Ambulation: Exploring Listening Technologies for an Extended Sound Walking Practice

Tim Shaw
Culture Lab
Newcastle University
tim.shaw@ncl.ac.uk

John Bowers
Culture Lab
Newcastle University
john.bowers@ncl.ac.uk

ABSTRACT

Ambulation is a sound walk that uses field recording techniques and listening technologies to create a walking performance using environmental sound. *Ambulation* engages with the act of recording as an improvised performance in response to the soundscapes it is presented within. In this paper we describe the work and place it in relationship to other artists engaged with field recording and extended sound walking practices. We will give technical details of the *Ambulation* system we developed as part of the creation of the piece, and conclude with a collection of observations that emerged from the project. 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. We will show how having an open, improvisational approach to technologically supported sound walking enables rich and unexpected results to occur and how this way of working can contribute to NIME design and thinking.

Author Keywords

Field recording, sound walks, performance, situated composition.

CCS Concepts

• **Information systems - Spatial-temporal systems** • **Human-centered computing - HCI design and evaluation methods** • **Applied computing - Sound and music computing**

1. INTRODUCTION

Ambulation is a headphone-based sound walk that adapts field recording equipment and DIY listening technologies to explore the sonic quality of different environments through an expanded performance practice. The performer collects acoustic and electromagnetic signals from the immediate environment and transmits them to audience members who are each wearing wireless headphones. By doing this, *Ambulation* configures field recording as a live, performative act. This project has been in continuous development since August 2014. Each performance is specific to its geographical and temporal context and the performance system has been designed by the first author of this paper to manifest this site-responsiveness. The listening technologies and sound processing systems employed are revisited in each performance in order to respond to the environmental context of each particular event. Whilst *Ambulation* continues to be performed in different locations internationally, we present here a comprehensive description and critical discussion of the work as a continually responsive yet complete research project and artwork.

2. A TYPICAL PERFORMANCE

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 we conducted through *Ambulation* considers how recording and performance exist as shared listening practices.

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

Over the past three years *Ambulation* has been presented at 12 different festivals, events and conferences around the world.

Figure 1: *Ambulation* at Compass Festival in 2016. Image Jonathan Turner.

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

2.1 Developing the Walking Route

When exploring the environment and planning the route that the performance will take place within, a diversity of spaces are sought with 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. The varied features of the places will suggest the application of different kinds of

sound technology. 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 the performer 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.

2.2 The Performance

Typically, at the opening of the performance, which is the beginning of the walk, omnidirectional microphones will be slowly faded in to allow the audience-walkers to get used to this new kind of listening. Even though these microphones have a similar field to the ears, it is unusual to experience environmental sound in this way if you are not used to field recording or listening through microphones. The live feed continues 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 made up of sounds such as cars passing, wind in trees, people walking and buses accelerating.

Figure 2: Dipping a hydrophone into River Aire during Compass Festival in 2016.

Once the audience seem to have become acclimatised to this way of listening, a sound that is more dynamically present will be sourced and presented to contrast with the ambient sound of the opening section. This might be achieved by standing close to a light-controlled pedestrian 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 streetlight, parking ticket dispenser or cash machine. This newly introduced material cuts through the ambient sound that begins *Ambulation*. Once a sound of this nature has been found, it is often recorded and stored for later use in one of the sample banks in the Pure Data (PD) system developed for *Ambulation*. The system has the capability to play back and loop sounds, and alter start and end points, allowing the sounds collected to be composed with as the walk unfolds (Section 4). Within a walk there are typically five or six of these moments when the performer stops to gather material at close range, attending to a small confined area or specific details of the environment.

The performance usually contains a dedicated hydrophone section (Figure 2). This gives a contrasting sonic space within the walk and is normally conducted in the following way. Where the hydrophones should be placed (in a river, fountain or other body of water) is planned prior to the performance. When approaching the location, recorded layers are built up using the ambient microphone feed and these layers are allowed to playback and interact with each other. The live feed of the microphones is then taken out and the hydrophone is readied to submerge into the water. Once submerged, the hydrophone channel is slowly brought into the mix. 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's headphones. The layered recordings are then removed, slowly revealing the underwater space. At this point, the hydrophone is held very still as any unwanted movement can cause it to strike a surface making a loud impact sound in the headphones. The *Ambulation* system is used to blend together the sound worlds from above and below the surface.

Towards the end of the walk different types of material are layered 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* at Compass Festival in Leeds, church bells were sounding and could be clearly heard at the starting point. These bells were not played back immediately, rather their recordings were brought in after they had stopped, making the relationship between immediate and remembered phenomena performable.

At the end of the walk, after building up contrasting sonic layers, the recorded material is slowly faded. Naturally, the immediate soundscape becomes apparent as the signal through the headphones gets quieter. After some time the performer takes off his headphones and continues to listening attentively to the 'natural' environment. This generally lasts a few minutes before everyone is thanked to indicate that the walk is over.

3. RELATED WORK

In this section we discuss the motivations for creating *Ambulation*. We do so in reference to the artwork and practices of others which place the work within a number of artistic, research and cultural contexts and provide reflexive anchors for thinking about what *Ambulation* achieves.

3.1 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 while listening closely. 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 often a solitary practice in which a focused attentive relationship towards environments develops over long-periods of listening. While field recordings are ubiquitous in the work of sound artists, the particular conditions of their recording can be difficult to render explicitly and share with an audience in live performance or installation settings.

Sound artist Lee Patterson performs live with everyday objects and recording technologies both solo and in ensembles. Using contact microphones, guitar pickups, hydrophones and motors he amplifies the resonances of springs, CD players, water-soluble vitamins, burning peanuts and glass bottles. Patterson's approach to performing with recording technologies is very different, say, to the tradition of electroacoustic music which prioritises the diffusion of recorded material over multi-loudspeaker systems [5]. 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.

3.2 Walking, Sound Walking and Site

Artists have used walking for many years to explore environments and create work on foot [6]. Within the field of walking as an artistic practice, sound walks emerged as a way of encountering environments through a focus on listening [13]. In the work reported here, sound walking is both a practical necessity and artistic strategy for the process of field recording. In *Ambulation,* sound walking is a structuring device for a live event that foregrounds the acts of field recording and listening.

Canadian artist and activist Hildegard Westerkamp conducts sound walks in order to experience and think about locational sound and time [13]. 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 often include a voice over, field recordings of the route and added Foley sound [4]. In comparison, *Ambulation* is not shaped according to an explicit narrative, nor is there a voice over and while it is a structured event and a guided aural experience, it differs from Cardiff and Miller's audio walks in making the act of recording, storing and processing sound live and improvised affairs.

German artist Christina Kubisch is known for her 'electrical walks'[1], which take a very different approach to that of Westerkamp, and Cardiff and Miller. In these walks Kubisch embeds electromagnetic inductors into headphones, which allow listeners to make their own way through an environment. Like *Ambulation*, Kubisch's walks tend to take place in urban settings and encourage listeners to explore the electromagnetic fallout of cash machines, alarm systems, fluorescent lights and the other 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.

Recently, artists have exploited the availability of wireless headphones to combine recording and sound walking. Dutch sound artist Dennis Van Tilburg developed *Musique Parabolique[2],* an augmented sound walk using a parabolic microphone and a computer running 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 highly directional microphone. *Musique Parabolique* was presented at the NIME conference held at Goldsmiths University 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.

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* walks are usually led by three people: one to guide the group, one to operate microphones and a third to mix and process sound live. Martin et al. use Ableton Live to process material to "explore a synthesis between a 'pure' form of listening to the environment and a heightened, technologically supported listening experience"[3]. Marin and Tilburg have made systems that allow them to record and recompose this material as a performance event. In contrast, *Ambulation* is performed by one person: the first author of this paper. He is both performing the microphone

positioning and the compositional system. Audience members are encouraged to walk behind him but are free to move at different paces and to focus their attention on whatever they like in their own time. While Van Tilburg's walk uses a parabolic microphone, *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.

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" [3]. He intends his *EcoSono* to offer an alternative model by engaging with what it means to make work outside in the wind and rain, in response and in collaboration with the elements. *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. 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, *Ambulation* works primarily with acoustic and electromagnetic signals rather than abstracted data.

Other artists and researchers have problematised sound art and its relationship to terms such as 'site-specific' [9] or 'site-responsive' [8]. Lauren Hayes writes about her ongoing project *Sounding Out Spaces* in which she collaborates and improvises within sites not usually associated with musical performance [8]. She draws on her experience of performing within 'unusual locations' to open up questions around site-specific art and its aesthetics. Hayes suggests that while site-specific is a useful term to describe the history of Western visual art, site-responsive is a more suitable description of the practice she, and many other musicians, have in engaging with place. *Ambulation* is responsive to the various environments in which it has been performed. New listening technologies and signal processing methods are added and adapted depending on the character of the environment. Therefore *Ambulation* is not *specific* to a single site but rather *responsive to and in* many.

3.3 Improvising with Recorded Material

During an interview with Douglas Simon, artist Alvin Lucier claimed that "live performances are more interesting than taped ones" [12]. As artists with a background in improvised music, the problematic relationship between recorded material and live performance has been central to our work. *Ambulation* is a particular example of the way in which (live) recorded material has been incorporated into an improvised performance which, at least in part, performs field recording itself.

Though the settings for *Ambulation* are researched 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 initial investigations and planning of the route. Some aspects of the environment are relatively predictable: public clock chimes, busy roads and the acoustic dynamics and resonances of physical infrastructure. These comprise the recurrent features which structure the route and frame performance. However, during the walk additional unanticipated sound events add challenges and underpin the performance as improvisational composition in which a diverse sonic material is encountered.

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[1] http://www.christinakubisch.de/en/works/electrical_walks
[2] http://www.dennisvantilburg.nl/index.php?/ongoing/musique-parabolique/
[3] https://www.espaces-sonores.com/recomposed-reality-eng

4. DEVELOPMENT PROCESS

Ambulation was not developed in a studio, but emerged through a daily practice of field recording. The system was developed through small incremental steps and regular testing in the 'real-world'. We understand the development process in *Ambulation* in relation to Tim Ingold's articulation of 'thinking through making' [11]. In opposition to a traditional conception of making through thinking, which prioritises design ideas over their materialisation, Ingold insists on how knowledge can be generated through physical engagement with materials over extended time-scales [11]. He contrasts 'hylomorphism', where pre-existing ideas form materials and which he dates from Aristotle and names following him, with 'morphogenetic' accounts of making, where gesture and materials entwine on a give and take basis. Ingold's articulation of thinking through making also supports an understand*ing* of *Ambulation's* process as divergent from solutionist approaches to artistic or engineering research, in which the solution to a problem is imagined and then made manifest.

Figure 3. *Ambulation* **controller setup.**

4.1 Hardware

A variety of DIY and commercially bought pieces of hardware were used within different versions of the walk. Particular attention was paid to making and selecting hardware that suited the perambulatory nature of the performance and allowed freedom of movement to use the full potential of the equipment along the route (and in all weathers).

At the center of the *Ambulation* system is a 'conventional' field microphone, the kind commonly used for the collecting of sounds outside of the studio. For most recent versions of the walk, DPA 4060 microphones were mounted as a spaced omnidirectional pair at either ends of the bag which contained a portable sound recorder (see Section 4.2). As well as conventional microphones, a number of other listening technologies are used to capture a diversity of sonic material. Hydrophones, which allow underwater sounds to be heard, have been employed in a number of the walks. Both DIY and commercially bought hydrophones have been used. Inductive coils of copper wire that can pick up electromagnetic energy when placed on or near electronic equipment can be used, like the hydrophones, as listening devices to hear sounds not usually perceivable by the ear. Inductive coils allow *Ambulation* to introduce listening to a hidden sonic world and provide more performative options for the work within the urban environment which is rich in electromagnetic spill.

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 design of *Ambulation*. Branded headphones such as Sennheiser or Bose are extremely expensive to hire and most new wireless headphones use Bluetooth technology. However, as *Ambulation* requires multiple headphones to receive from a single transmitter, the device pairing required by Bluetooth is not suitable. Hiring radio frequency (RF) headphones with a transmitter from a company whose usual trade is silent discos 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 face interference from other frequencies within the urban environment. This interference can significantly change the experience of the walk and affect the performer's ability to shape the audience experience. This has the consequence that the headphones can dictate the possible routes. For example, when presenting the walk in Brisbane (Australia), locally sourced RF headphones were so full of audio artifacts they became almost unusable. In contrast, in the city's Botanical Gardens, the 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 became something to tie into the creative decisions when planning the walk. As *Ambulation* is about the experience of sound, including phenomena not usually within our perceptual reach, this interference felt relevant to explore rather than obstructive. Different species of 'interference' became incorporated into 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, the audience were taken into areas of interference where in addition to the usual broadcast sonic material of *Ambulation*, various RF artefacts, audio cut outs and even the occasional taxi driver conversation could be heard. Though the exact character of such interference is beyond performer control, a route can be shaped around how much or little interference is desired and when. 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.

4.2 Software

The open-source language Pure Data (PD) was used in all instances of the walk. PD processed the incoming audio and manipulated 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 the performer's back. A small Korg NanoKontrol plugged into the laptop was placed in a shoulder bag (Figure 3). The *Ambulation* bag also contains a sound card (a Zoom F8) allowing microphones to be interfaced with the laptop.

In this section we give further details on the software instruments that were developed to support the *Ambulation* walk. These were designed to achieve maximal results using the minimum of controls [cf. 1]. As the NanoKontrol controller only has a limited number of knobs and sliders (8 of each) and 34 buttons, its limitation informed the design of the software instruments and dictated how many could be active during any given walk. All of the following *Ambulation* instruments were designed with live audio processing and manipulation in mind.

Soft Mixer is at the heart of the system and manages the different audio feeds coming in and the volume of each. The overall volume of the mix sent to the wireless headphones can be set as well as, in some cases, the stereo image. The *Soft Mixer* supports routing a signal to other parts of the system in a similar fashion to an auxiliary send on a hardware mixer.

The Sampler 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 behaviour is 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 performer hear them in the headphones. This is useful when a sound occurs during the walk but is not played back immediately in the composition. Once a sound has been recorded to a sample bank, using two knobs the start and end points of the playback can be adjusted to avoid, for example, an unwanted sound at the start or the end. Playback of the sounds with a granular character can be created by placing the start and stop markers very close to each other, creating rhythmic sequences and, at the extreme, pitched drones. *The Sampler* can also reverse sounds saved within the banks. Once the sample banks are cleared they cannot be recalled. To force the novelty of each walk and maintain their improvisational challenges, the sample banks are always cleared at the end of each walk.

The **Granular Pitch Delay** extends audio manipulation in *Ambulation* by recording small grains of sound into a wavetable which is played back through a delay line at a variety of speeds to alter the frequency of the grains. One knob was assigned as to send signals to this instrument. This also worked as an overall volume for the delay creating a combined wet-dry mix. Parameter controls were added for pitch, feedback and size of the grain recorded. With just three controls a variety of sounds were available, from long drones to short percussive textures.

Granular Moments is another granular synthesiser in PD for use within *Ambulation*. This allowed sounds to be recorded to the disk of the computer and then loaded into four separate wavetables. A single button on the NanoKontrol was used to randomise parameters for the position, size, frequency and volume of each grain. This gave a less predictable sound and was often used to improvise in transitional periods of the walk.

Spectral Freeze was made using the [rfft~] object in PD. By sending a feed of incoming audio from the Soft Mixer, the Spectral Freeze instrument freezes the spectral character of the audio to create an ongoing drone, using a button mapped from the NanoKontrol. Freezing the frequency spectrum served as a textural element in the composition which was particularly useful for creating transitions between different sections of the walk. It can also create impressive effects when pitched sounds such as sirens, air vents and buskers occurred during the performance. With this instrument any occurrent sound could be instantly turned into a drone. For example, the swooping of a siren can be caught and frozen with the press of a single 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 centre frequency of the filter and could be used to sweep the full human hearing range. This tool enabled low-end traffic noise that occurs in most city centres to be filtered out. This noise can become especially pronounced when listening through sensitive microphones and can accumulate when layers of recordings are played back. The filter was also used as a method to shift from one sound world to another, creating transitions between two sonically contrasting environments, for example, moving in and out of the hydrophone section.

5. 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 we report on four main reflections that emerged through the iterative development process and performances of the work.

5.1 Sound Situ: Performing Field Recording

Ambulation deals with the act of field recording as a performance activity. It engages with the soundscape as a live phenomenon, ever changing and geographically specific. The making of the work is conducted in close connection 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* [3], *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. In contrast with much sound art based on field recording, the act of recording is not a pre-made and inscrutable activity at the time the audience encounters the work. Rather, *Ambulation* makes field recording available as a live performed and technologically-mediated activity for the audience. *Ambulation* also responds to the unpredictable nuances of the immediate environment and is shaped by the character of the walked route. *Ambulation* can directly respond to unexpected sonic material including 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, changes and remains responsive to the different places where the work is presented.

5.2 Extending Perception

In keeping with this year's NIME thematic 'Blending Dimensions', *Ambulation* explores the idea of using tools to extend perceptual possibilities within performance events. By using inductive coils to sniff the hidden sound of electromagnetic energy, or hydrophones to listen through water, or contact microphones to reveal concealed resonances, *Ambulation* audiences are invited 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 everyday perception. Through artistic practice we 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). This 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 our environments.

5.3 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" [10]. *Ambulation* shares the very particular experience of listening through microphones that is familiar to sound artists with a wider audience.

5.4 Walking as a Compositional Structure

Ambulation uses the structure of a walk to bring together field recording and improvisation. The sonic environment is unpredictable and lends itself to the practice of improvisation. In order to perform the walk, a reliable technological system needed to be created that could deal with a variety of sonic material and allowed interesting manipulations of that material to be performed on foot. A strategy was also developed for carefully pre-composing the route the performance would take. This gave a predictable geographical structure to the walk, whilst allowing unexpected events to occur during the event. It also gave the walk a predictable duration which helps with

performance programming. The design of the walk enables particular realisations of *Ambulation* to have a specific character. 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 the Piksel Festival in Bergen in 2016, the piece began inside the large warehouse space that was being used as the main exhibition venue. The audience were led through corridors, up and down stairs and then outside to the industrial landscape surrounding the venue. Here contact microphones were attached to old pieces of machinery and hydrophones were dipped in the harbor. The walk finished at the front entrance of the warehouse, which had a particularly notable long reverberance.

6. DISCUSSION

This paper has concentrated on how *Ambulation* has developed as an unfolding work of artistic research, exemplifying a novel conjunction of creative concerns. *Ambulation* has been developed through multiple public presentations in a variety of settings to which we have given a comprehensive overview. There is not space here to thoroughly examine the experience and responses of *Ambulation's* audiences and evaluate the work against such an analysis. This is the subject of ongoing work.

Rather, to close this paper, we want to bring out three features of our research approach which further echo Ingold's writings about 'thinking through making' [11]. In this way, we intend to add depth to existing discussions [e.g. 8,9] of what working in response to site can mean.

6.1 Liveness

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. *Ambulation* creates an arena for action and listening*,* 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 all happen in advance, there is no complete composer privilege, rather the composition unfolds in time and space during the performance event. Though led by the performer, the activity of thinking through making is done collectively with the audience. As each iteration of *Ambulation* is improvised, each walk is uniquely responsive to site, time, situation and audience attendance. The experience of working on *Ambulation* suggests strategies for conducting performance walks of this nature. These strategies are open and flexible to different performance scenarios: technological, environmental, cultural and otherwise.

6.2 Improvisation

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 Bures Miller's walks, which draw on fixed recorded audio and linear narrative structures, *Ambulation* works with the immediate soundscape as creative material. 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", highlighting activities that accept place, structure and technology as productive features of performances and not "problematic obstructions" [2]. *Ambulation* accepts these unpredictable features and uses improvisation as a thinking through making process*,* extending Bowers' account of electroacoustic improvisation to the form of a performative sound walk.

6.3 The Aesthetics of Interfacing

Making artworks this way, whereby the characteristics of site, technology and situation are integral parts of the creative material and presentation, is an approach we believe to be of value to the NIME community. It offers an alternative to some of the more traditional engineering orientations to making new musical interfaces we sometimes see. For us, thinking, design, making, public performance and perceptual-aesthetic experience are intimately entwined rather than strictly iterated concerns. This leads us to an appreciation and engagement with 'site' which is rather different from those applications in 'locative media' which, say, associate pre-made sounds with pre-identified and bounded locations [e.g. 7]. While the walk route gives an indicative guide to what might happen, what is actually heard on-site is thoroughly made in the moment. Our approach also leads us to rethink what can count in such domains as 'the interface'. Neither performer nor audience have a fixed resource which serves as the focus for their engagement with *Ambulation.* The perceptual-aesthetic affect of the work emerges out of many resources in juxtaposition: the site, its sounds, how the performer records them, the juxtapositions he performs, how the audience's attention has been shaped, and so forth. In a significant sense for us, the extended sound walking that *Ambulation* exemplifies is a kind of *aesthetic interfacing –* between performer, technologies, audience, site and whatever unpredictable elements come their way.

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