Listening Through Making: Artistic approaches to sound, technology and field recording.

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Abstract

This thesis draws on notions of 'thinking through making' to consider how the act of field recording reveals new ways of thinking about how technology shapes sonic experience. Within sound art practice, evidence of the act of making audio recordings is commonly removed from or aesthetically neglected in the context of public presentation or performance; sound recordist and recording technology are made invisible to the audience. Rather than concealing the act of recording, the artistic projects presented in this thesis explore methods for engaging publics in the practical activity and particular material qualities of field recording.

Three artworks are presented that employ and examine field recording practices; a musical performance (*Fields,* 2014-2018), a sound walk (*Ambulation*, 2015-2018) and a sound installation (*Ring Network*, 2016-2018). Particular elements of the making processes, the technical materials employed, publicly manifested artworks and critical reflection thereon are shared alongside a supporting portfolio of documentation and presentation details (this can be found in the appendices and accompanying USB storage device). The written component of this PhD submission offers an additional access point into this body of work and is designed to accompany rather than stand in for the practice itself.

The artworks presented in the thesis were developed in relation to a programme of 'experiments' conducted within a number of different cultural institutions. The thesis defines these experiments as an artistic and research methodology, and describes how the process allowed for multiple lines of enquiry and numerous artistic outcomes to be explored in relation to specific thematic, material and contextual concerns relating to sound and technology. The learning that emerged during the creation of each artwork, through field recording and the making activities, contributes to dialogues surrounding practice-based research and the value of artistic practice within academic contexts.

Research findings emerging from this thesis offer insight to artists and researchers interested in field recording and electroacoustic music, performance and liveness, sound and technology and making as a research methodology. To the diverse fields

of sound art practice, sound studies and soundscape research, which this research is situated within, particular themes relating to sound and technology are also addressed. They include; critical reflection of field recording and electroacoustic practices and technologies, revealing the technological characteristics of creative systems through sound, liveness in relation to digital media, the use of listening technology to extend human perception, approaching technology as a material process and making as a research methodology. Discussion of these specific themes contributes to understandings of the role of listening in art practice, anti-solutionist approaches to technology, creating arenas for attentiveness in performance and sound walking. The work presented in this thesis extends Ingold's terminology of thinking through making to working with technologies associated with sound and media art practice.

Dedication

I would like to dedicate this thesis to my parents Karen Foulds and Clem Shaw, neither of whom lived long enough to see it completed. I would like to thank them both separately for their endless encouragement and for always believing in me. I wish they could have been on this earth a little longer to celebrate its completion with me.

Acknowledgements

I acknowledge support from my supervisors John Bowers and Pete Wright. A special thanks to John who has gone above and beyond the role of a supervisor. John has provided on-going intellectual stimulation and enthusiasm as a collaborator, colleague, comrade and friend. I hope we continue working together long into the future.

In Chapter 3 I describe a number of making activities carried out with the Club Transmediale (CTM), the Pacitti Company and Tyne and Wear Archives and Museums. I would like to thank these organisations for supporting the work of this thesis. My appreciations also go out to the artists who took part in supporting the making activities with the Pacitti Company and TWAM including John Bowers, Tom Schofield and Ben Freeth.

I also acknowledge the collaboration with Sébastien Piquemal for the *Fields* project described in Chapter 4. Sébastien is a very talented web developer and musician and without him many of the technical aspects of the project would not have been possible. Sébastien built the server infrastructure and maintained the web technologies for this project. We also performed the piece together. The writing and reflections which feature in this thesis related to *Fields* were done independently by me as an artist and researcher.

Finally I would like to thank Tess Denman-Cleaver for all of her support, care, intellectual encouragement and rigor not only in regards to this thesis but in all aspects of life. None of this would have been possible without her.

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Publications

Throughout my PhD I have disseminated research through the following publications:

Journals

Hudson, M., & Shaw, T. (2015). Dead Logics and Worlds: Sound art and sonorous objects. *Organised Sound*, *20*(2), 263–272.

Conference Proceedings

Bowers, J., Bowen, S., & Shaw, T. (2016). Many Makings. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems - DIS '16* (pp. 1246–1257). New York, New York, USA: ACM Press.

Shaw, T., Bowen, S., & Bowers, J. (2016). Unfoldings: Multiple Explorations of Sound and Space. *In Proceedings of the International Conference on New Interfaces for Musical Expression*.

Bowers, J., Richards, J., Shaw, T., Frize, J., Freeth, B., Topley, S., … Edmondes, W. (2016). One Knob To Rule Them All: Reductionist Interfaces For Expansionist Research. In *Proceedings of the International Conference on New Interfaces for Musical Expression*.

Shaw, T., Piquemal, S., & Bowers, J. (2015). Fields: An Exploration into the Use of Mobile Devices as a Medium for Sound Diffusion. *Proceedings of the International Conference on New Interfaces for Musical Expression*, 281–284.

Arrigoni, G., Schofield, T., Shaw, T., & Bowers, J. (2015). Prototyping Heritage: Collections, Materials and Emerging Approaches to Engagement. In *Proceedings of the 2nd Connected Communities Heritage Network Symposium*. Heritage Network project.

Shaw, T., & Bowers, J. (2015). Public Making: Artistic Strategies for Working with Museum Collections, Technologies and Publics. In *ISEA Vancouver*.

Bowers, J., & Shaw, T. (2014). Reappropriating Museum Collections: Performing Geology Specimens and Meterology Data as New Instruments for Musical Expression. *Proceedings of the International Conference on New Interfaces for Musical Expression*, 175–178.

Chapter 1. Introduction

Over the course of the twentieth century, and in relation to the growth of audio recording and communication technology, sound art has become an established and continually expanding field of contemporary art practice. Growing recognition of sound art as a distinct mode of practice exists in dialogue with the academic field of sound studies and soundscape research. Sound art has an intertwined relationship with the development of technologies for creating, recording and broadcasting sound. This has supported on-going artistic and academic enquiry into how technology shapes the way sound is experienced and understood.

This research is orientated around the practice of field recording and sound art. Over the course of this PhD I have been engaged with the activities of recording, performing, sound walking and installing artistic work in collaboration with a variety of venues and practitioners around the world. In this thesis I explain and discuss three principal artworks; a performance (*Fields,* Chapter 4), a sound walk (*Ambulation*, Chapter 5) and an installation (*Ring Network,* Chapter 6). Each of these projects has been presented extensively in a variety of different academic and non-academic contexts over the period of my doctoral research. As I explain in Chapter 3, all three artworks emerged out of experimental making activities carried out in collaboration with an arts organisation, a music festival and a museum. These engagements facilitated collaborative practice with other artists and partner institutions. As well as images embedded in the thesis itself, in the appendices and the accompanying USB storage device I provide further documentation of each of the principal artworks including images, videos and other supporting material. Supporting material includes links to reviews, interviews and promotional materials relating to each of the works. The appendices can be found at the end of this thesis, following the concluding chapter. Building on contemporary discourses on making, this research contributes to notions of how practice-based research operates and how artistic research is conducted in relation to sound and technology.

Through diverse practical engagements with sound and technology, I have developed knowledge via direct engagement with the materials of my practice, and through the process of making and presenting the artworks detailed in this thesis. The making and presentation of the three artworks opened up a number of thematic

research concerns, which are expanded and reported on in the concluding chapter of this dissertation (Chapter 7). These include; extending the act of field recording (including framing it as a performance activity and extending perceptual possibilities for experiencing the world), creating spaces for attention in the presentation of sonic art, and examining the relationship of sound and technology and non-instrumentalised approaches to technology within sound art. I also report on my own practice-based research methodology and consider the notion of 'thinking through making' (Ingold, 2013) in relation to sound and technology. This written thesis offers an additional access point into a body of creative work and its development, but is in no way intended to replace the performance and installation events themselves.

Background

In support of this practice-based research, and in order to orientate the reader to my artistic practice and background, I provide here some contextual background to my development as a creative practitioner. In 2007 I was accepted onto a BA Music course at Newcastle University. Towards the end of a BA Music course at Newcastle University (2007-2010) I focussed my interests on studio composition, electro-acoustic composition and collective improvisation. These projects grounded my interest in sound recording, making with sound and technology and improvisation using electronic media. Through this early work I developed a technical knowledge that changed the way I practiced music and art. Prior to this undergraduate course, I composed music using the guitar and experimented with sound generation using digital audio workstations such as Logic[1] and Pro Tools[2]. Since 2010 the use of recorded sound as a compositional material has become central to my practice. During my BA I was regularly performing as a professional DJ, which gave me a broad interest and knowledge of electronic media for musical performance. For my final BA performance I used a CDJ turntable and a DJ mixer to process and manipulate field recordings, amplified objects and found sounds.

Between completing my BA in Music and beginning my doctoral research, I worked as a community musician at the Sage Gateshead[3], continued to compose electronic music and perform regularly as a DJ, and co-managed a record label (Triptik Music[4])

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[1] https://www.apple.com/uk/logic-pro/
[2] http://www.avid.com/pro-tools
[3] http://www.sagegateshead.com/
[4] http://www.triptikmusic.co.uk/

from Loft Studios in Newcastle-upon-Tyne, and began teaching at undergraduate level on the Newcastle Music BA. Through this experience my practice expanded to incorporate a broader range of technologies and experimental approaches to sound performance and installation. In 2013 I presented *The Sonic Cosmos*[5] at Newcastle City Library as part of the British Science Festival. This installation work, created in collaboration with musician Ryan Collins, artist Guy Schofield and astrophysicist Dr James McLaughlin, explored sound and the solar system and was funded by Arts Council England. I was then commissioned by the Northumberland Exchanges programme to explore the sounds of rural Northumberland through my field recording practice, developing *Sound & Seclusion* for the Victoria Tunnels in Newcastle-Upon-Tyne in September 2013. This work can be read about in detail in Hudson and Shaw (2015). Following *The Sonic Cosmos* and *Sound and Seclusion* project I began my PhD at Culture Lab in association with the AHRC funded Creative Exchange[6] project. My research set out to study how field recording changed the way people experienced the aural world. I proposed to build a number of sound installations and compositions through which this question would be addressed. These projects emerged through exploratory research and collaborations as *Fields* (Chapter 4), *Ambulation* (Chapter 5) and *Ring Network* (Chapter 6), and through their making further questions relating to field recording, sound art practice and technology are considered by this research.

Research Projects

The first project of this doctoral research is *Fields*, a musical performance that uses mobile devices as a medium for the diffusion of sound. *Fields* was developed in collaboration with Sébastien Piquemal and originally conceived at the Music Makers Hacklab during CTM festival[7] in 2014. In performances of *Fields* a complex listening environment is created through the use of numerous small speakers distributed across the performance space.

The second project, *Ambulation,* is a sound walk that uses field recording techniques and listening technologies to create a walking performance with environmental sound. *Ambulation* engages with the act of recording as an improvised performance in response to the soundscapes it is presented within. *Ambulation* emerged from a

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[5] https://tim-shaw.net/the-sonic-cosmos/
[6] http://www.thecreativeexchange.org/
[7] https://www.ctm-festival.de/

collaboration with my supervisor and the Pacitti Company[8] during two artist residencies in 2014 and 2015.

The third and final project, *Ring Network,* is a sound installation investigating the relationship between acoustic and recorded sound and networked infrastructures. It uses physical, electro-mechanical and recording technology to send sound files to different locations around the world. *Ring Network* grew out of experiments conducted in collaboration with Tyne and Wear Archives and Museums[9] (TWAM) as well as creative concerns that emerged through the making of both *Ambulation* and *Fields*.

Within the work presented in this thesis I use a variety of open-source technologies to build the artworks. The visual programming language Pure Data[10] (PD) was used as a sound engine and to process live audio in *Fields, Ambulation* and *Ring Network*. The Arduino[11] prototyping board and integrated development environment (IDE) as well as the Python[12] coding language were used in the development of *Ring Network*. A number of web technologies were used in the making of *Fields* including WebPd[13], JavaScript[14], Hypertext Markup Language[15] (HTML) and Cascading Style Sheets[16] (CSS). In each chapter I give details of how these technologies were employed.

Research Contributions

The research claims emerged through creative practice and align with my practice as a sound artist. The findings I present in this thesis are concerned with my development as an artist as well as wider dialogues surrounding the materials and approaches I have adopted in the development of my work. This thesis is aimed at both practicing artists working with sound and technology, as well as researchers operating in related sound studies and soundscape research fields. As an articulation of practice-based and artistically motivated research it also offers creative practice

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[8] https://www.pacitticompany.com/
[9] https://twmuseums.org.uk/
[10] https://puredata.info/
[11] https://www.arduino.cc/
[12] https://www.python.org/
[13] https://github.com/sebpiq/WebPd
[14] https://www.javascript.com/
[15] https://www.w3.org/html/
[16] https://developer.mozilla.org/en-US/docs/Web/CSS

PhDs students a model for explaining how thinking emerges through making and the relationship between artistic development and academic research.

Expanding Field Recording, Extending Perception and Electroacoustic Music
This PhD investigates alternative methods for the presentation of and performance with field recording. Each of the projects uses field recording as a material or approach to artistic work with sound. Field recording is a primary element in my daily artistic practice and a central concern of this thesis. Through the work presented here I describe how field recordings are usually presented in ways that render the process of making that actual recording invisible, and offer alternative strategies presenting the process of field recording itself into the work. Rather than approach the act of field recording as the movement of audio material from one place to another in this research and body of work I configure field recording as a live and embodied process. Historically media theorists have considered the act of recording to be a process of disembodying sound from its source (Schafer, 1969, Kittler, 1999 and Conner, 2000). I will argue that through the practical work presented in this thesis, I orientate recording differently as practical, embodied engagement with sonic phenomena. Within my embodied approach to situating field recording as a live act and using field recordings within my compositions, I also explore methods for extending perception through engagement with sound. Not only do I extend perception within my work though listening technologies such as electromagnetic coils and piezo microphones, I also extend perception of technical aspects of the systems I am using by configuring them as central and present within public presentation. All of the projects presented here can be understood in relation to a lineage of electroacoustic music. While electroacoustic music uses recorded and electronic sound as its principal mediums, the source of the recorded material is often abstracted from the point of presentation. I will argue that each of my works reflects and expands upon traditional and contemporary notions of electroacoustic music.

Performance and Liveness
For some academics there is an inherent tension between performance and recording practices (Auslander, 2008). In this PhD thesis I explore these tensions and demonstrate, through creative practice, how field recording can be explored in relation to a variety of different performance forms. Through my research I have developed a number of ways that liveness can be thought of and accomplished by

engaging with technological materials and responding to the characteristics of the presentation environments. In *Fields, Ambulation* and *Ring Network,* I explore the creation of 'arenas of attentiveness' within live events or the live unfolding of installation works. I also investigate the liveness of media, extending on the work of Phelan (1993), Auslander (2008) and Ascott (2003) to consider the inherent time based dependencies of machines and the systems I use in my creative practice. In *Fields* and *Ring Network* I explore the liveness of machines that are connected through networked infrastructures.

Sound and Technology

Within the broad area of sound art, field recording and other genres of artistic practice the variety of technologies employed are often instrumentalised and used to bring about particular illusory effects. In the presentation of field recordings, for example, it is common for the process and making of the recording to be inaccessible to the audience. There is often a disconnect between the practice of gathering recordings and the presentation of them. In this dissertation I present work that attempts to challenge this instrumentalisation of technology within artistic practice placing it instead as a central material within the making process and the final work. I approach this research concern through creative practice and build three pieces of creative work to investigate this area.

Making as a Research Methodology

All of the projects presented in this chapter emerged from artistic making activities conducted within public institutions. As I will demonstrate through each project chapter, approaching the research in this way provides an alternative to problem-solution models of research, whereby a question or problem is resolved through the creation of a static and generalisable solution. Reflecting upon my research activity in the conclusion of this thesis I will comment on context specific making and discuss how the making activities I engaged were conducted on site and in situ with organisations I worked within. I relate these contextualised and materially engaged activities to Ingold's idea of thinking through making, recasting his theoretical articulation to practice-based research in relationship to work with sound and technology. This is a thematic research concern and a contribution of this thesis. What follows is a model of practice-based research and a way of understanding sound and technology within these research methodologies.

Practice-Based Research

In the project chapters (4-6) I give a detailed account of the artworks through which my practice has evolved. Through exploration and experimentations in sound installations based on field recordings, spatial and participatory performance, walking, combining fixed and non-fixed media material my practice changed from the use of technology to support listening experiences to listening to and through the sound of the technology itself. Over the course of this doctoral research I moved from creating virtual listening environments constructed through soundscape compositions (e.g. *Sound and Seclusion*) to revealing aspects of particular environments, and the technologies relating to them, through sound and technology. This thesis charts the development of my artistic practice and offers reflections on work with sound and technology that emerge from that process. My current practice is situated within sound art and draws upon soundscape research, sound walking, performance making and DIY technologies. My work speaks back to these fields in its attempts to connect site and technology. I am interested in the relationship between space and sound, and also how different technologies can change our material experience of place and extend our perceptual reach.

Most prevalent in the UK, Australia, New Zealand and Scandinavia, practice-based research has become a way of approaching the study of art, design, HCI and many other fields. Christopher Frayling discusses *Research in Art and Design* as a way of approaching artistic research within academic communities that values processes and material engagement as research (Frayling, 1993). *Research in Art and Design*, which this thesis is an example of, presents a model of doing research which surrounds the artistic object with studio diaries and artist accounts of making. Frayling argues this method allows a further access into artistic methods and contributes to communication of the work descriptively beyond the presentation of artistic outcomes. More recently this approach was incorporated into the thinking of Gaver (2012) and Bowers (2012) through work in the Interaction Studio at Goldsmiths, University of London. I have expanded on such conceptions of practice-based research in relation to my own work in this thesis.

Elkins has problematised artistic research, specifically in relation to PhD research in studio-based art. In his book *Artists with PhDs: On the New Doctoral Degree in Studio Art* (Elkins, 2009), he articulates three possible models for conducting PhD

research and interrogates the role of a written dissertation within artistic research. Elkins' framework offers different configurations of how dissertations and artistic practice can relate. Elkins three models include 'The dissertation is the research that informs the art practice', 'the dissertation is equal to the artwork' and 'the dissertation is the artwork, and vice versa'. I believe, however, that Elkins' dichotomies create quite ridged structures to see practice-based research through. The research I present in this dissertation, and its relationship to the practical work, could relate to any one of the models offered by Elkins essay, and rather than subscribing to his distinctions between academic endeavour and artistic practice, a hybrid version of his definitions would resonate most clearly for my own work.

In this thesis I offer technical, aesthetic, historical and auto-ethnographic (Ellis, 2011) writing as ways of communicating particular elements of making and presentation of my artistic work. In this textual accompaniment to the performance and installation pieces I have attempted to articulate each project on its own terms. Conceptual, theoretical and technical relationships are presented in connection with each of the pieces in the project chapters (4-6). Relevant references and contexts are presented in close proximity to the practical work.

This PhD was carried out as part of The Creative Exchange (CX), a Knowledge Exchange Hub for the Digital Economy supported by the UK Arts and Humanities Research Council. CX incorporated Newcastle University, The Royal College of Art and Lancaster University. Through interdisciplinary research collaborations, CX aimed to explore new areas of development in 'knowledge exchange' and 'digital public space', as well as investigate the nature and value of practice-based, collaborative research. CX attempted to exemplify a new model of PhD by facilitating cross-institutional collaborations and practice-based research. Over the course of my PhD, and as a responsibility to stipulation set out by CX, I worked in collaboration with a number of academic partners, cultural organisations and non-academic practitioners. Within this thesis I also provide a critique of the context in which my research was conducted, offering alternative ways to consider the outputs and value of artistically motivated practice-based research.

In the following chapters I give an overview of related work (Chapter 2), explain the experimental process through which the central ideas of my research emerged

(Chapter 3), and provide dedicated chapters for each of my research projects (4, 5 and 6). Thematic links between these creative works, a discussion of the learning that emerged from and a breakdown of my research contributions is discussed in Chapter 7, which ends with a review of potential future applications and further research based on my contributions.

Chapter 2. Contexts

In this chapter I contextualise my work and highlight key artistic and academic references that inform and support reflection upon my own practice. The artistic contexts I discuss in this chapter are those that are directly relevant to my own artistic research and, as such, I offer here only one perspective on a range of rich fields of practice, each of which would require a dedicated thesis to fully explore their nuances and histories. I would also like to add that I did not necessarily know all of these areas before beginning my practice. Many of these sources were discovered through the presentation of my work, through supervision meetings, informal conversations, Internet searches and complete coincidences. Some of the practitioners I mention in this chapter I have personal affiliations with and have made creative work with. The aim of this section is not to present a complete history of the areas discussed, rather to present how I contextualise my work and the key areas it relates to.

Sound Art, Sound Studies and The Sonic Turn

Sound Art. In this thesis I have used the term sound art to describe my practice-based research. For some artists and curators, sound art is a contentious term. Often used to describe work whereby sound is the primary focus, it is a phrase some artists, critics and curators have resisted. Artist and musician Max Neuhaus ridicules the term, arguing that to define work as sound art makes as much sense as coupling steel sculpture with steel guitar music and calling it 'steel art' (Neuhaus, 2018). Brandon LaBelle also problematises sound art in his book *Background Noise: Perspectives on Sound Art* stating that sound art holds an 'unsettled place within artistic institutions' (LaBelle, 2006, p. 153). Despite such criticism, sound art can be a useful way to describe a heterogeneous set of practices and aesthetics. It distinguishes particular artworks and processes from music, though again this distinction has been disputed. Sound art as a description of a field of practice can be a helpful way to plot the progression of the use of sound within the arts. In my own research I have looked at the development of sound art practices through the twentieth and twenty-first centuries. Whilst acknowledging the limitations and problematic implications of the term, I recognise my work within a lineage of artists creating work I refer to as sound art. I draw upon this lineage in my research to elucidate particular characteristics of my own work with sound.

Celebrated media scholar Marshall McLuhan defined the difference between acoustic and visual space in a number of articles written with Edmund Carpenter between 1953 and 1959 (McLuhan and Edmund, 1958, p. 65). McLuhan and Edmund argued that the written word, made ubiquitous through the development of the printing press, reshaped the world as silent and prioritised visual communication mediums more broadly. According to McLuhan, the development of radio and recording technology made the electronic world aural again (Ibid. p. 69).

R. Murray Schafer argued that the term "acoustic space did not attract critical attention until the World Soundscape Project was established at Simon Fraser University in 1970" (Schafer, p. 88, 1985). In 1977 Schafer published *The Tuning of the World*, a hugely influential work that triggered wider interest in sound studies, soundscape research and encouraged awareness of listening as a particular and creative practice. Schafer maintained a field recording practice and was politically active with regard to noise pollution and the urban environment (Schafer, 1977, p. 88). His research team based at Simon Fraser University in Vancouver City conducted research in ambient sound, recording soundscapes, architectural spaces, and the sounds of industry and wildlife. Other practitioners associated with the movement Schafer shaped and promoted, such as Hildegard Westerkamp (Westerkamp, 2015) and Barry Truax (Truax, 2001), are still academically and artistically active to this day.

Sound Studies. Sound studies' heterogeneous approach to researching phenomena and significances of sound provides a holistic alternative to more limited models of listening. The Shannon and Weaver model of communication, for example, formulates listening, through electronic means, in such a way that the listener is framed as having no extended encounter with the sound 'object' prior to the moment she or he receives it (Shannon and Weaver, 1949, p2). In this model there is a clear distinction between the message, the transmitter, the signal and the recipient who receives their version of the original message. The Shannon and Weaver model can be used to demonstrate the engineering concept of transmission and reception and how people communicate either successfully or otherwise. This model provides a rigid and convenient framework for articulating the reception of sound, whereby sound is sent, carried and received in particular formulaic ways. Other studies within

psychology and information processing also place listening in this rather dualistic model of encoding and decoding. Osgood-Schramm's Model of Communication is one example (Osgood and Schramm, 1954). Sound studies offers an understanding of listening as a way of creating meaning and generating knowledge. The generation of knowledge through listening, and practices of 'listening through making', is fundamental to me relationship with the field of sound studies.

Anthropologist and electro-acoustic composer Steven Feld made numerous field recordings of the Kaluli tribe in Papua New Guinea. In his book *Sound and Sentiment: Birds, Weeping, Poetics, and Song in Kaluli Expression* (Feld, 1990), he describes his experience of living with this community, to which – Feld learnt - listening is central to language and communication. Feld also describes how the Kaluli tribe describe birds by song and consider birdsong to be central to the origins of human music. Whilst in Papua New Guinea Feld collected field recordings of the tribe doing everyday activities such as cooking, hunting and building as well as singing and participating in musical activity. He found that whilst trying to analyse the recordings applying a Western musicological study to the Kaluli sounds did not allow for the nuances of their music, and its relation to environment, to be articulated. Through this research Feld developed practices now referred to as sound anthropology or acoustemology (acoustic epistemology), a way of considering sound without being encumbered by the limited analytical techniques relevant to Western musical structures. Instead of imposing foreign musical structures on the musical practices of the Kaluli tribe, Feld considered the music on its own terms and in relation to its own contexts. Feld also developed a unique way to process his material. Instead of approaching sound editing in the standardised way (i.e. in a studio, away from the point of recording) he would sit, analyse and edit with the Kaluli people in their own environment. He called this dialogic editing, a practice in which he edited text and audio recordings in response to reactions and discussions with the Kaluli community. Dialogic editing can be understood as a form of thinking though making that allows for a number of people to engage directly with in the process of making field recordings. In an interview in *In the Field: The Art of Field Recording* Feld states that "recording [is] a way of amplifying experience" (Lane and Carlyle, 2011). For Feld, recording is a way of making palpable the experience of listening and what it means to hear, and amplifying sound is a way of sharing, connecting and collaborating in that process.

Sound studies has an openness towards different types of practice and situates listening as a primary activity within many different disciplines. Within sound studies, listening is a way of generating knowledge. I approach the making of the art works in this thesis with a primary focus on sound. Feld's approach to conducting academic research through non-visual means has affinities to the research I will describe in this dissertation. His dialogic editing process has similarities to thinking through making and demonstrates an openness to the process of making and how this makes its way into the presentation of work.

Sonic Turn. During the mid 1990's, within what has been described as the 'sonic turn' (Kelly, 2011, p.18), a larger cultural shift towards an emphasis on sound was evident. It can be seen in the emergence of fields such as sound studies, sonic architecture and sound anthropology, which were growing within academic institutions around the world (ibid. p. 28). During this period a number of national galleries, including Hayward Gallery, Tate and Museu d'Art Contemporani de Barcelona (MACBA), presented exhibitions that had an emphasis on sound and listening (ibid. p. 34). My artistic practice is referred to as sound art throughout my research. It is a term I use in the everyday to describe what I do, and also which curators and audiences commonly use to describe public presentations of my work.

The increased interest in presenting sound art within mainstream museums, art galleries and other institutions as well as the proliferation of niche programmes has supported the development of my own practice and the progress of this research, which has been developed through extensive public performance and exhibition. My work is consistent with and can be understood in relation to the recent sonic turn across research and art practice and curation. The projects I describe in this thesis are presented in relation to sound art practice, discourses on listening, and sound studies as well as making reference to musical and performance practices.

Listening. Listening is key to my artistic endeavours, from the methods I use to extend perceptual possibilities in *Ambulation* and *Ring Network* to the listening practices supported by the performances of *Fields.* In his 1983 book *Imagined Communities,* Benedict Anderson uses the term 'unisonality' to describe collective listening experiences. He uses the example of ancient customs of singing as sonic

methods of bringing communities of people together as listeners, as well as noise producers (Anderson, 1983, p. 145). Sound studies configures a discourse around the politics of listening and includes various modes of sonic practice that encourage awareness of how sound is experienced in everyday life. Still referred to as a so-called 'emerging field' (Hilmes, 2005, p. 115), sound studies has been described as a multi-faceted research area that encompasses music, technology art, design, musicology, epistemology and sociology (Sterne, 2012, p.10). Within sound studies acts of listening are the principle activity of the disciplines it contains (Sterne, 2012 p. 18). Feld has made public critiques of the term 'sound studies', calling it an attempt to market rationalize and commodify the study of sound (Feld, 2015, p. 1). He argues that ninety-five percent of sound studies is actually "sound technology studies" and the majority of that is conducted by Western academics (ibid. p. 1). For Feld sound studies objectifies sound for a neo-liberal educational gain.

"*Listening implies a preparedness to meet the unpredictable and unplanned, to welcome the unwelcome.*" (Westerkamp, 2015)

Westerkamp, whose practice I will describe in more detail shortly, describes listening as a way of accepting uncertainty. This idea of uncertainty has been very productive for me over the course of this PhD. I use elements of chance and uncertainty in each of the projects described in chapters 4, 5 and 6, and I unpack this further in chapter 7. There is also a more general comment here about practice-based research, or all forms of creative research. Like many forms of creative research, the practice-based research presented in this thesis is inherently uncertain. Prior to the making process it is not known exactly what the work will look and sound like, how it will behave and what interesting aspects will emerge from it. I think it is important to accept this uncertainty as a productive character of this type of research. As sound studies is a way of appreciating listening and listening is a way of accepting uncertainty, then it makes sense for my PhD research to operate in this area.

Field Recording, Soundscape Research and Electroacoustic music
Field recording is an ever-growing artistic practice and has a well documented and researched lineage. Canadian artist Hildegard Westerkamp uses field recording and walking to create compositions that offer perspectives on listening, time and experience of place through sound (Westerkamp, 1974). Westerkamp was an original member of the World Soundscape Project, working alongside Schafer.

Kobler describes how Westerkamp's *Kitts Beach Soundwalk* uses recordings of a beach in Vancouver to demonstrate the tensions between recorded sound and 'non-mediated' listening (Kolber, 2002). *Kitts Beach Soundwalk* is a soundscape composition which consists of field recording, studio processing and a recorded voice over. The piece begins with 'natural' field recordings of the beach, sounds soon become manipulated using a variety of processes and the listener is transported to an abstract sound world. The composition consists of her revealing, through a spoken narrative and various studio techniques, the editing and processing possibilities of field recordings when they are taken out of their 'natural environment' and into a sound studio. It was originally conceived as a radio broadcast for Vancouver Co-operative radio and then developed for installation in the Vancouver Art Gallery in 1989 (Westerkamp, 1989).

Barry Truax and R. Murray Schafer researched and developed approaches to environmental and recorded sound through a variety of publications (Truax, 1984, Schafer, 1970) and compositions. Truax maintains the World Soundscape Project archive in Vancouver at the Simon Fraser University, which I visited in August 2015 as part of this research. The archive contains many of the original recordings made during the 1960s and 70s by the founding members and their community. The physical archive remains and many of the items are also now digitised and available through a private server. The World Soundscape Project initiated and continues to support ongoing dialogue around field recording practice and soundscape research. Around fifty years after the World Soundscape Project was founded this area has grown to include the practices of many musicians, artists and practitioners engaged with sound and DIY culture more broadly. The influence of the World Soundscape Project can been seen in programmes such as Music Hackspace[17] (London), which runs workshops on extended sound recording techniques and technologies led by artists such as Martin Howse[18], Phantom Chips[19] and Johann Diedrick[20]. I was invited to perform *Fields* and present an artist talk at Music Hackspace in 2015.

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[17] http://musichackspace.org/
[18] http://www.1010.co.uk/org/
[19] http://www.phantomchips.com/
[20] http://www.johanndiedrick.com/

Chris Watson[21] is one of the world's leading figures in contemporary field recording. He conducts extremely high quality recordings and presents them in a variety of contexts, including art exhibitions, television and film and participatory walks and workshops. In 2015 I worked with Watson on a project entitled *Tuning In, Listening Back in Time* which explored sound in relationship to World War One and was presented at The Discovery Museum in Newcastle-upon-Tyne. Since this work we have collaborated on further projects and programmes including a residency at CAMP[22] in France and a workshop in ambisonics[23] at Newcastle University. Watson's approach to field recording and the technologies he adopts have influenced aspects of my own practice and research. A recent work of Watson's creatively approached the sounds of Newcastle's Town Moor and re-presented them through an ambisonic sound system in the Tyneside Cinema, Newcastle-upon-Tyne (2016). Watson's approach often intends to transport the listener from the presentation or exhibition space to the place in which he first recorded the sound. These are not always real places; in his piece *Hy Brasil*, for example, Watson presented recordings from his archive from around the globe to create "a mystical island" (Watson, 2014). Even within this fictional island, however, Watson used his recordings to construct a world, and by doing so enable the listener to experience a different time or place to the immediate physical context of the work's presentation.

Within much of Watson's work field recordings are a material that are transported from one context to another, from the site of recording to the space of presentation. I have also conducted artistic work with field recordings in this way. My 2015 piece *Sound and Seclusion* brought field recordings from around Northumberland into the Victoria Tunnels, a subterranean space below the Ouseburn Valley in Newcastle-upon-Tyne (Hudson and Shaw, 2015). This method of transporting sound from one site to another is one of many possible configurations for the presentation of sonic art. As articulated by Wright in his PhD thesis *Contact Zones and Elsewhere Fields* (Wright, 2015) this approach to presenting field recordings has been conducted for many years. Wright cites Schafer and Watson as examples of this "transportation" approach to the use of sound (Wright, 2015, p. 41). Wright's thesis challenges 'traditional' approaches to field recording practice and questions the politics of such

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[21] http://chriswatson.net/
[22] https://www.campfr.com/
[23] https://www.ambisonic.net/

practices. Francisco Lopez has also challenged this type of approach, he states that the presentation of field recordings are often in pursuit of realism (Lopez, 1998). He criticises approaching the collection and presentation of recordings in this way, describing that every microphone 'hears' in a different way. Lopez claims that his pieces involving field recordings have the right to be presented in an 'unrealistic' and non-virtual way (ibid.).

In the work presented in this thesis, I configure the practice of field recording in such a way as to challenge the notion that recorded sound is just a transportable material that can be severed from both its original and presentational contexts. I argue here that my relationship with the sonic material is much more complex, it is transformed, juxtaposed and listened to afresh within the presentation space. This is a move away from simple forms of encoding and decoding more common in traditional models of communication. With *Fields*, for example, I created a performance that shaped a unique space for listening to soundscape and electroacoustic material that is context specific to the technologies used in the composition and presentation of the work. In *Ambulation* field recording techniques and technologies are used in a live, improvised performance walk that offers audiences an augmented experience of their immediate context. My research therefore speaks to traditions of field recording practice by challenging the implications of practices that intend to transport sound from one site to another. Bruno Latour discuss' the idea of 'immutable mobile' in his essay *Visualisation and Cognition: Drawing Things Together* (Latour, 1986). Here he describes how through various advances in communication media, pictures, for example, can be interpreted in the same way in very different contexts. Here the image becomes *immutable*, many copies of the same image can be produced, but simultaneously *mobile*, things can be mobilised and distributed in ways which were previously impossible (ibid., p.10). The distribution of information through an immutable mobile, such as a map for example, enables affiliation building around that particular piece of information. Latour argues that a map can have large discrepancies and through rapid distribution, concepts, whether discrepant or not, are accelerated between agents and communities (ibid., p.13).

'If the painter's job had been no more than fabricating likenesses, the invention of the camera might indeed have made painting obsolete. But painting is hardly just

"pictures", any more than cinema is just theatre for the masses, available in portable standard units.' (Sontag, 1996, p. 33)

Electroacoustic Music. Throughout the twentieth century, and in relationship to the development of audio recording technology, electroacoustic music has emerged as an approach to the composition and performance of electronic music (see Bowers, 2012 and Emmerson, 2007). Electroacoustic music was originally defined by its use of recorded sound as its primary material and its compositional rejection of the theoretical and harmonic structures of Western classical music. Simon Emmerson describes electroacoustic music more broadly as "music heard through loudspeakers or sound made with the help of electronic means" (Emmerson, 2007, p. 68). From the early experiments of Schaeffer and Henry in the Groupe de Recherche de Musique Concrète (GRMC) in the 1950s, through to contemporary composers such as Laurie Spiegel[24] and Kaffe Matthews[25], the term electroacoustic music acts as a banner under which many different types of electronic sound practices operate.

Field recording and electroacoustic music often go hand in hand. Electroacoustic music has its infancy in the creative appropriation of recorded media and many electroacoustic composers straddle both recording and compositional practices. Many soundscape researchers, such as Barry Truax, have also engaged with the composition and performance of electroacoustic music.

My own artistic research projects extend the lineage of electroacoustic music and contribute to associated research. *Fields* uses a bespoke sound diffusion system to play back field recordings and synthesised sound across a performance space. *Ambulation* uses electroacoustic methods and listening technologies to manipulate sonic environments through a live performance walk. *Ring Network* creatively appropriates live recording technology and acoustic bells in a generative sound installation.

All of the projects presented here welcome uncertainty and unpredictability, in this work I am trying to move away from the presentation of fixed media, something which is common in the presentation of electroacoustic performance and composition.

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[24] http://lauriespiegel.net/
[25] https://www.kaffematthews.net/

Performance and Liveness

Artist Allan Kaprow developed 'happenings' as part of the post war avant-garde movement in New York during the 1960s. Kaprow's way of approaching performance expanded the possibilities of performance-based art. These events often happened in public space, outside of places usually associated with artistic activity. Some scholars believe that Kaprow's performance works in New York seeded the beginnings of what is now known as performance art (Joseph, 2004). This is a performance practice that stretches beyond theatres and auditoriums. To fully review performance art would go beyond the remit of this thesis, so let me concentrate on how performance art opened up possibilities for live work to be shown in spaces not historically connected with performance.

Peggy Phelan overtly politicised performance practice in a number of essays published since the early 1990s. She writes in her book *Unmarked* that performance "cannot be saved, recorded, documented, or otherwise participate in the circulation of representations *of* representations: once it does so it becomes something other than performance" (Phelan, 1993 p. 21). For Phelan this is what makes performance unique as an artform: its temporality and consequent refusal of the commercial art market. Though Phelan rejects recorded media in performance, she does write about performance, without commenting on the technology of writing as a form of recorded media. Phelan's writing on the relationship between recorded media and performance is in direct opposition to Phillip Auslander, who claims that it is precisely mediation that creates the performance event (Auslander, 2008). Auslander has written extensively on how new communication technologies change the way liveness is perceived and experienced, claiming that liveness is completely entangled with recorded technology (ibid., p. 113). Recorded technology makes *non*-liveness a possibility and therefore a need for liveness emerges, a desire for the authenticity of the present moment grew out of the twentieth century's changing relationship to recording and broadcasting possibilities (ibid., p. 28). These two opposing views of performance and liveness, posed by Phelan and Auslander, hint at the complex spectrum of opinion that occupies the field of performance practice and research in relation to recording technology and liveness.

Auslander has shown that liveness has been understood differently in relation to different practices and at different points in the history of performance. He argues

that the rise of recorded media makes liveness necessary. Once recording a performance is possible, the non-recorded version of that performance is expressed as being live. Auslander identifies that notions of liveness become more complex in relation to digital technology. If liveness is something that has been traditionally understood as something which shares temporal and spatial frameworks, then what does this do to a live radio broadcast of a football match? The perception of this, as a listener, is that you are experiencing the football match, as it happens, but in the comfort of your car. And what about a live recording? A live recording, presumably, is to be experienced in a different place and a different time to the original performance of that recording. What does the limitation of recorded media do to this experience? And what does the asynchronous nature of a network, as explored in the work of Ascott, do to the temporal means in which the thing is live?

Nick Couldry has explored liveness as a social construct in relationship to digital media, specifically the Internet and the mobile phone, in a number of essays over the last two decades. He proposes two new forms of liveness within social contexts around these new communication technologies: *online liveness* and *group liveness.* *Online liveness* takes the form of Internet chat rooms and news sites which give a continuous flow of information such as breaking stories or new chat threads. This type of liveness involves a 'social co-presence', it allows for multiple voices to be transmitted and received simultaneously without interfering with one another (Couldry, 2004). *Group liveness* is a service or facility which enables groups of people to immediately stay in touch with one another even if they are dispersed in different physical locations, a contemporary example of this would be group messenger applications such as *WhatsApp, Facebook Messenger* or *Slack.* Here the liveness isn't formed through temporal co-presence or the continuous stream of real time data, it occurs through the technological possibility for immediate social interaction between people who are physically disparate locations around the world.

The concept of liveness has also been extended within the NIME proceedings by a number of academics since 2012 (Berthaut, 2015, Bown, 2015 and Nash 2012). These accounts of liveness, though interesting, usually address how audiences perceive the liveness of performance materials or how to design musical interfaces to bring a 'rewarding' interaction for performers (Tarakajian, 2013). In this thesis I am addressing liveness in direct relationship to field recording practices and to the

presentation of sound art. In *Ambulation* (Chapter 5)*,* I present field recording as a performance event. In *Ring Network* and *Fields* (Chapters 6 and 4) I discuss the liveness of the media through which I present the artwork, I propose latency as a live, creative material which is subject to change depending on the environmental conditions of the presentation venue.

Improvisation. Improvisation has as a long and complex history within performance practice and musical tradition. Improvisational practice was a point of contention for some philosophers and musicologists during the rise of jazz music in the first half of the twentieth century. Theodor Adorno wrote texts that challenged the value and legitimacy of jazz music in the thirties, claiming that this form of improvisation is mere mimicry. 'His improvisations come from the pattern, and he navigates the pattern, cigarette in mouth, as nonchalantly as if he had invented it himself' (Adorno, 1936). Adorno positions improvisation in a particular dualism with the European classical music of Beethoven and Mahler (Bowers, 2002). Positioning an improvisational practice in relationship with electroacoustic music is an approach discussed in recent academic texts by Bowers (2002), Ciciliani (2014) and Magnusson (2014). These papers describe electroacoustic improvisation and interface design, drawing on experiences of musical performances generally conducted by the authors using self-made instruments and interfaces. Since the mid-2000s live coding has emerged as a way of approaching laptop and electronic music through improvisation. Live coding is a computer generated music that uses coding languages to perform sound and visuals. Most live coding is improvised, with performers rarely following a predefined score (see McLean, 2012 and Magnusson, 2014). Live coding is a growing field of performance and music composition demonstrated through the increased popularity of *Algoraves* in recent years. Though I do not present work through live coding performances, some of the findings emerging from *Fields* (Chapter 4) and *Ambulation* (Chapter 5) offer insight into how improvisational practice can relate to computational supported performance. By creating artworks which are flexible and changeable depending on the presentation environment, these pieces offer a perspective on the design and making of performance systems for improvisation.

Many artists and composers have used chance as an improvisational strategy for generating artistic decisions during performance events. Expressly not identifying with improvisational practice, John Cage experimented using the *I Ching,* dice and

coins to generate random results. He used the outcomes of these methods to form the basis of live performances and compositions. These compositions embraced indeterminacy and uncertainty but Cage did not identify with an improvisational practice and encouraged performers of his work to steer away from it (Feisst, 1987). Though Cage used chance methods as a way to free decisions made by the composer, to avoid preference of taste or memory, in reality there were quite intensive structures which determined the outcomes (Jenson, 2009). In *Music of Changes* every other aspect of music, apart from the linear organisation of the composition, was decided and determined by Cage (ibid., p. 98). In his later work, the technical systems Cage used to generate chance were actually designed by other practitioners, and it is debatable how much he knew about the technical interactions within these systems. Cage used chance in a number of collaborative works with choreographer Merce Cunningham. In *Field Dances* (1963) performers could choose a selection of movements from a set of instructions formulated by Cunningham. Cage's *Variations IV* accompanied the performers' movement, however interaction between sound and movement was left completely to chance, allowed to unfold over the period of the live event. In work of this nature, either improvised or incorporating chance as a compositional device, the performance is not predetermined prior to the performance event and liveness is as much a part of the composition as it is the audience experience of the work. In an interview describing his collaborative work with Cunningham, Cage draws on Duchamp's notion that the work is completed by the observer rather than the artist. Cage describes how, in his work involving dancers, the audience members creates a unique, perceptive triangle between the dancer, the sound and the individual observers experience. It is only at this point, Cage argues, that the work is complete (Cage, 1981).

Tetsuya Umeda is a Japanese sound artist who presents work through live encounters and performative installations. In 2015, I supported Umeda at Café OTO in London. In this performance he used everyday objects to build an installation within the music venue. A small fan, motors, drips of water, butane stoves, pieces of paper, pendulums and film canisters made up a sounding performance environment built over the course of the live event. During his performances Umeda navigates the space attending to different objects and instigating a set of catalytic – and sound emitting - events. For Umeda, as well as artists such as Darsha Hewitt, Martin Howse and Ewa Justka concerns surrounding liveness and performance can be seen

originally in practices such as Cage's but continue to be explored within the field of in sound art.

Beyond performance and sound art, liveness has been addressed within the fields of design and human computer interaction (HCI) by researchers in media, computing science and art (Hook, 2012, Schofield 2016 and Maloney, 1995,).

Ring Network, Ambulation and *Fields* all use chance as a compositional device and indeterminacy features as a productive element within the composition and presentation of the work. As I will go onto describe, each work exists as an iterative process, within which the live event is integral and each performance is understood as one version of the composition.

I recognise my practice within a lineage of sound art and improvisational practice. *Fields* (Chapter 4) and *Ring Network* (Chapter 6) experiment with the liveness of media through performance and installation events. In Chapter 5 on *Ambulation* I describe a performance work that was presented in the public space of host cities, and consider how this project contributes to understandings of live performance as environmentally responsive.

Sound and Technology

From the early sound recording experiments of Edison and the environmentally responsive noise instruments built by the Futurists (Russolo, 1916), artists and creative practitioners have always used recording technologies to explore new sound making possibilities. Technology continues to play an important role in the development of the disciplines within which I have contextualised my own practice, particularly sound art, electroacoustic music and field recording. The development of electronic sound, including the possibility of recording media, emerged in the late eighteenth century and continues to change in relation to technological advancement today (Fowler, 1967). Throughout the twentieth century sound recording technologies have been used and appropriated by sound artists and musicians. According to Moulon sound art is "particularly appreciated within the digital arts community" (Moulon, 2017, p. 67). Moulon goes onto describe how sound has become considered an artistic medium in its own right, with the CTM festival, where *Fields* (Chapter 4) was initially developed, being at the heart of research relating to "emerging technologies" and sound (ibid., p. 67).

Since 2001 the New Interfaces for Musical Expression Conference (NIME) series has brought together researchers interested in music, sound and new technological possibilities. Growing out of a workshop at the Conference on Human Factors in Computing Systems (CHI), NIME offers an annual event of papers, posters, demonstrations, performances and installation for artists and academics interested in sound and technology. NIME's programme broadly questions how technology changes musical and sound art practices (Jensenius, 2017). I have published my own research, including elements of the projects presented within this thesis, through the NIME conference (see Bowers and Shaw, 2014, Shaw et al., 2015, Shaw et al. 2016, Bowers, et al. 2016). The breadth of subjects covered by the NIME programme is testament to the growth of interest in the relationship between technology and sound practice.

Since the mid-1990s communities of practitioners interested DIY culture and music making have continued to grow through initiatives that encourage DIY approaches to music technologies (Richards, 2013). Building bespoke instruments and interfaces for musical and sound making expression has been the activity of predominantly non-academic communities and is evident in the rise of institutions such as STEIM[26] and Music Hackspace. These new contexts for making can embrace an openness to technology engagement and allow for unique and bespoke hardware and software to be built. Many of the practices associated with these communities tend to reject 'virtualness' and are more concerned with 'material engagement with arts and crafts approaches' (Richards, 2013). Through the work presented in this thesis I offer some perspectives on making with technologies associated with sonic art, which have affinities to the communities surrounding DIY culture and music making. Through this research I not only offer insight into the artworks I have made, I think about approaches to making in relationship to studies of material culture which I shall shortly review.

Over the last sixty-five years sound technologies have dramatically changed the way music is consumed and experienced (Pinch, 2004). More readily available mobile sound recorders, such as the Nagra IV, allowed for Schafer and other members of the World Soundscape Project to experiment with the collection of sound outside of

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[26] http://steim.org/

studio contexts. The research presented in this thesis bridges field recording and electroacoustic practices with an engagement with new technologies associated with sound art and DIY communities. Building on the work of Bowers and Richards this thesis extends the practice of field recordings and relates it to DIY and maker communities.

Forms of Making

"The search for truth is more precious than its possession" (Gotthold Ephraim Lessing, circa 1750)

Throughout this dissertation I draw on Tim Ingold's notion of thinking through making to configure and articulate my artistic research methodlogy and the learning that emerges from projects presented in this thesis. Ingold asserted the importance of making as a topic in anthropology, archaeology, art and architecture (Ingold, 2013). His work adds to a growing discourse on how practice-based research operates and what its methodologies offer to a diverse range of disciplines and fields. Ingold's work in *Making: Anthropology, Archaeology, Art and Architecture* describes how learning emerges out of direct, responsive engagement with physical materials (Ingold, 2013 p. 6). 'The practised woodsman brings down the axe so that its blade enters the grain and follows a path already incorporated into the timber through its previous history of growth, when it was part of a living tree' (ibid., p. 45). This thinking can be extended to working with sound, and supports a consideration of the materiality and contextual nature of sound. Christopher Small's *Musicking* (Small,1998) argues that historically music has been defined by individual static works or composers, rather than experientially as acts of listening, making or performing. Small's concept of *musicking*, like Ingold's *thinking through making*, is an active, practice-based understanding of what music is and does.

Drawing on Heidegger, Ingold describes a profound difference between 'objects' on the one hand and 'materials' and 'things' on the other. Through an examination of the lived practices of 'makers' including painters, basket makers and musicians, Ingold argues that we can approach artefacts, or things, as *materials* that have inherent potential, rather than objects that have fixed cultural meaning. Ingold describes things as having "perdurance" (Ingold, 2013, p. 102), which he defines as 'the carrying on of material through time'. Rather than thinking of things as static, Ingold

considers our relationship to materials to be one of correspondence. Through Ingold, making is understood as a means of correspondence between maker, material and context. In my work, the intention was to configure materials, technologies and sites to find new ways that they could be understood, presented and engaged with as materials rather than objects by artists, makers and audiences.

Both Small and Ingold contribute to a growing interest in research that recognises how knowledge is acquired and affected through processes of making and in reciprocal relation to materials, places and people. These models of research challenge notions of knowledge as static and transferable more familiar within Western academic practice. Changing ideas about how research is carried out and the character of knowledge generated through different methodologies is changing the nature of study in a number of disciplines. Science, Technology and Society (STS) is a research area which empirically reflects upon how knowledge is practically produced (Latour, 1987). This can also be seen in the growing interest for new models of PhD research, described as 'practice-based' and carried out in collaboration with non-academic organisations and 'outside' practitioners. As a condition of my PhD funding, Creative Exchange expected my research to have a direct impact on the creative and cultural industry. Additional funding was offered by CX to support collaborations with companies and 'outside' practitioners.

Though Ingold is frequently referenced in the academic making community, for example he was an invited keynote at the technologically oriented Research Through Design[27] conference in 2015, he personally does not relate his research to the study of digital technology. When discussing the relationship between maker and material, Ingold's sense of material could be described as traditional, frequently referring to wood, metal, and stone rather than digital media or materials associated with contemporary technology. In *Making* Ingold makes rather negative remarks towards digital technologies, 'the values of a digitally enhanced society that ranks objects over things, mobility over movement, and the printed word over handwriting and drawing' (Ingold, 2013, p. 140). Ingold has not made an explicit connection to making in relationship to code, computer hardware, networked communication systems, recorded image, sound or other forms of digital media. My own research

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[27] https://www.researchthroughdesign.org/

forges relationships between Ingold's descriptive analysis of maker and material to the materials I work with in the creation of sound performances and technologies.

In parallel and in conversation with increased interest in making within academic communities there has also been a rise in the popularity of making in non-academic contexts. Since the late 1990s the maker movement has gained momentum with 'maker spaces' and 'hack spaces' appearing in different cities across the world (Taylor, Hurley and Connolly, 2016).

Chapter 3. Making

Introduction

The three principle artworks described in this thesis, *Fields, Ambulation* and *Ring Network,* emerged through creative activities which involved quick and prototypical approaches to making artistic work in collaboration with cultural organisations. These activities were designed to create a large number of artistic responses to specific themes set out by a museum, an arts organisation and an arts festival. The activities described in this chapter were the foundation for the three artworks that constitute my doctoral research described in chapters 4, 5 and 6. These activities took place during three creative interventions between 2014 and 2015. First, the Music Makers Hacklab hosted by Club Transmediale[28] (CTM) festival, which took place at the Kunstraum art gallery in Berlin in 2014. This Hacklab invited artists and musicians to explore sound and technology in relation to the festival's theme 'Dis Continuity'. Out of this initial making activity I developed *Fields* in collaboration with Sébastien Piquemal. Second, *Interglacial/Erratic's*, was a two part artistic residency carried out in partnership with the Pacitti Company[29] based in Ipswich and London (UK) an arts organization dedicated to supporting live art and performance, exploring artistic strategies for engaging with publics and local institutions. This residency took as its point of departure an engagement with artefacts drawn from Ipswich Museum's geology collection. *Ambulation* grew out of the activities that took place at this residency. Third, *War Workings,* was a collaborative project with Tyne and Wear Archives and Museums (TWAM) hosted at the Discovery Museum in Newcastle-upon-Tyne, UK. This activity, which marked one hundred years since the beginning of World War One, was part of a larger project named Decoded1914[30]. Decoded1914 invited artists to respond to artefacts in the museum collection relating to WW1. *Ring Network* emerged as one of the things made during this collaborative project. A detailed account of each of these activities is given later in this chapter.

'Hack days', 'hacklabs', 'make-a-thons', 'hack-a-thons' 'game jams' and other compound wordplay possibilities involving 'make' and 'hack' have grown popular as events that bring together diverse practitioners and conducting creative work around

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particular themes or 'problems'. These initiatives are used by a diverse range of organisations around the world including Silicon Valley giants (Google Impact Challenge[31], 2017), public institutions (NHS Hackday[32], 2017) and cultural festivals (Abandoned Normal Devices Hack at the This Way Up Film Conference[33], 2015). The premise of these events, which I will hereafter refer to as make-a-thons, is to quickly generate collaborative ideas and projects, the best of which might be awarded a prize or the offer of a further commission at the end of the 'hack' period. These events are usually hosted in a particular venue in which artists, engineers, designers, coders and other practitioners are invited for an intense period of making activity. '72 hours to make the world better for children with disabilities' was the headline of a press release for Unicef's make-a-thon hosted in 2016[34]. Make-a-thons have been used as a popular problem solving strategy for the world's biggest issues. It is not my intention to conduct a full critique of these kinds of making events, rather I want to give some larger context to the scenarios I will go on to describe. The activities I articulate in this chapter seeded the three artworks that make up my PhD, and connect to this culture of collaborative, experimental and intensive making. Importantly the making events I was involved with were orientated around creative practice rather than social, design or engineering issues.

There are many possible methodologies for conducting research through creative practice. With the rise of practice-based research, artists and academics are bringing research methodologies into question. I have approached my own research through making with sound and technology, and my doctoral research began in the context of the three make-a-thon environments I describe here. As a research methodlogy, the act of making allowed me to explore an area of interest (or mutual interest when conducting collaborative practice) by building work, exploring materials and engaging with technologies. Rather than responding to historical or theoretical narratives, as many artistic PhDs do (Leary, 2012, Barker, 2017, and Streffen, 2013), I got to know my subject area through practical investigations inherent within making processes. The creative results of my research were analysed and reflected up during and after the making process, and included in this thesis as observations and reflections within each project chapter. This section describes the emergent themes that were revealed

[31] https://www.google.org/our-work/google-impact-challenge/
[32] http://nhshackday.com/
[33] https://www.andfestival.org.uk/events/hack-this-way-up/
[34] http://unicefstories.org/tag/hackathon/

through the making and presentation of the three projects. It is important to note that, whilst some of the initial making activities shared in this introductory chapter were shaped by invitations and commissions, the themes that I went on to explore through my doctoral research were not imposed upon the making. Rather they became apparent through the practice of making and the act of presentation.

My PhD began with creative commissions from CTM, the Pacitti Company and TWAM. These initial projects allowed me to open up my research practice through collective making. My early experiments explored how making can generate new research around a particular theme or idea. Conducting work in this way allowed for fluid and collaborative creations to be developed and shared with the public in relatively short periods of time.

This open approach to the development and making of artworks in collaboration with institutions and other artists has gone on to be a significant body of work referred to as 'public making'. Public making is a strategy for the creation of artworks in relation to museums, art organisations and heritage sites conducted by John Bowers and I over the last five years. This work has been published at the following conferences and symposiums: New Interfaces for Musical Expression (NIME) (Bowers and Shaw, 2014), the International Symposium on Electronic Art (ISEA) (Shaw and Bowers, 2015) and Designing Interactive Systems (DIS) (Bowers, Bowen and Shaw, 2017). Though this is connected to the work I am presenting here, public making will exist in this dissertation as a methodological aside. The papers mentioned above give full accounts of a collection of making activities conducted over the last few years under the title of public making.

Fields

Fields was conceived, in collaboration with Sébastian Piquemal, during the Music Makers Hacklab event hosted by CTM festival in Berlin 2014. CTM is the sister festival to the Transmediale conference which claims to 'draw out new connections between art, culture, and technology'[35]. CTM's programme specifically includes music and sound art that relates to the themes of the larger Transmediale conference. It hosts practitioners who in some way deal with sound and technology, and has become an important event for people interested in experimental practice

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[35] https://transmediale.de/

within arts, technology and digital culture. CTM takes place once a year in different venues across Berlin.

Figure 1. Setting up for the performance of the Music Makers Hacklab at HAU2, CTM Festival, Berlin, 2014. Image CTM/Paul Lecat.

The Music Makers Hacklab brought together nineteen invited artists and practitioners, and facilitated collaboration during a week of practical activity. At the end of the week collaborative projects were presented to the public during a performance at HAU2 in Berlin (see Figure 1). The Hacklab provided a space for making that allowed fluid, fast-paced forms of interdisciplinary collaboration to emerge over a short period of time. The festivals theme in 2014 was Dis Continuity, and set out to look back at neglected histories of experimental music and create new trajectories and narratives for contemporary practice[36]. During the Hacklab week the public were invited to drop in, ask questions and explore prototypical work being created by the invited artists, which included Piquemal and I who had not previously met or worked together.

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[36] https://www.ctm-festival.de/archive/festival-editions/ctm-2014-dis-continuity/

Over the course of the Hacklab, Piquemal and I decided to build a system which would allow us to experiment with performing field recordings through the mobile devices of audience members. Piquemal had previously built a system, named Rhizome[37], which allowed for Open Sound Control[38] (OSC) messages to be sent from a webpage to other compatible devices. We used Rhizome for the basis of this performance. We bought a cheap Wi-Fi router from a local electronics store and experimented with triggering field recordings through webpages loaded on our own smartphones, laptops and other devices borrowed from fellow Hacklab members. We spent that evening exploring Berlin for environmental sounds. Using handheld recorders, we collected the sound of bridges, the U-bahn, frozen ice on the surface of the Spree, air ventilation shafts and traffic noise. Back at my hotel we listened and edited the sounds and built a simple composition for the performance the following day at HAU2. An in-depth description and reflection on the performances of *Fields* will be provided in the next chapter.

Initially emerging from this Hacklab process, *Fields* has been developed by Piquemal and I through an extended research and development period of four years. This development process has included numerous public presentations and different iterations of the work. Significant project partners and commissioning organisations have included; Culture Lab (Newcastle University), New Media Scotland (Edinburgh), Stereolux (Nantes), Sound and Music (London), Arts Council England (London), Eastern Bloc (Montreal), Café OTO (London), FACT (Liverpool), The Wired Lab (New South Wales), Sanctuary Festival (Dumfries) and Media Lab (Helsinki). More on the work of *Fields* in Chapter 3.

Ambulation

During two three-day residencies at the Pacitti Company, John Bowers and I creatively responded to a number of museum artefacts. This work culminated in two multi-channel sound and image installations open to the public. The first residency, *Interglacial,* explored various forms of data visualisation and sonification and included visiting local sites of interest connected to the museum collection. A concise description of our explorations in *Interglacial*, focusing on its relevance to sound making technologies, was published in the NIME proceedings in 2014 (Bowers and Shaw, 2014). The second residency, *Erratics*, built upon these concepts and

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[37] https://github.com/sebpiq/rhizome
[38] http://opensoundcontrol.org/osc

developed a second public presentation event. Both of the residencies were open to the public, people were invited to drop in and join us at any time during the process. We had around twenty-five members of the public drop in across the six days of the two residencies. A full account of both of these residencies, plus a durational performance created for Fort Process festival in Newhaven, was published within the ISEA proceedings in 2015 (Shaw and Bowers, 2015).

During our time on both the residencies we built a number of constructions using various forms of technology and engaging with specific themes suggested to us by the staff at the Pacitti Company. Constructions included a Sonic Microscope, a Sonified Weather Station, a Rock Harmonium (see Figure 2) and An Erratic Texture Generator, full descriptions of each of these can be found in the ISEA (Shaw and Bowers, 2015) and NIME (Bowers and Shaw, 2014) papers mentioned above. These constructions formed an incremental installation over the residency period.
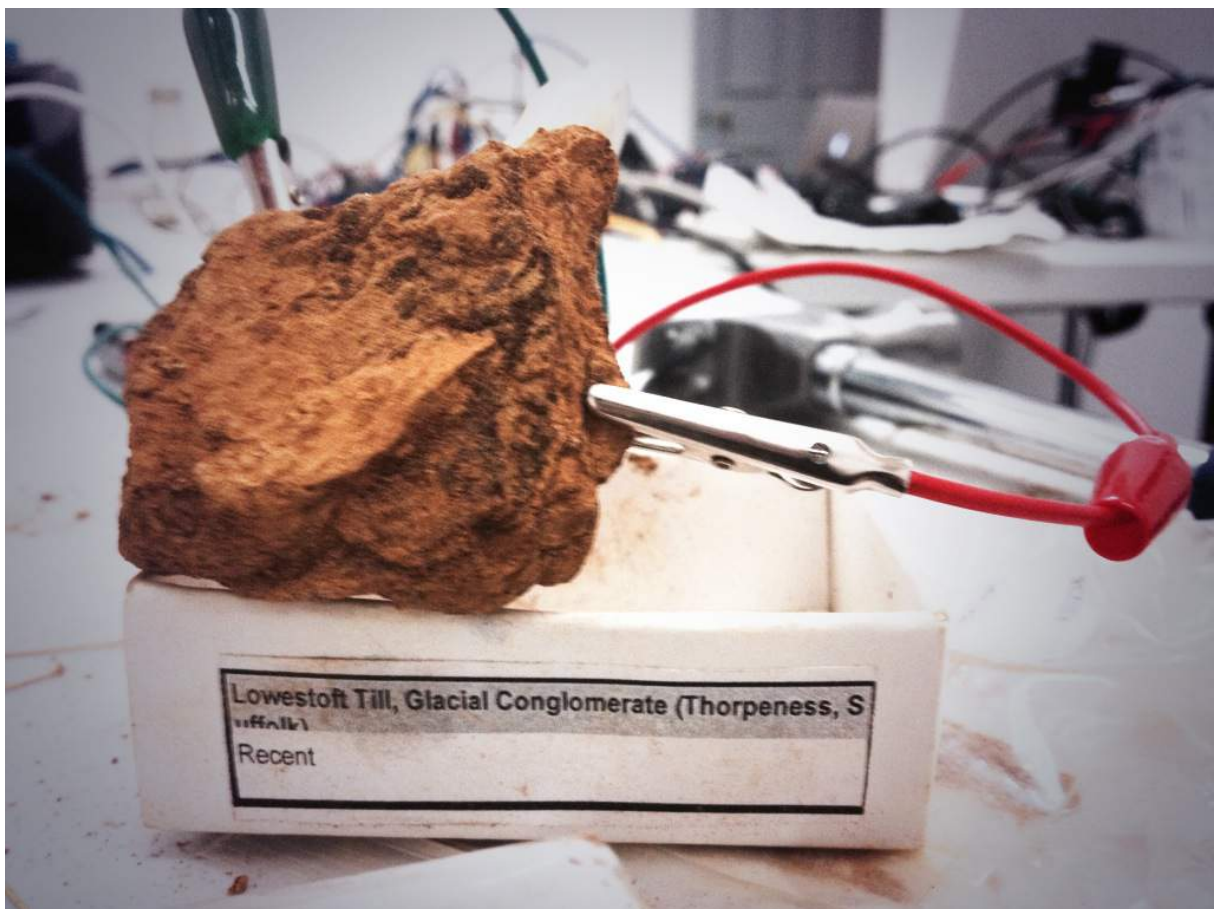

Figure 2. Rock Harmonium made during *Interglacial/Erractics* event at The Pacitti Company, Ipswich, 2014. Image Tim Shaw.

The artefacts were explored through a number of public making activities. One of our participants had a background in evolutionary anthropology and helped us explore and understand possible uses for some of the Neolithic hand tools in the collection. Another person, who had a particular interest in the digital video game Minecraft also visited us. With him, we explored the similarities between the museum materials and materials used in the game, giving us an alternative perspective on our work.

Another, a visual artist, began mapping the objects to their supposed geographical location. By locating where certain artefacts were found and identifying what material they comprised of we could compare these objects to geological maps that were also present. We began physically spanning the journey of these objects and their materials. While mapping the various artefacts to specific locations on the maps, we decided to collect a number of local, site relevant, field recordings of these locations. Trips were made from the project space at the Pacitti Company to the local erratic rocks by the Ipswich docks to make recordings, photographs and collect other materials. Once collected, the recordings were processed in a number of ways including granular synthesis (Roads, 1988), transducer to surface explorations, and various forms of manipulated playback. We approached the collected recordings as a fluid element that could be layered alongside other physical and sonic material within the installation space.

One way we approached the objects in the museum collection was through the idea of extending sensory engagement. By presenting geological artefacts alongside diverse data sets we hoped to create new interpretations of these objects. Abstract and tangential connections could be made between rocks, a weather station, field recordings and our other creations. This is key to the making approach employed here, exploring making as a way of opening up investigative possibilities, rather than as a way to solve a problem. Building on existing work from the Interaction Studio at Goldsmiths (Bowers and Gaver, 2012), John and I created a number of ambiguous responses to the museum artefacts, moving away from didactic interpretation of the artefacts to a space that supported more imaginative engagements with and appropriations of the collection.

We were concerned with extending sensory engagement with artefacts and present relevant phenomena in novel sensory forms. In some ways, this is an extension of

the practice that many museums conduct of 'handling sessions' where the look and feel of objects is brought to attention. In our case, however, we were concerned to go beyond what is normally the didactic business of such sessions and make, for example, geological textures and meteorological data available in ambiguous sonic forms. In this way, we hoped that public encounters with museum objects, and our work extending their sensation in juxtaposition across time and space-scales, would facilitate new imaginative trajectories for the collections we were working with. This idea of extending the perceptual possibilities of objects and materials also became a key feature of *Ambulation*. In *Ambulation,* which I went on to develop as a solo project, I used recording technologies as a way to extend what is usually perceivable by the ear. Audience members are invited to listen through a variety of microphones to hear the world differently.

Extended field-recording techniques became a good way to collect diverse sonic material relating to site and landscape during the residencies at the Pacitti Company. However, within the public making approach it was difficult to engage participants in the field recording activities themselves. Field recording often requires spending long periods of time outdoors hunting for sound, and demands patience and the development of an intuition around sound and recording possibilities. Furthermore, not all participants had sound recording equipment and it was hard to engage everyone simultaneously using only our own. Though I have conducted many field-recording workshops, these sessions were not orientated in this way. The sessions at Pacitti Company were intended to take a more open approach. *Ambulation* emerged as a solo project out of *Interglacial/Erratics* and through my interest in recording technology and environmental sound. In part it is an attempt to engage people in field recording activities through a public performance walk.

Following residencies at the Pacitti Company with Bowers, I was invited by Musée Imaginaire to create a piece for their public programme. I took this opportunity to develop *Ambulation* as a new piece of work which spoke to questions arising from the Pacitti Company residencies around public engagement with the act of field recording. Significant project partners and commissioning organisations have since included: Culture Lab (Newcastle), Compass Festival (Leeds), FACT (Liverpool), Sonic Environments (Brisbane) and Baltic (Gateshead).

Ring Network

Ring Network emerged through *War Workings,* a two day making session that took place at the Discovery Museum in Newcastle-upon-Tyne. This work was commissioned through the Newcastle Institute for Creative Arts Practice and was a collaboration between John Bowers and I in February 2015. Decoded1914, the larger project of which this was a part, included artistic work from Chris Watson, Guy Schofield, Phil Begg and Rachael Hales. *War Workings* took as its point of departure listening technologies that have their infancy in war time and the innovations that surround it. During the sessions we made a large number of creative responses to World War One technologies. John and I also invited a number of local artists to come and make work alongside us. The public were invited to observe and interact with the making activities of the *War Workings* sessions, thus engaging with the making process rather than fully resolved or refined artworks. The process culminated in a two-hour public event in the Great Hall of the museum, where the experiments we made were explored through performance.
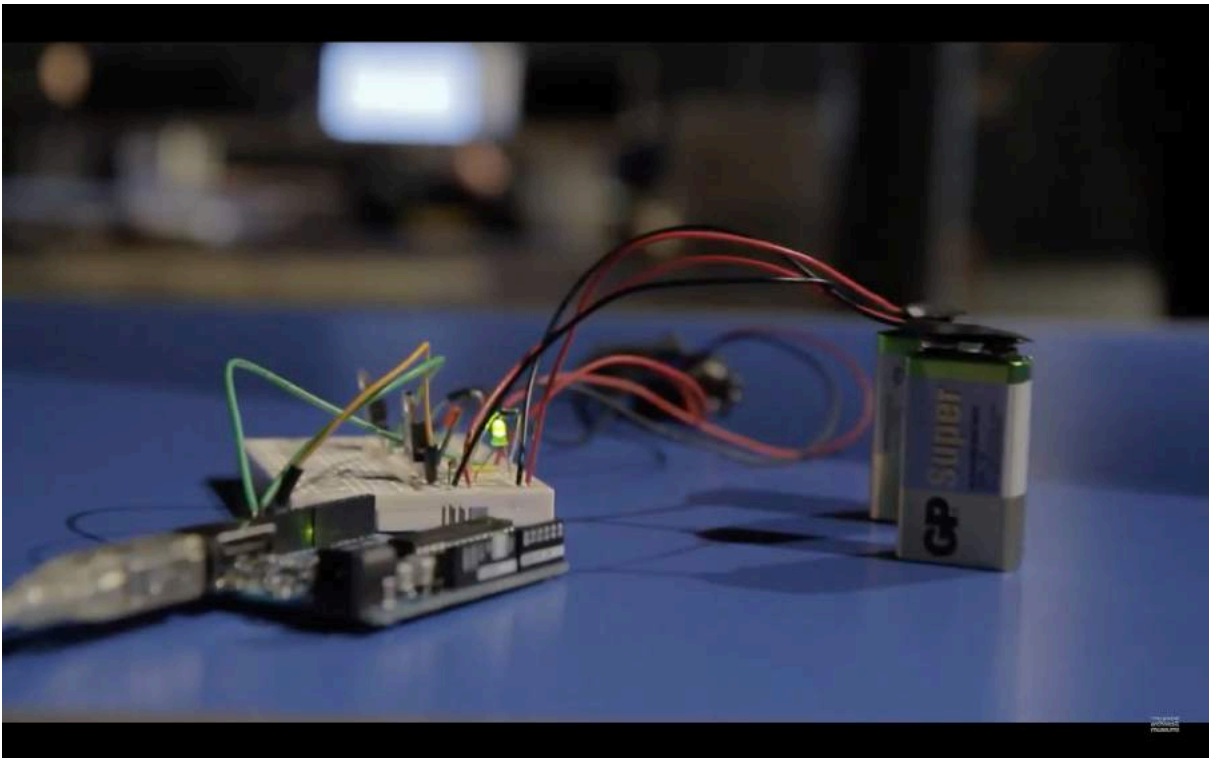
Figure 3. *A Message Around the World*, made during War Workings at the Discovery Museum. Image TWAM.

Many of the things we built included communication and listening technologies from the early 20th Century. AM radio transmitters, Morse code transceivers, sound

mirrors, flip-flop circuits, dazzle camouflage and hydrophones were incorporated into responses to period specific technologies. As a contemporary acknowledgement to communication technologies I decided to build a piece called *A Message Around the World* (See Figure 3). Using Pure Data (PD) running on a Raspberry Pi, IP and website addresses at different locations around the world were interacted with. The amount of time that the ping took to travel around the world and back, which varied from 400ms to 20 seconds, was used to create variable events in the visual programming language PD. Using an Arduino board and some push-solenoids, the pinged events caused the solenoids to actuate. The solenoids were then placed close to non-precious metallic materials including a helmet and an exploded bombshell and used to percuss them.
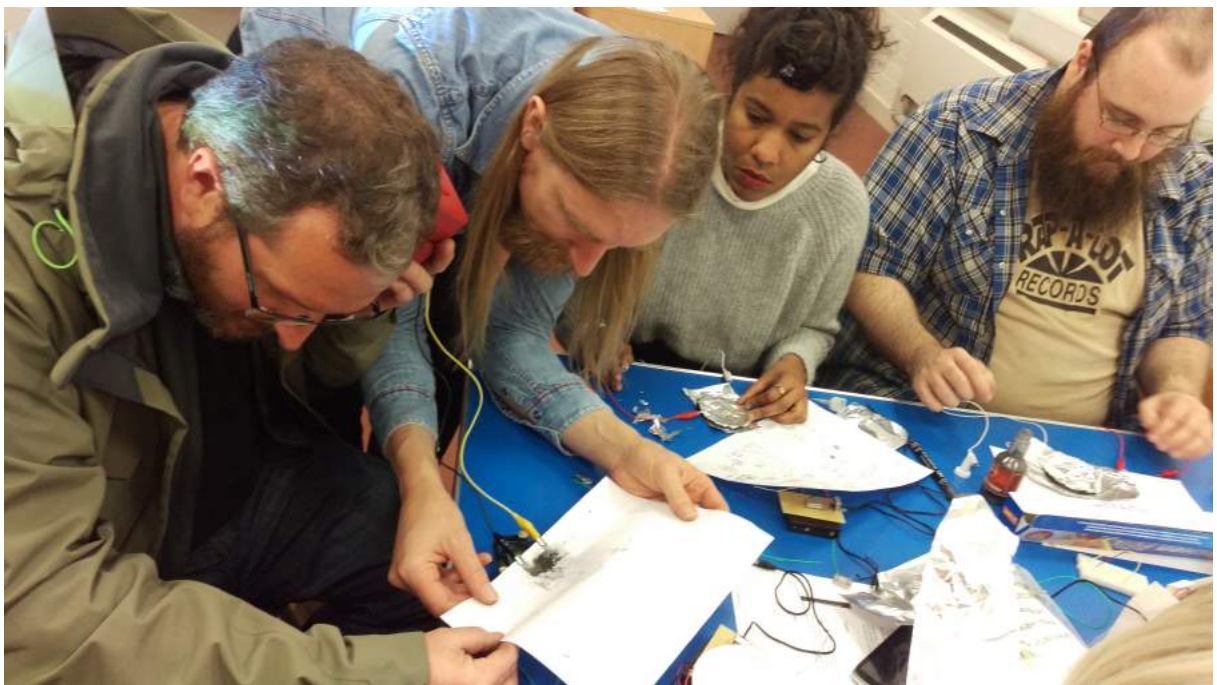
Figure 4. Building a Carbon Granule Microphone. Workshop activity as part of Transmit/Receive at the Discovery Museum in Newcastle-upon-Tyne. Image Tim Shaw.

Following *War Workings,* I was invited back by TWAM and the Discovery Museum to create a larger solo work within the same theme; this work was entitled *Transmit/Receive*. As part of this project a series of workshops were programmed that involved building listening technologies with participants in a more focussed manner (see Figure 4). Following the workshops, participants and other artists were invited to go to WW1-relevant sites around the North-East of England to experiment with recording and listening through these technologies. The experiments and interventions were transmitted to the Internet via an mobile application through a

smartphone. Walks between sites were also transmitted. *Transmit/Receive* created an opportunity for people to engage in the making of WW1 listening technologies and experiment with these technologies during a live event in site relevant locations. The ambulatory aspects of this process fed into thinking I did around *Ambulation. Ring Network* emerged from the activities of *War Workings,* specifically *A Message Around the World* which explored contemporary communication technologies in relationship to WW1. I went onto develop this work into a more established installation at The NewBridge Project[39] in November 2016. Other significant project partners include: Culture Lab (Newcastle), Fridman Gallery (New York), bb15 (Linz) and De Montfort University (Leicester).

Conclusion

I have described here how the three projects covered in this dissertation have their genesis in collective experimental explorations done in collaboration with other practitioners, an arts organisation, a museum and an arts festival. The activities recounted above approached making as an open and explorative investigation. Collaborative labour concentrated on the making activities and prototypical productions rather than complete finished objects, a way of challenging the distribution of value between making and the final artefact. Audience members could experience artworks in the making, processes and procedures were presented as visible and accessible. Over the next three chapters I will show how this philosophy has been continued into the three artworks that are the subject of this thesis. *Fields, Ambulation* and *Ring Network* developed out of the open make-a-thon style approaches to exploring materials and creative possibilities I have explained in this making chapter. The context-responsive and fluid nature of the making activates my research and informs how the work is presented. Ideas of technological limitation, site, locative composition and audience configuration mean that a single final version of each of these works cannot exist. Rather the infrastructures, principles and artistic approaches are applied to each particular presentation context to create a new version of the work for any given event. Every public presentation of the works I describe in the following project chapter is therefore a unique an iterative manifestation of my practice-based research.

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[39] https://thenewbridgeproject.com/

As an additional disclaimer I would like to make clear that even though a single final version of each of these artworks cannot exist, I can still clearly articulate my research findings and contributions. Despite the ever-changing nature of the work described here, I have presented each of the pieces enough times to report on significant research findings. As an aside I would like to argue an approach to research that is not product orientated, something I will go onto discuss in the concluding chapter (Chapter 7).

Chapter 4. *Fields*: A Performance

In this chapter I present and discuss *Fields*, a spatialised sound performance implemented with web technologies that run on the mobile devices of audience members. *Fields* is both a technical system that allows for a range of sonic diffusions to occur and a bespoke sound composition. *Fields* was made in collaboration with web developer and artist Sébastian Piquemal, and involved the construction of the technical system and the creation of compositions to be presented through the system's unique capacity in performance. Here I explain how the *Fields* system was created and implemented within our own practice, and show its potential for use and application by other artists and sound practitioners. I describe how personal mobile technology, used as a collective array of speakers and controlled live by a centralised performer, as in *Fields*, can create alternative forms of participation within musical performance. *Fields* not only offers a new technological approach to sound diffusion, it also facilitates forms of social engagement within sonic media contexts, which is articulated in the Discussion section of this chapter. In this section I also communicate how this artwork opens up new paradigms for spatialised music and media performance is supported by technical and aesthetic observations about performing and composing with a system such as *Fields*.

Fields is a networked system that uses personal mobile technology as a medium for sound diffusion. Personal mobile technology in this context includes smart phones, tablets and laptops as well as other portable devices that can run a web browser.

The project referred to here as *Fields*[40] is formed of to two main interconnecting parts:

> *An audio playback system using web technologies to diffuse sound live through the inbuilt speakers of the audience's mobile devices.*

> *A specially designed composition and performance created for presentation through the sound diffusion system.*

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[40] Whilst usually titled *Fields* and so referred to as such throughout this thesis, this work has also been presented under the title *Murmurate*.

Fields has been publicly performed a number of times to international audiences in the United Kingdom, across Europe, in America and Australia.

The Work: A Typical Performance

Over the last four years *Fields* has been performed at the following venues:

Glasgow Film Festival (Glasgow, UK, 2017)
Wagga Wagga Art Gallery (New South Wales, Australia, 2016)
Edinburgh Entertainment Festival (Edinburgh, UK, 2016)
MIT Media Lab (Cambridge, USA, 2016)
Eastern Bloc (Montreal, Canada, 2016)
Piksel Festival (Bergen, Norway, 2016)
Stereolux (Nantes, France, 2016)
FACT (Liverpool, UK, 2016)
Connect the Dots (Sheffield, UK, 2016)
Sanctuary Festival (Dumfries, UK, 2016)
Cafe OTO (London, UK, 2015)
Islington Mill (Manchester, UK, 2015)
Music Hackspace (London, UK, 2015)
Talbot Rice Gallery (Edinburgh, UK, 2015)
Grundy Art Gallery (Blackpool, UK, 2015)
Web Audio Conference (Paris, France, 2015)
New Interfaces for Musical Expression (Baton Rouge, USA, 2015)
Goldsmiths (London, UK, 2015)
Durham Castle (Durham, UK, 2015)
Sussex University (Sussex, UK, 2015)
Green Door Store (Brighton, UK, 2015)
Louisiana (Bristol, UK, 2015)
NK Projekt (Berlin, Germany, 2014)
ZDB (Lisbon, Portugal, 2014)
Third Space (Helsinki, Finland, 2014)
Fort Process (Newhaven, UK, 2014)
Culture Lab (Newcastle, UK, 2014)
International Computer Music Conference (Athens, Greece, 2014)
HAU2 (Berlin, 2014)

These performances consisted of a variety of different venues including art galleries, music venues, concert halls, churches, universities, conferences, heritage sites, and art and music festivals. In doing this a wide range of audiences have engaged in the work. These public presentations of the work are responsive to specific performance contexts and integral to the project development as a whole. Whilst the performance differs in each venue according to the behaviour of different audiences and character of the particular site, there are some features of *Fields* performances that remain consistent.

During a performance of *Fields* any audience member can join the piece at any time by using their smartphone, laptop or tablet to connect to a centralised Wi-Fi network configured by the performers. Once connected, the device is forwarded to a specially designed website, containing a simple map of the performance space, which requests the user to locate themselves in the space. Once the location has been defined a connection is established with the dedicated server, sound material emerges from the device's speaker and visual feedback is immediately apparent on the audience member's screen. The connected devices become part of an array of speakers, which the performers can then control live. The result, provided a number of devices are connected, is an omnidirectional, multi-locational sonic output, with each connection individually contributing to the overall composition. The connected devices create a spread of sound across the environment, with the specific dynamics of the sound diffusion directly informed by each audience member's location and movement. Each participant with a connected device becomes a node in a musical network.

Though *Fields* is a versatile system, which can be used in many different configurations and contexts, we have tended to perform the piece using a quadrophonic sound system alongside the audience's devices. The composition can then create an interplay between the quadrophonic system and multi-locational sonic output from the audience's devices. Furthermore, mobile device speakers tend not to be able to transmit low frequencies, so the low-end of our composition is delivered by the supporting quadrophonic system.

Figure 5. Performing *Fields* at Eastern Bloc in Montreal in 2015. Image Justin Desforges.

In what follows I will describe in detail the shape of the composition Piquemal and I developed with and for the *Fields* technical system. The composition was constructed from a mixture of field recordings and synthesised sounds, and loosely structured with sections of improvisation. Performances tended to last between 15 and 25 minutes. In the majority of the performances Piquemal and I avoided performing from a stage and, wherever possible, set up and performed from within or around the audience. In this configuration, audience members are invited to cluster around us, creating an intimate and intensified environment for collective listening (see Figure 5 and 6).

Motivations

Smartphones, laptops and tablets are common in the Western world and their built in speakers can be surprisingly loud provided you play the right sounds through them. *Fields* explores the potential of these devices for sound diffusion and creative composition. Multiple artistic motivations are at play in *Fields* regarding the decision to build and perform using a system that utilises personal mobile technology.

The Sonic Results. Hearing a concert diffused through many small speakers held in the hands of the audience is a unique experience. By having the speakers distributed throughout the audience we were able to create a multi-directional, textured sonic environment unlike traditional sound performance experiences. Rather than the even spread of sound found in a conventional concert setting *Fields* creates small 'pockets' of sound throughout the audience, which are shaped and dictated by the individual characteristics and distribution of the audience's mobile devices. The result is both an unusual sonic output as well as a very particular performer-audience dynamic.

Participation. Increasingly music concerts and sound performance involve people filming, taking pictures or reporting on their own audience experience using social media smartphone applications. This networked engagement extends the audience role and foregrounds the subjective experience of the event through the now ubiquitous personal mobile technologies that are present. By using the phone as a performance-instrument rather than a social media tool, in *Fields* we momentarily create an alternative relationship with this technology. The performance of *Fields* thus opens up alternative ways in which people can participate in a musical performance, embedded as they are in the compositional infrastructure of the piece. With audience members holding, moving and controlling their own personal speaker, each contributes their sound source to the overall composition.

Using What's Available. Aside from the unique sonic and participatory properties of this system, *Fields* offers a number of practical advantages for sound diffusion. Traditional forms of electronic spatialised sound require large amounts of equipment and set up time. *Fields* does not require this; once a network has been established participants can turn up, connect and listen. This allows performances to take place within novel and unique environments, outside of purpose built concert halls or event spaces. *Fields* does not require audience members to download a specially made application, nor do we need to hand out specially designed speakers. Contemporary smart phones provide us with ample technology to achieve sound diffusion in *Fields*. By using web-native technologies, we allow the system to be commonly supported on many devices, creating a low threshold for participation.

Related Work

Before going on to describe the work and development process in more detail, I will provide some examples of other work that relates to the concepts and technologies surrounding *Fields.*

Shared Spatial Sound Environments

Fields is not the first project to make use of technologically supported, shared spatial sound environments. Previous examples of work that involve similar themes include *Contact* by Ollie Bown, which I witnessed being performed at the NIME conference in London (2014). *Contact* required audience members to physically pass a number of portable orb-shaped, wireless speakers through the concert hall. This process provided a "tactile acoustic experience" (Bown, 2014) that allowed me and other participants present to physically engage with the sonic work. Moving the wireless speakers around the space meant that participants facilitated the spatialised structure of the composition. *Let Me Catch This* uses smart-phone technology to encourage audiences to 'collect' visual content during a cinema experience (Häkkilä et al., 2014). *Let Me Catch This* encouraged audiences to be 'active' participants in the event and through positioning their phones at the screen at particular moments, when they could collect informative or reward items associated with the film. *Let Me Catch This* claims to create a unique user experience with regards to visual content on the participant's personal devices. In both of these examples researchers have used wireless and mobile devices to extend a central composition or artwork. Unlike *Contact* and *Let Me Catch This,* in *Fields* the mobile devices of the audience are utilised for the spatial diffusion of sonic material. By implication the audience members become an integral and embedded part of the system and composition itself.

Latency as a Creative Material

Atau Tanaka's *Global String* takes the form of a giant "international" stringed instrument. Tanaka uses a global networked connection as a "resonant body", allowing two different sites to communicate through a sculptural, suspended string. Tanaka has described embellishing technical limitations such as latency as "creative material" within this work (Tanaka, 2000. p. 396). This approach to limited technical capacity resonates with the approach taken to sound design in *Fields*, where, as I detail below, we used network latency as an artistic material rather than a restriction. Latency as a creative feature is something I will explore in more depth in Chapter 6,

drawing on further examples from musicians and artists engaged with this area of artistic research.

Mobile Devices in Performances

A key artistic reference point for *Fields* is media artist Golan Levin, who created *Dialtones: A Telesymphony* in 2001. In this performance the artist requested that upon entering the performance space audience members gave their mobile numbers to the performer. Using a specially made system Levin telephone called blocks of audience members at different times, the ringtones resulting in a spatialised sound performance across the venue. As audience member's phones rang, a white light also showed where they were sitting in the space on a visualisation presented at the front of the venue. Levin describes his motivation for the piece as creating a collective experience with the phone, breaking away from what is usually a singular experience (Levin, 2001). Levin also uses the piece to reveal that the technology inherent in mobile phones in 2001 was advanced enough to be used within a musical performance. In documentation of the piece you can see the audience members using the phones in many different ways, amplifying the vibration function of the phone, playing with signal to speaker interference and making melodies with the phones' limited tonal quality (ibid.). Many of the aesthetic decisions made within Levin's piece bear similarities to the making of *Fields*: the cacophonous soundscape, the relational dynamics between audience members, and extending the phone as a public and collective performance instrument. Created over a decade after *Dialtones, Fields* utilises developments in smart phone technology and plays sound using a Wi-Fi network rather than the cellular technology used by Levin. In *Dialtones*, like Tanaka and Piquemal and I, Levin et al. explored the limitations of mobile phone technology as a creative and generative feature of a composition.

Figure 6: Performance of *Fields* at Talbot Rice Gallery, Edinburgh, UK. Image Chris Scott.

Development Process

By building the *Fields* system alongside the bespoke composition Piquemal and I allowed technical arrangement and sound design to be directly informed by each other. This meant that in the development of *Fields* we could explore and exploit the technical potential and limitations of the system. Our past experience as musicians and sound artists directly informed the technical design of *Fields*, as well as the aesthetic decisions made during the design and performance process. It is important to note that there is no ready-made music for this kind of project and the desire to compose a piece for the system was equal to the desire to build the system itself. Within *Fields* both elements have parity and equally parts of one artwork.

Our approach to the development of *Fields* aligns with Frayling's notion of research through art and design (Frayling, 1993). Frayling's approach to understanding creative processes as research has become particularly prevalent in the field of human computer interaction through the work of Bill Gaver (Gaver, 2012), and extended by Bowers (Bowers, 2012) amongst others. This approach can also be seen in the development and design of *Fields*. Working within the style of electroacoustic music we engaged directly with sonic material and built the piece using sound as our source material rather than a preconceived tonal or harmonic system. Furthermore, our appropriation of mobile technology allowed us to customise our own sound system. Approaching the technical design in *Fields* by highlighting

limitations of the particular technologies we were using was a way of engaging with the materiality of the tools of our performance.

I also understand our development process in *Fields* in relation to Ingold's articulation of thinking through making. In opposition to a traditional conception of making through thinking, Ingold expresses how knowledge can be generated through physical engagement with materials (Ingold, 2013). We allowed our engagement with sonic and technological materials to remain flexible and adaptable throughout the making of *Fields*, and our development of the work constitutes a research process into the technologies, compositional strategies and performance approaches we explored. Ingold's articulation of thinking through making also supports an understanding of our process as divergent from solutionist approaches to research, in which the solution to a problem is imagined and then made manifest. Our artistic research remained fluid and changeable throughout the project, never considered as the solving a particular problem, but as exploring the potentials of the materials we were engaged with.

Creatively Responding to Technical Limitations
We conducted various experiments to test for latency between the triggering of sound in the centralised operating system and it being heard on a wireless mobile device. There was a huge variation between devices depending on their age, operating system, how far away they were from the router and more generally the strain on the network. As we had little control over the types of devices people would bring to performances, it was decided to implement a sound design that would make use of this inherent latency in its compositional structure. This is comparable to Tanaka's use of latency as a creative material in *Global String* (Tanaka, 2000. p. 396). Within a *Fields* performance this use of latency meant that instead of the perfect synchronisation of sounding devices, the presence of numerous mobile device speakers created a 'shimmering' of sound across the room. The slight differences in timing and sound quality created an experience of spatial diffusion that also bears a resemblance to Levins' *Dialtones* performance. Historically, literature on networked sound projects focussed on the technological pitfalls of latency and the inability to achieve consistent audio quality across devices (see McPherson et al., 2016 or Barbosa et al., 2005, for example). With *Fields*, like Tanaka and Levin, we embellish the technical limitations of the system and technologies adopted, using it creatively and to our advantage in the sound composition.

In the following sections I will describe how the interrelated elements of sound, visuals and technical system were designed, and how they are shaped together as supportive and interwoven.

Sound Design

The sound design of *Fields* was developed in stages, adapted and progressed through its numerous and different performances. Various considerations within the sound design incorporate the characteristics of the phone speakers and degrees of latency, and create the particular spatial characteristics of the piece. Though live presentations of *Fields* retain a degree of performative flexibility, a typical presentation of the work adheres to the following structural elements and lasts approximately 20 minutes.

The piece starts with a soft drone, which moves between the channels of the supporting quadrophonic system. Simultaneously a layer of white noise and field recordings of water droplets, processed through a granular synthesizer, play from the now connected mobile devices. During this early phase in the event there are usually audience members still connecting, and as each device connects a new sound source joins and affects the sonic space. The water droplets and white noise create a dense texture, which is contrasted with the soft drone from the quadrophonic system. This opening dynamic creates an interplay between parts without them interfering or masking each other, and outlines the parameters and features of the system, sound design and performance space.

A loud gestural crescendo, a sonic action that implies a compositional change, emerges from the large speakers and marks the beginning of the second phase of the composition. Following this the phones remain as the only sound source to be heard, sounding for the first time without support from the quadrophonic system. Field recordings of cowbells (recorded as worn by cows, rather than played as a percussive instrument) processed through a granular synthesiser slowly emerge from the phones giving the piece a more harmonic tonal quality. As these field recordings and processed bell sounds become more present, the four-channel system plays back a more complex granular version of the same sound files. Each speaker is assigned a different grain with varying parameters emphasising the spatial quality of the surround system. The textures build, creating ambiguity between the web system

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and the quadrophonic system. A low-mid drone emerges from the quadrophonic system as bursts of tuned descending sine and saw tooth waves begin to emit from the phones. A percussive sound from the handheld speakers creates a subtle rhythmic element to this phase of the composition. This is supported by a very low-end kick drum that plays a poly-rhythmic sequence from the four-channel system.

In the next movement elements of the piece are slowly removed leaving a percussive structure with a bed of white noise created through a combination of noise generator and field recordings of the sea processed through a granular synthesiser. The loud gestural sound that marked the start of the second phase reappears to mark the end of the piece, giving the performance a clear cadence.

During performances of *Fields* phones can go to sleep and stop receiving commands from the server, this often results in phones continuing after this last cadence. This creates interesting and relatively unpredictable results that are incorporated into the event of *Fields*, whilst the gestural sounds give a clear sense of an ending. In this final moment audiences with unresponsive phones tend to either fade out or turn off the sound from their own device to bring the piece to a definitive close.

Visual Design

A very simple visual design displays on the webpage once participants were connected. This image has the function of giving a clear visual signal informing the participant that their device is connected. The image of commands being sent live between the control panel and audience screen are visualised automatically scrolling down the screen (see Figure 7). Like Levin's *Dialtones* the light that this image causes the phones to emit also adds to the aesthetic quality of the performance space, lighting up faces, hands and laps, and casting shadows about the space according to the particular strength of device illumination. This also has the effect of diffusing audience attention away from the spectacle of performer and around the performance space.
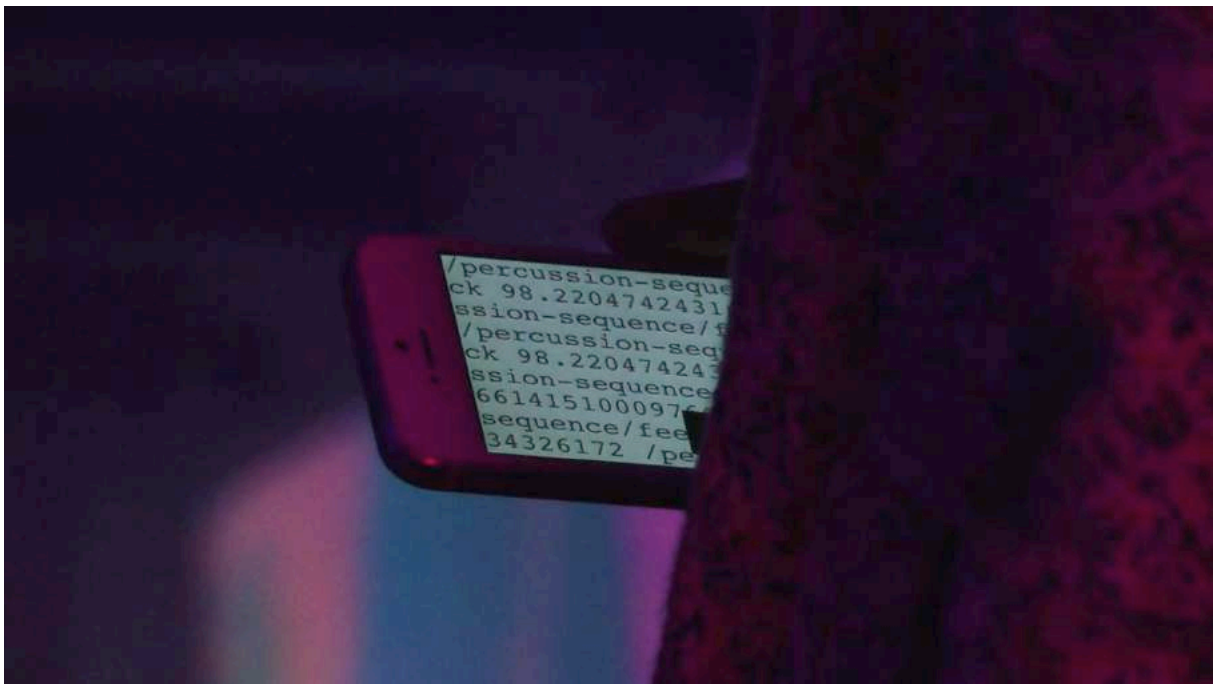
Figure 7: Audience member holding a device during a performance of *Fields* at Connect the Dots, Sheffield 2016. Image Jon Harrison.

Technical Design

Fields is implemented using primarily web technologies. A web server is exposed to participants via a wireless network. The system consists of three main parts:

Firstly, the audience web page is loaded on devices by the audience members as instructed by the performers at the start of the event. This page contains a variety of audio playback instruments (sample player, looper and granulator) implemented using JavaScript and Web Audio API. The page doesn't offer any control of those instruments by the audience. From the point of view of the audience this page just plays sound.

Secondly, the control panel web page allows performers to control, in real-time, the instruments loaded onto the devices via the audience web page. There is a separate panel for each instrument and each panel offers a number of parameters for that instrument, as well as room panning control. Each instrument is configured with a number of controls, which at its simplest consists of an on/off button and a volume slider. More complex instrument controls make use of buttons, sliders, XY axis and envelope drawers.
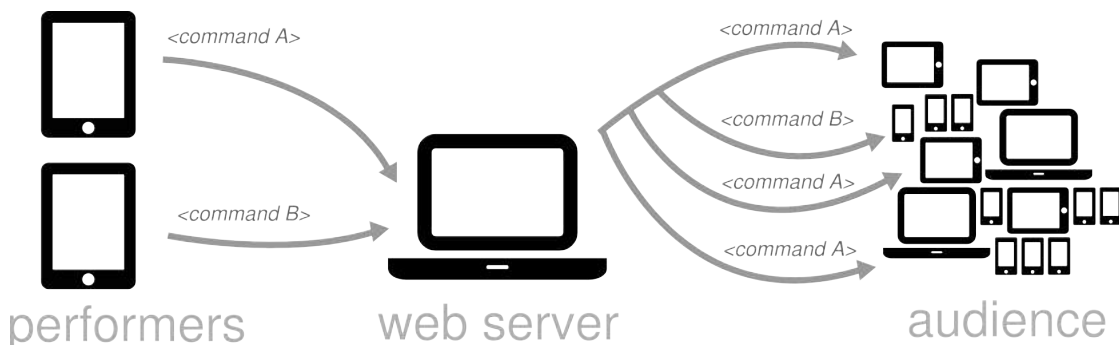
Figure 8. The communication flow for *Fields*. Image Sebastien Piquemal.

Thirdly, the server is central to the *Fields* network system, which serves the two web pages described above. The server handles communication between the instruments and the performer's controls (see Figure 8).

The JavaScript programming language is used throughout the system. The functionalities needed in the server are general enough that we were able to package them into a standalone library called *Rhizome* (https://github.com/sebpiq/rhizome), which is an 'out-of-the-box' solution for OSC to WebSocket communication built by Piquemal prior to our collaboration on this project. *Rhizome* does the heavy-lifting and handles all networking issues such as disconnections and the sending of large packets of data (see Figure 9).
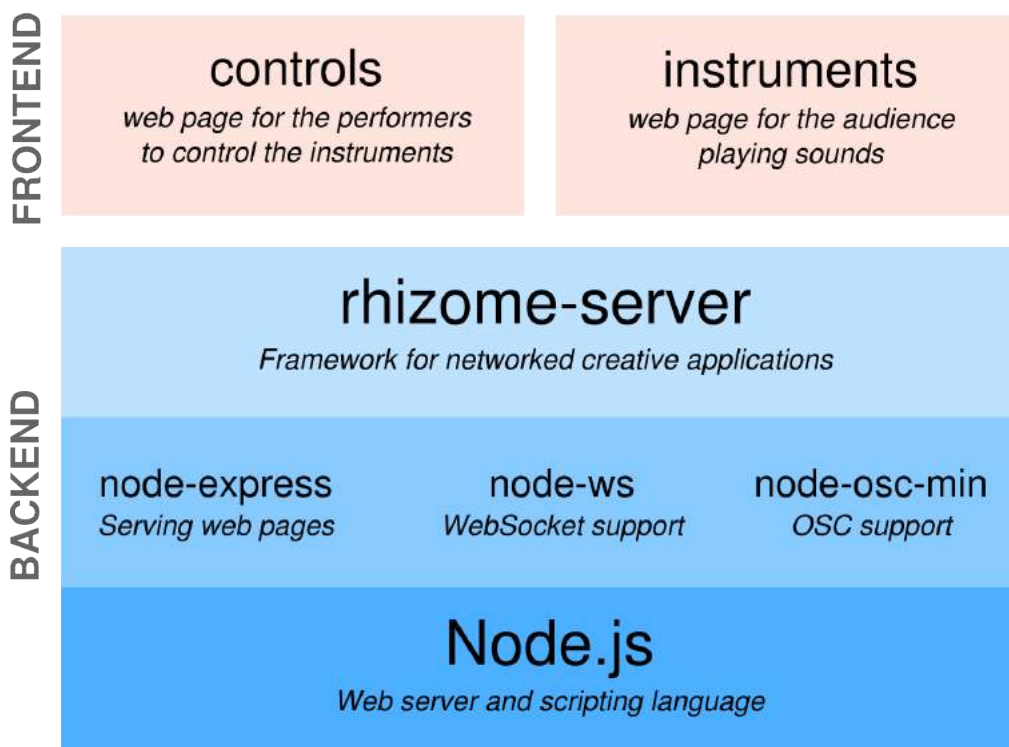
Figure 9. The software architecture. Image Sebastien Piquemal.

Instruments

One sound generation method used in the system of *Fields* involved the playback of pre-recorded sounds on the audience's phones in a variety of ways, techniques included looping, sequencing and granular synthesis. These playback methods were our instruments; in building them we had to consider the limitation of how much data could be loaded onto the webpage. We implemented a number of techniques to enable us to playback these files in different ways:

Triggering sounds was implemented to playback files from start to finish in a simple 'press play' manner. This method was stable but lacked performativity, and as such it was used alongside some other approaches.

Granular synthesis was used to playback audio from various starting points and using a variety of different sized grains. With this technique we could playback the loaded files with more versatility, giving us more performativity than by simply triggering sounds. We played back these grains *in unison*, with all phones reacting at roughly the same time (accommodating latency with the system), or *in combination* at different randomised times. Playing back different parts of the same sound file across a room full of mobile devices gave a heightened sense of the spatialised nature of the *Fields* composition. The *Fields* system supports every connected node to play *in unison* or *in combination* with other devices, and allows performers to choose between these two options in real time.

Sequencing tools were developed for the project to playback various pre-recorded files. Designing a sequencer for this system meant taking into account a big limitation; it is impossible to synchronize all devices together and have them play with a common timing. Therefore, considering this limitation we designed two different sequencers. The first is a centralised sequencer running on the control page. For each event in the sequence, a message is sent, triggering a sound on the devices. Due to latency, each device receives the message at a different time. Therefore all sounds are triggered at slightly different times. But as there is only one central sequencer, sounds are always synchronised on an 'absolute tempo', but not in relation with each other. The second sequencer runs on each individual device. With this sequencer, events are sent from the control page but the devices handle timing. Each device plays the same sequence, but the sequences have slightly different start

times.

Synthesis engines were implemented to give some flexibility away from the pre-recorded sound. With these the performer can control the pitch, volume and FM and AM modulation of a simple saw tooth and sine oscillator, as well as a white noise generator. By building a graphical envelope, automatic pitch and volume changes could be drawn in. This resulted in smoother changes than if this element of the composition had been performed manually.

Observations and Reflections

Throughout the development of *Fields* and my practice-based research, I regularly reflected on the creative, technical and aesthetic elements of this work and its development over the four-year period described in this thesis. In total around 200 days of practical development time was carried out to create *Fields*, along with 30 public performances with the system. Performances were well documented using video and audio capture. As part of the reflexive work of my PhD I conducted an analytical study of the raw video footage of performances. I also conducted informal interviews with various audience members. From this data I extracted a number of themes that unify the novel experience of *Fields* for audience members with the motivations and ideas that emerged from its making. I have organised these findings around three analytical themes:
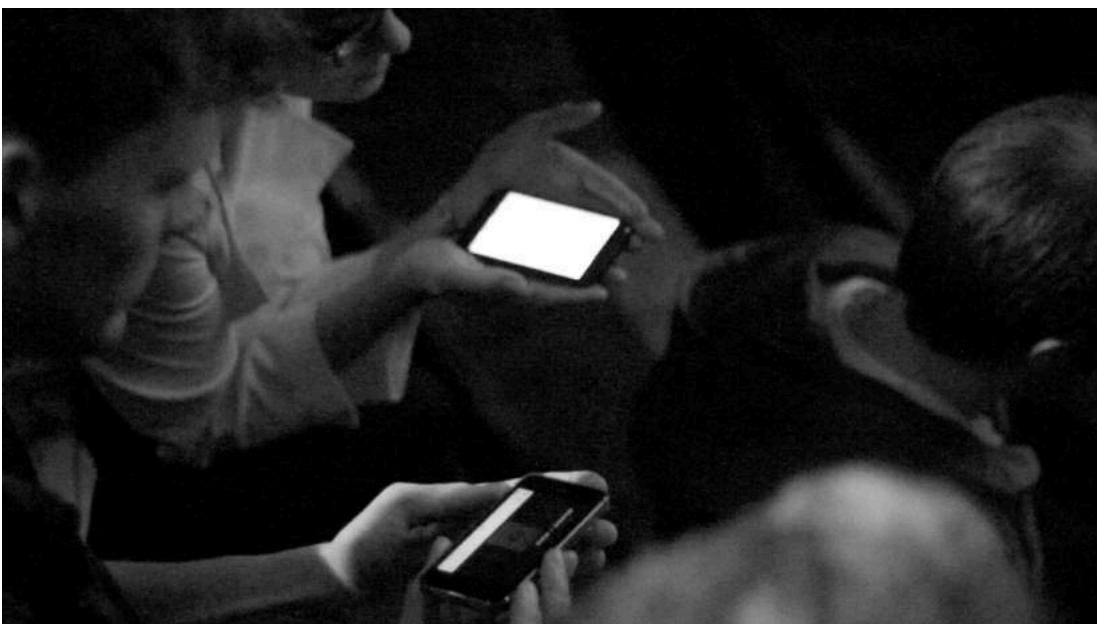
Performing the Phone

Figure 10. Participants at a performance of *Fields*. Image: Ben Jeans Houghton

Observations made as a performer within the performance space and via the video documentation reveal audience members interacting with their devices in unexpected ways. During performances of *Fields* individuals can be seen holding their phones between fingers, in laps, between knees and in palms in ways that are unfamiliar to the quotidian use of the device as a communication tool rather than a sound source (see Figure 10). Devices are held close to the ear at unusual angles or at arms length, and often dynamically moved between these locations throughout the event. People move their phones up and down to see how this effects what they hear and, in turn, this also effects what others hear and the relationships they have to other people's very literally 'mobile' devices. *Fields* audience members experiment with tipping the position of their phone to achieve filter-like effects through physical manipulations. From positioning the phone speaker into their mouth and changing their vocal tract to affect the sound emitted, to putting it into a glass or a cone made from the concert programme, in *Fields* there is a definite sense in which the phone is 'performed'. These physical gestures not only effect how the phone is heard by those around them, but are also observed, imitated and appropriated by others. Performed behaviours with the devices can thus be seen to ripple through the audience over the course of any given event.

The flashing light from the phone creates a further performable element for audience interaction; faces and silhouettes are dimly illuminated and shadows are cast as a consequence of this. A group of phones moving collectively create flock-like motions and 'murmurations' can be observed across the performance space. These simple forms of interaction allow audience members to move their attention to different areas of the performance venue. Awareness moves from their own phone to the phones of others, and their own phone is perceived in the context of a flock of sounding devices in the space.

As well as moving their phones, individuals also move backwards, lean forwards and tilt their heads to create different psycho-acoustic perceptions. In some contexts people get up and walk around the space to experience the soundscape from a variety of angles. *Fields* provides a rich environment for experiencing sound and encourages a diverse number of listening strategies for audience members to explore.

Within *Fields* performances, particularly those that have flexible or no seating, audience members often gather in small groups within the space. These social gatherings are made up of friends, partners, relatives and so forth. The small, independently formed groups often create micro performances for each other within the larger context of *Fields* (see Figure 11). People can be observed sharing phones with friends and creating coordinated movements. In one performance at the Mining Institute in Newcastle two audience members moved their phones in a rapid, circular motion around another audience member's head. The particular character of the *Fields* system enables small groups to create a local environment around them in which the work is experienced as distinct but coexisting with experiments that others might be making within the wider space. By performing with their devices in this way, audience members are themselves thinking through making in the context on *Fields*. The invitation to interact with *Fields* is deliberately left open; there was no predetermined way to perform or interact with the phone and the only instructions given are how to connect to the system.

Figure 11. Performing from the Centre of the Space at Eastern Bloc, Montreal. Image Justin Desforges.

Shaping the Sound

The development of *Fields* was a process through which the musical composition and technological system were created in conversation with one another. The sound design is shaped by an appreciation of the limitations of reproduction of certain sounds on a mobile phone. For example, very low sine waves cannot be heard through small speakers. Sounds had to be designed in such a way that they could be heard through the system. When multiple versions of the same sound were played back through the performance space we wanted to create interplay without interference. Throughout the making of *Fields* I reflected on the types of sounds diffused through the performance system and how they worked in the particular context that system supports.

Fields requires a degree of focus and attention from the audience in order for it to be successful, by which I mean it should take place in a quiet, dark environment away from distractions or too much ambient noise. Whereas in a conventional sound performance set up the singular spectacle of the performer(s) would hold attention, the diffused nature of *Fields* means that strategies had to be devised to hold attention and support the audience's listening experience. During an explanatory introduction (usually made by me) audience members are instructed to connect to the local network providing access to the *Fields* system. While connections are being made a soft drone is played out of the main PA loudspeakers. As soon as each device is connected it begins to make a sound. As more people connect, the performance space becomes more sonically intense, the piece begins to build and more layers are added. Whilst this is happening audience members often chat to each other, helping one another connect and orientate the unusual performance set up. When we believe most of the connections have been made the loud gestural sound signalling the second phase of the performance builds before being suddenly cut out. This swell, a musical crescendo, momentarily occupies all of the other sounds in the space. The sudden change in dynamics informs the audience of a transition and indicates a shift in attention and listening. This change helps set the focus for the next section of the piece.

Composing the introduction in this way means that the activities that surround *Fields*, such as having to connect to a network, are folded into the compositional structures of the work. The end of the piece works in a similar way. The final musical crescendo

returns to give the event a defined shape, and signal the end of the performance. When the gesture is finished and the sound fades away we send an instruction over the network to mute all of the phones. It is, however, quite likely that some of the phones will not receive this command due to losing network connection or crashing. These devices will keep sounding after the piece has ended. Beginning and ending the piece in this way, with a large gestural sound, enables the audience to identify that the remaining sounding phones are an irregularity. Even so, having one or two phones continuing to sound acted as a residual coda during some performances. In response to this accidental coda element to the composition, *Fields* was developed to tolerate technical failure by incorporating these irregularities into the larger aesthetics of the work. When performing this piece at Eastern Bloc in Montreal, Piquemal and I ended the piece by continuing to load sine wave oscillators onto the webpage after the final crescendo. This meant that each phone was forced to crash, and crashed at slightly different times, at which point audience members were confronted with an error page as a 'finale' to the work.

Figure 12. Performing *Fields* at ZDB in Lisbon in 2015 (audience seated in-between the performers). Image Ana Gutieszca.

Reconfiguring the Audience

The *Fields* composition was developed as an attempt to shape the audience's attention. As the sound builds at the beginning of the piece, subtle indications are given in order to focus the concentration of audience members on the work. We found that the non-conventional arrangement and activity of connecting personal devices required that an additional consideration was needed to support the focussed attention that the work requires of its audience as listeners. It was not just the sound design and musical composition that shaped the audience experience of *Fields*, however. Other elements also had to be carefully considered to support attentiveness.

We managed to create a focused space for the performing of *Fields* in a number of ways. We opted for the performance space to be dark and requested access doors to be closed during the performance to avoid any unnecessary interruptions. Lighting was used to indicate where the action would occur and create a contrast to light coming from the phone screens, which were in themselves a performable element. Using the multi channel sound system we managed to move sound around the performance space, facilitating obvious sonic diffusions around the audience in a massed 'cloud' of sound.

Throughout the many performances of *Fields* we explored various audience formations, experimenting with how audience members and performers were physically configured. We tended to perform *Fields* without a raised stage in order to situate ourselves closer to the audience, and in some cases the whole space would be occupied for the performance activity (see Figure 12).

By using a multichannel sound system arranged around the edge of the performance area, we attempted to give a strong sense of space for both the audience and performers. Sharing this sound space allowed us to get a good impression of how the diffusion amongst the separate devices was sounding and what the audience might be doing with their devices. Sharing the sound space with the audience was extremely important. We deliberately avoided creating a disconnect between the 'stage' and 'audience' sound system, which tends to be a dynamic of performances in auditoriums and larger music venues.

In early versions of the work Piquemal and I experimented with sitting anonymously within the audience. This was not particularly successful as it did not enable us to create focus within the performance space, in part because we were not able to signal the beginning and ending of the piece in satisfactory ways. By performing close to the audience, but explicitly identified as performers, we could share the same sonic space and also indicate key moments within the composition. This intimacy was useful for supporting audience attentiveness. In later performances it became preferable, if possible, to perform from the sides of the space, Piquemal and I facing one another as performers, with the audience situated between us. In this formation we had one another in our sightline as performers, and could encourage audience members to cluster between us. Bringing people physically closer together helped create an arena for attentiveness.

When sharing the performance space within a mixed concert program compromises had to be made, but our most effective performances of *Fields* have been where we have been able to create an arena for attentiveness through a combination of musical structure, compositional decisions, audience configuration, light and PA positioning. All of these are additional features to the *Fields* technological system and sound composition. Thinking about these wider issues when approaching performances of this nature is a key learning point within my research. Compositional content and technical stability are foundational, but it is important that the physical space encourages audience attentiveness and shapes productive relational dynamics between participants.

Site Responsive Instances of Fields

Since the original development of the system and composition, there have been further opportunities to develop site-responsive versions of *Fields*. In 2015 Sanctuary festival commissioned a performance of the work in the Dumfries and Galloway Dark Sky Park (see Figure 13). For this presentation it was necessary to rethink the hardware of the system as there was no power on site. For this event we ran the system from two car batteries and a leisure inverter to convert the 12v DC supply to a 230v AC output. These had to be carried a mile across the rocky terrain from the car to the performance site. Field recordings from the site were collected in advance of the performance during a site visit and included in the composition for Sanctuary festival. Also incorporated into the work was a signal from a local stream using a hydrophone. Using PD, an envelope follower was built and the signal from the

hydrophone was used to process the amplitude of a synth engine. Subtle changes in the rivers ebbs and flows modulated the synthesised voice during the live performance. We named this method 'streaming a stream'. This is one example of how a flexible and responsive approach to performing *Fields* was maintained through work with different sites. The performance/composition of *Fields* was not presented to the public as a static and complete composition. Rather, as can be seen in this example from Sanctuary festival, each public presentation informed on-going development and research and resulted new and context-specific iterations of the work.

Figure 13. Site of *Murmurate* at Sanctuary Festival in Dumfries and Galloway Dark Sky Par in 2015. Image Tess Denman-Cleaver.

Other Applications

Piquemal and I continue to be invited to perform and workshop *Fields* in different places around the world. In April 2015 *Fields* was taken on a UK tour supported by Sound and Music.[41] We have also been requested to create new versions of the work that respond to more specific commissioning briefs. In September 2016 we were invited by New Media Scotland to use the *Fields* system to creatively re-imagine the soundtrack to Chris Markers' film *La Jetée*. This version of *Fields* was presented as a live cinema event with a live narrator in the Assembly Rooms (Edinburgh) as part of

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[41] http://www.soundandmusic.org/

the Digital Entertainment Festival in August 2016 (see Figure 14). Our interpretation of *La Jetée* was then performed at the Glue Factory as part of Glasgow Film Festival in February 2017.

Fields continues to develop through regular performances and presentations. As a system it is designed to be open to a variety of creative possibilities. The flexibility of the system and sound design allows Piquemal and I to continually expand and explore different applications of the *Fields* system through further commissions and opportunities.

Figure 14. *La Jetée* at the Edinburgh Digital Entertainment Festival in 2016. Image Chris Scott.

Figure 15: Audience member using hands to filter sound. *Fields* at Pixsel Festival, Bergen. Image Zane Cerpina, PNEK

Discussion

The iterative nature of the *Fields* development process involved the creative and artistic appropriation of latency, the development of sound design in accordance with the particularities of the system and experimentation with audience configurations. In each of these aspects, the limitations of the technology were approached as generative and productive rather than inhibiting to the creative process. The thinking through making approach taken with *Fields* allowed technological and sound design aspects to become artistic material. Considerations around how to configure each of the new performance spaces we visited also became a continual part of the making process. The making here was not hylomorphic (Ingold, 2013. p. 20) rather it grew through our experiences of frequently performing the work and coming to know the nuances of our materials.

Thinking Through Making Fields

I have remarked upon how important it was for Piquemal and I to co-develop *Fields* as both a composition and technical system. This understanding of the co-dependency of different features of design extends further to include the audience. Effective performances of *Fields* involve creating an arena for attentiveness through configuring the

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audience in particular ways and unfolding the composition in a manner that focuses attention while giving latitude for experimentation and accommodating the unfamiliar nature of the system. Through improvised and playful performance gestures with their phones within this focused arena for attentiveness, the audience co-create a subtly complex and layered listening environment alongside the performers (see Figure 15). The arena of attentiveness thus becomes an arena for experimentation, and one in which all are supported to think through making *Fields*.

Personal Mobile Devices in Public

A mobile phone is a very personal device, holding personal information such as private text messages and emails as well as private security data. *Fields* momentarily changes the role of the mobile phone by configuring this private device as central to a collective and public performance. As with Levin's *Dialtones, Fields* uses individual audience member's devices to create a shared sonic and visual space. This has the result of opening up a public-personal space shaped by the particular characteristics of personal mobile devices (Taylor, 2017). This was not an original motivation for the work but emerged through numerous public performances and presentations of *Fields*. Unlike *Dialtones,* in *Fields* the sonic composition can be composed beyond the specific ringtones on individual's devices. Here the mobile phone becomes a channel within the performance work, each channel has the possibility of playing a unique element of the composition. In this way each individual's personal device becomes a distinctive part of the shared performance experience.

Re-configuring Mobile Design

There exist many examples of musical applications developed for mobile devices (examples include Michon, 2017, Tanaka, 2004 and Wang, 2016). Tanaka's work on mobile music making from 2006 looks at extending the early smart phones with sensors to optimise them for music making possibilities (Tanaka, 2004). His accounts focus on how the system works within the phone including technical details, communication protocols and interface design. My research reflections and artistic concerns surrounding *Fields* are orientated differently. By designing a very simple interaction between audience and phones (through listening) we leave an ambiguous space for creatively exploring and appropriating the device. Wang's work on the appropriation of mobile phones to create musical instruments with game-like interfaces has been a common feature within NIME conferences since 2006 (Wang, 2006). These expressive interfaces are impressive design objects but rarely consider

the social dynamics that surround the mobile phone. *Fields* involves a re-conceptualisation of designing for mobile devices. Rather than assigning focus to what is *inside* the device, as with Tanaka's work, *Fields* promotes thinking around what the device is within. This includes how audiences engage together around their devices in performances, how they share a sonic social experience and how they interact with their devices whilst contributing to an overall composition.

Artistic Development

Through the development of *Fields* the way I approach the use of technological systems in my work has changed. Prior to the development of this artwork, technology was simply a way of presenting my work and the system was rendered invisible, or only made itself apparent when something went wrong. Regular public presentations of *Fields* have also revealed to me how important considerations the surrounding structures of performance events are. The characteristics of the system and the configuration of the audience in *Fields* are intrinsically linked to these aesthetic decisions. This thinking through making in relation to the use of technology and the dynamics of performance events informed my approach to *Ambulation*, which I developed after *Fields* and which I discuss in the following chapter.

Chapter 5. *Ambulation*: A Sound Walk

Ambulation is a performative sound walk, which has been in continuous development since August 2014. *Ambulation* grew out of work initially conducted with collaborator John Bowers during residencies at The Pacitti Company in partnership with Ipswich Museum, as described in Chapter 3. Following the Ipswich Museum experiments I went on to develop *Ambulation* as a solo work that has now been presented in a variety of locations and in association with a number of festivals, art galleries and university partners. Each presentation of *Ambulation* is specific to its geographical and temporal context and the system I perform with has been designed by me to accommodate this site-responsiveness. I revise the listening technologies and sound processing systems employed in order to respond to the environmental context of each particular event. In this chapter I describe the work and place it in relationship to other artists engaged with field recording and artistic listening and walking practices. I will give technical details of the *Ambulation* system I developed as part of the creation of the piece, and conclude the chapter with a collection of observations that emerged from the project. Following this explanation of the project I discuss how I approach improvisation in relation to field recording within *Ambulation*. I will go on to argue that the research around the development and presentation of *Ambulation* contributes to the idea of field recording as a live, procedural practice, moving away from the ideas of the movement of documentary material from one place to another. I will show how having an open, improvisational approach to technologically supported sound walking enables rich and unexpected results to occur. As with other projects in this thesis, I will demonstrate how knowledge emerges via a thinking through making approach to the development of *Ambulation*.

Whilst I continue to perform *Ambulation* in different locations internationally, I present here a comprehensive description and critical discussion of the work as a continually responsive yet complete research project and artwork.

The Work: A Typical Performance

Ambulation is a headphone-based sound walk that uses adapted field recording equipment and DIY listening technologies to explore the sonic quality of different environments through an expanded performance practice. *Ambulation* configures

field recording as a live, performative act. Each *Ambulation* event responds to and engages audiences with the interplay between sound and space in a particular location. The performance supports a collective listening experience and the research I conducted through *Ambulation* considers how recording and performance operate as shared listening practices more broadly.

During the forty to eighty minute walk that is the performance of *Ambulation* I use a variety of listening technologies, which I have adapted to record and manipulate the sounds of the immediate context in real time. The sounds I 'collect' during the walk are broadcast live for the duration of the performance to wireless headphones worn by participants who are walking alongside me. With this set up we walk together along a loosely planned route around the local environment. Using the portable system that I have developed for *Ambulation*, along the route I record, re-sample and manipulate the soundscapes of the contexts we move through. No pre-recorded material is used in *Ambulation*, which means that the first time the audience hears a sound is also the first time I hear it as the performer. The event is thus constituted of listening to the environment we are walking through via my improvised sound performance.

Over the past three years *Ambulation* has been presented publicly in the following places:

Dorothea Quarry with James Davoll (North Wales, UK, 2017)
Baltic with ItsNiceThat and Google Design (Gateshead, UK, 2017)
Piksel Festival (Bergen, Norway, 2017)
The Newbridge Project (Newcastle-upon-Tyne, UK, 2016)
Compass Festival (Leeds, UK, 2016)
Research Through Design conference (Cambridge, UK, 2015)
FACT (Liverpool, UK, 2015)
Sonic Environments conference (Brisbane, Australia, 2015)
Culture Lab (Newcastle-upon-Tyne, UK, 2014)
Tender Buttons (Holy Island, UK, 2014)
The Northern Charter with Musée Imaginaire (Newcastle-upon-Tyne, UK, 2014)

Figure 16: *Ambulation* at Compass Festival in Leeds in 2016. Image Jonathan Turner.

Though elements of the performance have changed over the four-year development period of *Ambulation*, and each event differs due to its improvisational and site-responsive character, some elements remain consistent. Here I will describe the key features and loose structure of a typical *Ambulation* performance.

Developing a Sonically Responsive Walking Route
Ambulation performances have tended to occur within urban environments, cities with buildings, cars, roads, walkways, shops and other people. In preparation for a performance, when arriving in the city I spend at least one day exploring the environment in which I am going to present the work. The parameters of this environment are usually defined by proximity to the host venue and measured according to how far it is possible to walk with a group over the period of the scheduled event. Whilst exploring the local context I seek out interesting and contrasting sound spaces. I orient the walk with a starting place that fits with the organisation's predefined infrastructure. When I presented the work at Piksel Festival in Bergen in 2016, for example, the main exhibition of the festival was located in a disused industrial space on the outskirts of the city. I decided, with the festival organisers, that this would be the best location from which to conduct the walk. When *Ambulation* was performed in Leeds at Compass Festival 2016, the organisers and I

decided to start at the Art Hostel in the centre of the town, which was being used as the festival hub. The starting location is important for the structure of the walk; I try to start and end performances in the same location, creating a loop that avoids treading the same path twice. The improvised composition of *Ambulation* is shaped by and for this walked loop.

When exploring the environment and planning the route that the performance will take place within, I look for a diversity of spaces, the contrasts between roads, pedestrian walkways, indoor and outdoor spaces, tunnels, bridges, rivers, churches, cemeteries, parks, lakes and ponds, green areas, open and confined spaces and any other sites that provide sonically and visually dynamic environmental changes. I look out for such features within the environment with a consideration for how well the listening technologies I am using will interact with the environment during the performance. Fountains, rivers, lakes and other bodies of water can be listened to using hydrophones, for example. With the field recording devices embedded in the *Ambulation* system I can listen in to particular and pronounced sound spaces, collecting contrasting sonic material and allowing the audience to hear environments not usually perceptible to the human ear. Street lamps, phone booths, parking ticket machines, security cameras, RFID readers and broadband boxes are also aurally 'sniffed' during the performance using electromagnetic inductive coils. These features of the environment provide a diversity of sonic material for the walk. Features of the urban environment that provide sonic diversity thus influence how I plan the route, and infrastructural landmarks inform where and how the route is composed.

The route is limited by duration; typically walks last around one hour. I have performed longer versions of the piece, but due to practical considerations such as battery life and coordinating the piece within programmed festivals or bigger events. Within the hour long performance there is an introduction to the piece as well as a short debrief at the end of the walk.

Introducing the Walk

At the start of the event I meet the audience at the designated starting point and explain what the walk will entail. My introductory explanation consists of an overview of the piece and gives a sense of what will happen and what listening technologies I am using that day. I explain that the piece can be disorientating, clarifying that what we hear along the way will not necessarily correspond to what we see or to what is

happening immediately around us. I often give the example of a car passing: during the performance you may be able to hear a car approaching and passing besides you, but this could be a recording from another part of the walk. I also explain that all of the sounds we hear are encountered during the walk together and that there is no pre-recorded material, meaning everything we hear is heard for the first time by both the walkers and myself as we go. I hand out the wireless headphones and check that they are all working by broadcasting a test tone from PD via the radio transmitter in my bag. The test tone is composed of two tones; usually a short enveloped sine wave programmed to repeat sequentially in the left ear and then the right. Once the introduction is complete and it has been established that the system is working the walk begins and I fade out the test tone.

The Performance

Typically, at the opening of the performance, which is the beginning of the walk, I slowly fade in omnidirectional microphones allowing my fellow walkers to get used to this new kind of listening. Even though omnidirectional microphones have a seemingly similar field to the ears, it is unusual to experience environmental sound in this way, particularly if you are not used to field recording or listening through microphones. This opening section of the walk is designed to allow the group to become accustomed to listening to their immediate context through headphones and become comfortable with this new way of experiencing sound. I let this live feed continue for a few minutes as we walk together at a slightly slower than usual pace. The sonic material here is usually quite ambient, with a wide field and made up of sounds such as cars passing, wind in trees, people walking and buses accelerating.

Once the audience seem to have become acclimatised to this way of listening, I source and introduce a sound that is more dynamically present, which contrasts with the ambient sound of the opening section. This might be achieved by standing close to a pelican crossing and waiting for it to beep, or by placing one of the omnidirectional microphones into any available small hole, such as a drain, to capture its differently resonant character. Another way of implementing this initial dynamic shift in the performance is with the use of an inductive coil to pick up the electro-magnetic activity from a street light, parking ticket dispenser or cash machine. This newly introduced material cuts through the ambient sound that *Ambulation* begins with. Once a sound of this nature has been sourced I often also record it, storing it in one of the sample banks I have within my PD system for use later in the

event. The system has the capability to play back sounds, loop them and alter their start and end points, and allows me to continue to compose with sound I have collected. Within the walk there are generally five or six of these moments in which I stop to gather sonic material at close range, attending to a small confined area or specific details of the environment. During these 'close range' moments audience members are free to stay with me to observe what I am doing, or walk around the area, conducting their own physical journey within our shared listening.

If it has not been used at the start of the walk, the performance usually contains a dedicated hydrophone section (see Figure 17). This section gives a contrasting sonic space within the walk and is normally conducted in the following way: I identify where I will be placing the hydrophones, in a river, fountain or other body of water prior to the event. When approaching the hydrophone location during the performance I build up recorded layers using the ambient microphone feed and allow these layers to playback and interact with each other. Whilst this is happening I take out the live feed of the omnidirectional microphones and get my hydrophone ready to submerge into the water. Once submerged, I slowly bring up the hydrophone channel. As the sounds detected with the hydrophone are usually quite delicate, they cannot be heard over the other sonic material being broadcast into the audience headphones. I then take out the layered recordings, slowly revealing the underwater space. At this point I have to hold the hydrophone very still as I turn up the gain, any unwanted movement, might cause it to strike a surface and create a very loud impact sound in the headphones. During this section we are all still and the audience witness a delay; they see me dropping the hydrophone into the water but do not hear it immediately, eventually I use the *Ambulation* system to blend together the sound worlds from above and below the surface.

Figure 17: Dipping a hydrophone into Leeds canal during Compass festival 2016. Image Jonathan Turner.

Occasionally during *Ambulation* I perform directly with physical elements of the environment to generate new sounds. I enact small interventions using material found during the walk; screws, nails, house keys, cable-ties and small twigs are found and used to stimulate railings, galvanised fencing panels and lampposts. These sounds can be recorded, re-sampled and manipulated in the same fashion as the other sounds along the route. It is important to me that I use material found in the environment for my instruments in these interventions, rather than anything pre-prepared or brought with me from elsewhere. This principle ensures that the sonic material heard during *Ambulation* consists only of materials and phenomena encountered during the performance itself.

Towards the end of the walk I layer different types of sonic material to create a densely textured composition. Moving away from the recognisable or performed sounds of our immediate context to something more abstractly composed. This often includes material collected from earlier moments in the walk. For example, when conducting *Ambulation* in Leeds church bells were sounding and could be clearly heard at the starting point. I recorded these bells but did not play them back

immediately, rather I waited until the bells had stopped and then brought the recorded version of them in, making the relationship between immediate and remembered phenomena performable.

At the end of the walk, after building up contrasting sonic layers I slowly fade out the recorded material. Naturally, the immediate soundscape becomes apparent as the signal through the headphones gets quieter. After some time I take off my headphones and continue to attend to listening to the 'natural' environment. This generally lasts a few minutes before I thank everyone and indicate that the walk is over. This residual coda is similar to the ending of *Fields.* In both projects the end of the work is sonically ambiguous and dependent on the conditional specifics of the performance context.

Related Work

In this section I discuss the motivations for creating *Ambulation*. I will do so in reference to the artwork and practices of others, which, whilst they did not directly influence or shape how I made *Ambulation*, place the work within a number of artistic, research and cultural contexts and provide reflexive anchors for thinking about what *Ambulation* achieves.

A Field Recording Practice

Field recording is central to my practice and features in all of the projects I describe within this thesis; from the use of sounds that I have collected in the *Fields* composition to the idiosyncratic methods of recording sound in an installation environment in *Ring Network* explained in Chapter 6*.* I always carry a small recording device with me, making recordings as an ongoing discreet and daily practice. I conduct field recording not only as a means to collect sonic material, but also to engage with and enhance the act of listening in particular environments. Recording technology changes the way the world is heard in the immediate and present moment, as well as shaping the 'captured' sound (Krause, 2003, p. 48). Listening through amplified microphones we hear a more exaggerated and sometimes altogether altered version of our sonic environment. Different microphones have different characteristics and capacities and therefore create different listening experiences. For example, micro-sonic resonances can be revealed and collected through the use of contact microphones and hydrophones, and it is possible to convert electromagnetic energy into acoustic information using inductive coils. These

techniques and tools, which shape our listening experience and influence our relationship to the aural world, are widely used by field recordists and sound artists.

Many of the field recordings I make are never listened to. They occupy space on a variety of hard drives in different digital locations, underlining the idea that the act of recording is about shaping listening as much the collection of recorded sounds for later use. Mark Peter Wright explored the status and significance of recorded sounds in his work *(Auto) Dialogical Feedback: Towards an Archive of Loss*, which is also described in his PhD thesis (Wright, 2015). Wright's is an ongoing project in which he takes field recordings back to the places where he first made them, listens to them, and then deletes them permanently from his archive. This work was carried out in a variety of locations, including South Gare in Teesside, a site I have also visited to make field recordings. *(Auto) Dialogical Feedback* explores loss through recording. It problematises the act of collection and the supposedly permanent nature of digital technology. Wright's work examines his own relationship with his sound archive and configures field recordings as temporal material. In *Ambulation* the recordings made during the performance are deleted at the end of each walk. I start each walk with empty sample banks ready to be filled during the next event. Like *(Auto) Dialogical Feedback, Ambulation* is focused on the performative act of recording and the temporality of the audio file, rather than on the possibility of perpetuity.

Field Recording as a Live Performance

Field recording as a practical activity often requires one to spend long periods of time outdoors hunting for sound, withstanding all weathers and listening. It demands patience and, over time, the development of an intuition regarding sound sources as well as knowledge of technical approaches to recording them. Field recording is more often than not a solitary practice, and when conducting field recordings I am usually listening alone. The solitude of field recording creates focus and allows an attentive relationship towards environments to develop over long-periods of listening. Whilst sounds I personally record feature heavily in my work, the particular conditions of their recording can be difficult to render as explicit within live performance or installation.

Sound artist Lee Patterson performs with everyday objects and field recording technologies both as a solo performer and within ensembles. Using contact microphones, guitar pickups, hydrophones and motors he amplifies the micro-

resonances of springs, CD players, water-soluble vitamins, burning peanuts and glass bottles. These performances generally take place within gallery spaces or music venues, with Patterson stood behind a table of diverse and intriguing sound objects. Patterson's approach to performing with recording technologies is very different to the tradition of electroacoustic music. With his work we are hearing live processes in action, the hissing of soluble matter, the squealing of a burning peanut hull and the tonal twangs of amplified springs. Rather than pre-recorded material we are listening to events happening in front of our ears. In contrast, electroacoustic performances tend to take place in specially made concert halls with a large number of loudspeakers, the performer hunched over a mixing desk performing a sonic diffusion of pre-recorded material (Emmerson, 1986, p. 104). *Fields* is performed with recorded sound in a different fashion to Emmerson's description. Prior to a performance there are many unknowns: the number of compatible phones, where exactly audience members will sit, how fast the network will be. Like Patterson we perform with live processes, such as network latency and the spatial positioning of the audience members, as productive, procedural and immediate compositional materials.

As with my previous work, many compositions and sound installations that include field recordings as sonic material allow little or no access to the process of making those particular recordings (see *Dead Logics and Worlds: Sound art and sonorous objects,* Hudson and Shaw, 2015). Field recordings are often presented and experienced through loudspeakers after the act of recording; sound is transported from its point of capture to its destination with limited opportunity for listeners to access the process of the field recording or the effects of transportation itself (Smalley, 1997 and Voegelin, 2010). This use and presentation of field recordings means that the conditions of how a recording was made, what techniques were involved, and what challenges and mistakes were encountered are rendered invisible to the listener. *Ambulation* emerged as a desire to find strategies for engaging people in the act of field recording itself by configuring it as a shared and live act. *Ambulation* builds upon my daily practice of field recording and incorporates the recording technologies I use on a regular basis into a performance walk that makes the act of field recording public rather than private. Based on my own experience of field recording, through *Ambulation* I wanted to develop the process of field recording as a live artistic and creative procedure. Within *Ambulation* I record and perform with field

recordings in situ, creating immediate improvised and responsive compositions with the environment in which the sounds occur. By inviting audiences into this process, *Ambulation* offers a practical exhibition of the act of field recording during the performance walk.

Listening, Walking and Sound Walking

Artists have used walking for many years to explore environments and create work on foot (Evans, 2013). Within the field of walking as an artistic practice, sound walks emerged as a way of encountering environments through a focus on listening (Westerkamp, 1974). In my own work sound walking is both a practical necessity and artistic strategy for the process of field recording. In *Ambulation* I use sound walking as a structuring device for a live event that foregrounds the act of field recording.

Canadian artist and activist Hildegard Westerkamp conducts sound walks in order to experience and think about locational sound and time (Westerkamp, 1974). New York artist and musician Max Neuhaus conducted sound walks around Manhattan during the 1960s in which he would ask a group of people to meet him in a particular place, where he would stamp 'LISTEN' on their hand using a rubber stamp. Neuhaus would navigate groups through the urban landscape of Manhattan Island towards his studio, where he would conclude the event with a performance of percussion pieces that responded to the sonic environment encountered during the walk. In another of my own works, *Returning the Ear,* a collaboration with Polish artist Jacek Smolicki, a sound walk is conducted with a group of participants without any technology, followed by a responsive live performance. The pace and route of the *Returning the Ear* walk dictates the speed and timbre of the entire composition; walk and performance event merging into an extended act of listening. The structure of *Returning the Ear* resembles Neuhaus' Manhattan Island sound walks. Similarly to experiments described in Chapter 3, and the responsiveness of each *Ambulation* performance, *Returning the Ear* is created over the course of a couple of days. Like *Ambulation, Returning the Ear* is concerned with extending the practice of field recording through sound walking and performance. Smolicki and I have performed *Returning the Ear* to audiences in Barcelona, Sarajevo, Newcastle-upon-Tyne and Romainmôtier.

'Deep listening' is a practice developed by Pauline Oliveros as a musical and artistic practice focussed on sound and listening. Oliveros' approach moves away from

Western classical music traditions to consider environmental sound and holistic notions of listening as a creative act (Oliveros, 1995). Her written scores, such as *From Unknown Silences* (2009), engage with the idea of sound and silence as structural forms rather than addressing rhythm, harmony or melody. The primary activity for the participant in Oliveros' work is listening, and through listening the decoupling of musical practice from virtuosic technique or harmonic theory to emphasise the act of engagement with sonic phenomena instead. The Deep Listening Institute promotes a "heightened awareness of the sonic environment, both external and internal, and promoted experimentation, improvisation, collaboration and playfulness"[42]. Within her deep listening practice Oliveros also engaged with sound walking and a number of her text scores include instructions for walking. 'Sonic awareness' is a theory developed by Oliveros as a way of engaging with environmental and musical sound worlds through the act of deep listening. For example, from her *Sonic Meditations* series:

Take a walk at night. Walk so silently that the bottoms of your feet become ears.

(Oliveros, 2009).

Oliveros' deep listening scores and her theory of sonic awareness resonate with my own experience of field recording. The structure of *Ambulation* supports a collective act of listening through recording technology.

Since the late 1990s artists Janet Cardiff and George Bures Miller have worked together to create site-specific audio walks for numerous galleries, festivals and museums around the world. Cardiff and Miller's walks require the listener to don headphones, carry a media device and follow directions given to them from a pre-composed recording. Using binaural sound, the works include a voice over, field recordings of the route and added Foley sound, and lead listeners through an aural world (Cardiff, 2005). Cardiff describes her walks as a way of "slowing down the process of telling a story" (ibid.), and many of her pieces rely heavily on a text based narrative to drive the experience. Whilst *Ambulation* is not shaped according to an explicit narrative, nor does it include a voice over, it is a structured event and guided aural experience not dissimilar to Cardiff and Miller's audio walks.

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[42] http://deeplistening.org/site/

German artist Christina Kubisch is known for her 'electrical walks', which take a very different approach to that of Westerkamp, Neuhaus and Cardiff and Miller. Motivated by an interest in the sound of electromagnetic energy, Kubisch began by constructing large installations using copper wire and aerials. She invited audiences to explore these installations using handheld electromagnetic audio inductors like those employed within *Ambulation*. Kubisch's inductors use specially made pre-amplifiers to boost the sound signal for aesthetic preference, adding in operational amplifiers for filtering and frequency amplification, whereas *Ambulation* simply uses these coils of copper wire alongside other listening technologies used in the walk. In her electrical walks Kubisch embeds electromagnetic audio inductors into headphones, which allow listeners to navigate their own way through an environment. Like *Ambulation*, Kubisch's walks tend to take place in urban environments and encourage listeners to explore the electromagnetic fall out of cash machines, alarm systems, fluorescent lights and other electronic devices we find in our cities. Whilst *Ambulation* recordings are deleted after the performance, Kubisch has released albums of compositions made from electromagnetic material that she has recorded whilst conducting these walks.

More recently artists have used wireless headphones to explore the possibility of combining recording technologies and sound walking. Dutch sound artist Dennis Van Tilburg developed *Musique Parabolique*[43]*,* an augmented sound walk using a parabolic microphone and a computer running sound recording software. As in *Ambulation*, *Musique Parabolique* leads a group of people, all wearing wireless headphones, around an urban environment as Tilburg picks out sounds using a very directional microphone setup. *Musique Parabolique* was presented at the NIME conference held at Goldsmiths in 2014. Having witnessed a performance through the busy streets of Deptford, Tilburg's walk was an extremely effective way of picking out and abstracting sounds from the immediate context. As we walked together in a group, Tilburg used his highly directional microphone setup to pick out and curate the sounds of construction sites, bikes passing and a distant saxophone rehearsal emanating from a bloc of flats across the park. Stephane Marin et al. have also conducted augmented sound walks using wireless headphones and a variety of different listening technologies. Their *re_COMPOSED re_ALITY*[44] walks are usually

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[43] http://www.dennisvantilburg.nl/index.php?/ongoing/musique-parabolique/
[44] https://www.espaces-sonores.com/recomposed-reality

led by three people; one to guide the group, one to operate microphones and a third to mix and process sound live. Marin et al. use Ableton Live to process the sounds live, and "explore a synthesis between a 'pure' form of listening to the environment and a heightened, technologically supported listening experience" (Marin et al., 2018). Artist Dan Fox[45] has presented sound walks using wireless headphones in which he does not record or process the sound, rather he uses field recording technology to amplify aspects of the sonic environment, inviting audience members into this listening experience. Like Fox's work, my motivation around the development of *Ambulation* was to conduct field recording activities as a shared and collective experience. Marin and Tilburg have made systems that allow them to record and recompose with this material as a performance event. My work extends Fox's, which involves listening through microphones, to the recording and composing with sonic material live.

Though both of these artists' work has similarities to *Ambulation,* it differs in the following ways. Marin's work is conducted by three performers, each with a different task; one to lead the group, one to the hold and position the microphones and one to compose with the material using Ableton Live. Audience members are told where to go, what to listen out for and given instructions on how to listen. *Ambulation* is performed by one person: me. I am simultaneously performing the microphone positioning and the compositional system. Audience members are encouraged to walk behind me but are free to move at different paces and to focus their attention on whatever they like in their own time. Van Tilburg's walk uses a parabolic microphone whereas *Ambulation* employs a whole host of different listening technologies, including omnidirectional microphones, shotgun microphones, hydrophones, electromagnetic inductors and contact microphones. In this way *Ambulation* explores what listening is like through different technologies, and in doing so shows how these listening technologies change the way we experience the world.

Van Tilburg, Marin and Fox's walks differ from Cardiff and Miller's because they respond to the immediate sounds of the environment in which the work is experienced. Cardiff's sound walks use pre-recorded field recordings and pre-defined narratives, and approach the act of walking as a way of telling a particular story rather than experiencing a particular place. With the headphone walks conducted by

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[45] http://www.danfox.net/sound-walks

Fox, Van Tilburg, Marin, and myself the immediately encountered sound is a live source of creative material; not framed within the recalling of memory but as an instant response to the environment. As such, rather than pre-constructed narratives these works are improvisations conducted with the uncertainty of the sonic world as it is found through the act of walking.

In a paper describing his *EcoSono* work, composer Matthew Burtner details how environmentally responsive music is often made and presented away from the environment it is responding to. Typically, Burtner argues, electroacoustic work is made in "the safety of the studios, insulated from the natural world" (Burtner, 2011, p. 235). He goes onto explain how his *EcoSono* work was created as an alternative to this model, through engaging with what it means to make work outside in the wind and rain, in response and in collaboration with the elements. Tess Denman-Cleaver also explored this in her artistic research around performance and landscape conducted on Holy Island in Northumberland (Denman-Cleaver, 2014). *Ambulation* is an attempt to create an improvised sound performance within the environment it is responding to, rather than using field recording to transport sonic material from one place to another. In his *EcoSono* works Burtner employs environmental elements as complex data sources. For example, in a piece titled *Anemoi* he uses the wind as a chaotic input for a number of interactive instruments. Whilst sharing similar motivations to Burtner, with *Ambulation* I work primarily with acoustic information rather than abstracted data. However, future iterations of *Ambulation* could incorporate similar techniques to Burtner, involving data sensing of natural occurrences encountered during the walk as complex data sources. This is being considered and will be explored in future research (offered in Chapter 7).

Improvising with Recorded Material

During an interview with Douglas Simon, artist Alvin Lucier claimed that "live performances are more interesting than taped ones" (Simon, 1995, p. 94). As an artist with a background in improvised music the problematic relationship between recorded material and live performance has been central to my own work. Finding fixed media material difficult to work with in live performance settings, through this research I have explored possibilities for incorporating field recording into a live, improvisational practice. *Ambulation* is one example of the way in which I incorporate recorded material in improvised performance.

Though I do 'get to know' the environment through investigative processes prior to the walk, most of what is performed in *Ambulation* is responsive to the immediate soundscape and improvised during the walk. As the walk progresses many unexpected sonic events unfold, often beyond what could have been predicted during my initial investigations and planning of the route. Some aspects of the environment are relatively predictable; public clock chimes, busy roads and the acoustic dynamics of physical infrastructure. I use these more reliable features to structure the route. However, during the walk additional sound generating events that I have not anticipated add additional challenges to the performance and underpins it as improvisational composition. I understand the structure of the walk, based on predictable environmental features, as the score from which to improvise each event. The composed route allows me to walk the audience through different acoustic environments to encounter a diverse range of sonic material.

As discussed in Chapter 2, Felds' idea of dialogic editing, which he applied to sound recording and textual editing, has connections to the way I developed *Ambulation.* For me, the editing is not a separate act from recording, instead the making of the *Ambulation* composition happens in situ and in public as part of the process of field recording.

"*Dialogical editing is also an attempt to resituate, to create a different figure and ground for the work Kaluli help me do in order to 'write' them, and the work I had to do for them to 'read' that writing.*" (Feld, 1990, p. 244)

Ambulation addresses the central role that field recording has within my sound art practice by configuring it as a live, collective and perambulatory performance. It demonstrates how sonic material is composed with, translated and manipulated in the act of recording and how my practice blurs the line between studio and situated listening. The work explores the temporality of recorded material and is built upon the capacity for technological systems to heighten perception of particular environments. In what follows I detail how *Ambulation* was developed before going on to outline the technical system I designed for performing the work.

Development Process

As with *Fields*, *Ambulation* was created through an iterative development process that has included several public performances. The piece progressed each time it was presented and developed through the various contexts in which it was been performed.

Through this iterative and contextually responsive making process, I allowed for openness and flexibility within the technical system and the performative techniques adopted within the walk. This openness is key to my improvisational approach to working with recorded material. As with *Fields* and the generative experiments outlined in Chapter 3, the development of *Ambulation* shares characteristics with design strategies developed by Gaver and Bowers at Goldsmiths University Interaction Lab (Gaver and Bowers, 2013). Gaver discusses the importance of ambiguity as a design resource, a principle that I have adhered to in my own work and which can be seen in the making and open nature of *Ambulation* and *Fields* (Gaver, 2003).

Ambulation was not developed in a studio, but emerged through my daily practice of field recording. The system was developed through small incremental steps and regular testing in the 'real-world'. The first outing of *Ambulation,* following the residencies at the Pacitti Company, was with Museé Imaginaire, an arts organisation in Newcastle-upon-Tyne. In advance of this public event I spent a few sessions walking through Newcastle listening to different spaces and attending to the sonic character of the city with the organisers. By attending to the city acoustically, through the ear, allowed the work to develop through listening rather than the technological possibilities or details of the system. With each new walk, whilst preparing for the public event, I tried out a different aspect of the system in response to what I had heard before. On the second preparatory outing I took a shotgun microphone, a hard-disk recorder, two pairs of headphones and a headphone splitter. We listened through the microphones and I began to work out how a performance of this kind might be configured.

The media and technologies used in this performance were not developed abstractly; they were responsive to the environments I visited and experiences gained from previous performances. This responsiveness in how the system was developed is

also a feature of the development of *Fields.* Through regular performance, and consistent revision of the composition and system, *Fields* continued to develop in the event spaces it was shown.

Hardware

A variety of DIY and commercially bought pieces of hardware were used within different versions of the walk. During early iterations of the walk I was particularly concerned with the development of a hardware system that suited the perambulatory nature of the performance and allowed me freedom of movement to use the full potential of the equipment along the route (and in all weathers). Whilst many of these considerations appear mundane, they were crucial to developing the live and walking performance I was aiming at. I share them here to enable others to understand the practicalities of sound performances such as *Ambulation*.

At the centre of the *Ambulation* performance system is a 'conventional' field microphone, the kind commonly used for the collecting of sounds outside of the studio. The Sennheiser MKH 416 P48[46] shotgun microphone, mounted in a windshield blimp, was used in some of the early versions of the walk. As this was just a mono microphone it was limited in creating certain dynamic spatial effects. Replacing the MKH 416 P48, I began using the MKH-S stereo microphone[47], also mounted in a windshield blimp. This allowed for a mid-side (MS) signal to be decoded within the software and various image 'widths' to be achieved. This was immediately more desirable as it created more dynamic variation and I trialled it for the first time during the presentation of *Ambulation* as part of the Research Through Design conference (Cambridge), and again during a performance at FACT Gallery (Liverpool). The down side to using the Sennheiser MKH 416 P48 shotgun and MKH-S stereo microphone was that holding it tied up one of my hands, making accessing and using other listening technologies along the route (such as hydrophones and contact microphones) difficult. The cumbersome nature of this initial set up often resulted in undesirable handling noise for the audience-listeners. For the following presentation of the walk I adopted omnidirectional microphones, which were not held in the hand but strapped to my shoulders or to a bag. This allowed for the use of both hands to control the software and manage other listening devices. For this 'no-hands'

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[46] https://en-uk.sennheiser.com/short-gun-tube-microphone-camera-films-mkh-416-p48u3
[47] https://en-uk.sennheiser.com/stereo-shotgun-microphone-condenser-mkh-418-s

set up, I used a stereo pair of DPA 4060s[48] mounted onto my recorder bag, inside two Bubblebee Windbubbles[49] for added wind protection. These microphones give a similar sonic image to the ear and have become an established feature of the *Ambulation* set up. I used these mounted microphones for the presentation of this work at Compass Festival of Live Art (Leeds), Piksel Festival (Bergen) and at The Newbridge Project (Newcastle-upon-Tyne).

As well as 'conventional' microphones, a number of other listening technologies are used to capture a diversity of sonic material during *Ambulation* performances. Hydrophones, which allow for underwater sounds to be heard, have been implemented in a number of the walks. I have used both DIY and commercially bought hydrophones for a variety of purposes. The DIY hydrophones (see Figure 18) were created during a workshop I led in collaboration with artist and researcher Ben Freeth at the Discovery Museum (Newcastle-upon-Tyne) in 2015, as part of a collaboration with TWAM. These hydrophones used piezo microphones housed inside laser cut Perspex circles. They were very robust and cheap to make but lacked low end frequency. Following this I went onto use the Aquarian H2a Hydrophones[50] when presenting *Ambulation* at Compass Festival as they have a much better frequency response than piezo based microphones. The H2a use a small electret microphone inside oil, which in turn is encased within the capsule. This tends to give a clearer and more even frequency response across the acoustic spectrum. The H2a hydrophones have also become a consistent feature of the *Ambulation* set up.

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[48] https://www.dpamicrophones.com/dscreet/4060-series-miniature-omnidirectional-microphone
[49] https://eu.bubblebeeindustries.com/
[50] http://www.aquarianaudio.com/h2a-hydrophone.html

Figure 18: DIY Hydrophone made with Ben Freeth using a piezo microphone. Photo: Rob Blazey.

Inductive coils are coils of copper wires that can pick up electro magnetic energy when placed on or near electronic equipment. They are regularly used by sound artists to reveal the hidden energy of the electromagnetic spectrum by transforming it into sound. The coils used in such equipment occur in fluorescent light bulbs and small motors, and can be salvaged and used to 'sniff' electric environments. They are also available to buy as 'telephone coils', used to amplify or record telephone conversations.[51] Within *Ambulation* I use inductive coils bought from sound artist and microphone maker Jez Riley French[52]. I have also salvaged and built my own, which have occasionally been incorporated into the work. In some instances I have scavenged copper coils from discarded electronic equipment I have found when developing the route of the walk itself and then applied these foraged parts to the walk in the form of a DIY inductive coil microphone. I decided to use inductive coils as a way of introducing more sonic diversity into the material I was collecting. Like the hydrophones, these listening devices allow you to hear sounds not usually perceivable by the ear. Inductive coils allow me to introduce listening to a hidden sonic world and provide more performative options for the work within the urban environment.

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[51] https://www.amazon.co.uk/Black-Telephone-Pickup-Sensitive-Microphone/dp/B000L1OZG8
[52] https://jezrileyfrench.co.uk/

The hardware set up of *Ambulation* also includes the headphones worn by audience members for the duration of the walk. Sourcing suitable wireless headphones was one of the most challenging aspects of the hardware design of *Ambulation*. Branded headphones such as Sennheiser or Bose wireless headphones are extremely expensive to hire and most new 'personal' wireless headphones use Bluetooth technology rather than radio frequency (RF). As I use multiple headphones, receiving from a single transmitter, in *Ambulation* Bluetooth is not suitable as it requires device pairing. Hiring RF headphones with a transmitter from a company whose usual trade is silent discos[53] presented itself as an effective solution as they are affordable and readily available. These headphones work reasonably well, but are not of very high quality and sometimes become interfered with by other frequencies within the urban environment. This interference can significantly change the experience of the walk, affect my ability to control the audience experience of sound and means that the headphones can dictate the possible routes. Some of the headphones I sourced, when presenting the walk in Brisbane (Australia) for example, were so full of audio artefacts they became almost unusable. For this particular walk I sought 'refuge' in the city's Botanical Gardens, where interference of the urban environment did not impede the *Ambulation* signal as much. The interference experienced in walks such as Brisbane was an interesting problem, however, and something I wanted to tie into the creative decisions when planning the walk. As *Ambulation* is about the experience of sound, including the unearthing of phenomena not usually within our perceptive reach, this interference felt relevant rather than inhibiting to the work's intention. It was incorporated into future walks and became a part of the creative sonic material of *Ambulation*. The route in Brisbane started within the park where little or no interference occurred. Towards the end of the piece I navigated the audience into areas of interference. The second section included of the usual sonic material I was broadcasting from my system, as well as artefacts, audio cut outs and even the occasional 'tuning in' to taxi driver conversations on a locally broadcast network. Though I was not directly in control of the effects of the interference, I could dictate a route that shaped how much or little interference would occur. The walking route in these instances was built around the quality of possible broadcast, and moved through areas of 'compositional ambiguity', in which it would become unclear what was being performed and what was incidental to the walk.

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[53] https://www.hedfoneparty.com/

Software

The open-source visual programming software PD was used in all instances of the walk. It was used to process the incoming audio and manipulate it live. PD ran on a MacBook laptop, running with its lid closed (using the Don't Sleep software), and placed in a rucksack on my back. A small Korg NanoKontrol[54] plugged into the laptop was placed in the bag that I carried on my shoulders (Figure 19). The *Ambulation* rucksack also contains a sound card allowing microphones to be interfaced with the laptop. In what follows I outline the software set up I developed to support the *Ambulation* walk. As with my description of the hardware, this explanation is intended to offer practitioners and researchers a practical insight into how work such as *Ambulation* is constructed and operated.

Figure 19. *Ambulation* controller setup. Photo: Tim Bowditch.

Software Instruments

A number of software instruments were constructed for *Ambulation* using PD. These were designed to achieve maximal results using the minimum of controls. Work of this nature was further explored in a collaborative project I did named *One Knob to Rule them All* (Bowers et al., 2016). As the NanoKontrol controller only has a limited amount of knobs and sliders (8 of each) and 34 buttons, its limitation informed the

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[54] https://www.korg.com/uk/products/computergear/nanokontrol2/

design of the software instruments and dictated how many instruments I could have during any given walk. All of the following *Ambulation* instruments were designed by myself with live audio processing and manipulation in mind.

Soft Mixer is at the heart of the system and allows me to manage the different audio feeds coming in and the volume of each of them. I can control the volume of the mix being sent to the wireless headphones as well as, in some cases, the stereo image. The Soft Mixer enables me to send out a signal to other parts of the system, and acts in a similar fashion to an auxiliary send on a hardware mixer.

The Sampler I designed for *Ambulation* enables incoming audio to be sampled and recorded to three sample banks, which exist independently of each other. Each sample bank's default is programmed to loop the sample. The sample banks work using three buttons. One button starts the recording, one stops it and the other clears the bank. The sampler can record sound even if the Soft Mixer's faders are down, allowing sounds to be recorded before the audience or myself hear them in the headphones. This is useful when a sound occurs during the walk that I want to save to memory, but not play back immediately in the composition. Once a sound has been recorded to the memory bank I can adjust the start and end points of the playback, this is useful in a very functional sense, as if the sample contains an unwanted sound at the start or the end of it, I can remove this with ease whilst we are walking. It also enables me to create granular sized playbacks of the sounds, by placing the start and stop markers very close to each other to create rhythmic sequences and, at the extreme, pitched drones. The Sampler also allows me to reverse sounds saved within the banks, giving me another tool to manipulate the audio. Once the sample banks are cleared they cannot be recalled. I always clear the sample banks at the end of each walk, making sure they are empty for when the next walk begins.

The Granular Pitch Delay allowed me to extend the possibilities of the audio manipulation by recording small grains of sound into a wavetable and through a delay line. This delay line could be played back with a variety of speeds, therefore altering the frequency of the audio grains. One knob was assigned as a send to the granular pitch allowing signals of the audio input to be sent to this instrument, this also worked as an overall volume for the delay, a wet-dry mix. Parameter controls

were also added to control the pitch, feedback and the size of the grain recorded. With just three controls a large variety of sounds could be achieved, from long drones to short percussive textures.

Granular Moments is a more conventional granular synthesiser within PD for use within *Ambulation*. This allowed sounds to be recorded to the disk of the computer and then loaded into 4 separate wavetables. I used a button on the NanoKontroller to randomise the parameters of the position, size, frequency and volume of each grain. This gave me a less predictable quality of sound, which I often employed for improvising in transitional periods of the walk.

Spectral Freeze was made using the [rfft~] object in PD. By sending a feed of incoming audio, as determined by the Soft Mixer, the Spectral Freeze instrument freezes the spectral character of the audio to create an on-going drone. Using a button mapped from the NanoKontrol I could create a freezing of the frequency spectrum and have this continue as a textural element in the composition. This instrument became very useful for creating transitions between different sections of the walk. I also used it when pitched sounds such as sirens, air vents and buskers occurred during the performance. With this instrument any occurring sound could be instantly turned into a drone, this worked best with sounds with identifiable pitches, the swooping of a siren could be caught and frozen with the simple press of a button.

A simple high pass filter was created on the 'master' channel to sculpt the various sound sources coming into the system using the [hp~] object in PD. A knob on the controller was used to adjust the frequency of the envelope and could be used to sweep the full human hearing range. This tool allowed me the possibility to filter out the low-end traffic noise that occurs in most city centres, which becomes especially pronounced when listening through sensitive microphones. I also used it as a method for shifting from one sound world to another, creating transitions between two sonically contrasting environments, for example, in the hydrophone section.

Observations and Reflections

Adopting a thinking through making approach to the development of *Ambulation* allowed for the creation of the walk and the technologies that support it to respond to the sites and sounds with which it was performed. Here I report on four main

reflections that emerged through the iterative development process and performances of the work.

Sound in Situ: Performing Field Recording

Ambulation deals with the act of field recording as a performance activity. It engages with soundscapes as a live phenomenon, ever changing and geographically specific. The making of the work is conducted in close correspondence to where the sound originates, and does not involve the moving of material from one environment to another, but rather the processing of and engagement with sonic material in situ. Like Burtner's *Ecosonics*, *Ambulation* engages with sound and site as part of the making process. The composition is not pre-made, but unfolds with the audience as a live improvisation. It also responds to the unpredictable nuances of the immediate environment. For example, when performing *Ambulation* in Brisbane, I got extreme audio artefacts in the headphones from various communication infrastructures in the local environment. Rather than letting this ruin the walk, I decided to fold this feature into the composition. The interference became a way of structuring the route of *Ambulation*. In *Ambulation* I respond directly to unexpected sonic material created as a consequence of the technological by-products of urban activity. These artefacts are not limitations but potential material for the performance of the work. Through adopting a thinking through making approach this work adapts to environmental phenomena, change and remains responsive to the different places I present the work. Tess Denman-Cleaver discusses this in relation to her work *Project R-hythm,* in which she strives for a non-anthropocentric approach to landscape performance. In this artwork, the human moves away from the centre of the performed world and environmental factors such as rain, tidal rhythms and landscape are configured as actors in a performance event (Denman-Cleaver, 2014).

Extending Perception

As with the work John Bowers and I did in collaboration with the Pacitti Company from which this project grew, *Ambulation* explores the idea of using tools to extend perceptual possibilities within performance events. *Ambulation* applies these ideas to the context and structure of a sound walk. By using inductive coils to sniff the hidden sound of electromagnetic energy, hydrophones to listen through water and contact microphones to reveal concealed resonances, I invite *Ambulation* audiences to listen to the otherwise inaudible sounds of our sonic environments.

The physicality of our shared networked infrastructures, electricity, Wi-Fi networks, radio broadcast frequencies (prior to demodulation) and Internet communications are often inaudible to us in the everyday. Through artistic practice I look beyond the surface of telematics to investigate physical manifestations of networked infrastructures (for example by listening through an inductive coil attached to a cash machine). My work creates opportunities for audience members to hear aspects of the world that would usually be out of reach and uses technology to offer alternative perspectives on environments. This thinking was further developed in my later work *Ring Network* (Chapter 6), which looks at the relationship between acoustic and recorded sound as well as the physical and temporal realities of the Internet.

Artist Aram Bartoll looks at what it means to physically locate digital technologies and networks. In his work *Keepalive* Bartoll embeds a Wi-Fi router in an indigenous rock in Neuenkirchen, Germany. By lighting a fire under a specific part of the rock, a thermodynamic converter converts the heat created by the fire into electricity to power the router. Participants are invited to use a smart-phone, tablet or laptop to access the network and browse a selection of survival guide PDFs. With *Keepalive* Bartoll questions the act of connecting to a network, situating digital technology within the act of building and lighting a fire. In this work networks are not about the Internet, rather they are tied to a specific site and space. Through extending perception *Ambulation* offers an alternative way to experience networks (and other communication infrastructures) through the simple act of walking.

Figure 20: Walking into the graveyard of Liverpool's Anglican Cathedral during a performance of *Ambulation* at FACT. Image Simon Bowen.

Collective Listening

Ambulation opens up the act of field recording as a collective listening experience. Moving away from its traditional uses in the archiving of sonic material, or incorporation in electro-acoustic composition, *Ambulation* uses the live potential of field recording and a bespoke performance system to support shared listening amongst the audience of walkers. Bernie Krause describes how listening through microphones changed the way he heard: "amplified sound gave me a way to translate the language of the natural world in ways my 'civilized' ears could not" (Krause, 2002). *Ambulation* shares the very particular experience of listening through microphones that had become familiar to me as a sound artist with a wider audience.

Walking as a Compositional Structure

In *Ambulation* I drew on my experience as an improvising musician and field recordist, using the structure of a walk to bring together these artistic interests and practices. The sonic environment is unpredictable and lends itself to the practice of improvisation. In order to perform the walk I had to create a reliable technological system that could deal with a variety of sonic material and allowed me to perform interesting manipulations of that material on foot. I also developed a strategy for

carefully pre-composing the route the performance would take (see Figure 21). This gave a predictable geographical structure to the walk, whilst allowing unexpected events to occur during the event.
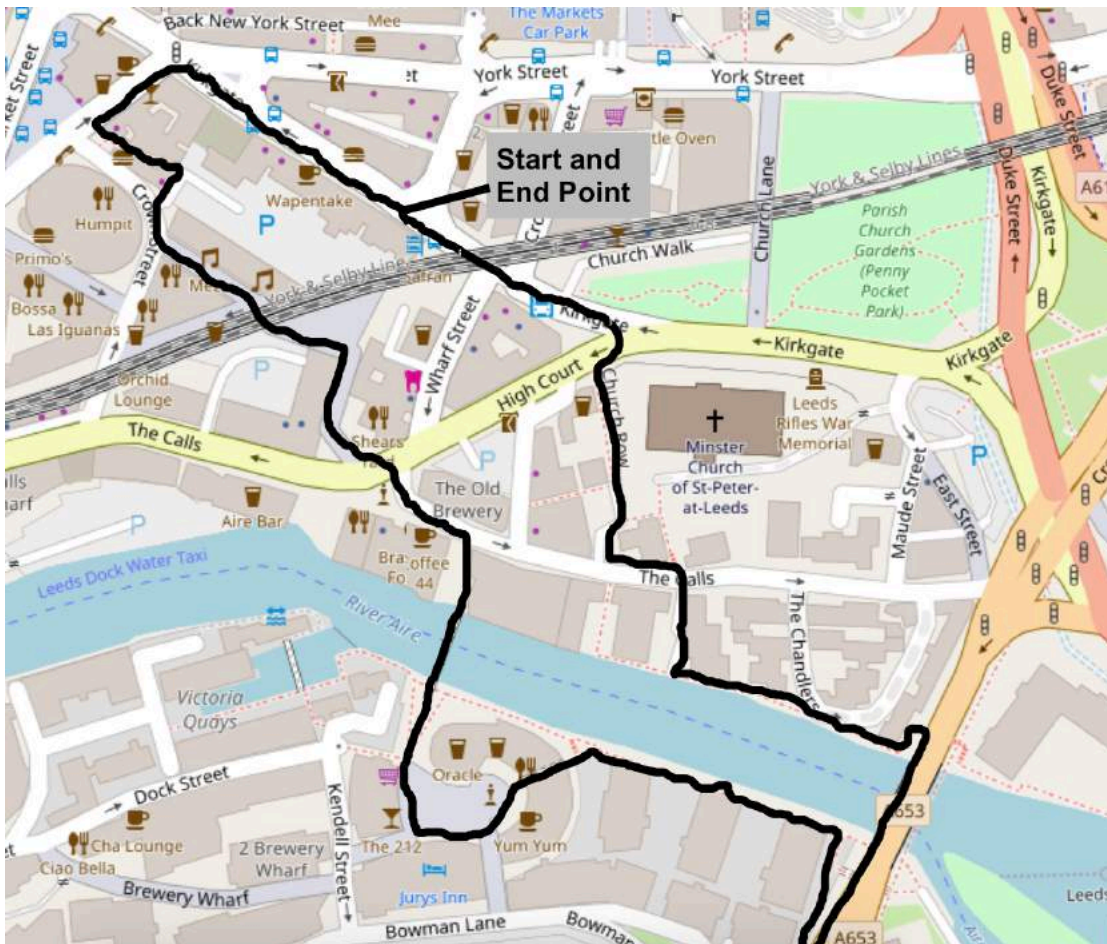
Figure 21. Walking route for *Ambulation* at Compass Festival in Leeds, 2016. Image Open Street Maps and Tim Shaw.

When presenting the walk in Brisbane the route became a way of navigating other technological infrastructures, moving in and out of areas of radio transmission density. At Compass Festival (Leeds) the route began outside the Art Hostel next to a busy road and with a train track overhead. I then led audiences to the pedestrian walkways alongside the River Aire where the ambient sound levels were much lower and more detailed sonic material could be sourced. The walk ended by crossing under the train tracks again and walking through the centre of Leeds with its many pedestrians, buskers, market callers, cars, buses and passing freight trains. The beginning and end of the walk were characterised by the sounds of the city, with the middle section much quieter and allowing different types of sonic material to be collected. At Piksel Festival (Bergen), I began the piece inside the large warehouse

space that was being used as the main exhibition venue. I led audiences through corridors, up and down stairs and then outside to the industrial landscape surrounding the venue. Here I attached contact microphones to old pieces of machinery and dipped hydrophones in the harbour. The walk finished back at the front entrance of the warehouse, which had a peculiar long tail reverberance to end the piece.

By pre-composing the walk according to features I deemed to be characteristic and dynamic in a given performance context, I determine the broad structure and presiding thematics of the performance. Within this structure we encounter particular events and sounds as material for live improvisation.

The performance taking the form of a walk means that the movement of the group, led by me, determines the pace of the *Ambulation* composition, and I productively move through different spaces at different speeds to create rhythmic changes in the piece. When entering an underground car park in Brisbane, for example, I slowed the walk down and the sound of the busy street above was contrasted with this new and relatively empty space. As I slowly moved through the car park, followed by fellow walkers, each step created a reverberant impact within the space. When we reached the exit I began to walk at the pace previously established before entering the car park. When performing the piece alone, for example when I am trying out the system or scouting for new routes in an unfamiliar space, I often walk faster than I do when I am with a group. The group dynamic changes how fast I walk and also how long I might stay at a particular location and attend to its character. The shape of the piece is dictated therefore by the character of each group I walk with.

Discussion

Though no two *Ambulation* walks are the same, I have developed numerous strategies for creating dynamic performances. The work has been developed through multiple public presentations in a variety of settings. Like the other projects presented in this thesis it demonstrates a research approach akin to Ingold's thinking through making, applying this principle to work with sound, technology, site and performance. In relation to this methodology I offer two points for discussion below.

Liveness and Thinking Through Making

The liveness of *Ambulation* means that making is not separated from the performance event. Rather, performer and audience are simultaneously part of the unfolding of the improvised composition, which responds to the immediate environment. Making, and the thinking that it entails, occurs through the walk itself, in the use of the pre-built system, in the shaping and collective experience of the pre-planned route, in the interventions with materials encountered during the performance, the dipping of hydrophones and the induction of electromagnetic energy. With *Ambulation* I create an arena for action and listening*,* I set up a situation that allows for outside factors to influence the outcomes of the walk. The making happens with the audience as a live and public process. The making does not happen in advance, I do not have complete composer privilege, rather the composition unfolds in time and space during the performance event. Though led by me, the activity of thinking through making is done collectively rather than centrally by the audience. As each iteration of *Ambulation* is improvised, each walk is uniquely responsive to site, time, situation and audience attendance. The research outputs of *Ambulation* are not presented as findings; instead I have offered strategies for conducting performance walks of this nature. These strategies are open and flexible to different performance scenarios: technological, environmental, cultural and otherwise.

Improvisation and Thinking Through Making

The uncertainty of the sonic urban environment and its potential for musical expression is communicated and reflected through the *Ambulation* sound walk*.* Approaching the walk through an improvisational practice allows for the uncertainty of the sonic world to be tied into versions of *Ambulation.* Unlike Cardiff and Miller's walks, which draw on fixed recorded audio and linear narrative structures, *Ambulation* works with the immediate soundscape as a creative material. It thus operates in a similar way to *Fields*, which accepts latency as an unpredictable technological feature of its performance environment. Approaching media through an improvisational practice allows for complex and unpredictable elements to occur. As Bowers explains in his monograph *Improvising Machines,* he approaches electroacoustic improvisation through responsive action (Bowers, 2002). Highlighting activities that accept place, structure and technology as productive features of performances and not "problematic obstructions" (Ibid, p. 49). *Ambulation* accepts these unpredictable features and uses improvisation as a thinking through making

process, extending Bowers' account of electroacoustic improvisation in the form of a performative sound walk. Approaching the making of artworks in this way, whereby the characteristics of site, technology and situation are integral parts of the creative material and presentation, is continued in the making of *Ring Network,* a piece I detail in the next chapter.

Chapter 6. Ring Network: An Installation

In this chapter I describe a sound installation that emerged out of experiments first conducted during a residency with Tyne and Wear Museums in Newcastle-upon-Tyne. The genesis of this project is described in full in Chapter 3. The piece, which went on to become *Ring Network*, was further developed and presented in September 2016 during a group show at The NewBridge Project (Newcastle-Upon-Tyne). In this chapter I give details of the work itself, the motivation behind its development, its relation to work by other artists, and describe how the development of *Ring Network* as part of my research trajectory. As with previous works presented in this thesis, I comment on the making and design process and conclude with critical observations upon the development, presentation and interrogation of the work.

Figure 22 *Ring Network* presented at The NewBridge Project in Newcastle-upon-Tyne in 2016. Image Tim Shaw.

The Work: A Typical Installation

Ring Network is a sound installation that uses physical bells, networked technology and digital sound processing to create a generative and ever-changing soundscape.

It was installed in The NewBridge Project gallery space for three weeks, during which time the system ran continuously. The exhibition piece was accompanied by the following text:

Bells have long been used as signalling devices to transmit messages across space. A church bell defines its parish and early telegraph designs used bell patterns to encode messages. Ring Network works with the hidden spatial qualities of network latency and investigates the relationship between acoustic and recorded sound.

3 bells are placed in the gallery space, a bell rings and it is recorded to the disk of the computer. The recorded version of the bell is then sent to a remote server in Iceland, Las Vegas or Seoul. The same sound file is then requested back by the local computer and the digital file returns to the exhibition space. The recorded bell is then played through a speaker at the time it took to travel around the world and back.

Ring Network explores network latency as an artistic material. It plays with the idea of the Internet as a physical medium, one in which geographical space informs our experience of a network. Sometimes the dynamic sound files are rejected, spat out of the system and left to hang in the ether, other times they transfer effortlessly, taking less time to travel around the world then they take to listen to.

The NewBridge Project iteration of the work was commissioned for a group show entitled *PolySpace* curated by Peter-Ashley Jackson and Oliver Perry. *PolySpace* explored themes around physical space, technology and environment. Other exhibiting artists included Charles Danby and Rob Smith, Holly Hendry, Alexandra Hughes and Anna Udall. Further versions of *Ring Network* have been presented at the following galleries and institutions:

> Fridman Gallery (New York, USA, 2018)
> Telematic Hacking (De Montfort University, UK, 2017)
> bb15 (Linz, Austria, 2017)

Within the works that precede *Ring Network*, *Ambulation* (Chapter 4) and *Fields* (Chapter 5) I engaged with the technological processes inherent to the projects as creative methodologies, and with technological limitations and characteristics of the

technology I employed as creative material. In *Fields* the limitations, as well as the potentials, for using mobile devices as sound diffusion tools are central to the work, which encompasses both the system Piquemal and I developed and the sound composition we created with and for it. In *Ambulation* the affect of listening through microphones on our experience of an environment was foregrounded, and I explored and exploited the capacity for listening technologies to both extend and distort the collective sonic experience of place in the development of the performance. As discussed in Chapter 4, *Fields* specifically addressed and creatively approached the presence of latency in the bespoke system. My interest in latency as an artistic material was extended and brought into focus in the making of *Ring Network*.

Figure 23 *Ring Network* presented at The NewBridge Project in 2016. Image Tim Shaw.

In *Ring Network* a bell is placed in a space, with a microphone positioned above it, sounds with a trigger, which starts a sequence of events. The trigger simultaneously enables the microphone to record for five seconds, as the bell continues to ring out it is recorded to the disk of a computer. When this process is complete, the sound file is sent in WAV format to a remote server in a distant country. Technically these servers could be in any country, though for the *PolySpace* iteration of *Ring Network*, the files were sent to servers in Iceland, Las Vegas and Seoul. After the file has finished transferring, the programme on the computer is notified, which then requests

the file to be sent back to the exhibition space. The returned file is saved in a different disk location and when the 'return' transfer is complete, the recorded version of the bell is played back through a speaker situated in the space. The 'returned' sound plays back for the duration it took for the file to travel around the world and back; if, for example, the sound file took fifteen seconds to get to Seoul and back then the file is time-stretched to play back through the speaker for fifteen seconds. The time it takes to travel around the world, between servers, depends on a variety of factors and is consistently changing during the period of the installation. The composition that results from this set up is thus dictated by network latency, which is defined by global Internet activity and server traffic across the different geographical locations. *Ring Network* is, in this way, a sound piece entirely built upon and within the latency of networked systems.

In the installation there are three bells, each with corresponding speakers, and three separate servers with each of the different files being sent to and from them respectively. The bells ring at different times and microphones positioned above them pick up the sounds of their multiple resonances in the space, as well as the ambient shuffles and mutterings of the audience in the gallery, so that the immediate soundscape surrounding the piece also influences the sonic results of the composition as a whole.

Related work

Telematic Art

Roy Ascott coined the term 'telematic art' during the 1960s to describe a growing field of artistic work being created with and within the structures of cybernetics and telecommunication technology (Ascott, 2003). Ascott observed that the ability for artists to communicate and collaborate, in real time, over large geographical distances opened up new possibilities for artistic practice and research (ibid., p. 112). Ascott claims that telematic practices of the mid-twentieth century changed the way time was shaped and experienced through the artworks produced. Possibly the earliest example of the artistic use of telematics is Moholy-Nagy's *Telephone Pictures* [1923]. Moholy-Nagy claimed to have ordered the pictures over the telephone, instructing the enamel manufacturers of the geometric design. This method exaggerates physical distance between artist and art object, and also demonstrates the notion that an image can be configured as transferable data.

Network exchanges were (and still are) asynchronous by nature, messages took time to travel across infrastructures and therefore arrived at different moments. The result of this inherent asynchronicity is that communicating through this technology has unpredictable consequences. Moholy-Nagy's use of telematic communication in the creation of *Telephone Pictures* introduces not only expanded physical distance, but also introduces a degree of chance into the artistic process, dissolving the artists' control over the finished product.

This unpredictability of telematic communication opens the potential for extending practices dependent upon chance operations, such as developed by Cage. Drawing on Asian philosophy such as the *I Ching*, a book which is consulted through generating seemingly random numbers, Cage was fascinated with the idea of chance, randomness and unpredictability. *Music of Changes* (1951) used *I ching* number generation methods to choose from specially designed charts relating to durations, dynamics, rhythms and timbres, moving autonomy away from Cage as a composer (Lochhead, 2001). In *Imaginary Landscapes No. 4* (1954), Cage uses a score of broadcast frequencies to instruct twelve performers tuning twenty-four radios over a designated time frame. As each radio is tuned live broadcasts from different stations are received and amplified in to the performance space. The piece cannot ever be repeated; the elements of chance are tied to time, location, the noise of radio static and the content broadcast by reachable stations. *Fontana Mix* (1958) which I was invited to perform at the Baltic Centre for Contemporary Art in Gateshead in 2012, is a graphic score for an ensemble of musicians. The score is made up of pieces of paper and transparencies; performers are instructed to arrange the sheets to create new intersections and therefore a new score each time the piece is performed. Cage used contemporary technologies and chance operations to creatively achieve random encounters and to move autonomy away from the author in both his visual and musical artworks (Jensen, 2009).

Technologies associated with the development of telematics, telephones, radio, the telegraph, television and more recently the Internet have the ability to "bend time" (Ascot, 2003 p. 27). Broadcasting sound, light and text over networks can change the way time and media are experienced and has been exploited by artists to create performances, bespoke communication systems and installation artworks. Mark Hansen and Ben Rubin's *Listening Post* (2001) uses a specially made computerised

system to scrape 'real-time' data from hundreds of forums, chat-rooms, newsgroups and other Internet based public communication channels. This information is then displayed in an installation environment across two-hundred screens accompanied by a soundtrack of text-to-speech voices and sonified data. The sheer amount of data displayed simultaneously plays with the idea of time and scale, experiencing multiple voices from all areas of the globe concurrently creates new temporal possibilities. The 1999 piece *Ride the Byte* made by Berlin based art collective ART+COM uses automated processes to transfer packets of data around the globe. The journey of these small parcels of data are visualised on an LCD screen. 'Ride the Byte visualises the ever-changing spatio-temporal structure of the Internet, indicating both its massive size and its technical idiosyncracies'[55]. The time these packets take to travel to their destination is entirely dependant on the speed of the internet infrastructure and how much web traffic there is. Time, in *Ride the Byte,* is infinitely variable due to technological characteristics of the Internet. *The Photostroller* (Gaver et al. 2010) and *The Prayer Companion* (Gaver et al. 2011) which were developed at the Interaction Research Studio also exist as examples of art and design which use web-scraping online content for creative purposes. In *Ring Network*, I continue the line of thinking brought about by Internet artworks such as *Ride the Byte* and *Listening Post.* Here I use the sound of a bell, a traditional device used for communication, to expand the idea of time and place through contemporary networked technologies.

I have already discussed the multimedia potentials of telematics with the examples mentioned above. *Ride the Byte,* visualises the journey of internet data transfer, *Listening Post* creates a large-scale sound and light installation using data collected from hundreds of internet chat rooms. The possibilities of exchanging ideas through audio, video, performance and movement demonstrated the interdisciplinary nature and appeal of telematic art. As the Internet has become more commonplace for most people living in the Western world, over the 2010s, more artists across multiple mediums are approaching this space creatively (Moulon, 2017). *Ring Network* specifically uses sound to reveal the time taken to transfer files across networks. In *Fields,* nuances of the network are also revealed through the time that it takes from the message to travel from the server to the individual device. Sound and light are

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[55] http://v2.nl/archive/works/ride-the-byte

used to indicate the arrival of the messages and a complex, intertwined and overlapping sound and light space occurs.

Ring Network sits in relation the lineage of telematic art that Ascott describes, appropriating global networked systems to create a sound installation that is defined by the unpredictability of its own technological infrastructure. The audience of the work encounter a temporality that is shaped by the chance workings of global Internet activity and server traffic across the different geographical locations. The chance operations that define this work place compositional control at a distance from myself as artist and author of the piece. Though there is an openness to unpredictability and chance in this work I acknowledge that I have made a lot of fundamental decisions to allow for chance to happen. Here I am not setting chance against a dualism of chance and no-chance, rather creating am *arena for chance* and unpredictability to occur within, in a similar way I create an *arena for attention* in *Fields* (Chapter 4).

Latency as a Creative Material

As described in Chapter 4, latency played an important part in approaching the sound design of *Fields.* It became evident through making the work that the delays between sending signals from the server and these messages reaching each mobile device playing sounds differed. Each time the piece is performed the affects of latency on the composition differs. It is dependant on the amount of people connected, the size of the audience, and the variety and behaviours of the devices being used. This chance operation of the *Fields* system informed our creative decisions regarding the sound design. In *Ambulation* the performance is entirely dependant on the sounds encountered during the walk, which required me to design a system which was open and flexible to chance encounters and unforeseen activity within the environment. *Ring Network* builds upon previous work by extending my interest in latency as a particular chance operation within sound composition. It is consistent with my preceding engagements with the limitations of technological systems as generative materials.

A number of artists have explored network latency as a creative feature and material of their work. Russian artist Olia Lialina has been making net based art since the early 1990s, exploring the Internet as a creative medium. Her work takes the form of obscure narrative games hosted within web browsers, animated GIFs and other

pieces of Internet enabled art. Many of her works were inspired by 'slow to load' webpages, for example in *My Boyfriend Came Back From The War* (1996)[56] she uses the aesthetic and temporal experience of 'slow to load' webpages to build tension and uncertainty into a narrative. In 2013 Lialina released *Summer* (2013)[57], a twenty-one frame animation made up of a short loop of the artist sitting on a swing suspended from the browsers search bar. Each image of the animation is hosted on a different server and the browser is automatically redirected to the next frame in the animation once the image is loaded. Like *Ring Network*, the speed of the animation is therefore dictated by a number of chance factors, including global Internet activity and server traffic.

Lialina approaches latency, the speed at which the sequential webpages load, as a creative material in her work rather than as a limitation to the context for which it is produced. She is not just using the web as a medium to present her work, rather her work engages with the intrinsic temporal and material character of the Internet, revealing the nature of networked technologies. Lialina's work, like *Ring Network*, differs from practices which use media technology as a discreet presentation mechanism for artistic context. *Summer* is an example of work that, in its simplicity and engagement with the intrinsic character of new media technology, I have returned to throughout the development of my own practice.

The ability to conduct live performance of sonic compositions over the Internet has also opened up many possibilities for collaboration and communication within the field of telematic art. In many New Interfaces for Musical Expression (NIME) conferences, as well as the International Computer Music Conference (ICMC), often whole conference tracks are dedicated to music making across networks. Researchers in the field of computer enabled music making have long tried to eradicate latency from the workflow of musicians in the studio and within live performance (see for example McPherson, 2016, and Barbosa et al., 2005). With the rise of network music, since access to the Internet has become more widely available, latency and the performance of networked computer systems has become a common topic within these communities. Many attempts to eradicate latency, describe the desired creation of a 'realistic' environment within which musicians can

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[56] http://www.teleportacia.org/war/
[57] http://art.teleportacia.org/olia/summer/terms.html

collaborate (Drioli, 2013). In work done by Tanaka (2000), and later Freeth et al. (2014), however, networked music making is approached in a way that uses latency as a part of the complex and heterogeneous materials artists are able to work with. This approach to incorporating latency is aligned with my own development of *Ring Network*, a piece defined and dependent on inherent latency of its system. Building on the ideas and strategies for using latency that emerged through *Fields*, I created *Ring Network* to further explore and reveal the artistic potential of an aspect of our networks that we tend to ignore, or consider a limitation, in everyday life.

Artists Using Bells

Within the *Ring Network* installation a number of physical bells are placed within the gallery space. Many contemporary artists have explored bells as artistic sound objects. Marcus Vergette, for example, creates sculptural bells and uses new research in finite element analysis (FEA) to explore the possibilities for new harmonic relationships within their materiality (O'Brien, 2001). FEA is an area of study at the intersection of mathematics, physics and engineering, using scientific models to observe how vibrations travel through material. Vergette presents his work in public spaces in the form of long-term installations, for example *Tidal Bells*, in which bells are played by the ebb and flow of the water they are placed within (Vergette, 2018). Vergette's *Ringing Bells* series invites the public to play the sculptures themselves, supporting public, collaborative sound making activity. Vergette describes his work *My Feet in Earth* (2003)*,* which is installed in Devon, as the first publicly accessible bell in the UK. Highhampton, where the work is installed, is a small village which was drastically effected by the foot and mouth outbreak of 2001. Vergette describes *My Feet in Earth* as supporting "democratising" bell ringing, with a publicly accessible bell that can be rung by anyone at any time to "celebrate the community's survival and strength" (Vergette, 2018).

Artist Fiona Banner developed a large-scale public bell called *Tornado* in 2010. Commissioned by Locus Plus and presented in Gateshead during the Great North Run, the *Tornado* bell was crafted at the John Taylor & Co. Bell foundry, which at the time was the last bell foundry in the UK (Pinnock, 2018). Banner's bell is constructed from the metal of a Tornado fighter jet. In an interview Banner describes a bell as the simplest form of communication, placing this simplicity in opposition to the complexity of a fighter jet (Banner, 2010). There is a long history of bells being crafted from military instruments. The Pummerin Bell, "the largest bell in history" rings from the

belfry in St. Stephen's Cathedral in Vienna and is cast using captured cannons from the Turkish Siege of Vienna in 1686 (Benet, 2000). Historically during wartime bells were smelted down and used for making artillery, such as cannonballs and bullets. In World War One it is said that 90% of all bells in Lower Austria, Salzburg and Tyrol were requisitioned for military purposes (Weitensfelder, 2018). Banner's *Torando* speaks to this tradition of transforming bells into weaponry by reversing the process and plays with the idea of material in flux, moving metal between war and 'simple' acts of communication.

In both Banner and Vergette's work bells are used as visual and sonic symbols of communication. Banner encourages participants to perform with her sculpture in a similar manner to Vergette's *My Feet in Earth,* and both artists refer to the collaborative sound making that bell ringing enacts. *Ring Network* does not invite immediate physical interaction from local participants. However it quietly extends the dialogues around communication present in Banner and Vergette's work in the sense that it exists within global communication infrastructures. Furthermore, the time that it takes for the audio recording to travel around the world and be played back within the gallery space is influenced by communications activity that surround the work (such as the amount of people connected to the gallery's Wi-Fi).

Development Process

Whilst conducting experiments at *War Workings* in Newcastle in early 2015, I developed a small prototypical piece called *A Message Around the World.* This early work opened up the ideas and enquiry of *Ring Network*, and is described in full in Chapter 3. For *A Message Around the World* I used simple communication messages (network pings), to interact and exchange information between different networked locations around the globe. Timings from the pings were used to trigger two solenoids to create percussive events. Having created this prototypical work, I use the opportunity of the PolySpace exhibition at New Bridge to further develop a sound installation based on this networked premise, which became *Ring Network*. As well as the potentials for chance composition within the *Ring Network* system, the work also combines – in the use of live and recorded bells - my interest in both acoustic and recorded sound, which is previously seen in *Ambulation* (Chapter 5).

As well as the early experiments with *A Message Around the World*, *Ring Network* also emerged out of the creation of a piece entitled *GUST*[58] that was presented at Llantarnam Grange Arts Centre[59] (LGAC) in Wales in 2016. GUST used a variety of domestic and everyday bells to indicate the movement of air in the exhibition space. Telephone, bicycle and fire alarm bells were collected and mechanically struck using solenoids. The bells sounded each time an anemometer (a circular wind speed measuring device) rotated a predefined number of times (see Figure 24). Like *Ring Network*, *GUST* included three independent bells and accompanying anemometers, Arduinos and stands. After its presentation at LGAC in January 2016 I went on to show the work at Fort Process in Newhaven in September later that year.

Figure 24: *GUST* presented at LGAC, Cwmbran, Wales in 2016. Image Tim Shaw.

Through *GUST* I developed methods for mechanically stimulating bells using an Arduino board and a sensor input. *A Message Around the World* used pings over a global network to determine rhythmic events. *Ring Network* combines these elements in a more complex new installation piece.

The three *Ring Network* bells included a second hand military vehicle bell and fire alarm bell, and a newly purchased bell designed for installation in an industrial setting

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[58] https://tim-shaw.net/gust/
[59] http://www.lgac.org.uk/

such as a factory or warehouse. I sourced the bells online, meaning that though I could see they were different sizes, I had no idea what they sounded like. This was a chance operation in itself, I could select bells based on the images provided but would not know how they would sound. All of the bells were solenoid driven and as such were consistent with the *GUST* infrastructure.

Technologies Used

A variety of open-source technologies were used to build *Ring Network*. Although the resulting sonic composition has the potential to become complex, the system supporting it is relatively simple. In this section I will outline the technologies used and some additional details regarding the development of the work.

Ring Network communicates across a number of remote servers around the world. Based on geographical spread and ease of access, server space was located in Iceland, USA and South Korea using a variety of hosts. Amazon Web Service[60] offer server space all over the world, the server in South Korea was purchased through this service, whereas Blinkenshell[61] and SDF[62], who offer a free UNIX shell account on a Linux server in a remote location, provided the servers in Iceland and the USA.

A Python[63] script was coded that allowed shell commands to be automated. Secure Copy (SCP) was used to safely transfer files from the local computer to a server in the host country. In the eventuality of the server not responding, or if something crashed, a timeout of 60 seconds was included to kill the process and restart the execution. Once a confirmation of the file transaction was complete, the Python script then requested the file back from the server and it would return to the local computer. At the beginning of the code, an event would trigger a bang in Pure Data (PD) via a textfile. When the file had successfully transferred to the remote server and back again the time it took would be printed and sent to PD via the OSC protocol.

The three microphones and loud speakers were controlled from PD using an external sound card plugged into a MacBook computer. When PD receives and event

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[60] https://aws.amazon.com/
[61] https://blinkenshell.org/
[62] http://sdf.org/
[63] https://www.python.org/

indication (a bang) from the Python code it sent a message to a connected Arduino that made the associated bell ring. Simultaneous to the bell ringing the microphone input was recorded using the [writesf~] object. Once recorded to the disk of the computer, the bell sound file is sent to the remote server. When the file returns, an event lets PD know it is complete and the sound file is loaded into a wavetable (which stores the file in the RAM of the computer).

A [phasor~] object then creates a signal at the length of time it took for the computer to make the transfer, which results in the sound being played back over the time it took to travel around the world and back. This is played back over one of the speakers placed opposite the related bell. Once the sound file has been played in its entirety the process starts again from the beginning.

As there are three bells, three speakers and three remote servers, the code is executed three times, and there are three instances for each process. There is no communication between each instance, the three parts of the system do not have any technical interaction; they are never synchronised. This provides an ever changing soundscape in the presentation space between the physical bells, the recorded sound coming from the speakers and the ambient sounds occurring in the gallery.

Installation Specifics
Ring Network is presented as a multiple of three, three physical bells, three speakers and three remote servers exist in parallel of each other. All of these components of the system are controlled from a central MacBook, also situated on site and in sight. The laptop has an external monitor that displays the terminal activity between Python and the external servers. Using iTerm2 the external monitor is spit into three columns each one relating to one instance of the system. The external monitor is displayed in portrait mode and the laptop is running closed using the Don't Sleep software (also used with *Ambulation*). Providing a window into the server transfer activity reveals some of the technical processes to the audience and gives a sense of the 'liveness' of the work (see Fig 25).
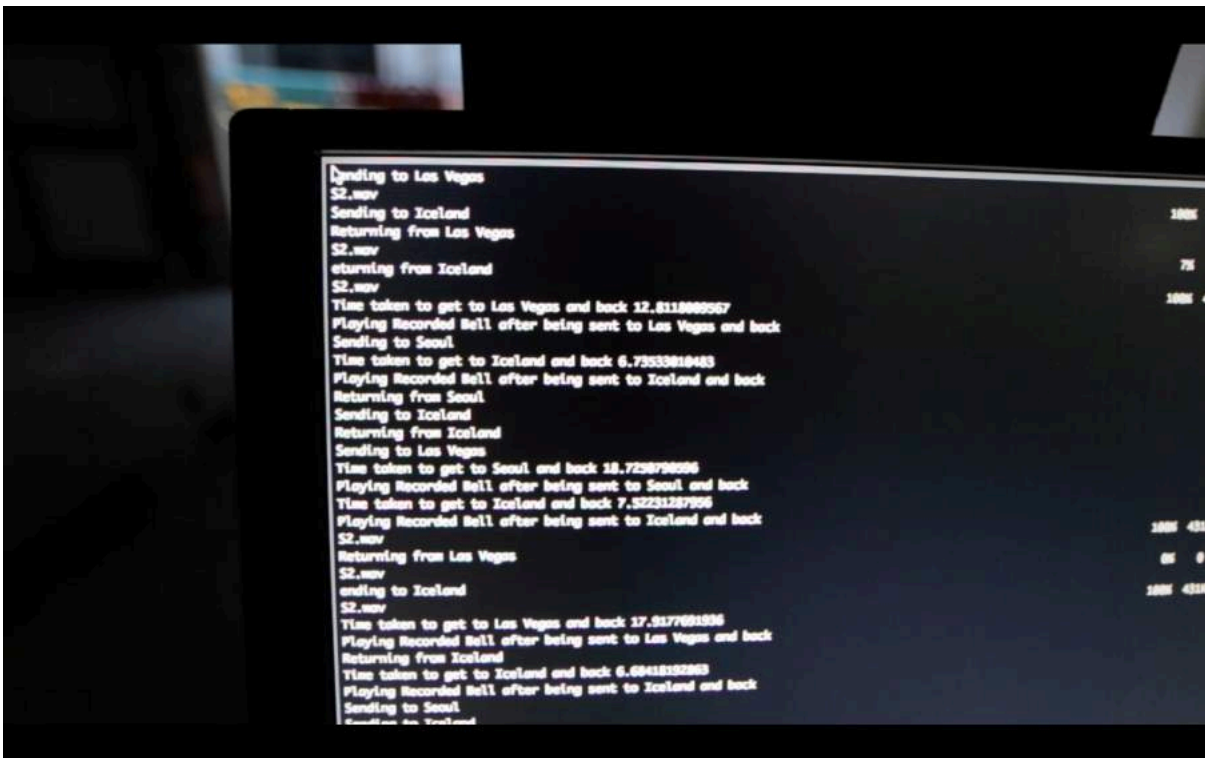
Figure 25. Image of monitor screen showing server transactions at The NewBridge Project in 2016. Image Tim Shaw.

The microphones and bells are installed on three separate microphone stands. I built the hardware around microphone stands as they are simple, structural objects that are utilitarian in their appearance and are widely available as a universal standard. This also means that when I take the work to a new venue I can request microphone stands as part of my 'technical rider' and know they will fit the bell clamps and microphone clips I have designed. Each of the speakers are placed on top of stands and positioned at the same height as the microphone.

The installation is designed to allow the audience to walk between the speakers and the acoustic bells. A lattice of listening points (this term was also explored in the following papers: Shaw, 2015 and Bowers et al. 2016) are dispersed across the presentation space. Each combination of bell, microphone and speaker can be attended to individually, and the work can also be experienced as a whole. A distance is composed between the microphone and the bell and its related speaker to give a sense of scale to the sounds as they travel around the world. The Arduino, along with the electronic components, 3D printed stands, breadboards and wires are all on show, presenting these parts as artistic materials of the work, rather than hiding them inside a box or behind walls.

Presenting the technical materials in this work was an important design decision. I wanted these materials to be in full view of audience members, these components are offered as part of the complex elements that make up the artwork. The MacBook on the floor, the utilitarian nature of the microphone stands, the visibility of the Arduino's and the revealed server transactions are all attempts to open up the black boxes of technological systems (Latour, 1987). Presenting work in this way tolerates a wider range for creative interpretation, the technological work becomes available and visible for visiting participants.

Presenting things in multiples allows for complex interactions to occur in the work, with three versions of the same system coincident and concurrent events allow entangled intersections to occur. In keeping with the chance operations of Cage, Ascot and Moholy-Nagy *Ring Network* uses the unpredictability and uncertainty of networked systems as a primary artistic resource. By presenting the system as a threesome, this incalculability is ramped to the power of three.
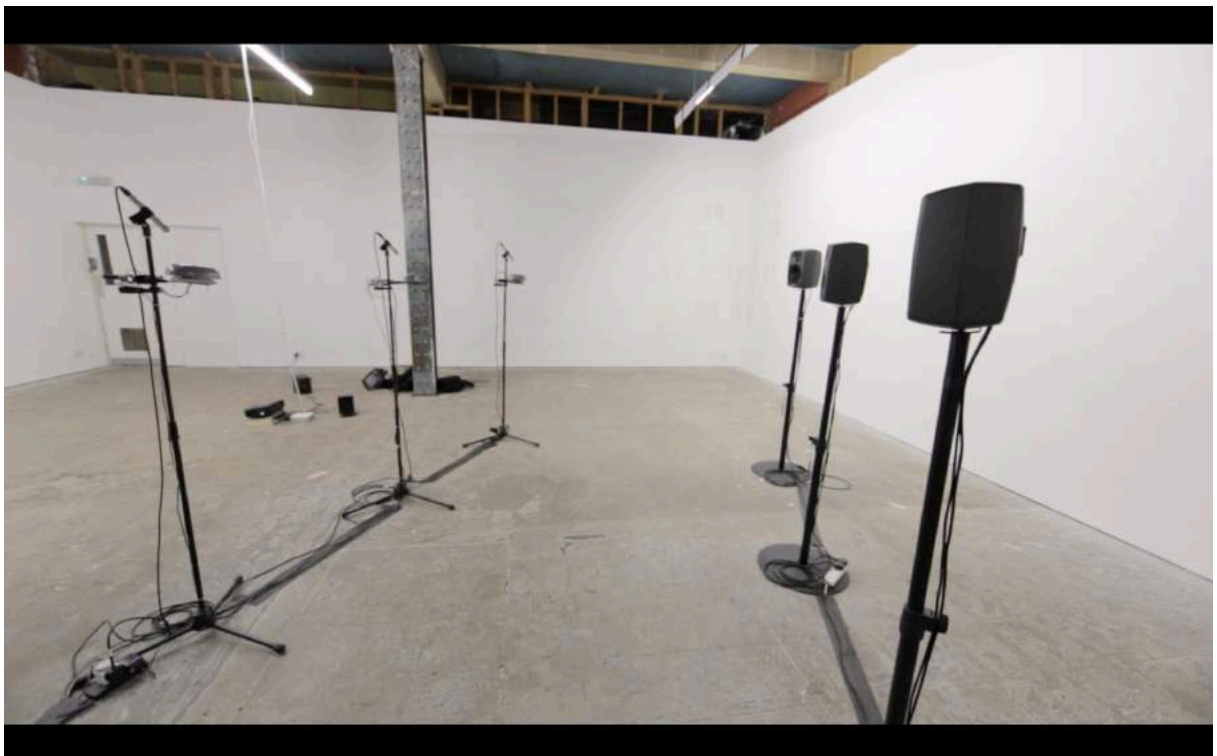

Figure 26: Installation configuration of *Ring Network* in the New Bridge Project in 2016. Photo Tim Shaw.

Performance Extensions of Ring Network

As well as its installation form, I have also presented *Ring Network* as a performance piece. The development of *Ring Network* as a live event emerged out of an invitation to present *Ambulation* as part of the PolySpaces programme at The NewBridge Project. The result was a fusion of both *Ambulation* and *Ring Network* as a live event that included a walk.

The walk began inside the gallery space where *Ring Network* was running, and I recorded and incorporated the sounds of the work into the beginning of the walk. I then led participants out of the gallery and into the centre of Newcastle, with the sounds of *Ring Network* blending with the chimes of the Reid and Sons clock at the bottom of Northumberland Street.

These unintentional links between the two works led me to further develop a performance version of *Ring Network* during a residency at the bb15 art gallery in Linz (Austria) in 2017. Here I presented an adaptation of *Ring Network* as part of a collection of works I had made in response to the diverse soundscapes of Linz named *Collect/Diffuse*[64]. This time I presented the work without the physical bells, but rather using field recordings of bells I had collected from around the city. The field recordings were played through 3 different speakers in the installation space and picked up by shotgun microphones placed in adjacent positions. The microphones recorded the sound from the speakers, as well as other sound from within the installation space, and the system sent these sounds to different servers around the globe. During the second week of my residency I performed live using the system, playing additional sounds into the space using a variety of sounding objects including radios, modular synthesisers and a collection of speakers bought from the local flea market. These added sounds, along with the field recordings of local bells, created a cacophonous, complex result, the process of the latency added additional layers to the dense texture.

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[64] http://bb15.at/termine/Collect_Diffuse

Figure 27. Performing with *Ring Network* as part of my residency at bb15 in Linz, Austria in 2017. Image bb15.

In November 2017 I was invited to De Montfort University in Leicester to present a performance version of *Ring Network* as part of their 'Telematic Hacking' programme. As part of a larger programme of EU funded work through the Interfaces Network[65], this project was set up to explore the act of telematic making and performance. For this event, I set up a version of *Ring Network* as part of a larger performance space where other musicians and artists were also performing, both locally and remotely. For this iteration of *Ring Network* I explored playing with the recorded material as part of the performance, the time of the rings and the latency was still determined by the network speed, but I altered the system in order to create live manipulations of the collected audio. For example, I built a small granular engine that could collect and process small grains of sound from the bells during the performance and I processed sounds through my modular synthesiser and other hardware. Accompanying these elements I built a synthesiser using Python and PD that pinged various websites and IP addresses around the world and used this information to create complex LFO modulations within an FM sound engine. During the performance I mixed and layered these different elements to create a dense soundscape. Each of the elements had its own unpredictable nature which was a productive source for an improvised performance, similar to the unpredictable nature

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[65] http://www.interfacesnetwork.eu/

of the sonic environments folded into the performance of *Ambulation* or the latency and technological limitations of *Fields*.

Ring Network originated as an installation but has been developed as a live performance for a series of different events. The automated recording alongside the ever changing nature of latency, which is determined by locative and temporal specifics of the site and the networks it exists within, make it a rich and interesting system to improvise and perform with. As a performer my agency is resituated, instead of making direct decisions on the sonic material I become a facilitator to what is heard. Mixing generative source material without knowing the consequences of the outcome. As *Ring Network* directly responds to the material qualities of our global network infrastructures, each place I perform the work new outcomes occur. This unpredictability is furthered when travelling to different locations to present the work.

Observations and Reflections

Ring Network adopts a thinking through making approach in a number of ways, it demonstrates an open presentation of the technological materials and has an indeterminate approach to sonic composition. I list four reflections which emerged through the making of the artwork.

Acoustic and Recorded Sound

Ring Network plays with the relationship between acoustic and recorded sound. By simultaneously presenting the rings of electro-mechanically actuated bells alongside recordings of these actuations the piece demonstrates how differently we perceive acoustic and recorded sound, and offers a way into hearing the nuanced differences between different types of sound reproduction. As with *Ambulation* where field recordings are understood as not simply the transferring of material from one place to another, but rather an engagement with the performative act of recording, *Ring Network* deals with recorded digital audio not as a way of storing or archiving of sound but rather as a live, malleable and immediate thing. *Ambulation* takes place within the sonorous space of our acoustic environments whereas *Ring Network* has only been shown in galleries or music venues (though it has a dependency on different locations around the world). With *Ring Network* the unpredictability comes from the networked latency, we hear the acoustic bell and then the latency changes how the digital version of it is heard (through a time stretching algorithm).

Latency as a Compositional Device

As with *Fields, Ring Network* explores the idea of latency as a compositional device. Throughout my practice I do not consider latency as a negative limitation of a system, rather I draw on the telematic and material aspects of the technology I use as a generative structure in my work.

Latency as an unpredictable source of timing, if desired, could be added to any technological system by programming a random delay into its structure. However, I work with networks in order to reveal the material and temporal nature of the communications systems that pervade everyday life. The art that is made in relation to them offers another way to experience a network revealing its temporal attributes. It is a fundamental characteristic of networked systems that signals take time to reach their destination, whether that network be a lighthouse, a church bell, a telegraph, a telephone or the infrastructure of today's global internet. Network latency as it exists in communication systems is the foundational creative characteristic of *Ring Network*, it also shaped my previous work *Fields*. *Ring Network* attempts to reveal the geographical character of our globally connected technologies through latency. This is conducive to the perspective of time geography, where time and space become intertwined through practice.

Before beginning to make *Ring Network,* I had little idea of how rich networked latency would be in the context of a sound installation. The system here is not just getting a job done, it is not just making the artwork work, it is revealing the very nature of how the data is shared and how long it takes to transfer files across the Internet. With *Ring Network,* the Internet is not a virtual, immaterial space, as described in some reflections of digital cultures (Rheingold, 1993). It has a physical consequence, it takes time, it is complex and inherently unpredictable. Through the use of latency as a creative resource I hope for *Ring Network* to highlight the material consequences of Internet infrastructures.

Combining Contemporary and Traditional Technologies

The bell, as described by Bannon, is the simplest form of communication (Bannon, 2010). Humans have used bells for thousands of years for a whole range of practical, spiritual, musical and communicative purposes. In Europe the church parish used to be defined by the bell, the larger the bell the larger the parish. Until industrialised steam power, the sound of church bells was the loudest sound most people would

ever hear. The sounds of the bell marking the passing of time, not only defined duration but also place. Bells create soundmarks (Schafer, 1987) within landscape, creating site-specific spatial sonic ambiences. In my own work I have become increasingly interested in the contemporary cultural meaning of bells. Each time a bell rings in the installation it does so slightly differently, due to the nature of the bell's mechanism. At full speed this difference probably goes unnoticed but if the bell is time stretched by the PD algorithm these nuances are extended and exposed. By combining a digital system with a physical bell more unpredictable outcomes are possible, the unpredictability allows for opportunities to become more varied and complex. *Ring Network* can be understood as an attempt to create a bell that reflects current communication media and technology.

Liveness

Schofield has discussed the idea of liveness in interface design, specifically looking at interfaces and data visualisation to aid creative responses to the Bloodaxe books poetry archive (Schofield et al., 2015). Discussing this work Schofield describes server latency, scheduling and execution time as 'features of material interest' within the project. Time that it took to retrieve information from the server became a feature within the design system. This project resonates with *Ring Network* in which the real time transfer of sound files from the local computer to the remote server is always live, meaning that no two transactions will be the same. The complexity and unrepeatability within the resultant composition is exaggerated by the inclusion of three instances of this process happening simultaneously. As with the work of Schofield, Freeth and Tanaka, this work explores the liveness of machines, computational technologies and the connections between them.

Discussion

Through numerous presentations of *Ring Network* and also adapting a performable version of the work for live events I have found a number of emergent points for discussion. As with *Fields* and *Ambulation,* no two presentations of *Ring Network* are the same but I can report on three consistencies below.

Latent Productivity

I have identified here that a large proportion of research in the field of music technology approaches latency as something that is unwanted or rendered invisible in presentation events. *Ring Network*, as with *Fields*, approaches this thinking very differently. In keeping with Lialina's piece *Summertime*, it uses the very nature of

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latency as a foundational principle and creative material. By connecting with the variable elements of telematic structures the piece takes on characteristics of chance and unpredictability. Extending upon the work of Lialina, *Ring Network* explores this relationship through sound, and offers an insight into the differences between acoustic and recorded sound. I consider the media material here as something that is live and temporal, the piece achieves liveness through the resistive structures of asynchronous networks. *Ring Network* attempts to deal with the character of a network and reveals its nuances through a performance and installation. I do not use the Internet here as an invisible medium decoupled from geographic consequences (Rheingold, 1993) but rather an attempt to uncover the spatial nature of media and the networks that connect them. The audience are invited into a presentation which plays with an expanded sense of space and time. The location of where *Ring Network* is installed also determines how the system will function. The characteristics of the network and acoustic specificity of the presentation site, as well as the locations of the servers it is communicating with, all effect the sonic outcome of the piece.

Ever-Changing Chance Encounters

With a knowing nod towards the chance encounters developed by Cage, this piece draws on the uncertainty and unpredictable nature of remote communication systems. Though I acknowledge the groundwork done by Cage, as well as Tudor and Cross who built some of the chance systems for him, I do believe that Cage's approach to chance sometimes neglect the many decisions he made around these procedures. Cage used chance as a way of attempting to remove his own taste and preference from of the music he was writing.

"My favorite music is the music I haven't yet heard. I don't hear the music I write. I write in order to hear the music I haven't yet heard." John Cage, 1990

As mentioned in the contexts section (Chapter 2) it is arguable how much Cage knew about the details of the technically supported chance systems he was using. He relied on the technical knowhow of Tudor and Cross to build his hardware and software structures. Kaprow, a student of Cage, was much less strict in approaching chance and indeterminacy (Joseph, 2004, p. 211), accepting 'intuition' and 'wisdom' into his happenings and instructional scores (Kaprow, 1958, p. 51). Kaprow's writing in *Assemblage, Environments & Happenings* offers 'change' as an alternative to

chance, he insisted that his 'happenings' should be performed once only otherwise the whole concept of 'change' is compromised (Kaprow, 1966, p. 263). Rather than thinking of chance as a dualism, here I would rather offer the term an *arena for chance* to happen within. With *Ring Network*, there is very little control over how long the file transfer is going to take, this unpredictability of our networked infrastructures is tied directly to the outcome of the composition of the piece. Even though there is an element of uncertainty many of the other elements were composed through with detail. I made creative decisions throughout the process and presentation of *Ring Network*, altering the code, configuration of physical materials and choice around some of the aspects of the sound design. I believe the chance of telematics can create undetermined pieces of work which are only completed when the audience witness them. A more nuanced understanding of chance, by folding in the thinking of Karprow, for example, is important when considering open artworks of this nature.

Telematic Art

Ring Network builds on the work done within the frame of telematic art conducted over the last 90 years. Drawing on the Internet as a source of creativity and uncertainty the piece uses messages sent via communication networks as a primary feature of the work. *Ring Network* folds in the thinking of Lialina's seminal work *Summertime* but extends it to a sound installation which draws on the particular acoustic and network characteristics of the site it is presented within. Here *Ring Network* expands telematics, it puts the infrastructures of communication technology in correspondence with acoustic space, sound objects and the event venue in which it is presented.

Chapter 7. Conclusion

In this thesis I have described three projects, giving details of the making processes involved, public presentations and reflections upon how each project contributes to dialogues relating to thinking through making, sound art and technology, and expanded field recording practice. The artworks I developed during the course of this research use open source technological applications commonly associated with sound and media art practice such as PD, Python and Arduino. I also worked with a variety of listening technologies related to field recording. Through the project chapters I have articulated how, through an experimental approach to making as a research methodology, I explored new approaches to working with sound and technology. This research has resulted in three principal pieces of creative work: a musical performance (*Fields,* Chapter 4), a sound walk (*Ambulation,* Chapter 5) and a sound installation (*Ring Network,* Chapter 6). These works emerged out of the initial experimentation activity I describe in Chapter 3. They were all developed through multiple public presentations in a variety of different contexts, including: festivals, art galleries, music venues, academic conferences, universities and maker spaces. Through the development of each of the artworks described in this thesis I have engaged with field recording, networked systems, walking and sound design practices in a thinking through making approach to research. I have presented my research findings in relation to some of these projects in multiple conference papers and academic journals including Organised Sound, NIME, ISEA and DIS.

In this concluding chapter I outline thematic connections between the artworks and the research trajectories of each project, articulating the contribution my artistic research makes to the contexts I position the work in relation to in Chapter 2: field recording, soundscape research and electroacoustic music, performance and liveness, and sound and technology. The themes I discuss in this concluding chapter emerged through the making and presentation of artistic practice, a process in which research is led by creative activity. Following my discussion of how each project contributes to the above fields, I reflect on the experimental process through which my research emerged as a model and methodology for conducting artistic research.

The research presented in this thesis speaks to practitioners interested in sound art, sound studies and the sonic turn. In particular it addresses the role of technology

within these fields and in relation to making with sound. As shown in project chapters, the approach taken in this research is orientated differently to that of sound artists such as Janet Cardiff, Bill Fontana, Sandro Catallo, and Chris Watson as well as Susan Philipsz, whose work I will discuss further later in this chapter. Though I admire the work of these practitioners, and have personal affiliations with some of them, my practice offers an alternative approach to working with sound that privileges the visibility of the technologies and techniques used to record and broadcast that sound. In the work presented here I am not only listening *with* technology I am also listening *to it*. As well as attending to the ways in which audiences are configured around sound works in particular contexts.

Within *Fields* the technology that supports the listening experience is not employed as a mode of presentation. Rather, the piece is shaped through its material engagement with the particular limitations of the technology it is made with and of. The latency heard in the sound design, due to the network involved, is specific and characteristic of this system and is built into the aesthetic of the work. This approach to working with technology differs, for example, from work such as Bill Fontana's *Sound Sculptures* (1976 to present day). Since 1976 Fontana has been streaming sounds from one location to another to "create networks of simultaneous listening points that relay real time acoustic data to a common listening zone" (Fontana, 2018). Fontana's *Sound Sculptures* do not engage with the materiality of the network used for broadcasting sound, rather the artist uses it to bring about a particular effect: to hear the sound of another location. The mode of presentation in Fontana's work is not therefore integral to the material reality of the work. In *Fields,* technology and the composition are not separate elements in the work. This approach is continued with *Ambulation*, in which the act of recording, the recording technologies used and the recordings themselves are configured as malleable and fluid materials, experienced in situ through a performance walk.

The expanded field recording practice I describe in Chapter 5 on *Ambulation* is distinct from Chris Watson's *Hy Brasil* (2014), for example, in which Watson uses his personal archive of recordings from around the world to create a mystical island. In *Hy Brasil* the recordings are dislocated from their point of origin and used to create a fictional space within the Howard Assembly Rooms in Leeds. Recordings within *Ambulation* are not disembodied or moved to another place for presentation, instead

they are situated and the listening technologies used to mediate between sound source and listener are exposed. The recording technologies are seen, discussed, dropped, shuffled around and handled in front of the audience. The composition that emerges is an improvisation with and within the soundscape encountered during the live event.

German artists Sandro Catallo and Markus Cremers created *Tank-FX* (2006), which invited participants to provide sound content for the work via an online system. This piece received an honorary mention at Ars Electronica in 2006. In this work people could upload up to 60 seconds of audio and have it played remotely inside a large concrete tank with an impressive reverberance. The played back sound was recorded from the tank and made available to download in a variety of formats from a dedicated webpage (at the time of writing the website is down and no longer functioning). *Tank-FX* bears some similarities to my third project, *Ring Network*. It incorporates the movement of sound files being sent over a network to a remote location. *Ring Network* extends the artistic research around *Tank-FX*, however, by making visible (or audible) the time it takes to transfer a file between remote servers. In *Ring Network* the network itself becomes implicit and is brought into the material and audience experience of the artwork.

As well as contributing new knowledge to a number of artistic and research contexts my thesis offers a model for how practice-based research can operate through experimentation and open-ended making activity. This aspect of my research I discuss in more detail at the end of this chapter and in relation to Ingold's notion of thinking through making. Specifically, I outline how my research offers a model of doctoral study that acknowledges technology and sound as materials for making and thinking through.

Upon beginning this PhD my practice spanned field recording and electroacoustic music. Through my research I have expanded my approach to working across these fields and developed new approaches to composition, performance and presentation of my work. The learning that has emerged through my own practice-based research speaks to both academic contexts and artistic practice beyond the institution. The description I give in this thesis of how I have developed my own practice in relation to

both academic and non-academic contexts demonstrates that my research reaches diverse audiences of artists and researchers.

Field Recording and Electroacoustic Music

Field recording is becoming commonplace in a variety of academic and artistic contexts and continues to grow in popularity within sound art and music disciplines, as well as other art forms. Audio recording equipment is becoming cheaper and more accessible, which is opening up access to this practice for more people, and resulting in wider appropriation of recording technology. One example of this rising popularity is the website Radio Aporee[66] which provides a global sound map for users to upload their field recordings to. Radio Aporee currently hosts hundreds of thousands of sound files and is both a way for people to share their own recordings and a rich resource for studying sound. In this thesis I have provided a perspective on field recording that values process over production and reconfigures recording as a performative and contextual act. This approach is an alternative to the use of technology to transport audio material from one place to another. Commonly, in the presentation of field recordings the act of recording is rendered invisible and the process of recording is configured as a means to an end. This means that audience members have little or no access to the activity of audio recording and the presentation mode does not disclose the character and material affects of the technologies that have been used. As I have shown in the project chapters, particularly Chapter 5 on *Ambulation* and Chapter 6 on *Ring Network*, within my own work I approach field recording as a performative and live activity. In *Ambulation* the act of recording is not separate from the mode of presentation. I do not prepare a composition for audiences to witness, rather the composition emerges through improvisation and engagement with the environment through the recording technology employed. The making of field recordings in *Ambulation* is embedded in the live performance of a sound walk. In *Ring Network* recording technology is presented alongside the acoustic sound of bells. Incorporating latency as a creative material, the act of recording is experienced live within the *Ring Network* presentation space as an integral and ever-changing element of the work itself.

Expanding Field Recording

Field recording is a fundamental part of my daily artistic practice. Through explorative making and creative experimentation with the technologies and activity of field

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[66] https://aporee.org/

recording I have developed new approaches to the presentation of audio material. *Ambulation* opens up the act and process of field recording as a performance event. Historically the act of recording and broadcasting has been understood as a disembodying practice (see Kittler, 1999, Schafer, 1969 and Weiss, 2002). Kittler puts recording technology within the lineage of ghost and spirit communication in paranormal research, whereby the technology used becomes a medium for bodiless beings to communicate with the human ear. Connor also makes similar comparisons, claiming that recording technology, alongside telephones, radio, film and the Internet, creates a kind of sonic ventriloquism (Conner, 2000). In this conception of audio recording the voice can be heard and not seen and the body (or otherwise sound emitting physical presence) is removed from the scenario. The character of field recording has been shaped by this thinking to this day and as a result it is rare, for example, to hear a field recording presented in a gallery or on film that includes the rustlings of the recorder's jacket, coughs or footsteps. The person doing the recording is disembodied in the sense that any sonic evidence of their presence in the field is removed from the final presentation of the sound. Schafer used the term 'schizophonia' as a way to describe the dislocation of naturally occurring sound from its recorded counterpart. Schafer argued the rise of radio, telephone and recording technology disconnected people from their natural soundscapes (Schafer, 1969 p. 42). In *The New Soundscape: A Handbook for the Modern Music Teacher* Schafer states that a consequence of disembodying sound from source is that "any natural sound, no matter how tiny, can be blown up and shot around the world'" (Schafer, 1969 p. 43). When conducting a recording activity and broadcasting it to the audience of *Ambulation* I resist the idea that recording is a way of disembodying sound from source, the phenomena Schafer describes as schizophonia. Instead *Ambulation* is a way to reconnect and relocate sound in relationship with the site in which it is being recorded. The act of recording, collection and broadcast – along with the audience - are situated within the context of the 'naturally occurring sound' that the piece is working with. Within a performance of *Ambulation* the act of recording enables participants to hear an amplified version of their world, sometimes processed and manipulated, often supporting the making of new connections between sound and source. These connections would not be possible without the recording tools or listening system with which I perform the work. In *Ambulation* field recording practice is expanded in the sense that it moves away from the techniques used to disembody sound to configure the act of recording as central to a live and context-specific

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performance event. This approach to field recording is not an act of collecting or archiving sound, rather it is a way of using the technology of field recording to support situated and transitory experiences of listening. This is exemplified by the fact that the sounds collected during the live act of composing *Ambulation* are not kept, by me, after the event. They are not transported to another place – a hard drive or a gallery – or used to create listening environments in another space or time to the live performance. For artist and electronic instrument builder Martin Howse field recording is a way to collect and analyse sound, but this sound is never presented to the public. For his new instrument, *Wormed Voice* (2017), he uses a variety of speech synthesis techniques to create strange formant sounds through touch-based interaction[67]. I built one of these synthesisers in a workshop led by Howse at Music Hackspace in late 2017. One of the wave tables for this synthesiser is based on field recordings Howse made of crows near his studio in Berlin. He captured the voice of a crow and presented it within the inner workings of his synthesiser, which can be used by the performer to create new sounds. This approach has affinities with the live performance approach I took to field recording in *Ambulation. Ambulation* is however presented as a sound walk rather than an instrument for generating electronic sound. Howse's work explores how field recordings can be embedded into experimental electronic instruments, whereas *Ambulation* offers an engagement with field recording through a live, performance walk.

Ring Network extends this idea further, with an installation constructed around a recording situation experienced by the audience, who are present within a space that is being recorded in real time. The act of recording is driven by the live processes running on the computational system and the sound captured includes the bells situated within the space as well as atmospheric noise and the sound of the audience talking and moving around the work. The frequency of recording is dictated by both human and non-human factors. *Ring Network* plays with the tension between recorded and acoustic sound and, like *Ambulation*, moves away from field recording as an archiving or collection process to situate it as a present and live event within the work. As in *Ambulation*, the sounds created in *Ring Network* are not stored, archived or logged in anyway. Rather, they exist as temporary, transient material within a live process. David Cunningham's *Listening Room* (2002) uses sound recording technology and automated processes to explore space and listening. In

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[67] http://1010.co.uk/org/wormedvoice.html

this work Cunningham places a microphone at one side of a gallery space and a connected speaker at the other. In between the two is a noise gate and a filtering system. When the microphone and speaker begin to feedback and the amplitude goes over a certain threshold the noise gate cuts the signal and all that is left is a reverberance, which resonates through the space. When the amplitude falls below a certain threshold the signal is allowed back through and the process repeats (Cunningham, 2018). Italian artist Agostino Di Scipio has also explored similar themes in his work *Audible Ecosystems,* in which he uses amplified and processed recordings of the background noise of a presentation space as the main compositional material in the piece (Scipio, 2005). Like *Ring Network, Listening Room* and *Audible Ecosystems* are installations that explore the relationship between recording technology and the sound of a given space. However, *Ring Network* extends the boundaries of the presentation space by connecting different locations through networked infrastructures.

Extending Perception

Many artists have explored the notion of extending perception through artistic activity. As discussed in Chapter 5, Kubisch explored extending what the ear can hear to create sound walks whereby audience members experience electromagnetic energy using specially made headphones. Academics concerned with new design strategies have also used the idea of extending perception as a way of approaching HCI (Gaver, 2013). *Ambulation* uses recording technology to extend perceptual possibilities during an improvised performance sound walk. The piece combines the use of contact microphones and electromagnetic coils with conventional microphones to reveal sounds that could not otherwise be heard, or which may usually be disregarded in the everyday. Through doing this I discovered a wealth of material available through use of extended field recording techniques. Incorporating audio material via contact microphones, electromagnetic coils and hydrophones into a sound walk gave a sonic diversity to the improvised composition of *Ambulation*. The *Ambulation* system I developed opened up new possibilities for environmental listening within the context of a performance artwork. *Ambulation* invites audiences into a sound world that is usually unperceivable to the ear, revealing unexpected resonances and sonically diverse electromagnetic energy present in the spaces the work occurs in. Unlike the pre-recorded and linear sound walks composed by artists such as Cardiff, *Ambulation* draws on the immediate surroundings for sonic material. *Ambulation* also extends the ideas manifest in Kubisch's *Electric Walks* by

incorporating a variety of listening technologies, including electromagnetic coils, in a single walk.

Ring Network furthers the approach taken in *Ambulation* and focuses on revealing latency as an environmental feature that is not usually perceivable or attended to as a subject of interest in everyday encounters with technology. Perception of the space surrounding and distances inherent in Internet infrastructures are made audible in the frequency, time and rhythm of the work. *Ring Network* attempts to highlight the physical infrastructure that surrounds globally connected technologies, and use these technologies as materials and contexts for the creation of artistic work. Through multiple presentations of *Ring Network* I discovered how variable network latency is and how sound is a productive medium for revealing the material nature of networks. In any given presentation of *Ring Network* the diversity of the soundscape always surprises me. The recorded bells returning to the presentation space would playback over a very diverse time range, sometimes three seconds, at other times it would take over a minute. By listening within *Ring Network* one gets a sense of the network infrastructures at play in the work and the technologies we use to communicate on a daily basis. In his installation *Acoustic Radiator* (2016) Kristian Roos uses a Wi-Fi router to send out 'beacon frames' into the gallery space. He uses a collection of radio and electromagnetic receivers to make audible the sound of the network (Eck, 2017). *Acoustic Radiator* allows audience members to hear phenomena outside of human perception, thus extending our listening capabilities to hear inaudible frequencies. *Ring Network* also extends the possibilities of experiencing a network, but rather than revealing inaudible frequencies as Roos does, it makes network latency audible through a time stretching algorithm.

Electroacoustic Music

In *Fields* we create a complex and densely populated space for listening. There are some similarities here to soundscape listening. For example, when you listen to the wind blowing through a tree you may hear numerous small rustlings from each of the individual leaves. This is analogous to listening within the *Fields* system, where one hears many small nodes of sound playing together, which creates interplay without interference. I discuss this term in more detail in my paper on *Fields* published in the NIME proceedings (Shaw, 2015). With *Fields* I was interested in creating a complex listening environment inspired by my experience as a soundscape listener and field recordist. As well as being informed by my experience of making audio recordings,

Fields also extends the possibilities for presenting field recordings and soundscape material. There exist many systems for the 're-creation' of sound worlds. Ambisonics[68], Dolby Atmos[69] and other surround sound speaker arrays create sound spaces that are sometimes used to represent or recreate 'real world' listening environments. *Fields* is orientated differently; it uses a bespoke system for the diffusion of sound in an unfixed and unpredictable way and is not designed to be representative of a 'natural environment' or 'real world' situation outside of the work itself.

In *Fields* the latency of the network is perceived through choices made by my sound and system design. The composition uses sounds, such as cow bells, which can be easily located in space. When many of these sounds are played together a 'shimmering' texture emerges across the performance space. As each of the phones receives the command at a slightly different time due to the networked latency, this 'shimmering' is exaggerated and is part of the idiosyncratic and effective space for listening and sonic design that *Fields* enables. The sonic composition of *Fields* builds on the latency of the networked system which would usually be hidden or unperceivable. By making this technological feature apparent *Fields* allows the technological limitations inherent in the work to be perceived both sonically and visually during the performance. Sound artist Ray Lee used kinetic rotatory speakers in his piece *Siren* (2014), which I witnessed at Spill Festival[70]. In this work, 24 tripods each with two speakers placed on spinning arms play tonal drones tuned to an aeonian scale in a church in central Ipswich. The movement of the loudspeakers creates a complex and ever changing soundscape in which audiences are free to roam around and perceive the work from different points within the space. Moving away from fixed speaker placements more commonplace within electroacoustic presentation, Lee's *Siren* uses kinetic sculptural objects to move sound around the sonic environments. *Fields* also destabilises the notion of fixed speaker placements, but by placing the speaker in the hands of the audience. As detailed in my discussion on performing the phone (Chapter 4), where audience members are informally invited to perform with their personal devices, interesting and unexpected outcomes occur which affect the wider composition and performance.

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[68] https://www.ambisonic.net/
[69] https://www.dolby.com/us/en/brands/dolby-atmos.html
[70] https://spillfestival.com/show/siren/ray-lee-siren2/

Fields is a system that creates new possibilities for the performance of sound through a unique listening environment. Unlike a fixed speaker, multi-channel audio system, the *Fields* system is held in the hands of the audience. This means that the placement, character and number of speakers is unknown until the audience arrive for the performance event. This element of chance is central to what the system is for the performance and composition.

Ambulation also reconfigures modes of electroacoustic composition and presentation. In many presentations of electroacoustic composition the composer of the work makes the composition in one place and time and presents it in front of an audience in another. *Ambulation* resituates the act of electroacoustic composition within a live improvised performance walk. Through numerous presentations of *Ambulation* I have developed new approaches to the composition and the performance of electroacoustic music. My approach to electroacoustic composition before starting this PhD usually consisted of separating the activities of environmental recording (usually conducted in the outdoors) and composition (conducted in the studio). Through the making of *Ambulation* I realised that electroacoustic composition can be situated, embedded and in response to the environment it is performed within. My practice therefore moves electroacoustic composition away from studio practice to a process of improvising with the immediate environments. Work done by Bowers (2002), Burtner (2011) and Edmondes and Edmondes (2014) also moves away from traditional forms of electroacoustic composition. Yeah You, a duo consisting of Will Edmondes and Freya Edmondes, often perform in places not usually associated with musical activity. Car journeys, lay-bys and car parks become places for the performance activity of Yeah You, and the character of these environments become incorporated into their improvised compositions. In *Catagorically Impressive* (2014) the duo perform from a rock by a highway somewhere in Europe. The rock becomes a surface from which to perform and they incorporate the shrubbery around the rock into a performance ecology. In *Guy Havoc* (2015) Yeah You perform from a car park in Vienna and Freya Edmondes uses the lamppost she is performing underneath as a percussive element of the composition. Though Yeah You also perform in music venues, the situated performances they conduct implicitly incorporate elements of their surroundings into improvised, electro-acoustic compositions. With *Ambulation* improvising with

environmental elements is key and forms the basis of an electroacoustic composition presented as a headphone-based sound walk.

In *Ring Network* recorded sound is slowed down or speeded up according to the time it takes for a sound to travel to a remote server and back. The early electroacoustic experiments conducted by Pierre Schaeffer in the GRM in Paris involved experimenting with slowing down and speeding up sound recordings for musical purposes (Schaeffer, 1952, p. 35). In *Symphonie pour un homme seul* (1949) by Schaeffer and Pierre Henry, tonal transformations of recorded voice and piano can be heard throughout movement 9, *Apostroph.* Speeding up and slowing down recorded sound is a common technique in electroacoustic music. *Ring Network* employs this technique but places it in an affective relationship with the network speeds of communication infrastructures. Instead of the speed of the recording being determined through compositional preference or mechanical limitations (as is the case of the tape machines used by Schaeffer), the speed is determined in real-time by the connection rate between the remote server and the local environment.

Performance and Liveness

Through the work described in this thesis I have engaged with ideas of performativity and liveness through performances, sound walks and sound installations. Out of this work I offer two research observations below on creating arenas for attention and the liveness of media.

Creating Arenas for Attentiveness

Fields is a highly spatial audio system with dispersed small sources of sound, which is very different from the traditional multi-channel diffusion systems associated with the presentation of electroacoustic music. As described in the project chapter, the position of the sound sources in *Fields* is dependent on the amount of people, the character of the space and the number of compatible mobile devices brought to any event. These elements are not pre-defined and require the work to be fundamentally responsive to its context and the audience dynamic. Piquemal and I developed the *Fields* setup through collaborative experimentation around how to stage the audience-performer relationship. The configuration of the space was important because it creates focus between audience and performer, and supports an *arena for attentiveness*. In our ideal (though not always possible) configuration we perform from the centre of the room, not on a raised stage, and encourage audience

members to assemble around us in close proximity. This focuses the audience attention to form an intense shared listening space. Audience members are part of the infrastructure of the space and performance due to the use of their mobile devices.

The character of the performance venue also informs the nature of each *Fields* performance, and we developed strategies for dealing with different types of space. To support an *arena for attentiveness* we kept the lights of the performance space low and used a multichannel sound system to define a sonic space in support of the mobile devices. By keeping the performance structure open and flexible we were able to create a work that responded to different spaces, technical configurations and the potential differing dynamics of any given event. It became clear through many performances of *Fields* that some configurations worked better than others. Having to consider the wider aesthetics of performance events is a key research finding in presenting this work. In his paper named *A History of the Audience as a Speaker Array* Ben Taylor names *Fields* (amongst many others) as an example of a distributed musical performance that involves the audience as a speaker array (Taylor, 2017). Presenting a rich lineage of distributed musical performances Taylor draws on the work of Levin, Schaeffer and Maceda as well as work done by Piquemal and myself. The research I have presented in this thesis extends the work of Taylor by providing artist perspectives and details of how audience configuration and the characteristics of performance space were developed in this work.

I have also identified in my analysis of *Fields* how people configure themselves around their devices in performances of the work. Through inviting people to interact with a very simple thing (sound being played from the speaker of the phone), phones began to be performed in various ways (devices being placed in resonant objects or moved around others' heads). This performance dynamic in audiences was possible because we kept this aspect of the design open and ambiguous, allowing the behaviours within the performance event to be shaped by audience rather than dictated by the requirements of a complex and particular sounding system. This approach resonates with Gaver's 'Ambiguity as a resource for design', who argues that uncertainty in design can create 'personal engagement with systems' (Gaver, 2003).

Like *Fields, Ambulation* also explored sound as a spatial medium and supported a unique listening environment for audiences. Through presenting this work in multiple cities around the world I resituated my practice of field recording as intrinsically linked with my performance practice. In *Ambulation* I invited audiences to listen to environmental sounds through microphones that aided the "amplification of experience" (Feld, 1990). By intensifying the way audience hear the world *Ambulation* creates an *arena for attentiveness* for soundscape listening as well as improvisational performance.

Ring Network adopted a different approach to thinking about sound, space and attention. In this work the bell, a simple and recognisable symbol of communication, is juxtaposed with the less visible temporal and spatial characteristics of the global Internet infrastructure. Through this project, which uses sound to expand notions of space, emerged a new way of experiencing spatial and temporal aspects of contemporary communications infrastructures. Space within this project includes distance on a global scale, which is used to create an ever-changing spatial soundscape. Artist duo MTAA created *Want v3* (2009-2011) to highlight network activity in a highly connected and consumerist Internet world. Two short videos are loaded onto a webpage in which each of the artists makes a statement starting with 'I want…': 'I want a sexy avatar', 'I want a Taco Bell', 'I want a prime number' and so on.[71] When the video finishes another random video loads and the process repeats. The time that it takes to load the videos and the length of each video creates an ever-changing rhythm for the piece. By simply reloading the webpage a whole new 'narrative' emerges. In *Want v3* attention is brought to the time that it takes for the video to load and how the system presenting the work functions. Like *Want v3, Ring Network* plays with the nuances of a network through acoustic and recorded sound.

In his paper on artistic approaches to network timing Schofield reports on *Ring Network*: "the interest of the piece for the audience is in many ways projecting imagination into the spaces of silence as we wonder where the sound is now and how long it will take to return" (Schofield, 2017, p. 289). Here Schofield discusses how space and time are extended beyond the walls of the gallery in *Ring Network*. The work reveals how media are constrained to their characteristics; in *Ring Network* technology is not used to bring about effects but rather to expose the limitations of

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[71] http://www.mtaa.net/art/want.v3/

the media itself. As Schofield puts it, *Ring Network* "attend[s] to the notion of immanence rather than that of technological transcendence" (ibid. p.293). *Ring Network* reveals the activity of a networked system. As the system is connected to the gallery Wi-Fi, anyone else using the Internet will also affect the timing of the piece, despite potentially being oblivious to interacting with the work. Similarly, global Internet activity, shaped by human activity, also affects the pace of *Ring Network*. Extending the work of Vergette and Banner in their works *My Feet in Earth* and *Tornado* which invited audiences to interact with bells by physically ringing them, *Ring Network* offers a more discreet interaction whereby both human and non-human actors inform the time that it takes for the bells to ring. As with the design thinking surrounding the development of *Fields, Ring Network* reveals and brings attention to the physicality and ever changing nature of our networked infrastructures.

The Liveness of Media: Liveness as Resistance
Fields explored the liveness of media in a variety of different ways. Firstly, a source of uncertainty was how much latency the system would produce. As performers, we didn't know the extent of this until starting the performance, when the nature of latency in each event unfolded as a live element of the work. The performance instruments and the compositional structure of the work were built with this in mind and allowed us to respond to these elements in real time. As with my other work, by choosing to embrace latency in our performance system we kept the technological characteristics a material aspect of the compositional aesthetic. The work therefore uses the nuances of a network to explore the liveness of its media. Recent research conducted at IRCAM in Paris has attempted to create synchronised audio events between heterogeneous devices for distributed musical performance (Lambert, 2016). Though this is interesting and important work, the research conducted through the making of *Fields* is orientated differently. Instead of creating synchronous events between devices, *Fields* draws on the inherent nature of latency as a productive, creative element and immediate material. It provides another perspective on engaging with networks as live mediums for musical expression and uses the idiosyncrasies of particular media within the work.

Ambulation works with the act of field recording as a live performance activity. Instead of simply moving sound material from one environment to another, *Ambulation* uses recording technologies and digital signal processing to create a direct response to the immediate soundscape. Through a variety of self-built

technologies and artistic strategies I have developed methods for conducting headphone-based sound walks and approaching the collection of sound material as a live activity. The performance system and sound technologies I use are constantly changing and they are revisited in response to the environments I choose to present the walk within. This work uses field recording technologies to improvise within a shared soundscape. In the development of *Fields* I took field recordings from one environment and played them back away from the source. *Ambulation* looks at the spatial and contextual character of sound in situ, and the liveness of this work comes from engagement with the immediate environment in which it is presented. This places *Ambulation* on a different terrain to the sound walks of Janet Cardiff, for example, whose narrative driven sound works attempt to abstract and fictionalise the immediate environment through Foley audio and 'storytelling' (Cardiff, 2005).

Liveness exists at the heart of *Ring Network.* In a similar vein to *Fields, Ring Network* explores latency and uses the changeability of its system as a source of liveness and uncertainty. Though not originally conceived as a performance, I have presented performance versions of *Ring Network* at bb15 (Linz), DMU (Leicester) and Fridman Gallery (New York). Both as a performance and installation this piece creates an ever-changing soundscape, the sound design is directly responsive to Internet speeds, global web traffic and geographical distance. Since *Ring Network* is connected to an unpredictable infrastructure, the telematic nature of information traveling over a network is drawn upon as the primary characteristic of the work. Performance or not, the piece is always live, the sounds always changing and situated within the time and location it is presented within.

Auslander (2008) problematizes the distinction between performance and the act of recording in *Liveness: performance in a mediatized culture.* Reporting mainly on popular genres such as rock and jazz, he defines the studio and performance practices that surround these genres:

"*The historical relationship of live performance to recorded music in rock culture anticipated the logic of simulation, since live performances always derived from the very recordings they served to authenticate.*" (Auslander, 2008, p. 118).

Auslander argues that rock music is a genre made for recording and that live performances are often re-enacting such recordings. Auslander does not report on more niche types of sound recording presentation such as field recording or soundwalks, within which *Ambulation, Musique Parabolique*[72] and Stéphane Marin's *re_COMPOSED re_ALITY*[73] sit. Through creative research and reflexive analysis of *Ambulation* I have demonstrated that the act of recording can be a performative and live process, going beyond Auslander's claim that recorded media and live performance are separated by embedding recording and performance within the same activity.

Couldry claims that new communication technologies create new forms of online and group liveness (Couldry, 2004). Online liveness, as defined by Couldry, includes chat rooms or news sites which continuously update in real-time with new headlines or topics for conversation. Group liveness emerges from simultaneous chat facilities such as WhatsApp and Facebook Messenger. Couldry's research could be resituated within the work of *Fields.* In performance we use a network and a web browser to create a dense, sonorous shared listening environment. A sort of *online liveness* is formed through the latency of the network. Activities passing through the Wi-Fi signal, from the server to the device are informed by the number of people connected, the amount of messages we are sending and particularities of the site we are performing within. The *group liveness* is not formed through dislocated individuals dispersed across the world but rather in intensified interpersonal dynamics formed through the *arena for attentiveness* created within the performance environment.

Liveness is a characteristic of my work that arises out of the materials I choose to employ and my approaches to engaging with site and technology. Rather than a property that is guaranteed by doing things a certain way, 'performing live' for example, I achieve *liveness as resistance* through attending to certain 'live' materials and technologies. Liveness here is not a formal definition, like 'live performance'. I see it more as a practical accomplishment (Bowers, 2006), it is practically organised and orientated, and inherent in the technologies and materials I engage with as an artist. I consider liveness here as a type of *resistance,* exploring how the

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[72] http://www.dennisvantilburg.nl/
[73] https://www.espaces-sonores.com/recomposed-reality-eng

characteristics of the material and site are incorporated into the presentation activity. For example, in *Fields*, the latency is performed with as a resistive characteristic as the message passes through the network and connects to the participants phone. At each performance venue the latency changes depending on the amount of people connected to the network, the configuration of the space and other Wi-Fi networks in the local area. The liveness here emerges from the work and the conditions of the presentation space through the exploration of technical and material systems. It is not a disposition pre-imposed upon the performance.

Sound and Technology

Through the practical and reflexive elements of this thesis I have shown how I engaged with technical, historical and conceptual aspects of work that connect with sound and technology. There are two key contributions that emerged from my engagement with sound and technology, which I report on below.

Technology Within an Artistic Practice

Sound recording technologies and sound art have had a close relationship throughout the twentieth century (Caleb, 2011). In recent times, with the rise of digital technology, presentations of sound art have obscured the material character of the technologies being used. Sometimes when listening to a field recording in an art gallery the framing of the audio implies a transportation of listener to the time and place that recording was made, a virtual listening experience (among many examples see Chris Watsons *Hy Brasil* mentioned above). In this virtualising approach to presenting sound there is an illusion of liveness, of immediate contact between listener and sound source, which disguises the material character of the technological mediums being employed. I have shown how in my own work recording is not used to convey a separate reality or create a virtual world, but rather it is present and identifiable as an audio recording. The technology used to hear or playback this recording is not hidden in my work, as it is in work that employs technology only as a presentation tool. In my work it is employed as a medium and material engaged with in the creative development of the project. In *Fields* this can be seen through the engagement with latency as a resistive resource. In *Ambulation* the act of recording and the act of composition happen coevally and are not dislocated. In *Ring Network* the networked infrastructure becomes central to the composition. In the work I have presented here technologies are explored through

their limitations, and engaged with as materials for making *with* rather than tools to get the job done.

Levin's *Dialtones* used mobile phones as a multi-speaker array for a performance event. Like *Fields,* Levin's work plays with spatial combinations as a means to compose a sonic work. Levin was limited to the ringtones and vibration sound inherent within the communications technology available at the time of making *Dialtones*. When describing his work Levin draws on this limitation as a productive element (Levin, 2001). Due in part to the advancement of mobile technology, *Fields* involves a more diverse range of sonic material broadcast through the audience phones. As such it follows Levin in its use of available and everyday technology for the creation of both a composition and a sound system. Also in line with Levin's approach, *Fields* uses the limitations of contemporary technology to shape a composition that is context specific. Smartphone speakers have limited frequency response and as such their capacity for broadcasting particular sounds shapes the character of the *Fields* composition. The technology of *Fields* shapes both the composition and the spatial experience of the work.

Technology Within Research Methodologies
In this PhD I have approached digital technologies as intrinsic to artistic processes, as material rather than presentation tools or products. This aspect of my thesis speaks back to the Creative Exchange (CX) agenda of contributing to 'the digital economy' through academic research. In *Fields, Ring Network* and *Ambulation* I have resisted solutionist approaches to technology, whereby technology is rendered invisible or used to solve problems, create products, market services or encapsulated as an 'application'. The technology I use is in constant development, evolving with each presentation of the work, and is a creative material that is continuously revisited and reshaped.

"Technology is a way of revealing" (Heidegger, 1954)

In *Discourse on Thinking,* Heidegger talks of the different modes of human thought and specifies two types of thinking, meditative thinking and calculative thinking (Heidegger, 1966). For Heidegger calculative thinking is concerned with planning, research and it can be used to 'count on definite results' (ibid, p 46). Calculative thinking is used to compute, to work out particular problems within particular

scenarios. On the other hand he describes meditative thinking as something which transcends problem-solution scenarios, it is 'in flight-from-thinking', it takes its own path and functions within the limits of the individual's mind. Heidegger says that meditative thinking is no good for dealing with business or economic models, it cannot be used to carry out practical affairs, but it is essential to 'dwelling' in the world, to reflect, to take time and to ponder. Heidegger applies these models of thinking to our approach to technology. Calculative thinking is applied to approaching technology, as computational technology is concerned with computing tasks a calculative approach makes sense. What is missing in Heidegger's model is our reflection on this; meditative thinking about technological processes and the social-political impact of these processes in a reflective and non-structured way. Meditative thinking "enables us to keep open the meaning hidden in technology, *openness to the mystery*" (ibid. p 55). New meanings emerge from reflecting and meditating on our complex relationship with technical devices but also through non-solutionist approaches to technology. For Heidegger, meditative thinking must be practiced alongside calculative thinking to allow our relationship with technology to 'flourish'.

My approach to the technological aspects of making the work described in this thesis has affinities with Heidegger's meditative thinking. This has also been channelled through Ingold's writing in his distinctions between hylomorphism and morphogenetic ways of thinking (Ingold, 2013, p. 22). I approached technologies through open and non-specific briefs, allowing the nuances of the system and the limitations of the technology to shape the artworks. In *Fields* this was demonstrated through the openness of the sound design, folding in latency and the limited frequency response from the devices speakers into the aesthetic qualities of the work. In *Ambulation* alterations to the system, the choice of microphones and listening devices continued to change in different instances of the work. I responded to the material qualities of the space I was presenting the work within and reflected on previous instances of the walk in order to develop it. In *Ring Network* limitations in the technology are foregrounded as creative materials of the work, the artwork attempts to reveal the hidden technological processes and to support a meditation on how it shapes the dynamic of the work. In all of the ways I have used technology I move away from the idea of technologies being understood as mere tools. For me technology is an artistic material, a material that can be approached through meditative rather than calculative thinking.

Many approaches to technology take a calculative approach, whereby an idea is formed in the artist's head and technology is employed to realise it in the world. Theorist, sound designer and film editor Walter Murch calls this process in filmmaking the 'black box', an approach in which filmmakers want full control over the making process and do everything in their power to make the idea in their head translate to the screen (Murch, 2001). The other end of the making spectrum, according to Murch, is the 'snowflake', in which something is formed spontaneously and from variably infinite possibilities. In *Pandora's Hope: Essays on the Reality of Science Studies,* Bruno Latour also discusses 'blackboxing' as a way in which "scientific and technical work is made invisible by its own success. When a machine runs efficiently, when a matter of fact is settled, one need focus only on its inputs and outputs and not on its internal complexity" (Latour, 1999, p., 304). Latour argues that it is through opening the blackboxes of science and technology that we can understand the link between different elements of the technological process and the social dynamics that surround these technologies.

Ambulation, Ring Network and *Fields* all emerge through meditative approaches to technology that dismantle the black box approach and favour a model of responsiveness, listening and material engagement. The pieces of artwork remain unfixed and variable, unfinished until they are presented to an audience, and they continue to change and adapt with new presentation opportunities. This feature of my work could be described as morphogenesis, which unfolds through a meditative approach to thinking with and through the technology I am using. The role of the technology here is not to create calculated solutions but to open up and reveal elements of technologically supported sound art that may otherwise be inaccessible.

Making

My research has not been configured as a problem-solving process, whereby a particular question or problem is responded to through the creative development of a solution. Rather, I explored a number of open thematic ideas and developed a variety of strategies for working with particular materials and allowed the movement of my creative practice through each project to shape my research focus and trajectory. As articulated in the introduction to this thesis, processes of making within my research are understood as consistent with Ingold's notion of thinking through making.

Ingoldian approaches to new contexts of making also need further work and experimentation, his descriptions of craft and making do not incorporate contemporary forms of technology. In fact in *Making* he makes direct negative statements about a 'digitally enhanced society' which values 'objects over things' (Ingold, 2013, p. 140). Some artists using new technologies have explored how making processes using code relate to traditional craft practices, such as weaving or crochet (see McLean, 2014 and Nissen, 2015 for example). My own research continues such enquires by interrogating our relationship to new modes of making with technology. Questioning the role and status of technology in thinking through making approaches to artistic research.

Anti-Solutionist Approaches to Technology

My research was supported and undertaken in relation to the AHRC's Creative Exchange (CX), part of the 'Knowledge Exchange Hubs for the Creative Economy'. CX had three core concerns: digital public space, knowledge exchange, and new models for practice-based PhDs[74]. The anticipated and encouraged outcomes of CX were in products or services aimed at enhancing 'the digital economy' within the UK. The CX agenda encouraged PhD students to build products and services that would have 'impact' on the creative economy. The work I have presented here has had an impression on the creative economy, both in the UK and abroad, through my many public presentations and publications. However, as well as the ever-changing nature of my outputs and resisting commercial and economic models that CX makes reference to, the way I have conducted my research is from within the communities associated with small artist run galleries, cultural festivals, maker spaces and music venues. By conducting my research within fields of practice that are not economically motivated I have contributed to knowledge and research in and around artistic practice and alternative uses of technology. This approach challenges economic models of research that instrumentalise artistic practice for economic ends. Another example of such a model is Creative Fuse, an initiative running between five universities in the North East of England since 2016. The programmes tagline is "unlocking the true potential of the creative, digital and tech sectors to drive innovation & growth of the region's economy"[75]. Among other things it offers local artists and businesses the opportunity to collaborate with academics across the involved universities, and parties can apply for modest pots of funding for projects

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[74] http://www.thecreativexchange.org/
[75] http://www.creativefusene.org.uk/

that demonstrate 'innovation'. The Creative Fuse model, like the ambitions of the CX project, create dualisms between academic research and creative practice, keeps practice and making at arms length from the university, and calculates the value of artistic endeavour according to economic 'impact'.

The artistically motivated and anti-solutionist approach to research that I have described in this thesis offers discussions around models of practice-based PhDs that CX aimed to contribute to. An alternative and critical example of doctoral study is instead offered through the work of this thesis. In the experiments I describe in Chapter 3 the act of making together with artists and members of the public allowed for my creative research to be led by practice and exploration, rather than a pre-composed research question. Exploring creative concerns in an open fashion, without pressured predetermined outcomes, helped generate ideas and strategies for the creation of a series of artworks. These artworks developed as research projects addressing particular fields of interest relating to my practice.

Context Specific Research Methodologies

The experiments described in Chapter 3 show strategies for working with diverse institutions, collections, sites and publics. These experiments emerged as a way of approaching and conducting creative research on site and in situ, and for opening up potential research trajectories in relation to sound art and sound studies, field recording, performance and liveness, making and artistic approaches to sound and technology. The projects presented in Chapters 4, 5 and 6 emerged directly from my early experiments and deepened my engagement with particular research areas. Working in this way, through an initial open ended experimentation process and then following up particular concerns through separate projects, meant that the focus of the research conducted was driven by the making activity inherent to my artistic practice. It is also shaped through creative dialogue with the contexts in which I worked. This methodology allows artists and the public to collectively shape artistic and research ideas through the activity of making together and in public. The things presented during the experimental residencies and exhibitions (explained in Chapter 3) were often prototypical in nature, with the emphasis placed on the activity of making rather than a finished product. Here the contexts in which I operated cannot be separated as a clean methodological model. Rather than imposing methodological frameworks onto my research I rather let the making happen in response to the circumstances I found myself within.

Thinking Through Making with Technology

Throughout this dissertation I have related my making process to the ideas of anthropologist Tim Ingold. Ingold describes making through thinking, the traditional way that making has been understood, as an imposition of thought on materials. Traditionally, according to Ingold, we have tended to understand that "in order to make something, you must have first thought it", and that the "artefact is the materialisation of a thought" (Ingold, 2013). This conception of making resonates with the black box notion of filmmaking described by Murch I discussed earlier in this chapter. Ingold articulates an alternative understanding of the relationship between making and thinking in a number of his texts as thinking through making (see Ingold, 2013, 2007 and 2015). Thinking through making is Ingold's way of describing a making process in which maker and material are in a continuous, reciprocal and responsive relationship. Ideas are formed through the making process, rather than superimposed onto it prior to activity. As described throughout this dissertation and demonstrated in the practical endeavours which accompany it, my approach to the making of creative work is in keeping with Ingold's understanding of making as a materially engaged mode of thinking and research. I have not imposed a theoretical discourse onto the making of the work, instead I have allowed points of theoretical and aesthetic interest to emerge as findings from the development of multiple iterations of my artworks.

Ingold defines perdurance as the continuation of material across time in relationship to the maker. This notion can also be seen in the work of this thesis. *Fields* is continually revisited and resituated in each presentation. Changes in audience-performer configurations, sound design, instruments built for the system and other aspects that surrounded the performance event continue to be made and remade throughout development and presentation of the work. New iterations of *Fields* were also made in response to invitations in particular sites and as a sound track to Chris Marker's *La Jetée. Fields* is not presented as a finished system, rather it continues to change, adapt and develop. Similarly *Ambulation* was redesigned and reconsidered in each instance of the work. In Brisbane I allowed for unpredictable local radio interferences, which were revealed through the headphones and incorporated into the composition of the work. *Ring Network* also continued to change, starting off an as installation in an art gallery, I then adapted the work into a performance piece that was presented in New York, Linz and Leicester.

In the *Interglacial/Erratic* work we allowed the general public as well as the institutions and organisations who hosted us to gain access to the making and construction of artworks. These works involved the use of digital media as well as a whole host of related technologies and heterogeneous materials. Our achievements were not presented to the public as finished artefacts, but as things and prototypes in process, as materials with perdurance. Our approach to the making of these works was focused on facilitating connections between the things we made and the context in which they were created. Audience members were invited into the production and procedures of the making process. In my work I do not present products but rather invite people into structures that I have employed to generate learning, in other words sharing *knowledge through making*. This relates back to my resistance to CX and other 'innovation' research initiatives whose agenda's often involve the commercialising and commodifying of research outputs.

Ingold has not explicitly engaged with contemporary digital technologies within his descriptions of making. The nature of thinking through making with technology is an underdeveloped area of research which my thesis contributes to. I have demonstrated in this thesis that thinking through making can be applied to contemporary sound art practices that involve digital and other allied technologies. In the work I have created I show that my thinking with technology has not objectified or instrumentalised this technology, but that I have thought *with* and *through* it. In *Fields* the nuances of the technical system were folded into the composition of the piece, through the making latency become apparent and instead of letting become a problem I incorporated it into the sound design of the piece. *Ambulation* used listening technologies not to capture sound and resituate it in another place but rather engage with these technologies in situ through an improvised sound walk. In *Ring Network* I created an installation that attempted to reveal the processes of the technologies involved. My technological approach has not been a means of realising a pre-formed idea; rather it has a complex and reciprocal engagement with technology as a material. This has similarities to Heidegger's definition of meditative thinking, in that I have openly approached technologies through experimental processes of making. I allowed for this uncertainty and unpredictability of the process to be folded into the learning outputs of this thesis.

Each of the principal pieces of work have their genesis in experimental approaches to making. As articulated in papers I have published on these projects (Shaw and Bowers, 2015, Bowers and Shaw, 2014), thinking through making operates in my material engagements with technologies, museum collections and sites of interest. From the infancy of *Fields, Ambulation* and *Ring Network,* an open approach to the exploration of technology continued to occur.

I have gone on to develop this approach to thinking through making in a number of other collaborative projects (see for example Bowers et al., 2016). *Many makings* is a strategy for conducting creative research with a technological character in collaborative contexts. It is a way of collaborating with "micro-businesses, artists, researchers, their institutions and their publics to create media, installations, performances, and participatory workshops" (ibid.,). The *many makings* approach allows creative practice to lead research thematics through material explorations and site responsive investigations. 'Curated research' (Bowers et al, 2016 and Bowers et al, 2018) is another method to which I have contributed with my own research on thinking through making with technology, and is designed for bringing together diverse artistic responses to a common theme.

Research Contributions

For consistency and legibility the contributions emerging from this PhD are listed as follows:

Principal Artworks

- *Fields*
- *Ambulation*
- *Ring Network*

Field Recording and Electroacoustic Music

- Reorienting field recording practice to reconnect it to the site and process of collection.
- Critical interrogating the listening technology electroacoustic music relies upon.
- Using listening technology as a way of extending perception through recording practice.

- Revealing the technological characteristics of creative systems with sound.
- Readdressing electroacoustic music through new approaches to handheld multichannel audio in a performance (*Fields*), situated composition in a sound walk (*Ambulation*) and automated recording processes in a sound installation (*Ring Network*).

Performance and Liveness

- Approaching the performances of sound works through creating arenas for attentiveness.
- Exploring liveness as resistance, and as a quality of performance achieved through combining and exploring heterogeneous materials, processes and technological systems.

Sound and Technology

- Opening up technologies as material processes rather than modes of presentation or productisation.
- Applying Heidegger's meditative thinking to contemporary art practice and current practice-based research methodologies.

Making

- Anti-solutionist approaches to artistic practice through making with DIY and digital technologies.
- Engaging in open ended experimentation processes as a research methodology.
- Creative approaches to digital technology that value process over production.
- Extending Ingold's terminology of thinking through making to working with technologies associated with sound and media art practice.

Future Research and Application

Building upon the development of *Fields* I will be working with Sébastien Piquemal in 2019 to create new work around experimental approaches to the use of Wi-Fi networks and the presentation of artworks on captive portals in public spaces. In this future work we will place small battery powered routers in public places, the Wi-Fi networks acting as if they are portals to free Internet services. Connecting through a captive portal, the participant will be asked to fill in a number of questions with the promise of a free Internet service at the end of the questionnaire. As they click 'continue' each page will become more abstract. The phone becomes the medium for

the presentation of sound, image and experimental websites in this project and develops our use of mobile devices in *Fields*. 'Audience' members will never get free Internet. This work will, to some extent, extend some of the findings that emerged through the making of *Fields*, exploring the mobile device as a place for artwork to be presented, and looking further at how people perform the phone. Presenting work of this nature has the potential to open up new unfamiliar relationships between artists and audiences, extending the exploration of performance dynamics developed through *Fields.*

As a continuation of the research I conducted through *Ambulation* I presented a version of the walk at a Google Design and It's Nice That event at Baltic Centre for Contemporary Art in Gateshead in 2017. I used the *Ambulation* walk to move people through the quayside area of Newcastle and Gateshead and, in relation to Google's interest in creating new ways to experience data, the event encouraged a dialogue about sounds that are normally overlooked or imperceptible in the everyday. During this iteration of the work air quality data was collected using a FROG-4000[76]. Upon returning from the walk to the venue, recordings from the journey alongside visualisations and sonifications of the collected air quality data were presented in order that participants could re-experience the walk through this time specific data. This presentation of *Ambulation* shows how the project has developed since the period of my doctoral research and also demonstrates potential applications of the work beyond its initial research context.

I will continue to develop *Ambulation* in relation to the collection and artistic use of environmental data. Specifically this *Ambulation* research will be applied to a future collaboration with computer scientist Dr. Paul Vickers (Northumbria University), John Bowers and Bennett Hogg (Newcastle University). In this future work I will create a new version of the *Ambulation* walk that is focussed on engaging people with environmental data, acoustic information and locative data sets. My collaboration with Vickers et al. will extend the academic value of this project and is currently being developed into a Leverhulme Trust funding bid.

Ambulation will also be further developed with Brighton Dome in October 2018 as part of a Heritage Lottery Fund project through which I will apply the project's

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[76] http://www.defiant-tech.com/frog-4000.php

infrastructure and learning to engaging audiences in sites of sonic and heritage interest around Brighton.

Findings from *Ring Network* will continue to inform my approach to making artistic work. Since creating *Ring Network* and presenting it in Newcastle-upon-Tyne, Linz, Leicester and New York, I have further developed my work with bells, incorporating them into my practice alongside the digital technologies I describe in this thesis. This further research and artistic development focuses on their cultural and aesthetic significance as early communication devices. My continued work with bells builds upon the ideas I have presented in this thesis. It has, to date, been conducted through artistic residencies at ARC in Romainmôntier in Switzerland[77] as well as the creation of *Plain Changes*, a piece installed in St. Andres Church in Heckington, UK.[78] Through this ongoing work I continue to appropriate and reimagine contemporary communication infrastructures, including the Internet, through the character and material of bells. Exploring the cultural and communicative nature of bells through my practice offers a reflexive dialogue on the nature of contemporary communication technologies and digital media.

Within the diverse communities that surround field recording practice many DIY and self-made devices are built to appropriate indoor studio equipment and make it suitable for outdoor use. Though field recording is a growing area of interest, many tools needed for practical activities 'in the field' are not commercially available. There are only a small number of companies dedicated to field recording products (including Sound Devices[79], Nagra[80], Sonosax[81]) and many of their products are expensive. This is one motivation for people building their own. The Wildlife Sound Recording Society offer online guides to 'homebrew microphone designs'[82] for sound recordists who want to build cheap microphones themselves. Practitioners also customise microphones, stands, blimps, holders and windshields for their own preference. For example, Chris Watson uses a wire coat hanger to hang spaced

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[77] https://tim-shaw.net/the-house-of-the-bell/
[78] https://vimeo.com/228046100
[79] https://www.sounddevices.com/
[80] http://www.nagraaudio.com/
[81] https://www.sonosax.ch/
[82] https://www.wildlife-sound.org/resources/equipment/12-resources/equipment/78-homebrew-microphone-designs

omnidirectional microphones (DPA 4060s[83]) when recording ambiences such as the dawn chorus. Sound recordist Martin Eccles[84] uses specially made microphone blimps and clips (constructed from birdfeeders and hairclips) to attach four omnidirectional microphones to a wide brim hat. It is clear that practitioners of field recording are engaged with making and DIY techniques and technologies. Building upon the work I have done around field recording and thinking through making, an investigation of DIY approaches to field recording, how practitioners approach the building of devices and how building your own equipment changes the way one listens and records would be a timely and interesting research trajectory to take. Through such research there is potential to uncover how technology (DIY or otherwise) can be made materially palpable for field recording practice and listener experience, further deepening my work on making technology present in sound work. Such research should include a critique of DIY techniques and consider their role in sound art and field recording practices as more than simply a means to an end, but a process of engaging with the world. Central to this potential further research are the following questions: How do DIY approaches to technology extend field recording practices? How do these practices fit into the notions of thinking through making?

Based upon the research I have presented here one could also further explore the liveness of media in the context of performance and installation practice. To extend the work described in this thesis this could continue thinking about liveness in relationship to field recording. In *Transmit/Receive*[85] (referred to in Chapter 3) I presented a live stream of environmental recordings at sites associated with WW1 events in the North-East of England. In this project audience members could tune into the stream via a web link provided and promoted on social media. I intend to develop this artwork and further consider how recorded liveness can be presented within gallery spaces.

In a recent piece called *Radio Television*[86] (see Figure 26) created for Sanctuary festival 2017, I developed research I have presented here and explored radio broadcasting as a method for transmitting images across a festival site. Distortions in

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[83] https://www.dpamicrophones.com/dscreet/4060-series-miniature-omnidirectional-microphone
[84] https://soundcloud.com/mpeccles
[85] https://tim-shaw.net/transmitreceive/
[86] https://tim-shaw.net/radio-tv/

the image were generated by the environmental conditions of the site (temperature, rainfall, humidity) as well as by the precarious nature of the radio broadcast and reception. In this work the immediate conditions of the site were imposed directly onto the content, each time a picture was broadcasted it would look different depending on these conditions. The liveness here emerged from how the environmental surroundings affected the radio broadcasts and therefore how the material context effected images on the screen.
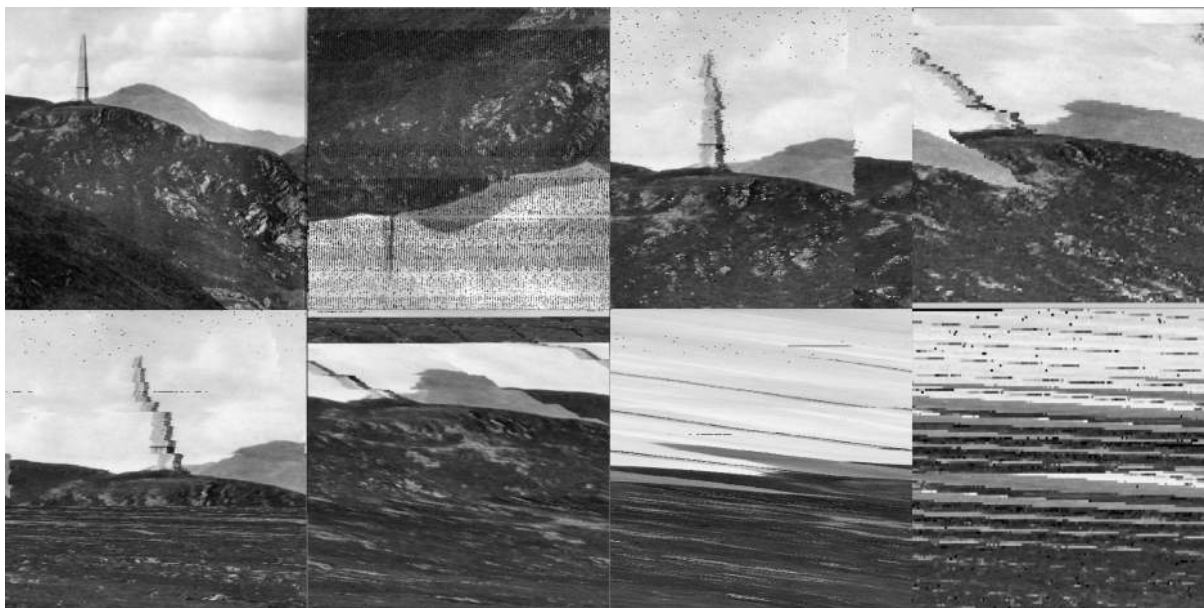
Figure 28. *Radio Television*, an images being sent over a radio broadcast multiple times. Image Tim Shaw.

A more in-depth analysis of Heideggarian thinking in relation to contemporary maker practices and digital technologies could be conducted, using the work in Radio Television as a point of departure. Earlier in this concluding chapter I opened up a dialogue with Heideggarian concepts. This could be developed further to consider how Heidegger's theories align with philosophical areas such as The New Materialism and Object Orientated Ontology and how to relate this to the practical work I have discussed in this thesis. More explicit philosophical engaged practitioners dealing with sound and technology include Denman-Cleaver (2014), Scrimshaw (2017) and Arnold (2017).

What I have offered here is an account of conducting a PhD in digital media which focussed on field recording, sound art, studies of technology, performance practice and electroacoustic music. The approach to working with sound, recording,

technology, site and process that I have taken could also be applied to a number of different disciplines. Having conducted my research in a variety of contexts, including museums, heritage sites, music venues, academic conferences, hacklabs and maker spaces, I am aware of dialogues within HCI, design, music, museum and heritage studies, visual arts and craft practice, to which this research has value beyond my own discipline. As I continue to be invited to work alongside a variety of practitioners from both academic and non-academic communities, the work I present through this dissertation will provide a mechanism for multi-disciplinary communities I continue to work with in the future to engage with and build upon my findings.

Through this thesis I have achieved the making and presentation of three significant pieces of art: *Fields, Ambulation* and *Ring Network.* I would like to remind the reader that this submission also includes these three artworks. I offer access to this work through the detailed project chapters (4, 5 and 6) and the documentation provided in the Appendices in the following chapter. I have articulated how these pieces emerged through collaborative context for making through events which took place in a variety of different cultural institutions. I have addressed contributions to a number of fields including sound art, soundscape research, electroacoustic music, performance, sound and technology studies, heritage and media culture. As this work was conducted through practice-based research I hope that the findings and processes are useful for other researchers conducting work of this nature. The philosophical upshots of this work articulated in the conclusion could be expanded and articulated in future research done by me or others. My aim is that this thesis is useful and accessible for artists and researchers from both academic and non-academic communities. I hope that the artworks, descriptions, related work and research trajectories offer an insight to the activities I have been engaged with across this PhD.

The materials, technologies, techniques and theories developed through this body of work will continue to occupy and inform my artistic and academic thinking long into the future.

Appendices

A. Fields

Images

Figure 1 Performance in the Mining Institute Newcastle, UK. (August 2014). Image Ben Jeans-Houghton.

Figure 2. Sound Check at NK Projekt, Berlin. Germany (August 2014). Image Jonas Hummel.

Figure 3. Performing at Sanctuary Festival, Scotland, UK (Daytime) (September 2015). Image Sanctuary Festival.

Figure 4. Performing at Eastern Bloc, Montreal, Canada (November 2016). . Image Justin Desforges.

Figure 5. Introducing the work at the Talbot Rice Gallery, Edinburgh, UK (January 2015). Image Chris Scott.

Figure 6. Handheld phone at Eastern Bloc, Montreal, Canada (November 2016). Image Justin Desforges.

Figure 7. Instruction card given to audience members. Image Tim Shaw.

Figure 8. Another version of instruction card given to audience members. Image Tim Shaw.

Figure 9. Performing at Piksel Festival in Bergen, Norway (November 2015). Image PNEK.

Figure 10. Performing with Markers La Jetée, Glasgow Film Festival, UK (February 2017). Image Glasgow Film Festival.

Figure 11. Performing with Markers La Jetée at EDEF, Edinburgh, UK (August 2016). Image Chris Scott.

Figure 12. Promotional Material for UK Tour (April 2015). Image Tim Shaw.

Videos

Performance at NK Projekt, Berlin, Germany (August 2014)
See accompanying USB storage device for video media
Fields/1_Fields_NK Projekt_BerlinGermany_August2014.mp4

Performance at Zé Dos Bois, Lisbon, Portugal (November 2014)
See accompanying USB storage device for video media
Fields/2_Fields_ZeDosBois,_LisbonPortugal_November2014.mp4

Performance at Connect the Dots, Sheffield (October 2015)
See accompanying USB storage device for video media
Fields/3_Fields_Murmurate_ConnectTheDotts_SheffieldUK_October2015.mp4

Performance at Eastern Bloc, Montreal, Canada (November 2016)
See accompanying USB storage device for video media
Fields/4_Fileds_Murmurate_SiteAndSoundFestival_MontrealCanada_November
2016.mp4

Additional Material

Interview in Impakter Magazine
https://impakter.com/sound-tech-intersect-interview-tim-shaw/

Event at Music Hackspace, London
http://musichackspace.org/tim-shaw-and-sebastien-piquemal-fields-april-16/

Event at Café OTO. London
https://www.cafeoto.co.uk/events/tetsuya-umeda/

Feature in NARC Magazine
http://narcmagazine.com/news-fields-durham-castle/

B. Ambulation

Images

Figure 13. Ambulation Presented at Compass Festival, Leeds (November 2016). Image Jonathan Turner.

Figure 14 Performance with Musee Imaginare, Newcastle, UK (September 2015). Image Musee Imaginaire.

Figure 15. Audience members put on headphones at the beginning of the walk at SPAN, Baltic, Gateshead, UK (October 2017). Image Tim Bowditch.

Figure 16. Listening in the Anglican Cathedral park. FACT, Liverpool, UK (September 2016). Image Simon Bowen.

Figure 17. Walking into the Anglican Cathedral park. FACT, Liverpool, UK (September 2016). Image Simon Bowen.

Figure 18. Sound Walk at Dorethea Quarry with James Davoll Wales, UK (October 2017). Image James Davoll.

Video

Walk as part of Google SPAN, Baltic, Gateshead, UK (October 2017)
See accompanying USB storage device for video media
Ambulation/1_Ambulation_SPAN_BalticGateshead_October2017.mp4

Walk as part of Compass Festival, Leeds, UK (November 2016)
See accompanying USB storage device for video media
Ambulation/2_Ambulation_CompassFestival_November2016.mp4

Research and Development in Newcastle-upon-Tyne, UK (September 2015)
See accompanying USB storage device for video media
Ambulation/ 3_Ambulation_R&D_NewcastleUK_September2015.mp4

Additional Material

Feature in a-n
https://www.a-n.co.uk/news/walk-this-way-compass-festival-brings-live-art-to-leeds-streets/

Feature in Leeds Expired
http://www.leedsinspired.co.uk/events/ambulation-tim-shaw

Feature in Its Nice That
https://www.itsnicethat.com/features/newcastle-gateshead-googlespan-event-241017

Feature in Google Design
https://design.google/library/revealing-invisible/

C. Ring Network

Images

Figure 19 Ring Network installed in the New Bridge Project in Newcastle upon Tyne in November 2016. Image Tim Shaw.

Figure 20 Ring Network performance at Fridman Gallery, New York with Katherine Liberovskaya (February 2018). Image Johann Diedrick.

Figure 21 Performing Ring Network at De Montfort Univeristy in Leciester, UK (November 2017). Image James Andean.
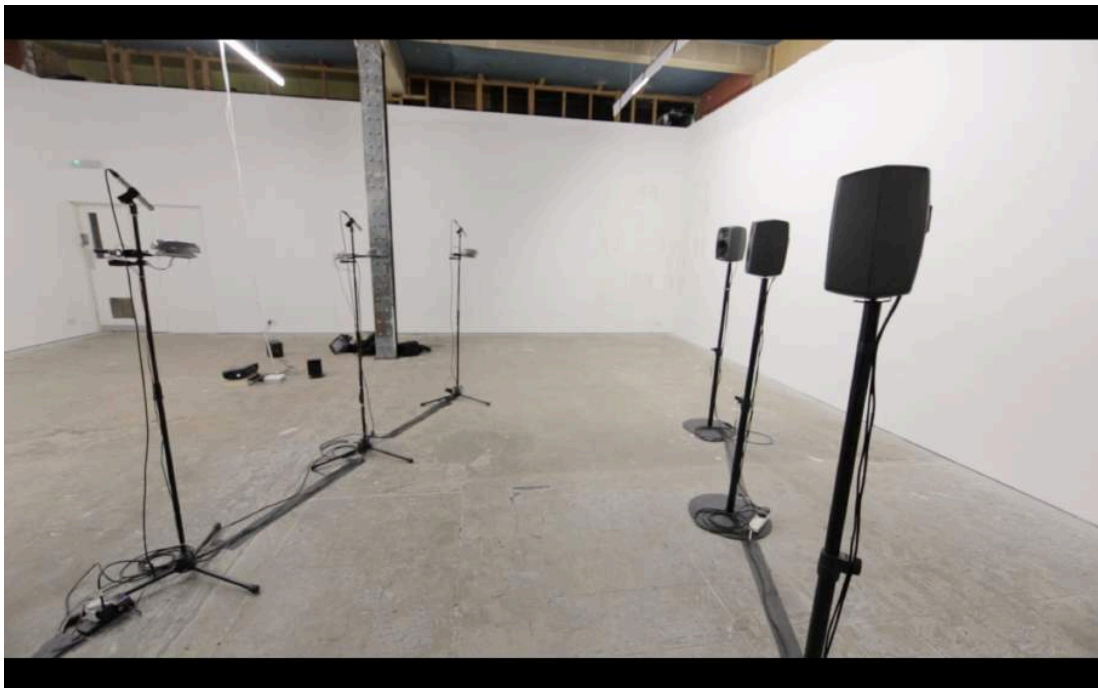

Figure 22 Ring Network installation view at The New Bridge Project, Newcastle, UK (November 2016). Image Tim Shaw.

Figure 23 Ring Network set up as part of a performance at bb15 in Linz, Austria (April 2017) Image bb15.

Figure 24 Ring Network performance at Fridman Gallery, New York with Katherine Liberovskaya and Phill Niblock (February 2018). Image Katherine Liberovskaya.

Video

Installation as part of Polyspaces at the New Bridge Project, Newcastle, UK
(November 2016)
See accompanying USB storage device for video media
RingNetwork/1_RingNetwork_NewcastleUK_November2016.mp4

Additional Material

Exhibition Review in Corridor8
http://www.corridor8.co.uk/article/review-polyspace-the-newbridge-project-newcastle/

Ring Network explained in relationship to other piece Radio Television in Alphr
http://www.alphr.com/art/1006924/an-off-grid-festival-wants-you-to-experience-true-darkness

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