Subsequent works such as *Stone Garden 02* and *Warehouse wires* extended and refined these understandings, aiming to establish ways in which works based on chaotic positive feedback systems could avoid quickly escalating towards static endpoints, instead remaining in a balanced intermediate state characterised by continuously varying behaviours and their accompanying sounds.

In 2015, a transition from wire to sheet metal facilitated new possibilities for interaction ranging from a fully touch-based performance (*Ten hours of drone*) to standalone installation works (*The sound was already inside*). For the first time, external dynamics control using Max/MSP computer software was incorporated in the signal chain, revealing nuanced harmonic outcomes that were previously hidden beneath the surface in systems prone to much wilder and more extreme behaviour.

In the final iterations of the main body of work, such as *21296 sliding*, large steel sheets were used as part of an approach in which feedback energy was consider more of an 'energetic impulse'. This approach replaced any assumption that the audio transducer and contact microphone perfectly capture and reproduce the sounds we hear; they instead act as mechanical devices ringing the materials in much the same way a percussion mallet rings a cymbal, however with energy tuned to the object's particular harmonic characteristics.

Although this project centres on an examination of Ingold's notion of textility (implying a sensitivity to and awareness of intentionality, materials, and outcomes) there was an ever-present tension between the researcher's intention and many of the research findings as the practical works unfolded. At the beginning of the project there was a desire that outcomes be autonomous, stable, and portable. Such assumptions were understood as resulting from prior training in western art music, and more general cultural assumptions related to a 'white cube' gallery and fine art culture[18] in which a great deal of installation artwork 'floats' in abstract space, being ideally quite fixed, reliable, and does not require constant maintenance.

The first works such as *Resonant Strings*, *Stone Garden 02* and *Warehouse wires* were explorations led by a musician's understanding of harmonics, acoustic feedback loops, and guided by specific aesthetic ideals such as the 'purity' of the signal chain[19] and the desire for self-sufficiency. Testing focused on finding ways in which various material forms and energetic/harmonic responses could be 'brought into balance' to achieve these aims. There was an intuitive understanding that such states could be achieved, and that the work could operate stably at such a point. However, during testing and development it seemed that any degree of stability was often accompanied by dangerous levels of monotony[20]; it seemed that the works could not have both stability *and* variation.

There lay a desire, born of fleeting experience during exploration, for works to teeter on the edge of collapse; as energy levels rose and fell over several minutes the system would move through multiple energetic modes resulting in long cycles of energetic and harmonic variation.

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[18] *Inside the White Cube: The Ideology of the Gallery Space* (O'Doherty & McEvilley, 2000), and the discussion between Niklas Maak, Charlotte Klonk and Thomas Demand found in *The white cube and beyond* (Maak et al., 2011) are excellent sources of further reading on this topic.

[19] Purity in this context means nothing was to be hidden and the signal chain was 'free from intervention' from, for example, the use of complex electronics (such as compressors or limiters) or computing technologies.

[20] Any permanent static or unchanging state was felt to offer very little in terms of both ongoing research and aesthetic outcomes.

In early testing conducted in Germany, Thailand and Leeds using metal wire and loudspeakers it was possible to arrive at such states, but these situations were highly ephemeral and often involved ongoing or even continuous hands on interaction in order to sustain. For example, during testing in Thailand, long hanging sections of wire weighted with a stone would produce extremely interesting variable chordal responses, but only when they were swinging (which required putting the system into motion using touch). Another observable feature was that while frequencies generally tended towards being high (a natural outcome for positive acoustic feedback loops as energy levels reinforce themselves), when an unstable state moving back and forth between multiple harmonic modes was achieved, frequency outcomes could be chordal with multiple distinct harmonics over a wide range at medium dynamic levels. These kinds of sonic outcomes were felt to be ideal; the task (at the time) lay in exploring how to achieve these states (a balance of energy and materiality) in a way which would allow the pieces to function as autonomous installations.

The early investigation based on metal wires and loudspeakers pursued these findings in several ways. In *Warehouse wires*, much longer lengths of wire were used in combination with larger loudspeakers to test whether more massive[21] sections of wire would promote outcomes with lower, longer frequency wavelengths. Additionally, as the methodologies for interacting with the works developed, specific somatic bodily approaches were explored. During the development of *Warehouse Wires* physical activities such as sweeping the workspace each day with a broom were intended to induce states of calm, potentially achieving improved outcomes in methodologies relying on poise and an ability to reflect on relationships between intention, outcomes, and intervention. It was important to wait, even if the sonic outcomes of the works were at times harsh, and no progress was apparently being made. Much of the testing focused on attempting to try to find 'break points' on the materials which would, in combination with various amplification level settings, allow energetic responses to wander across, or teeter on the edge of, multiple harmonic modes. Touch was used, often tracing a finger along the wire, until a point was found that caused the system to alter its response. An alligator clip was then attached to the wire at that point in order to mute vibrations.

During these earlier works there was substantial development in terms of my aesthetic, particularly in relation to the acceptability of various sonic outcomes. Situations in which the

[21] Meaning both heavier in weight and longer in length.

work produced harsh (unwanted) sonic outcomes were difficult at the time and were taken as a sign that the works were not yet behaving as intended. Yet such experiences reflect directly on the notion of textility - a give and take between intention and materials – which over time led to an altering of the broader aesthetic and a more nuanced appraisal towards how research questions and findings were unfolding. The works were producing outcomes that were completely acceptable in the context of contemporary sonic art yet were not responding according to criteria which had been in the mind of the maker at the conception of the project, notions and intention which had been brought to the project from previous experience and training, and wider cultural expectations which had not yet been called into question.

The introduction of sheet metal in works such as *10 hours of drone* and *The sound was already inside* was intended to test differing methods for physical touch-based interaction with the works and at this point a choice was made between performing the objects in a manner similar to a musical instrument using continual hands on touch, or continuing the investigation along lines already established (as 'tended' installations). The latter was chosen as one of the core aesthetics, and research, aims of the project and has always remained that of finding ways in which the materials 'articulate themselves'. It was felt that a hands-on performance methodology would also become quite limited, for example by a performer's tastes, or notions of musical form.

A fundamental change that occurred at this time as the result of evolving aesthetics was a relaxing of the notion of 'purity' in the signal chain, which led to the introduction of external dynamics control. Energy levels could now be more precisely controlled, and this decision allowed the responses of the materials to move to areas that were previously difficult or impossible to achieve and opened up new sonic outcomes. The levels of energy in the system could now also be varied over time[22] to create slowly evolving variation in harmonic responses. It may appear that such changes were quite hylomorphic; attempts by a maker to reassert control over unruly materials. However, this relaxation of previous limits emerged as the result of experimentation, resulting in a more nuanced understanding of the nature of textility itself, and practice as research testing methodology that was unfolding. Applying new signal chain restrictions in fact opened up new possible responses from the works without removing their emergent and highly ephemeral nature. The works still resisted control; they lacked any sense

[22] For example, by changing the limiter settings from -25dB to -20dB over 10 minutes.

of being portable and remained unstable. The introduction of dynamics control in no way altered the working process from being one of 'feeling things out' in situ, and of hands-on exploration, as opposed to simply setting up a piece and having it repeat previously prepared behaviours.

Such struggles are a healthy and natural aspect of making *if* an open and reflective dialogue is maintained between maker, materials, and outcomes. This dialogue lies at the very heart of the notion of textility itself. However, textility is not just a relationship between a maker and the object standing before them, but something that is very strongly related to any desire and intention in relation to a work's exegesis: what is the idealised manner in which the idea should be publicly presented?

Throughout the project there was an emphasis on emergence and process, yet process was not seen as an end point in and of itself. Open ended structures requiring constant interaction were often not fully recognised as being valid 'final' states worthy of public presentation or exegesis. While being an understandable result of prior training (focused on the performance of more-or-less fixed, portable musical works), and a desire for the research works in this project to operate autonomously, meant that certain research pathways may not have been fully recognised or taken advantage of at various points in the project.

An appraisal of textility, of the interweaving of intention and materiality, needs to extend beyond the immediate object and consider how that object is situated in both space and time. The majority pieces that form the core of this project are site specific and were developed in the architectural space in which the work took place. In many cases the work is integrated into the surrounding space itself, for example metal wires in the work *Resonant Strings* are woven into the fabric of the built environment (a tree surrounded by a rope sculptural form). This is a natural result of the fundamental nature of the pieces themselves; the works are not the result of arguments decided elsewhere which are then transposed into a space, but emerge from a dialogue between object, sound, and the space itself. Their highly sensitive nature makes such transpositions impossible; the works therefore require a fundamental relationship with the space they are located in in order to succeed. Such relationships are expressed in the material forms and sonic outcomes each work eventually finds; in *Resonant Strings* the swaying of a tree alters the tension of metal wires and the resulting pitch of the acoustic feedback frequencies they are producing; *Overflowing room tones* emerges from the interaction of multiple acoustic feedback loops taking place in a room space between many loudspeakers and a single

microphone; *Warehouse wires* takes advantage of structural metal beams in a disused warehouse space.

An indication of how crucial relationships between making and space are to the project can be seen in instances where a work was attempted to be translated into a new space, rather than emerge from a process of feeling out in situ, perhaps with this 'feeling out' acting as the performance itself. *Overflowing room tones*, which functioned effectively and coherently as an installed work, fell flat when placed into a performance context with an audience. As with the installation version, acoustic relationships in the space were recorded as pre-sets, yet this took place with no audience present. Later, when acoustic relationships were significantly altered by the presence of many bodies, key elements of the work ceased to function and core ideas and relationships underpinning the work became almost unintelligible. This seemed a clear result in terms of how these kinds of works could or should be presented publicly; any attempt at simple transposition from one location to another will most likely fail; the works rely on being built 'from the ground up' in response (or dialogue with) to multiple layers of material, space, and time.

An essential aspect of these works is that they are voluminous. As with a grand piano they occupy a large area of physical space, emitting different sounds at different physical points. The works suggest, or even require, an encounter based on movement in order to fully explore them. This varies with each work; the 'hanging garden' encountered in *Stone Garden 02*, in which a participant may explore various positions inside or outside the sounding objects (similar to Tudor's Rainforest IV), differs substantially from 30 metre sections of metal wire in *Long Wires*. Encountering this piece, a listener may find themselves observing the details on a small section of vibrating wire 20 metres from a loudspeaker and negotiating with an object that effectively divides the architectural space it inhabits in two.

As the project progressed, this spatial element of the work was extended and there was a desire to work with increasingly large pieces of material. Larger materials allowed for longer distances between contact microphone and audio transducer and for longer, lower wavelengths of sound to be produced. More surface area allowed for the object to produce an array of sounds over a wide area of physical space; additionally, the object could be used to problematise spatial aspects of the room itself.

These fragile relationships between sound, materials and space are fundamental to the overall investigation and the aesthetic of the researcher. At no point, even in response to the

works (very) often confounding intention and expectations was there a desire to compromise core elements of the practical investigation by removing or in some way neutralising the responses of the materials, in favour of something that might perhaps conform more easily to artistic intention. This could have been achieved for example by making the works much more musical or relational. Amplification settings could be turned up to extreme and using a limiter this would almost guarantee a 'flat' energetic outcome within a specific range. Multiples of such an object could then be used to create interest along more musical lines. Alternatively, an approach more like a musical instrument maker could have been taken in which the objects were measured then cut and specifically tuned to produce a desired 'musical' outcome. In the opinion and aesthetic of the researcher, both approaches are too hylomorphic and any study of textility would be marginalised in favour of musical (and relational) research aims and objectives.

The relationship of the works and the notion of textility to time is a complex one. Certainly, the pieces emerge from a chaotic relationship (a positive acoustic feedback loop), in which relationships must be discovered, or uncovered, in situ. Any change in any aspect of the arrangement of the elements of the work results in a large change in outcomes. Both Stan Brakhage[23] and Brian Eno refer to this approach of working with materials and forms in terms of *gardening*.

Gardening acts as a powerful metaphor. The gardener establishes a boundaried workspace within which multiple layers of emergent complexity arise. As a project evolves, things fall inside this boundary and other outside, a situation referring to both Lucier's methodology for creation by 'taking away', and Brakage's notion of artwork as ecology. Eno characterises this 'gardening space' as being 'bottom up' - things growing upwards and outwards, as opposed to 'top-down' and the illusion of total control. The gardener responds to an intention, yet as soon as they act their materials push back with their own materiality and life force. Forms (and outcomes) are unique, collaborative, and emergent. The complexity emerging from simplicity that characterises such activities quickly moves the outcomes of such works beyond a situation in which a maker could claim credit for each small detail.

I would argue however that the activities of making, and gardening are in fact at once both bottom up *and* top down. A human agent (the maker) has a plan in mind, yet once acted

[23] Starr, J., & Movshovitz, H. (1985). *Reflecting thought: Stan Brakhage*. Denver, Colo, KRMA-TV. 19m11s

upon materials respond according to their unique nature, shifting emerging outcomes in line with "the grain of the world's becoming" (Ingold, p91). Relatively simple actions, taking place at the 'bottom' result in increasingly complex and emergent outcomes at later stages. However, a human agent then interacts with the *overall* situation and attempts to shape any emerging complexity to their own ends. To use a gardening analogy, this would mean trimming a plant or weeding the garden itself. Various aspects of 'the work', resulting both from the intention and direct action of a human agent, and a 'coming into being' of the materials/ world, is taking place at both the 'top' and 'bottom' of the activity at the same time.

The works that form this research project require constant 'tending', which is a way of making and interacting with materials that requires an ability to know when to act and when to wait. An ability to allow outcomes to emerge from the materials, and resist an urge to constantly interject, was something that developed alongside these work's emerging aesthetic as the project progressed, and as the researcher became more familiar with their various natures, their sounds, shapes, and possibilities. In works using steel plate, contact microphone attachment strategies were developed such as placing object such as matches underneath a section of the microphone's brass backing plate. Bending the microphone away from the steel surface was found to create sonic outcomes that had a much wider frequency content. Originally discovered by accident due to a microphone having gaffer tape on one side only, it was felt that deliberately creating an imperfect connection between the microphone and steel surface created a noisy outcome; the small surface where the two objects met was constantly being 'opened and closed' as the metal was in vibration. Deciding which direction in which the microphone cable hung[24] created tension in different parts of the piezo disc, again significantly altering the sound.

Another example of 'tending' the materials can be found in works using wires. In order to discover points of interest that resulted in harmonic change a finger was traced along the wire until this touch caused a change in the sonic outcome. Once such a point had been identified an alligator clip was placed on the wire in order to damp that particular node or anti-node, hopefully altering the harmonic response of the system in some way. However due to the vibration of the wire, the loudspeaker resting on it would constantly move, changing any overall relationships and necessitating the placement of other alligator clips.

[24] Should the microphone be sideways, upside down etc.

Both strategies, although known to 'work', required feeling out in the moment, and even once organised in a manner that gave a productive sonic outcome[25], were strategies that either altered over time due to the nature of the vibrating materials, or were always something that could be slightly altered or manipulated in order to see what other possibilities might arise. The situation was essentially one of, even when very satisfied with current outcomes, these needed to be let go of to explore other possibilities. A situation of 'try it and see …. if you dare'[26].

Such poise crucially relies upon a nuanced understanding of notions such as textility and hylomorphism in practice; a nuanced notion of gardening acted as a key guide in the latter stages of this project in relation to how best to act towards materials and outcomes that were simultaneously both processes and end points.

We can trace a progression of aesthetics and intention which resulted from understanding the outcomes of multiple iterations of testing; textility and hylomorphism came to be seen as aspects of making that were both in operation at the same time. To use the gardening analogy, activity takes place at the bottom and top simultaneously. Layers of intention, control, and surrender, provide clear evidence of how practice based experimental arts making methodology leads to complex new positions in terms of research findings and understandings.

[25] The sonic aims have been expressed earlier in the conclusion (long slow cycles of variation with multifrequency (chordal), wide ranging frequency output).

[26] It must be kept in mind that generally 'there was no going back' once a change had been made as the systems are too complex and chaotic to reliably recapture past outcomes. The slightest alterations almost always result in large shifts in resultant sound.

Final thoughts:

- Choice and action responding to intention are (obviously) required and inevitable.
- Choice and action should not be conflated with hylomorphism.
- The portfolio represents an evolving methodology in which the artist researcher sought ways to establish a balance between materials, intention, and form in which Ingold's notion of textility and the concept of hylomorphism may present themselves and be evaluated within a sonic arts context.
- Making, and working with, materials is give and take. In practice, during this project, the lived experience did not feel as oppositional as the notions of textility and hylomorphism may suggest. A degree of frustration, a feeling that an activity might not be 'going your way', is normal. So too is responding by trying alternative forms, structures, or controls. This does not necessarily equate to hylomorphism. Hylomorphism and textility are useful oppositions especially when related to the reading of artefacts and any tacit cultural understanding that these objects are the 'pure' outcomes of human intention. These more oppositional notions make visible and enhance our sensitivity towards aspects of making, and of reading the results of the work of others that, as Ingold points out, we have inherited as the result of the past few hundred years of western cultural history.
- Taking another look at Ingold's anecdote of kite building with students: on the tabletop the materials being worked on appear inert, in Ingold's words, "it seemed that we were assembling[27] an object" (2010, p. 95). It is not until the kites are taken outside and set aloft in the wind that they take on a life of their own, requiring a nuanced interaction as the kite and operator navigate an unfolding, emergent world. However, flying the kite in the sky seems neither a perfect example textility *or* hylomorphism, but more likely both at once. It is bottom up *and* top down. There is intention in the mind of a human agent based on previous experience with kites, and the world, as to how the kite must look, what it is to be made of, how it should be flown, and where it should be flown. In the moment the kite is sent aloft in the wind however, a human agent, object, and environment, engage in an emergent collaboration the outcomes of which if entered into as a dialogue rather than a previously conducted argument with a set of foregone

[27] This use of 'assembling' is interesting as the use of this term seems to somehow minimise or avoid the responsibility of choice, of intention/ hylomorphism.

conclusions, open up a more dynamic relationship with making; of actions, intentions, materials and outcomes[28].

- In the case of kites, when testing in an environment which is too extreme (such as no wind or too much wind), any nuanced space for interaction between the world and human agent would be severely restricted or lost entirely. The imposition of limits cannot be conflated with the notion of hylomorphism.
- In the case of the works forming this portfolio, if energy states tend towards extremes in which an acoustic feedback loop is either too immediate and static (or completely absent), there is limited space for any kind of ongoing interaction or study to take place. Textility can be observed in a situation in which positive feedback loops immediately rise out of control to a static end point, but only very narrowly (and perhaps not very interestingly).

The researcher's background has resulted in a body of work which is fundamentally interdisciplinary. This is seen as a strength; fluency in multiple ways of making and their accompanying bodies of knowledge has allowed for the creation, testing, and evaluation of problems from multiple perspectives. This is something that has, however, been accompanied by assumptions and expectations in terms of forms, outcomes, contexts, what is meaningful in terms of creative practice.

One of the major realisations emerging from this project is that the nature of these works are exploratory; highly ephemeral, emergent, and cannot be forced into the tight, often pre-packaged nature of traditional concert or gallery presentations. They must be felt out in situ, stumbled over or upon, uncovered; the works inherently require this kind of working method.

There remains an ongoing question as to what the best context for the presentation of these works might be; this must surely be a mix between installation and performance, which takes place over an extended duration, and a such for such contexts shall characterise my future research and activities in this area. One thing that has become increasingly clear over the course of this research is that outcomes cannot be imposed on materials that have been deliberately organised so as to problematise human control and agency!

[28] Of course, the obvious textility/ hylomorphism that becomes apparent when the kite is flying is also present in the making of the kite-object on the workbench.

Appendices

Appendix 1: Wood beetle (2013)

Figure 24 Wood beetle. Piezo contact microphone clipped to metal nail. Battery powered self-made audio amplifier. Audio loudspeaker. Doi Saket, Thailand 2013

Overview

Wood Beetle is a study made in 2013 during an arts residency in Thailand (the main focus of which was *Stone Garden 02*). One day in the small house where I was staying I heard a very sharp and quite loud scratching sound coming from one of the posts of the staircase. It seemed obvious that some kind of larva or beetle was inside the wood, scratching, tapping and grinding away at the material. I realised that the sonic impulses produced by the insect could be explored in the context of the larger project that I was engaged in: *Wood Beetle* is based on the idea that the sounds created by the animal moving would provide the acoustic energy needed to establish a feedback loop in which the wooden post and a metal embedded in the material transmit acoustic energy between contact microphone and loudspeaker.

Realisation

A loudspeaker was jammed into a crack in the wooden post at its base and a contact microphone attached to a metal nail embedded near the top of the post. The amplification level was set as close to the threshold where acoustic feedback would form as possible. The aim was that there should be no acoustic feedback occurring unless the system received additional energy from the movement of the insect. This was a challenging balance to achieve and relied on a combination of manual gain settings and placement of loudspeaker and contact microphone. Various microphone positions were tested, including placing the microphone into a crack in the wood, and attaching the microphone to a nail in the wood. It was found that attaching the microphone to the metal nail had a very apparent filtering effect on the resultant sound.

Observations

The idea was surprisingly successful, and technically stable in terms of being able to maintain an appropriate level of amplitude just below unity gain. This allowed energetic impulses from the insect to ring frequencies across the harmonic spectrum, then fall back to relative silence when the insect was not moving and acoustic energy was not being fed into the system. For example, the scratching sound from the insect created a short chord-like feedback response which died away again as the insect stopped moving. Depending on the strength of the movement, the harmonic response was able to ring a greater range of frequencies in the harmonic series as the acoustic impulse would contain a greater amount of energy. As a result, the acoustic response of the system was variable in both timing (when) and degree (harmonic content) which created ongoing interest.

Conclusions:

- Previous works explored a wide range of outcomes due to instability needed to be established using microphone/ loudspeaker placement, various muting techniques, and human intervention. This work provided a different perspective on the idea within the project, by establishing a state of 'ongoing change' in which the materials could explore themselves. Variation in the sound was now the result of differing levels of kinetic energy created by an animal residing inside the materials of the piece itself.
- The conceptual and aesthetic notion that the movement of an invisible, sentient animal within the work could be reflected sonically by acoustic energy transmitted through the material the animal was inside, was very pleasing.
- The nature of how the sound was made in this work sits slightly outside of the rest of the study. The materials connecting microphone and loudspeaker do not resonate. The necessary energy to set up a point of acoustic feedback is provided by the insect movement. The quality and pitch of the sound is likely therefore to result from the resonance of the loudspeaker/ microphone combination itself.

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Acknowledgement of collaborative work within the thesis

The candidate confirms that the work submitted is their own, except where work that has formed part of jointly authored publications has been included. The contribution of the candidate and the other authors to this work has been explicitly indicated below.

The candidate confirms that appropriate credit has been given within the thesis where reference has been made to the work of others.

Work One: Resonant Strings.

This work, as stated in the body of the thesis document, emerges from a sound installation workshop led by Kingsley Ash and myself, hosted by Phillip Schulze, and attended by students at the Robert Schumann Hochschule in Düsseldorf, Germany, 2011.