SONIC ENVIRONMENTS - ACMC2016

Proceedings of the Annual Conference of the Australasian Computer Music Association

Hosted by the Queensland Conservatorium, Griffith University

Sunday 10th- Monday 11th July 2016

Proceedings of the 2016 Conference of the Australasian Computer Music Association ISSN 2206-5296
Proceedings of the 2016 Annual Conference of the Australasian Computer Music Association Brisbane Australia

Sunday 10th - Monday 11th July 2016
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Published by:
The Australasian Computer Music Association
ISSN 2206-5296

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SONIC ENVIRONMENTS
JULY 10-11, QUEENSLAND CONSERVATORIUM, BRISBANE, AUSTRALIA

Convenors’ Welcome

Drawing inspiration from contemporary acoustic ecology, Sonic Environments invites composers, performers, academics, field recordists, acoustic ecologists and technologists to present research and creative works exploring the ecological, social and cultural contexts of our sonic environments. This conference aims to expand our current understandings of acoustic ecology and the role of sound and technology in understanding rapidly changing environments across the world. The conference theme encourages interdisciplinary perspectives on sound and aims to explore the possibilities of emerging technologies ranging from augmented reality sound walks and generative ecological compositions to networked performance connecting communities and immersive sound in virtual reality. We also invite research exploring aural awareness and investigations of natural and anthropogenic sounds and their relationship with the environment.

Sonic Environments is hosted in collaboration with NIME 2016 (New Interfaces for Musical Expression) the premier international conference in designing human-computer interfaces and interactions for musical performance.

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THE AUSTRALIAN FORUM FOR ACOUSTIC ECOLOGY
The Australian Forum for Acoustic Ecology (AFAE) was formed in 1998 by people interested in the awareness, experience, and study of sound and soundscapes. The AFAE is a not-for-profit, which is home to a collection of people across Australia who listen and who have a professional or personal interest in fields such as: acoustics, audiology, architecture, digital design, education, health, landscape, phenomenology, sound art, sound culture and sound design. The organisation brings together people who aim to promote a culture of listening to raise awareness generally of issues around listening, sound and sonic environment; and to encourage discussion, debate, education, practical activities and research.

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TABLE OF CONTENTS

FULL REFEREED PAPERS

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roger Alsop</td>
<td>usedlost: creating a multi-spatial audiowork from virtual locations</td>
<td>9</td>
</tr>
<tr>
<td>Merate Barakat</td>
<td>An Architectural Approach to The Soundwalk Method</td>
<td>13</td>
</tr>
<tr>
<td>Jesse Budel</td>
<td>Creative Responses To Soundscape Ecology: Innovative Frameworks and Case Study</td>
<td>21</td>
</tr>
<tr>
<td>Joe Cantrell</td>
<td>Paying It Forward: Sound Art Strategies for the Post-Anthropocene</td>
<td>29</td>
</tr>
<tr>
<td>Teresa Connors</td>
<td>The Aesthetics of Causality: A descriptive account into Ecological Performativity: a creative research practice.</td>
<td>37</td>
</tr>
<tr>
<td>Mace Francis</td>
<td>From Traffic Rises: Site Specificity and the Compositional Process</td>
<td>43</td>
</tr>
<tr>
<td>Cornelius Fuhler</td>
<td>Splinter at Mungo: the Art of Communication</td>
<td>51</td>
</tr>
<tr>
<td>Stuart James</td>
<td>A Classification of Multi-Point Spectral Sound Shapes</td>
<td>57</td>
</tr>
<tr>
<td>Jillian Scott</td>
<td>Aural Roots: Cross-modal Interaction and learning</td>
<td>65</td>
</tr>
<tr>
<td>Ian Stevenson</td>
<td>Soundscape Analysis for Effective Sound Design in Commercial Environments</td>
<td>69</td>
</tr>
<tr>
<td>Cissi Tsang</td>
<td>Hexadecimal compositions – using hex data to sonify images of the found environment</td>
<td>75</td>
</tr>
<tr>
<td>Lindsay Vickery, Michael Terren, Sam Gillies and Josten Myburgh</td>
<td>Between the Real And the Imaginary: Ecostructural Approaches to Composing with Field Recordings and Acoustic Instruments</td>
<td>81</td>
</tr>
</tbody>
</table>

ABSTRACTS AND POSTERS

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abby Aresty</td>
<td>Of Earth and Sun: Generative Soundscape Composition and Biophilic Design</td>
<td>91</td>
</tr>
<tr>
<td>Leah Barclay</td>
<td>Biosphere Soundscapes: Exploring the art and science of listening to UNESCO Biosphere Reserves</td>
<td>91</td>
</tr>
<tr>
<td>Damian Castaldi</td>
<td>Tambourine Bay</td>
<td>92</td>
</tr>
<tr>
<td>Sabine Feisst</td>
<td>Listening to Deserts in the American Southwest: Garth Paine’s Explorations of Sonic Placemaking</td>
<td>96</td>
</tr>
<tr>
<td>Nigel Frayne</td>
<td>Re-imagining a site specific soundscape design project into a sonic art performance space.</td>
<td>97</td>
</tr>
<tr>
<td>Sally McIntyre</td>
<td>Huia Transcriptions: re-collecting Colonial era witness accounts of extinct birdsong</td>
<td>99</td>
</tr>
<tr>
<td>Iris Garrelfs</td>
<td>Traces In/of/with Sound: an Artist’s Experience Of Audio-Visual Space</td>
<td>100</td>
</tr>
<tr>
<td>Sally McIntyre</td>
<td>Huia Transcriptions: re-collecting Colonial era witness accounts of extinct birdsong</td>
<td>101</td>
</tr>
<tr>
<td>Johannes Mulder</td>
<td>On Solo – A Progress Report</td>
<td>102</td>
</tr>
</tbody>
</table>
Garth Paine
Listening for Presence 103
Garth Paine and Sabine Feisst
Sonic PlaceMaking in the American Southwest: The Listen(n) Project 103
Andrew Skeoch
What Can We Learn from Listening to Nature? 104
Sandy Sur
Sonic Environment in Vanuatu: Exploring Water Music 105
Vanessa Tomlinson
Piano Mill 106
Ian Whalley
Developing telematic electroacoustic music 106
ARTIST TALKS
Camilla Hannan 108
Mara Helmuth: Sonic Refuges 108
Jordan Lacey: Sonic Rupture 109
Peter Mcilwain: The Phonozoa Project 110
Mari Ohno 110
CREATIVE WORKS
Concerts 112
Installations 115
Immersive Installations 122
Augmented Reality Soundwalks 123
SONIC ENVIRONMENTS - ACMC2016

REFEREED PAPERS
USEDLOST: CREATING A MULTI-SPATIAL AUDIOWORK FROM VIRTUAL LOCATIONS

Roger Alsop
Victorian College of the Arts and Melbourne Conservatorium of Music Production

ABSTRACT
usedlost was created for the 2015 Prague Quadrennial for the SoundKitchen call for works “compiled or composed using field (location) recordings made during Prague Quadrennial 2015 [and] linked to the main theme of PQ ’15: “SharedSpace: Music Weather Politics”. It explores linking new and old information distribution technologies, to create a sense of location that can be experienced and possibly understood through virtual representations of varying histories and languages.

An 8-channel audio system was used for sound dispersal in the New Stage of the National Theatre in Prague, and a max patch was designed for creating and recoding the 22’ work.

1. INTRODUCTION
The sense of space and relations to it are deeply personal and individual, and comprised of the mental and physical state of the individual experiencing their location within it. The resonances of any location is dependant on the individual listener and their position within the location, and these resonances may have physical/acoustic causes, such as those resulting from standing waves or wave cancellations, or be the evocation of memories, or experiences, encountered while in the location These evocations may be just as much a result of the physical properties of the space as of the felt, perceived, and conceptual aspects of the space [1], resulting from the “omnipresent ambience of sound and smell, the feel of air, soft soil, and hard ground, the happy accidents and the occasional blows of fate - these are the common experiences of life that may add up to a profound sense of place” [2].

While it is impossible to create Tuan’s list in an electro-acoustic work, there are sounds and ways of organising them that can readily evoke a sense of a particular space within a different space. It is also possible to create a sense of inclusivity and of being part of that particular space through technologies [3-6].

usedlost was composed in Prague and designed to represent the locations used in the 2015 Prague Quadrennial, the history of those places and their uses for the Quadrennial, and the variety of cultures and languages represented there. These were all shared real spaces that were represented in a variety of virtual spaces. English was the lingua franca of the Quadrennial, however it was a second language for the vast majority of the delegates.

The virtual spaces that were inhabited by the delegates of the Quadrennial formed links to and with the real spaces. As many of the delegates had little idea of the city and its history web based systems were used to grant this access, these included: web descriptions of the locations, updates and descriptions of events, event reviews, maps and histories of the locations. While very useful this way of navigating the city and the events of the Quadrennial was in many cases unique to the individual. This was due to the differences in technology – particularly hand held and personal technology – and their capacity to use it. This capacity may be influenced by: personal expertise, qualities of the internet provider used by the individual, qualities of the technology being used, and so on. The presence and affect of different cultural norms (considering a culture to have a geographical and temporal location) and the equally pervasive and affective presence of non-geographically non-temporally located internet or virtual cultures also has great influence [7-9].

Using the virtual to navigate and understand the real offered advantages and disadvantages in that the histories of the locations could be readily understood and interpreted by the individual. However, any understanding and consequent interpretation was subject to the information accessed, and this was influenced by many factors. Possibly most pressing of these was that Czech and English were the two languages used, this meant that any other language had to be translated, and this was usually done through a program such as Google Translate or Microsoft Translator. The previous sentence was translated from English to Icelandic (a language of delegates to the Quadrennial), then translated back to English as

Possibly the most important aspects of the proposals were Czech and English were two issues to use, this meant that other language to mean that snake, and this was done through the normal program such as Microsoft, Google Translate or Microsoft Translator using Microsoft Translator, and

Proceedings of the ACMC/AFAE2016 Conference ISSN 2206-5296
Possibly the most pressing of these was the Czech and English, two languages used, this meant that other language had to be translated, and this was usually done through programs such as Google Translate or Microsoft Translator.

using Google Translate.

These differences, while not as extreme as those encountered when translating between English, which like Icelandic has a subject-verb-object structure and other languages such as Korean, which has a subject-object-verb sentence structure. In this case the original sentence is translated as

Among them it was probably means that the most pressing both Czech and English language translations of other languages, this was usually took place through programs such as Google Translate or Microsoft Translator.

It can be seen that these translations, while representative of the initial idea, required some interpretive gymnastics to glean that idea’s original intended meaning.

The real spaces, while less open to varied interpretation due to being tangible, could be construed in many ways. The locations and buildings in which delegates presented works ranged through the Clam-Gallas Palace, which was built in 1752 and has hosted Mozart, Beethoven, and Kafka; the Bethlehem Chapel, originally built in 1391, demolished in 1786, then rebuilt to the original plans in the 1950s; and the New Stage at the National Theatre where usedlost was performed, and built between 1981 and 1983. There were sixty-one locations in total and fourteen principal locations used most often.

2. PROCESS OF DEVELOPING USEDLOST

In developing usedlost it was decided to incorporate these aspects outlined above, representing the locations used and the languages of the delegates. As computer based processes, such as maps, histories, timetables, outlines of activities and so on, they provided an ‘other lingua franca’ as the primary form of communication between organisers and delegates.

After it was decided to take this approach the descriptions of each of the main venues, as written for the Quadrennial brochures, the English translation of the original Czech descriptions was translated into the following languages: Albanian, Arabic, Australian, Bosnian, Catalan, Chinese, Czech, Dutch, English, Esperanto, Estonian, French, Finnish, German, Greek, Hindi, Icelandic, Indonesian, Italian, Japanese, Korean, Latin, Russian, Slovak, Spanish, Swahili, Swedish, Tamil, Thai, Turkish, Vietnamese, Welsh.

This translation was then read by the computer voices in a 2014 MacBook Pro, and in the case of English, which has a variety of accents based on the location in which it is being spoken, were used. This resulted in seventy-one sound files that could be selected from for playback.

Figure 2: usedlost Max patch, shows the entire Max patch used in the creation of usedlost. It is made up of five sections, the Sound file and synthesis subpatch.

The Sound file and synthesis subpatch allowed the playback of sound files randomly chosen from the 71 possible computer readings and translations. These were then slowed or sped up, without changing pitch, and played through a convolution process that blended the reading with a mix of saw, rectangle and triangle wave forms. These waveforms were amplified to create a mix according to the proximity of the respective node to the centre of the nodal area. Figure 4: amplification of saw, rectangle and triangle waves, shows that the triangle wave will be slightly louder than the rectangle wave which will be slightly louder than the saw wave.

The resulting sound was then split to go to both a stereo reverberation patch and directly to the mixer, seen in Figure 5: Localizing sound subpatch. The translation sound files were also fed to another stereo reverberation patch and directly to the mixer. This generated six sound streams sent to the localization mixer.

Each of the waveforms were pitched, creating a four note chord, of which there were twenty possible variations. The possible variations are seen in Table 1, below. Each waveform can play the chords, which were randomly chosen within a set gamut. In the performance of usedlost for the Quadrennial only the first four chords were used.

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<table>
<thead>
<tr>
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<tbody>
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</tr>
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</table>

Table 1: Twenty possible chords

The six resulting outputs were sent to the Localizing sound subpatch. Figure 5 shows the six possible inputs
across the horizontal axis, and the eight possible speaker outlets along the vertical access. This image shows that the reverberated sound from the left output of the reverberator is being played out of speaker sven, the sound of the harmonized reading is being played out of the fourth speaker and the reverberated harmonized sound is being played from the third speaker.

Each of the four Sound file and synthesis subpatches had similar systems and output, resulting in twenty-four possible sounds that could be heard through eight speakers.

![Figure 2: usedlost Max patch](image1)

![Figure 3: Sound file and synthesis subpatch.](image2)

![Figure 4: amplification of saw, rectangle and triangle waves](image3)

![Figure 5: Localizing sound subpatch](image4)

### 3. PERFORMANCE

usedlost was presented as a fixed work, played back through an eight channel sound system using a TiMax system to spatialize the audio. The speakers were arranged as needed in the performance space, and while it was impossible to have all speakers absolutely equidistant from each other all were time and amplitude aligned to a point in the centre of the listening area.

The listening area was relaxed, with couches, bean bags and chairs, holding between sixty and seventy people. The choices of sounds, chords, speed of sound motion, and amplitudes were made to reflect this relaxed atmosphere. It was decided to make the work as much a part of the event as possible.

Creating a work in response to the variety of temporal, geographical, social, real and virtual locations, of an event, and the presentation of the work in that event,
required significant understanding of the inhabitants of that event and its purpose. By taking the approach of composing specifically for an event and exploring the many inherent resonances of the location, approach to the event, and the inhabitants of it generated an outcome in which the location formed the fundamental resources of the work.

4. FUTURE WORKS

It is intended to use this system and approach with other texts and with other speaker arrangements. These may also be developed for web based dissemination and potentially for interactivity, in which audience members may be able to input their own text, or in real-time recording and playback.

5. REFERENCES

AN ARCHITECTURAL APPROACH TO THE SOUNDWALK METHOD

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Architectural Association
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ABSTRACT
A series of on-site surveys are conducted to observe possible qualitative aural pattern formations by using spatial measurements as fundamental parameters. The method assimilates the Soundwalk technique and the Relative Approach from the fields of soundscape and psychoacoustics, respectively. Soundwalking is an in situ technique typically used in soundscape research that can be designed to satisfy different research aims. It is a method that is highly dependent on the participating listener and the expected results. The Relative Approach is a method that considers the human response. These two site analysis methods are integrated within a customary architectural site-survey proposed to map the sonic morphology of urban spaces.

1. INTRODUCTION
Any research connected to soundscape refers to Schafer’s book ‘Soundscape: Our Sonic Environment and the Tuning of the World,’ to the extent that some argue that it is a cliché (Foale, 2014, p. 17). Regardless, it is important to note his contribution for a number of reasons. Schafer’s thesis establishes the base concepts as a broad scope.Anthologist Tim Ingold’s (2007) criticism of the field of soundscape aligns with Sophie Arkette’s (2004), who criticised Schafer’s original conjecture, noting that, when he declared “The world to resemble an orchestrated composition, he invites us to take assertive action to change its form and content” (2004, p. 161), he did not suggest metrics or methods for implementation beyond an electronic music studio. The non-specificity seems to be an advantage, rather than a limitation of the field. Schafer’s contribution allowed the field to evolve through the increasing interest of specialists from various disciplines including acoustics, anthropology, ecology, communication, design, landscape, literature, media arts, musicology, philosophy, psychology, political science, sociology and technology (Zhang & Kang, 2007).

Until recently, architecture and urban design have addressed the sound environment in sporadic attempts, and only by architects that have musical and/or engineering training like Iannis Xenakis (1997) and Peter Zumthor (2006). Björn Hellström criticises the architectural research by stating that “hitherto, architectural research has largely ignored the sound[ing] environment” (2008, p. 423). Indeed, only recently has there been a reference to Schafer’s conceptualisation of soundscape in the context of spatial design, as an architectural discourse. Like its earlier counterparts, this novelty situates the field of architecture in a position to interpret Schafer’s thesis through the mediation of spatial design. The other reason for referencing Schafer’s contribution is to appreciate the continued research conducted by the World Soundscape Project (WSP) that he founded and was extended by a number of composers. Hildegard Westerkamp is one of such composers that founded the soundwalk method. Soundwalking is “a form of active participation in the soundscape” (Truax, 1999) that is designed and documented (or scored) in several ways. A group of subjects (i.e. persons) is encouraged to walk purposefully in a particular area engaging aurally with their surrounding through discriminate listening. Westerkamp states that there is no direct method of soundwalking. The participant group can be a group of one, two or more, and the participant can follow a map, or create one as a score (Westerkamp, 1974/2001; Truax, 1999). The methods recently changed when the collaboration included architects. To date, there is only one ongoing research that aims to standardise and characterise soundscape semantics for urban design, at the School of Architecture, University of Sheffield.

This paper is part of a research synthesis that aims to survey the spatial configuration of acoustic spaces within urban spaces. The intent is to employ and adjust and customise the soundwalk method as and architectural site-survey to map potential qualitative acoustic spatial boundaries. The soundwalk is designed to provide a map that determines the physical locations of the sound sources, in relation to the receiver, and ascertains which sources are within the acoustic horizon, and which are beyond it. The synthesis also employs the Relative Approach with the aid of Real-time Analysis (RTA) devices. In employing the Relative approach, the RTA spectral patterns are examined to deduce qualitative results. The soundwalk method is customised to document the relative locations where a particular spectral pattern associated with a considered sound sources is detected.

This research uses architectural and spatial measurements as fundamental parameters to observe possible qualitative aural pattern formations in these investigations. This paper proposes a possible method for architects to consider and map sonic events within a space that can be used for design research and practice.
2. SEMANTICS

The term soundscape has many loose interpretations, some of which provide insight into what tools may assist the study. This discourse necessitates explicitly stating which terms pertain to this research and the associated definitions. Given the spatial character of this research and the need for quantifiable spatial factors, this study is aligned with the definition provided by Genuit and Fiebig (2006) that considers the spatial distribution of sounds. Genuit and Fiebig define soundscapes as domains that "consist of a number of spatially distributed sound sources, which give the soundscapes their distinctive features" (2006, p. 953). This concept allows the research to consider and map aural spatial patterns. The framework is informed by the interdisciplinary psychoacoustic and soundscape research, and architectural practice.

This research is attempting to map the acoustics spaces at a microscale (urban square). The focus is on the foreground signals that are immediately located on site. Keynote signals and broadcasting signals that are beyond the perimeter of the considered urban space are reduced to background signals. The terms assimilated from soundscape literature, including soundscape ecology and aural architecture are:

2.1. Receiver | Sensor
A receiver refers to a human listening/perceiving the sonic environment. In the context of field survey, this term denotes to the sound measurement equipment. If specified, it may refer to the person holding the device.

2.2. Sonic Event | Sound Source | Signal
The sounds considered are foreground signals, and will be denoted as sonic events. These terms refer to the events emitting a signal that are located within the urban space.

2.3. Auditory Channel
According to Barry Truax (1999), if the distance between a receiver and a sonic event allows the listener to detect and distinguish the signal, then an auditory channel forms. The level of information determines the strength of that channel. A receiver can be connected to multiple channels. An auditory channel can be disconnected for various reasons, including an increase in distance, other competing channels, the presence of a stronger channel connection, and the diversion of the listener’s attention.

2.4. Acoustic Horizon
According to Truax (1999), and Blesser and Salter (2007), the acoustic horizon is a space centred on the listener. The delineation of this area is mediated by the number and strength of auditory channels connecting the listener and sonic events.

2.5. Acoustic Arena | Acoustic Space | Patch
Truax (1999) presented the term acoustic space. Blesser and Salter (2007) adapted the idiom for aural architecture as an acoustic arena. A similar concept is known in the field of soundscape ecology, referred to as a patch (Farina, 2014). These three terms refer to the area of space where a sonic event can be heard, and it is centred on that event. Acoustic arenas have different forms and are delineated by the human response to frequency content.

2.6. Edge
A number of auditory channels are connected to the receiver in the presence of multiple adjacent sonic events, and the associated acoustic arenas ‘overlap.’ In that intersecting domain, two conditions may occur: 1) the strongest auditory channel severs the other weaker connections, or 2) all connections are of equal strength negating each other. In the former case, the receiver is considered in the arena associated with the strongest auditory channel and the emitting signal is considered dominant. In the latter case, the receiver is not connected to an auditory channel and may be counted in the edge domain. Edge is a term assimilated from the patch-edge epistemological concept that is adopted in both fields of soundscape ecology and urban design (Farina, 2014).

2.7. Soundscape pattern
As an extension of Genuit and Fiebig’s (2006) definition of soundscape, soundscape patterns may be regarded as the spatial morphologies mediated by the acoustic arenas (or patches) centred on the spatially distributed sound source, and the edges forming between them. Since the event spatial distribution distinguishes the features of the soundscape, each soundscape would have a characteristic morphological pattern.

3. IN SITU AN ARCHITECTURAL APPROACH

A series of soundwalk investigations are designed as in-field pattern mapping surveys that are set up for an urban space case study. The soundwalk ‘score’ (or documentation) is designed as a spatial site survey that documents the properties of the space, such as dimensions (in metres), materiality, and the properties of the mapped aspects. In this case, the mapped elements are the sonic events occurring within the urban space and their associated properties (frequency content and relative sound level), and the human response (auditory threshold and detection).

In an attempt to assimilate in-situ soundwalking, RTA and the relative approach method, the goal is to ascertain and document three spatial aspects: 1) the sonic events within a receivers’ acoustic horizon at a particular location; 2) the dominant signal, i.e. has the highest relative level; 3) the associated relative source-receiver distance (in metres).

According to the concept of acoustic spaces, if a signal dominates, then the receiver is located in the associated domain. The primary concern of this field survey is the acoustic horizon and strength of the acoustic channels. The strength of the acoustic connection is determined by the source-receiver distance and the auditory threshold, and the strongest connection determines the dominant sonic event. For example, Figure 1 shows three distinct sonic events $S_1$, $S_2$, and $S_3$. If the RTA device located at point $R$ records the spectral patterns of all three signals...
(regardless of the relative levels), then they have an acoustic connection to receiver \( R \). The acoustic horizon centred on \( R \) includes all three events. If the spectral pattern records \( S_1 \) as having the highest sound level, in relation to \( S_2 \) and \( S_3 \), then \( S_1-R \) is the strongest connection and \( S_1 \) is the dominant sonic event.

Figure 1. Schematic diagram of possible acoustic horizon patterns connecting a single receiver and multiple sonic events.

For multiple sources, \( S_1 \) and \( S_2 \), and receivers, \( R_1 \), \( R_2 \) and \( R_3 \), as shown in Figure 2, the strongest channel determines the dominant sound for each receiver. If the RTA spectrogram indicates that channels \( R_1-S_1 \) and \( R_1-S_2 \) are of equal strength, then \( R_1 \) is not dominated by a sonic event, and \( R_1 \) is within an edge domain. If the spectral patterns recorded at \( R_3 \) show that \( R_3-S_1 \) and \( R_3-S_2 \) are equally weak acoustic connections, \( R_3 \) is located in an edge area. By nature, such patch and edge conditions are not permanent in the field. The RTA spectrogram gives an indication of the change in acoustic channel strengths and the manner in which the aural spatial patterns are changing on site. This qualitative analysis is conducted by considering the spectral patterns, similar to the relative approach to map aural spatial patterns in the field.

3.1. Spectral Patterns and the ‘Relative Approach.’

According to the way the human auditory short-term memory functions, if signals are similar in terms of their temporal structures and spectral patterns, but only differ in the absolute level, the human ear is almost completely unable to detect the slight differences (Kuwano, et al., 2002). On the basis of these considerations, Genuit (1996) developed a procedure that considers temporal structures and spectral patterns for determining ‘acoustic quality,’’ namely the ‘Relative Approach.’ The relative approach recognises the standard soundscape studies approach spectral analysis, and it is a method that represents an analysis of the relative intensities at a resolution of different frequencies with a particular time lag (Joo, et al., 2011).

Figure 2. Schematic diagram of possible acoustic horizon patterns connecting multiple receivers and multiple sonic events.

This objective is achieved by observing continuous spectral formations of a reference signal as an average in the time and frequency domain (Genuit, 1996). Modulation spectral analysis is adept at identifying temporal structures or tonal components in a sound (Genuit & Fiebig, 2005). In using the relative approach, Genuit (1996; 2001) found that it is possible to measure objectively apparent pattern differences between two spectrographic displays, taken by different equipment. It is possible to deduce reasons for a negatively evaluated acoustic quality, by comparing the relevant temporal structures and patterns (Genuit, 1996; 2001). In a binaural investigation, Genuit and Fiebig (2006) provide a modulation spectra depicting the relative approach that shows that the ‘disturbing’ patterns remain unchanged with distance, although the \( L_{Aeq} \) decreases with distance (Genuit & Fiebig, 2006).

The benefit of using the relative approach can be found in two principal outcomes: 1) equipment accuracy is not a concern, and 2) the spectral patterns can identify the dominant sound detected, in relation to other sources. Although the reviews for the employed RTA application indicate its relative accuracy (see next section), compared to high-end equipment, these investigations are only concerned with the recorded spectral patterns. If Genuit
and Fiebig’s (2005) assertion that spectral analysis can identify temporal structures and tonal components, with any equipment at any distance holds true, then by using the relative approach it is possible to measure objectively clear pattern differences and make deductions accordingly. Here, the deduction is relatively straightforward. If a particular spectral pattern has the highest relative level, for a given time (surveying duration), then the associated signal is perceived at the receivers’ (i.e., RTA equipment and volunteer) location as the dominant sonic event.

3.2. Real-time Analysis (RTA) Equipment

There is a debate among sound specialists concerning sound level and Real-Time Analysis (RTA) equipment (for ongoing discussions see (AudioTool Discussion Group, 2011)). Specialists consider that it is necessary to invest a large sum in developing equipment to ensure they produce accurate readings. Recently this impression is changing with the increase of technological equipment at lower prices. The quality of audio measurements depends on the quality of the microphone used. For example, the microphone employed in these field surveys is the calibrated Dayton Audio iMM-6 (Figure 3), plugged into the headset jack on Android devices (Table 1). The iMM-6 is a Class 2 microphone that is considerably cheaper than the high-end Class 1, and the resulting measurements compare well (for reviews see (Parts Express, 1996)).

This type of microphone can be used with a cheap Android application (app) Audio Tool, created by Julian Bunn, who previously consulted for Ivie Technologies. Brent Butterworth wrote a review of the Audio Tool app, for the Sound and Vision Consumer periodical, stating that “the sound pressure level meter feature [of this app] gives you the same functionality as the famous RadioShack SPL meter […] the core function you’ll use most is the audio spectrum analyser […] I haven’t seen a free spectrum analyzer app that delivers such high resolution” (2011, p. 1). Audio Tool uses A- and C-weighting networks. The application can be calibrated against a standard sound pressure level (SPL) metre, to account for differences of Android device microphones (Bofinit Corporation, 2014) that can be compensated for by with the use of the calibrated Dayton Audio iMM-6. Google play user reviews note “Kevin Worrell: […] Once calibration is performed with the phone and mic, the results are fairly accurate. Compared to stand-alone commercial measurement tools which all cost thousands of dollars” (for more reviews see (Google Play, 2015)). It is worth mentioning that the principal aim of these field investigations is to create qualitative maps of the aural spaces on site. Although using relatively good quality RTA equipment is beneficial, and the calibration would offset recording errors, only the relative sound levels, and the spectral patterns are of consideration here, specifically when employing the relative approach.

4. CASE STUDY | COVENT GARDEN MARKET, LONDON, UK

Historically, the configuration of the Covent Garden Market marks it as a cultural place where entertainers and musicians perform. The agora-like image of a bustling fruit and vegetable market, with merchants trying to out-shout their competitors, is not very different from the sonic character of the space today. Covent Garden Market was developed during a time when entertainment and commercial advertisement was based on using unamplified sounds. Currently, performances in the courtyard and the structure use high-fidelity speakers.

The arcade configuration of the space permits activities to proceed within 15,500 m² of space without interfering with each other; however, event amplification reduces the number of the events that can be held simultaneously within the confined space. Currently, the Covent Garden Grand Court functions as a central shopping and touristic focal district in London. Vehicular access is minimal, and the single accessible street is located at the south corner. The configuration of the space marks it as a cultural place where entertainers and musicians perform. At any given time, at least three events are occurring concurrently.

5. PROCEDURE

Multiple site visits to Covent Garden Market have been conducted. This section selects two experiments in which more than one volunteer was available to take simultaneous measurements. Two foreground sources are

![Figure 3. Real-Time Analysis (RTA) equipment | Three Android devices used with microphones, simultaneously running the Android Tool application.](image)

<table>
<thead>
<tr>
<th>Android Device</th>
<th>Dimensions (mm)</th>
<th>Display Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>OnePlus One</td>
<td>152.9 x 75.9</td>
<td>8.9 1080 x 1920pix 401 ppi</td>
</tr>
<tr>
<td>HTC One M7</td>
<td>137.4 x 68.2</td>
<td>9.3 1080 x 1920 pix 468 ppi</td>
</tr>
<tr>
<td>HTC One V</td>
<td>120 x 60</td>
<td>9.1 480 x 800 pix ~252 ppi</td>
</tr>
</tbody>
</table>

Table 1. Display specifications of the three Android devices.
considered here. A regular folk music performer (Figure 5) located at the North-East corner is surveyed at three simultaneous locations, and a Tibetan music performer (Figure 6) situated along the North-West façade is surveyed at four consecutive locations.

5.1. Soundwalk Score/Map

A printed spatial plan is obtained from a three-dimensional (3D) scanned model (ScanTech-International ltd., 2002) of the urban space (Figure 4) for in-field notations. The model is generated from a 3D point cloud. A preliminary plan section is cut and used for documentation for each site visit that includes:

1. Relative Dimensional Mapping (metres) of:
   a. The locations of sonic events
   b. The locations of RTA equipment (receivers)

2. Photographic documentation of:
   a. The spatial material properties
   b. The sonic events documented in images

3. Spectrograms recorded at each receiver location

4. Audio and video recordings of the sonic events

The in-field notations and the volunteer’s observations are then translated using computer aided design CAD model as interpolated splines. There are two splines to denote the furthest distance that: 1) where the volunteers can detect (hear) the selected sonic events and 2) where the devices detect the associated spectral patterns.

5.2. Sonic Event 01 \Sonic performer

Figure 7 shows the CAD map resulting from surveying the Folk performer. In this case, an RTA device is located close to the performer for pattern reference, denoted \( R_0 \). Location \( R_A \) is the farthest distance where the person holding the device can hear the performance. Point \( R_B \) is selected at the point beyond where the instrument holder can aurally detect the music. However, the spectrogram still shows the observed sonic event as the dominant pattern.

5.3. Sonic event 02 \Sonic Tibetan music performer

In the second case, an RTA device is also located close to the performer for pattern reference, denoted \( R_0 \) in Figure 8. Location \( R_A \) is the farthest distance where spectral patterns show high SPL levels. Point \( R_B \) is selected at the point beyond the device holder can aurally or visually detect the performance. At \( R_c \), the device holder cannot hear the considered source, rather can hear another simultaneous event \( S_1 \) that is an amplified male speech performance (Image not available). Surveys gathered at \( R_A, R_B \) and \( R_C \) occurred consecutively while the RTA device at \( R_0 \) remained stationary as a point of spectral pattern reference.

6. OBSERVATION AND DISCUSSION

Although the field of soundscape design was originally intended as a paradigm-shift for urban design, both fields continue to develop separately, and the sound phenomena have remained a secondary spatial design aspect. The process of considering the aural spatial signature of urban open spaces has not yet been made readily accessible in modes that align with architectural and urban design procedures. This is because spatial designer training lacks adequate design concepts, metrics, and methods to integrate acoustic sensory aspects into the different aspects of urban design, including site survey.

The adopted methods of Soundwalk, the Relative Approach, and RTA have been in use in their respective domains. The novelty of this proposed process is in the incorporation of these techniques as an architectural field survey to qualitatively map acoustic spaces on-site. This provides a method for architects conduct pre-design information gathering or design research in modalities that align with design processes. For example, this method is developed as a validation process for an architectural
design research developing a computation tool that aims to map aural patterns within urban spaces.

There are a number of observations that are with pointing out. It is interesting to note that although the points where the device holder could not hear the foreground signals, the RTA spectral patterns clearly show similar patterns to the control points. This is worth noting because in considering attention masking the primary attention of the surveying individual is the considered sonic event. Normally the urban space users’ attention may be linked to the architectural programmatic use of the square (i.e. the activity the space is designed for). Also, the difference in the delineated acoustic spaces centred on the Tibetan music performer seems smaller. This may be due to the difference in ambient level at both locations that may be a result of the presence of more outdoor seating areas towards the North-East corner. The main Covent Garden underground tube station was closed during these particular visits that may attribute to the lower ambient sound levels in the North-West corner of the square.

The temporal nature of sonic events active within an urban space and the environmental aspects put a limitation on this process. Although this method is adequate for a number of architectural applications, there is a number of considerations that can be aggregated to the soundwalk design. Further development of this approach can include social activities changing in time (hour, day and season), as well as, reverberation time, and early and late reflections, which, according to literature, are contributors to the envelopment aspect of acoustic spaces. The on-site surveys can also consider these temporal environmental changes parameters such as windshield, atmospheric pressure, and environmental temperature.

According to Westerkamp’s original definition of the soundwalk method, these considerations can be included according to the ultimate aim of the on-site data gathering.

7. REFERENCES


Figure 7. RTA survey for a Folk performer: As a foreground source $S_0$, RTA instruments are located at three points. $R_0$ is the control point, $R_A$ is the farthest distance west where the holder can hear the performance, and $R_B$ is beyond the farthest distance south where the device holder can hear the performance. Estimated pattern (white dotted rectangle on spectral patterns) shows 5-octave bandwidth and mean frequency (white dashed) show on spectral analysis. Time stamped screen shots of the simultaneously recorded spectral patterns. The acoustic horizon (dashed black lines) and the acoustic horizon (blue dotted lines) are estimated demarcations based on the spectral patterns (thick dots) and the human perception (thin dots).
Figure 8. RTA survey for a Tibetan music performer: As a foreground source $S_0$. Further simultaneous events are denoted as $S_1$, amplified male speech and $S_2$ Folk performer. RTA instruments are located at four points, where $R_0$ is the control point, $R_A$ is the farthest distance east where spectral patterns show high levels, $R_B$ is beyond the farthest distance south where the device holder can hear or see the performance and $R_C$ is beyond the farthest distance west where the device holder can see the performer but can hear $S_1$ more clearly. Time stamped screen shots of spectral patterns show that recordings at $R_A$, $R_B$ and $R_C$ occurred consecutively while spectral analysis at $R_0$ remained stationary. The acoustic horizon (dashed black lines) and the acoustic horizon (cyan dotted lines) are estimated demarcations based on the spectral patterns (thick dots) and the human perception (thin dots).
CREATIVE RESPONSES TO SOUNDSCAPE ECOLOGY:

INNOVATIVE FRAMEWORKS AND CASE STUDY

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ABSTRACT

Soundscape ecology is becoming a pioneering discipline in contemporary ecological research, investigating the relationships between landscape and soundscape (or topographic and acoustic patterns). In recent years, the discipline has enjoyed increasing international attention as a prominent field of research in contemporary ecology, with a proliferation of associated publications and conferences.

The breadth and scope of this field offers many possibilities for innovative creative applications. Whilst there is already a strong body of artistic work with the humanities-oriented acoustic ecology movement and other ecoacoustic compositional approaches, the comprehensive frameworks and methodologies of soundscape ecology have thus far not been specifically explored in a creative context. This paper explores a creative process-in-development that adapts these principles of soundscape ecology, and presents a compositional case study in response to Mobilong Swamp (near Murray Bridge, South Australia), and its related soundscape and ecosystem.

1. INTRODUCTION

Soundscape ecology is becoming a pioneering discipline in contemporary ecological research, in recent years enjoying increasing international attention through significant interdisciplinary publications and collaborations, and the formation of related societies.

The breadth and scope of this field offers many possibilities for innovative creative applications. Through the rise of environmental activism and technological development in recent decades, there is already a strong body of artistic work with the humanities-oriented acoustic ecology movement (notably, through the soundscape composition work of Truax, Westerkamp and others) and multiple other ecoacoustic compositional approaches. Even so, the relative novelty of soundscape ecology has meant that comprehensive principles, frameworks and methodologies of soundscape ecology have thus far not been specifically explored in a creative context - a gap that this paper endeavours to address.

First, an outline of the foundational principles of soundscape ecology is considered, establishing its interdisciplinary background, analytical concerns and methodologies. A creative framework-in-development adapting the discipline is subsequently explored, with attention given to each stage of the process. A case study in response to Mobilong Swamp, near Murray Bridge, South Australia is subsequently presented, with discussion around its environmental history and current ecological status, and application of the creative process to the site.

1.1. Background

Soundscape ecology is the study of the relationship between landscape and soundscape, or topographic and acoustic patterns. It “[describes] complex phenomena at community, ecosystem and landscape scales within natural and human dominated systems” (Farina 2014).

First proposed in a 2011 Bioscience article (Pijanowski et al.), and followed soon after with a special issue of Landscape Ecology (Pijanowski and Farina 2011), soundscape ecology garnered attention as an innovative and promising field in contemporary ecology. In recent years, a seminal textbook (Farina 2014) and establishment of the related International Society of Ecoacoustics has done much to further broader interest and research.

Drawing on research in the areas of spatial (or landscape) ecology, psychoacoustics, bioacoustics, and acoustic ecology, the discipline takes an interdisciplinary approach, representing perspectives from ecology, psychology, ethology and the humanities respectively. It should be noted that there is inclusion of a cognitive element here, as “the description of soundscape patterns is an indispensable, but not sufficient, way of studying (ecologically) this matter; a biosemiotic approach is also required to understand and interpret the uses and functions of sounds” (Farina and Pieretti 2012, 22). As such, the consideration of both active contributors and passive observer in soundscape participation and interpretation is integral.

1.2. Analysis

Through drawing on the multitude of knowledges from each of the above disciplines, soundscape ecology is able to form a coherent and comprehensive understanding of a soundscape, its component parts, and underlying ecological processes and relationships.

There are three categories by which sounds may be basically described (Krause 2002):
biophony - is the collection of sounds produced by all organisms at a location over a specified time
geophony - are the sounds originating from the geophysical environment, which includes wind, water, thunder, movement of earth, etc.
anthropophony (also anthrophony/technophony) - human produced sounds, created by stationary and moving human-made objects

Additionally, there are a number of parameters that are considered in the analysis of soundscapes, including:

1.2.1. Frequency Patterns
As organisms vocalise in broad sonic spectra, their individual and collective communication systems have several suspected ecological causes. Inspecting the behaviour of biophonies, soundscape ecology draws on various bioacoustics hypotheses, seeking to better understand and explain how interspecific vocalisations have arisen with respect to evolutionary processes, and related performance and communication strategies in soundscapes.

These include the Morphological Adaptation Hypothesis (correlation between evolution of physiological traits and vocalisation characteristics), Acoustic Adaptation Hypothesis (correlation of vocalisation with communication strategies appropriate to physical environment attributes), Acoustic Niche Hypothesis (explanation of biophonic organisation into frequency and/or temporal niches for communicational efficacy) and the Species Recognition Hypothesis (explanation of different vocalisations between sympatric species to prevent hybridisation).

1.2.2. Temporal Patterns
Many recognised temporal cycles are exhibited in soundscape activity, often reflecting the timing of organisms’ life histories. At the relative microlevel, dawn and duck choruses of birds, amphibians, insects and other organisms correlate with diurnal and nocturnal cycles, often motivated by feeding or mating activity. Mesoscale seasonal cycles impact many organisms’ activities each year, including breeding, migration and hibernation. Most broadly at the macrolevel, climate patterns and geological activity impacts and alter ecosystem composition and the resultant soundscape.

1.2.3. Spatial dimensions and gradients
In seeking to establish identifiable spatial dimensions in soundscape analysis, the concepts of ecotopes (landscape patches with coincidental geotopes and biotopes) and ecotones (the boundaries between ecotopes) from landscape ecology can be adapted to sonotopes, soundtopes and sonotones:

sonotope - a distinct sonic unit or sonic patch produced by the overlap of geophonies, biophonies and anthropophonies, resulting from each sound’s different spatial and temporal extension.
soundtope - a subdivision of a sonotope specifically related to biophony, that inspects the active and passive exchange of information among collaborative members of a community.

sonotone - the boundary between adjacent sonotopes.

Related to a soundscape’s spatial dimensions are gradients, which are the gradual changes in abiotic factors in an ecosystem. Through their dynamism, they impact multiple elements of an ecosystem and its soundscape, and include:

altitude - elevation, air pressure, wind, precipitation
flow - rain and stream flows
habitat interior-edge - species distribution, changed weather dynamics (wind speed, turbulence, vorticity)
latitude - annual climate patterns (temperature, solar radiation), climate change
human disturbance - land use and transformation

1.2.4. Interactions
This area of analysis looks at the interactions between biophony, geophony and anthrophony, and the way each responds to the other through agency (by adapting call amplitude, frequency, or timing in animals, or modifying activities in humans) or abiotic process. Each of these areas of analysis produce specific information that collectively provides a comprehensive understanding of a soundscape’s component parts and ecological processes and relationships.

1.3. Methodologies
Soundscape ecology is founded on the methodologies of landscape ecology, which in turn directly employ or appropriate field techniques and methods from ecology and naturalist studies, in addition to those of its other associated disciplines. As Farina writes, the discipline uses a “broad range of field and laboratory approaches from bioacoustics to psychoacoustics and truly heterogenous methods to collect, process, and interpret sonic data’ (2014, 221).

As such, multiple tools are employed to develop a comprehensive understanding of a landscape and its acoustic environment. Spatial analysis tools (including geographic information systems (GIS), remote sensing technology and spatial metric software) have allowed landscape ecology to flourish as a discipline, and are accordingly used in soundscape ecology research. Additionally, particular to the study of sound, there are a number of tools that soundscape ecology employs:

1.3.1. Digital sound recording
The efficiency and fidelity of contemporary recording equipment permits high quality sound recordings of a soundscape, resulting in rich data for analysis and interpretation. Microphone type, quantity, direction and placement, and recording system, are selected appropriate to the soundscape type and conditions, and research objectives. Automated recording technologies also permit the recording of soundscapes at specified times and durations, allowing for strategic capture of acoustic data. There are a number of challenges that remain, including storage of large data quantities, equipment maintenance on recording networks, and until recently, equipment cost, which is now
increasingly diminishing (Krause 2002; Monacchi 2011).

1.3.2. Analytical tools, measurement, and metrics

Sound can be measured in a number of ways, and in soundscape ecology, the main goal is “to process data to extract the emerging patterns in terms of complexity/information of the sonic environment” (Farina 2014, 239). The spectrogram is most commonly used in this regard (mapping frequency, time and amplitude), and other emerging tools related to other parameters (i.e. geographic and topological mapping, sound source identification) are increasingly used.

Additionally, metrics have been developed for evaluation and comparison of different recordings and soundscapes, such as noise and exposure levels, and entropy, richness, dissimilarity, complexity and evenness indices (ibid., 239-47).

1.3.3. Software and databases

The development in audio technology over the past few decades has seen many advances and improvements in the levels of information captured and analysed in sound. Complementing the rise of digital sound recording was the release of increasingly sophisticated software and database packages, which permitted precise analysis, manipulation and rendering of sound samples, correlation of these with spatial interfaces and databases, and calculation of metrics. In soundscape ecology, this has furthered researchers’ capacity for ecological enquiry and interpretation. Notable examples include Wave surfer (Sjölander andBeskow 2006), SEEWAVE (Sueur, Aubin, and Simonis 2008), SPEAR (Klingbeil 2009), Raven (Cornell University, 2014), and Pumilio (Villanueva-Rivera and Pijanowski 2012).

2. CREATIVE FRAMEWORK

With the establishment and development of this field comes many opportunities for creative application. Whilst there is already a strong tradition of artistic work with the acoustic ecology movement, and more recently and relevantly, David Monacchi’s utilisation of the acoustic niche hypothesis (Krause 1993; Monacchi 2013), the comprehensive principles, frameworks and methodologies of soundscape ecology have thus far not been specifically explored in a creative context.

To address this gap, these principles have been adapted into a creative compositional process, with the intention of engaging meaningfully with specific places and their ecosystems and soundscapes, so as to produce representative and reflective creative responses.

The stages of this creative process are conception, collation, preparation, composition, realisation and reflection.

2.1. Conception

After first selecting the site to engage with, one may begin developing the conceptual foundations of the creative work.

2.1.1. Research

In order to make informed and effective plans throughout the compositional process, it is necessary to research multiple perspectives of the place, by reviewing multiple sources of information (i.e. documentation, maps, field recordings, artefacts, oral transmission, etc). Related to soundscape ecology, this understandably refers to ecological and environmental information; additionally, historical, sociocultural and other sources of information should also be considered, to add context to the site’s contemporary environmental situation and associated ecosystems, soundscapes and identity.

2.1.2. Sketching

Following the research, preliminary sketching may take place, which brings together the multiple perspectives of place investigated to provide creative context in the planning stage. This should consider the parameters of the work, including the duration, media (whether acoustic, electroacoustic, or a combination) and performance space, amongst.

At this early stage, engagement with place and investigation of resources should be permitted influence over the final outcome of the work, as per Westerkamp’s reflections on the dynamic work cycle of soundscape composition (2002, 54). As such, such sketches need not provide definitive compositional structures, but instead act as preliminary guides as to how the space might be engaged, and with which perspectives it might be examined.

2.1.3. Planning

The research and sketching will inform the plans for the engagement with place and ensuing creative work.

As the soundscape ecologist operates with similar field work approaches as a regular ecologist, considerations regards equipment and logistics will need to be made (appropriate recording, monitoring and documenting equipment; field trip resources including clothing, food, accommodation and amenities) respective to the location’s conditions and emerging creative concepts.

Additionally, planning should also be made regarding the eventual presentation of the creative work, involving liaising with relevant ensembles and organisations to successfully present the work.

2.2. Collation

The preparations made during the conception stage can now be applied during the collation stage. Practically, this may also be understood as the engagement with place, where one travels to the location being researched and conducts field work, collecting resources (materials, information and ideas) for the composition. Activities may include:

2.2.1. Sound walks

A predominant activity of acoustic ecology, sound walking on location allows the composer to become familiar with the physical and sonic qualities of the place and soundscape, informed and contextualised by
the information gathered during research in the conception stage (Schafer 1993; Allen 2013).

2.2.2. Observation and documentation

Surveying the place draws on the methodologies of both soundscape ecology and acoustic ecology. The former combines traditional approaches as employed by naturalists and ecologists (documenting geographic, biological and other environmental factors) as well as the contemporary considerations of soundscape ecology (observation of bio-, geo- and anthrophony; examination of bioacoustics hypotheses and effects of gradients, use of available technologies) (Krause 2002; Farina 2014; Krause 2015). The latter, by contrast, encourages more subjective and aesthetic observations (as per the concerns of acoustic ecology (Schafer 1993)).

2.2.3. Field recordings

Capturing an acoustic environment through recording is integral to soundscape ecology activity, and remains the most effective and efficient way of documenting the sonic realities of a place. Many decisions factor into the recording process (type of equipment, microphone position, time of day, duration of take, encoding), which are considered with respect to the intending compositional outcomes, particularly spatialisation (Monacchi 2011).

2.2.4. Consultation/Literature Research

Liaising with people associated with the place of research (living, working, etc.) and reviewing documented materials often reveals more specific and intimate knowledge and perspectives (Schafer 1993).

2.3. Preparation

Following the collation stage, the materials are analysed and transformed in preparation for the composition stage.

2.3.1. Analysis

Initially, analysis of the materials is necessary, so as to not only extract information about the content and context of each resource, but also inform the transformative techniques that will adapt them to a musical context. This might be quantitative analysis, assisted by technology, to measure materials and calculate metrics; or qualitative analysis, involving subjective evaluation of the materials.

Additionally, there is a need in the creative process to relate soundscape ecology analysis to musical concerns, in the interest of preserving content identity (mimetic relationship between materials and source) and context (ecological relationships and processes) (Monacchi 2011; O’Callaghan 2012).

Considering the frameworks of soundscape ecology, it is noted that the discipline analyses a variety of different parameters’ patterns, including frequency, temporal, amplitudinal, spatial, and interactional patterns. Music similarly is comprised of multiple elements, defined by Burton as sound, structure and artistic intent (2015, 25). Sound may be qualified into further sub-elements:

**pitch** - ‘represents how the mind perceives the cycles, repetitive nature of sonic vibrations’, i.e. the perception and cognitive organisation of sonic frequencies.

**duration** - ‘represents the onset and offset signals created by nerve responses to sounds’, or rather, the perception of temporal phenomena of sound, including pulse, rhythm, and tempo.

**loudness** - ‘represents the totalled number of auditory nerve stimulations over short cyclic time periods’. Perceptively, this relates to amplitudinal phenomena including dynamics and articulation.

**timbre** - ‘represents the product of information gained from frequency transients, noisiness, unsteadiness, perceived pitch and the spread and intensity of overtones in a sound, all of which is used to identify the sound.’

Moving beyond single sound sources and considering the total sonic environment, further sub-elements include:

**texture** - ‘relates to the number of sound sources and the interaction between them.’

**spatial location** - ‘represents the cognitive placement of a sounds in an environmental context; including the placement of a sound on both the horizontal and vertical place, the distance to the sound source and the characteristics of the sonic environment.’

Complementing sound are two additional musical elements:

**structure** - an inherent part of the compositional act is synthesising sonic elements into meaningful structures, as, ‘if music is to communicate information of any form, sounds need to be structure in an understandable way.’ (ibid., 26)

**artistic intent** - as music is an art form, it is reasonable artistic intent as an integral element. This can refer to either a composer’s intent in assembling sounds as music, or a listener’s intent of listening to sounds as music.1

The use of this particular system of musical element identification is apt for this creative process, in that soundscape ecology analysis is described through the acoustic properties of sound, as well as cognitive elements related to soundscape recognition and interpretation, which can be related to structure and artistic intent.

Comparing these musical elements then with the parameters of soundscape ecology, a number of relationships might be established:

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1 As Burton argues, “the art of the music composer is to affect the listener by structuring or organisation sound. The art of the (music) listener is to organise sound into meaningful patterns; whether the patterns are intentional, as when listening to a symphony, or environmental, as when listening to the gentle, rhythmic tinkle of wind chimes or John Cage’s 4’33”.” (ibid.)
2.4. Composition

Once the materials have been developed, the composition of the work may take place.

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The end result of the composition should be a cohesive work that creatively represents the place, whilst also reflecting upon and responding to the identity of the place.

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The final step of the process is reflection, where evaluation of the process and outcome of the work can determine strengths and weaknesses of the approach and the reception of the final product by an audience. These insights can then inform the way one might approach future compositions.

3. CASE STUDY: MOBILONG SWAMP

3.1. Background

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European settlement saw reclaiming of the floodplains for irrigation, and intent for the Murray to remain a constant water source (for agriculture and navigation) saw the introduction of locks, barrages and levee banks along the river channel. This understandably interrupted the natural cycle, with the groundwater discharge diverted to the irrigation areas themselves. Drainage channels and irrigation cycles artificially replicated the natural process, but multiple droughts in between 2000-2010 saw significant drops in the river level and water table, in turn impacting irrigation activities via reduced water allocations. This in turn allowed the saline groundwater to rise and acidify the heavy clay soil profile, compromising agricultural and farming activities in the area.

The acquisition of much of Mobilong by SA Water has seen the trial of various remedial activities, including revegetation with native eucalypts and plans for diversion of the now acidic discharge water through a nearby local wetlands for natural filtration on route to the river (Sims 2013).

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2.3.2. Transformation

There are many techniques that one may employ to develop and transform environmental materials. At a basic level, for acoustic media, these may include transcription of sonic materials or gestures, and sonification/mapping of data; likewise, for electroacoustic media, typical manipulation and editing of the sound samples with various softwares and hardwares occurs, as well as sonification and eco-structural treatments of data. Additionally, novel transformational processes made be developed through adaptation of various environmental dynamics related to the specific place.

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3.2. Engagement

As Mobilong Swamp is little more than a kilometre away from my home in Murray Bridge, I have been able to engage with it over an extended period of time. Whilst some of the initial inspiration for writing a work in response to the site came a couple years ago, it was only in the latter half of 2015 that more thorough engagement occurred. This involved a variety of approaches that include community consultation, review of published literature, and on-site observation.

Through contacting with the Rural City of Murray Bridge’s environmental officer, I was referred on to a local contractor (previously a dairy farmer at Mobilong) who put me in contact with project managers from SA Water and DEWNR, and researchers from the Waite Institute and Acid Sulphate Soil Centre, University of Adelaide. Through this, I was able to develop an understanding of the ecological evolution of the space, especially in the past decade. Additionally, I spoke with previous landowners (fifth generation farmers), who were able to provide historical perspectives of both European and Indigenous uses of the land.

This contact with the various groups aforementioned provided access to published literature on Mobilong Swamp. These were primarily in the form of departmental reports and independent research on the place’s environmental circumstances, but also survey maps care of the local council. Additionally, a list of local birds was sourced from a nearby birdhide, significantly reducing time in identifying species.

The proximity of Mobilong Swamp to my home allowed for ongoing visitation and monitoring of the site quite freely. This consisted of both visits as an individual, which involved observation, documentation and recording of the place, as well as with contractors, environmental scientists and researchers (in their own field work), which allowed for explanation of ecological and environmental circumstances in place.

From this, I was able to develop an understanding of the area’s ecosystem and soundscape. Some main points of consideration that emerged include soil conditions, identification and analysis of flora, fauna and habitat, and related sonic spatial distribution.

The salinisation of large soil patches resulting from irrigational land use and recent droughts has directly impacted on the species of flora able to survive in the area. The most impacted areas are now largely populated by samphire and saltbush, by comparison to more alluvial soils which support various grasses and reeds (particularly Phragmites australis). As part of ongoing land management, numerous trial plantations of eucalypts (river box (e. largiflorens) and river red gum (e. camaldulensis) and other natives have been introduced to maintain soil conditions in less impacted areas.

Figure 1: Overview of Pump Road, Mobilong Swamp and adjacent land qualities (Image: Google Maps)

The distribution of flora, combined with boundaries including fences, channels and transport infrastructure, creates distinct habitats with associated fauna. These appear to be in three general types: open field, occupied by small song birds, birds of prey and crickets; plantation, which is populated with a greater variety of small to medium perching and song birds; and river front, which has a notable presence of water birds and frog species.

Each of these overlapping geophonies and biophonies in turn creates distinct sonotopes, through which an observer can pass experience subtle but dynamic changes in the soundscape.

3.3. Creative Response

Essentially derived from the sound walk experience of Pump Road, an 880 metre stretch of unsealed road which bisects the swampland, the overall form of the piece is a idealised procession of the observer (audience) along the road towards the river, in line with the setting sun’s shadow cast by an abutting cliff face (at the foot of Pump Road, to the west). Either side of the audience are speakers in front, beside, and behind; between each of these are four miniature string ensembles, creating distinct sonic fields comparable to the fields where much of the soundscape activity occurs either side of the road (Fig. 2). The sonic materials progress from the front of the performance space to the rear (alternating between electronic and acoustic media), evolving over time as new sonotopes within the soundscape are passed through.
Figure 2: Performance spatialisation layout, consisting of both electronic and acoustic elements.

There are a number of ecological processes that have been integrated into the responding creative work, including relationship between cricket choruses and temperature, dusk chorus activity, and the impact of habitat alteration on the soundscape.

It has been long known in folklore and scientifically verified that temperature effects the chirp rate of crickets (Walker 1962). At Mobilong, the aforementioned cliff casts a shadow at dusk gradually proceeding towards the river front, creating variation between illuminated and dimmed areas in addition to the cooling of air temperature. As many where many field crickets call at dusk, the resulting choral drone gradually descends, providing a subtle shifting pitch centre.

Additionally, many soundscapes’ biophonies are recognised as being most active at dawn and dusk. In addition to crickets, the many species of birds and frogs at Mobilong collectively vocalise as the day draws close to twilight.

This is coupled with the progression through the space’s sonotopes. Through change in habitats resulting from Mobilong’s restorative management in recent years, the sound walk experience along Pump Road proceeds first through open fields, before passing the plantation and dense reed beds to finally arrive at the rich biodiversity of the river front. Creatively, this experience provides a natural crescendo that is utilised in the form of the responding work, building from a sparse beginning to a climactic finale.

The compositional process began with work the electronic component. Essentially a reconstruction of the soundscape in Ableton Live 9, this utilises recordings made on site in each of the identified sonotopes, with transitions between material determined by temporal calculations relating observer pace to sonotope exposure. Each of the six tracks (front, mid and rear left and right) was further broken down into strata of fore-, mid- and background, allowing for layering of materials based on proximity to the listener.

This was followed by the assemblage of the score for each miniature string ensemble, made up of violins, violas, and cellos. Devised as a modular score where each performer plays the transcribed materials at their own discretion (resonating with the agency of active soundscape participants), the content is comprised of transcriptions of bird song, cricket stridulations and geophonic activity (wind blowing through reeds and trees). Each ensemble’s content is, like the electronic counterpart, temporally correlated with sonotope exposure, using time cues to remain in sync. Transcription of the various organisms’ calls was done through spectral analysis using the program SPEAR, which permitted a great comprehension of each vocalisation’s spectral profile and possible instrumental representations (through the use of standard and extended string techniques).

Figure 3: Example from score, featuring various bird calls from which the performer may choose from.

4. REFLECTION

In aspiring to represent soundscapes and ecosystems through ecoacoustic creative work, it is important to recognise that any attempt at exact reproduction is principally flawed. Any creative process that involves collation and development of materials requires multiple decisions that increasingly abstract from the direct soundscape experience, where content (sound and related source) is situated in an environmentally meaningful context (relevant ecosystem and soundscape). This includes not only instrumental resynthesis, which is confined to the timbral and performable limits of the instruments, but also electronic recording and reproduction, which involves many elements (equipment, recording duration and direction, signal processing, to name a few) that subtly distort the original acoustic source and surrounding context through each morphological iteration (O’Callaghan 2012). Performance spaces and circumstances may add further levels of abstraction.

Recognising and adapting one’s approach in relation to these issues can in turn provide creative flexibility, whereby one can redirect their attention towards meaningful mimetic or formal representation, rather than exacting authenticity.

To this end, a number of compromises were made for artistic and logistical purposes:

**temporal cycles** - Like all spaces, the area is subject to meso- and macrolevel temporal cycles, in the form of seasonal and climatic changes and associated dynamics (flooding, solar activity, migration, etc.). In the interest of creating a broad-scale representation of place, rather
than of a specific time period, certain environmental processes were disregarded to preserve creative concept (i.e. the sun’s fluctuating azimuth, which for periods of the year does not fall behind the cliff) or heighten performance possibilities (transcribing as many bird vocalisations as possible, disregarding seasonal migration).

**pitch materials** - a number of vocalisations are pitched beyond the standard range of the violins, and thus a number of these calls are transposed an octave lower to remain playable, with occasional (*poco sul ponticello* bowing directions intended to provide appropriate higher partials.

**call selection** - occasionally, calls of certain bird species were deemed too complex to transcribe for the capabilities of the available instrumentation, or too variable/improvisatory to provide meaningful instructions within the established performance methods, and were therefore not included.

**anthropophonic sounds** - a number of human produced sounds featured in the Mobilong soundscape, including production from a nearby meatworks, passing vehicles on roads, watercraft on the river and overhead aircraft. Additionally, there were various pieces of infrastructure that were thought initially to produce sounds - measuring bores (with wind passing over the opening), powerlines (wind passing through the wires), and an irrigation pump (occasionally operated) - but were either absent/ineffective in the soundscape experience, or too obtrusive in the latter case to warrant inclusion for this work.

From preliminary research and onsite activity to creative analysis and synthesis, and finally realisation of the compositional response, the Mobilong test case study demonstrates the viability and usefulness of adapting soundscape ecology principles to ecoacoustic composition. Moving past superficial engagement with place that might result in impressionistic or highly abstract, mimetically-unrelated responses, and also approaches that centre on specific environmental interests, the discussed framework offers a comprehensive and integrated methods of engaging with place, and related ecosystems and soundscapes.

From this initial investigation, further refinement of the framework will ensue, with additional application through responses to four contrasting South Australian ecosystems (river - Long Island, Murray Bridge; coast - Murray Mouth; sylvan - Adelaide Hills; arid - Farina, Far North SA).

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PAYING IT FORWARD: SOUND ART STRATEGIES FOR THE POST-ANTHROPOCENE

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ABSTRACT

In the 1980s, geographer Eugene F. Stoermer coined a term that has achieved pronounced attention in the 21st century. Known as the Anthropocene, the conception refers to a geological period of time from the late 19th century to the present, in which the most profound force affecting change on the earth is the collective, often unconscious action of humanity (Crutzen, 17).

In order for sound art to sustain meaning and functionality across epochs, new conceptions of time and materiality and their relationship to sound must be examined.

In this text, I will use the conceit of the Anthropocene to provide a framework for envisioning and designing sound art that is informed by the prospect of the end of an era in which human activity is identified as being the primary agent of change on Earth. In doing so, I will outline strategies that can be put into place to evoke, for inhabitants of the far future, a very personal and aural sense of the contemporary moment.

1. INTRODUCTION

The specter of the Anthropocene and the extreme environmental degradation that accompanies it, points up a stark limitation to the potential lifespan of the mechanisms of global capitalism and modernity itself. As this human-defined epoch progresses, climate change and retreating energy reserves increasingly point to a near future in which global systems as a whole may cease to function in a manner that would continue to support global capitalism as it exists today. This poses drastic consequences, not only to the overall mechanisms of human survival, but to cultural constructions of media, communication and the understanding of sound itself.

Considering this, any conception of sound practice designed to extend past the current era must realign itself with time and material in order to reflect and project sound experiences in a meaningful manner. This reflection must mirror the sensibilities of a world saturated with electronic and digital media, but have no expectations of directly using said media. As the recipients might well exist beyond the reach of the mass-produced commodities afforded by contemporary global capitalist infrastructures, media reliant on electronic, electrical or even mechanical processes will likely lose any semblance of functionality for them.

This seemingly oxymoronic proposition can be instantiated by taking cues from past mediums that have survived to the present. The conception of a passive aural archive draws from preservational gestures of ancient archaeoaoustic designers and combines them with materials and techniques within the reach of contemporary subjects. By designing sonic experiences into physical, geologic and architectural structures that embrace linear and cyclical understandings of time, the lived sounds and expressions of contemporary artists have the possibility for latent long-term aural communication. Combined with passive fixed media materials that have indefinite lifespans, I will outline methods that have the potential to enable sound media artists to extend their expressions across vast spans of time and circumstance.

2. THE ANTHROPOCENE

In recent times the concept of the Anthropocene has reached almost mythical proportions, which is understandable considering the consequences that are at stake resemble apocalyptic narratives. Indeed, the consideration of the degradation of global control by human beings has spawned as varied conceptions of possible futures as religion has sects and schisms. Although the term originated with Eugene Stoermer in the 1980s, it was not until 2000 when term reached national prominence. Co-authored with atmospheric chemist Paul Crutzen, the brief article appeared in the IGBP Global Change Newsletter and has since been increasingly in the public eye.

Although the term has popular momentum, the acceptance and understanding of the term is far from settled. The International Commission on Stratigraphy, the group charged with officially defining geologic eras for the field has of this writing not produced an official position on the matter (LaTour, 75). In the humanities, definitions and interpretations of the Anthropocene are similarly unresolved and convoluted. Imagined post-Anthropocenic eras include a wide variety of conceptions involving possible futures for terrestrial inhabitants. Many shift philosophical focus away from an extinct humanity onto other forms of possible life – what post-
human author Donna Haraway dubbed the “Chthulucene” (Haraway, 255). Others open this literal post-human space up even further to allow for the collective intellectual capacity of computational technology to emerge sui generis from the ashes of humanity, as artificially intelligent beings born of interconnected technological systems unmoored and benignly left unguided by human direction (Bratton, 10). Still others leave room for humanity, albeit in a more humble form; a conception of future that is compelled by necessity to abandon anthropocentrism and its compulsion to constantly expand and consume. Bruno Latour, in his Gifford lecture series, outlines such an understanding, and it is his perspectives on the Anthropocene that I will use here to frame its conception.

3. LATOUR ON TIME AND MATERIALITY

3.1. Adaptation and anthropocentrism

Specifically, it is Latour’s conceit of additional adaptive understandings of time that I will engage with here. For Latour, the Western conceptions of linear time are inextricably linked with eschatological religious ideals and endless capitalist production. The understanding of time that drives Western ‘progress’ is ultimately backward-facing, defining itself by the improving upon the rejected flaws of the past as a projection toward an imagined better future. In this linear conception of time, there is a direct connection between “what is” and “what ought to be” (Latour, 125).

Latour expands on this conception in his six Gifford lectures given at the University of Edinburgh in 2013. In it he outlines new possibilities for conceptions of time that may enable crucial adaptation in the present moment. Namely, that the failings of linear time can be addressed by more cyclical understandings of temporality that include physical ecological reactivity. In other words, an adaptation of time that jettisons anthropocentrism and prioritizes ecologic reaction within its designs: “Not flat maps but entangled retroactive feedback loops” (Latour, 133).

This is not meant as an erasure of history or modernity. The inclusion of human action and thought, including linear conceptions of time is also caught up in the temporal ecological feedback. Latour presents that a consistent loopback of understanding of the present and past is vital for an engagement with the constant present that is fully aware. He urges us to “keep the loop traceable and publically visible or else we will be blind and helpless with no soil on which to settle, strangers on our own land” (Latour, 135). In order to fully grapple with the present moment, we need to inscribe the materialities and boundaries, both good and bad that pointed to it.

3.2. Applications to sound art

It is LaTour’s engagement with time and materiality that will be used here as a point of entry into conceiving of sound art and the post Anthropocene. If, as John Cage suggested, that sound is not only linked to the ecology, but that sound as an action is ecology, then the prospect of sound art as a means to rework our relationship with the ecosystem is, in the present moment, strikingly imperative (Kouvaras, 115).

Drawing on LaTour’s discourse of the post-Anthropocene, a conception of sound art for the moment at hand should do four things:

1. Outline how linear conceptions of time and preservation can be adapted and enjoined with cyclical, looping temporalities to produce sound art that is responsive to the present, but retains the data of the past.
2. Explore how materials play into these expanded engagements with time, place and meaning.
3. Explore how space and architecture may also be considered as a reactive, temporal material.
4. Give examples of existing and proposed works that utilize these concepts in a meaningful way.

The previously outlined schema of Bruno LaTour’s understanding of linear v. cyclical time will be used throughout this text to connect a renewed understanding of time to the works and materials discussed. That said, the question of materials can be addressed. Specifically, the fixing of performance instructions or sound recordings within a medium intended to last for long spans of time, but can still echo the ‘loopbacked’ sense of place. Thus, the communicative properties included can be directly instructional or experientially evocative, as is best suited for the individual preserved expression. The following is a brief survey that will examine theoretical and functional frameworks that have the potential to provide sonic expression over vast distances of time and circumstance.

4. TECHNIQUES AND MATERIALS

4.1. The archive

The traditional linear methodology to interactions across large periods of time has been the archive. Namely, the preservation of traces of meaningful experience (aural, visual, and architectural) that can outlast the era in which they were created and collected. The nature and meaning of an archival instance reflects in some way the community from which it emerges. As such, the meanings projected by an archive change over time and culture.

An archive simultaneously engages three aspects of temporality: the past, present and future. An effort to preserve the present so as to engage with the future has at its core an assumption of the present as a projected past. In his text *Archive Fever*, French post-structuralist
Jacques Derrida referred to this tripartite temporality as “…the injunction of memory with the anticipation of the future to come” (Derrida, 79). That is, in creative projection, we put ourselves in the place of future beings in contact with a long-dead past through the conduit of the present. As such, our forward projections can be influenced and aided by an effort to engage with the linear projections of the past and the questions that might emerge.

This is all to say that although the embrace of cyclical understandings of time are essential in the era after the Anthropocene, it does not necessarily warrant the wholesale rejection of all characteristics of linear temporality. The aspect of material preservation is one of these functions that can play an essential role in the task at hand, specifically when addressing electronic and digital information and the archive.

An examination of the durability of electronic storage necessitates the discussion of the 20th century’s urgent dependence on fossil fuels, as well as the cumulative detrimental effect of their use on the global ecosystem. The prospect of the ultimate depletion of fossil fuels as well as the physical, economic and political upheavals that would accompany extreme environmental degradation, points up a stark limitation of collective digital systems. Namely, as our servers are in a large part created from, powered with, and are maintained by systems reliant on fossil fuels, what happens when the oil runs out? As a non-renewable resource, the limited reserve of petroleum lays bare a crucial weakness in long-term electronic storage: decay.

4.2. The archive and decay

The effects of decay are especially problematic for digital systems. This potential for decay has been described as a series of ‘digital dark ages’ in which the threat to data permanence changes in tandem with changes in technological trends.

The first of these dark ages involves the degradation and entropy of physical digital media and changes in hardware and software formats. Digital media, although highly reproducible and transferable, rely on physical storage mechanisms, which are often more volatile than analog formats, and are less recoverable when damage has occurred. Furthermore, the high density of digital formats makes the loss of a digital repository a more catastrophic event than an analog one (Bollacker, 107).

All this is to say that in terms of deep time considerations, it may not be wise to consider the collective digital sphere or even electronic mediums as archives that can survive into the far future. Instead we must turn to find materials that can be counted on to have a maximum longevity and are not reliant on fragile systems of infrastructure to operate.

4.3. The archive and materials

In terms of physical longevity not all media are created equal. Substances like paper and cloth decompose rather quickly and very few examples of work from the ancient world still exist today (Bollacker, 106). Some of the most durable on the other hand are ceramic, bronze and more recently, plastic. These materials tend to resist decay and are common enough to be widely available.

4.3.1. Ceramic

Archival examples of this medium are replete, with many pieces dating back thousands of years. Thus, information embedded on ceramic benefits from an extremely long potential to communicate. The ancient Minoan text known as Linear B was recorded on clay tablets dating back to 1450 BCE. Deciphered in 1955 by Michael Ventris and John Chadwick, the tablets now provide an insight into the lives of persons living over 3000 years ago (Chadwick, 81). There are limitations to any data storage system, and although the medium can last indefinitely the ability to parse the information does not. The language that preceded Linear B, known as Linear A has yet to be fully deciphered (Schrijver, 1).

Despite this limitation, the possibility of ceramic as a means of expression for the far future is distinctly appealing. The relative ubiquity of ceramic tiles along with their ability to be embossed with complex imagery and text makes them an effective vehicle for informational and aesthetic projection on a large scale, either by direct manipulation of the clay before firing, or by inscription on existing ceramics via chemical or laser etching (Figure 1).

![Figure 1. Laser-etched ceramic tile.](image)

Media longevity of notated prescriptive scores of Sumerian Hurrian songs date back to eras nearby those of Linear B (West, 161). The clear indication here is that a set of instructions either in visual or textual form can be produced to the ends of making sound as well. It
would be a simple matter to engrave myriad of pieces in many forms of notation onto ceramics. While this can be effective, it also has a risk of similar encoding problems, as the amount of persons able to read music is exceeded by those who cannot. This being the case, we can expect a higher chance of textual or graphical instruction based forms of sonic aesthetic to be more effective for future populations than pitch-based notational systems.

By focusing on a timbral, sonic transference of performative information, the limitations inherent with pitch systems can be mitigated. Instructions for the creation of sound spaces and experiences to be enacted can be easily transferred to a more permanent media that, although encoded in language and/or images, does not require electricity, knowledge of a specific flavor of pitch relationship, or any specialized instrumentation to enact. Alison Knowles' #1 Shuffle (1961) is a clear example of instructional works that extend a sense of sound, action and place, but require no specific technical skill by the performer, other than reading. The piece instructs a group of performers to “shuffle into the performance area and away from it, above, behind, around, or through the audience. They perform as a group or solo: but quietly” (Knowles, 4).

Graphic instructions and ‘vocal tablature’ may also be employed to overcome the limitations of linguistic decay (Figure 2). Put into physical form, instructional sound pieces such as these have the ability to span vast periods of time and extend the performative possibilities far beyond the present moment.

Figure 2. Irish phonetic diagram for performance of fictional text poems by Róisín Madigan O’Reilly (Ford).

Beyond a re-contextualization of the social norms of sound practice as a conceptual gesture, a re-mapping of a sound space in deep time is also added. Instruction-based sound works become in a sense, a ‘recording’ of a communally-enacted sonic space that is extremely resistant to decay and that has an extremely high chance of surviving indefinitely under harsh environmental conditions that can potentially span culture and even species.

4.3.2. Plastic

It has been said that plastic is forever, and although efforts have been introduced to put biodegradable options into wider circulation, a vast amount of these materials will remain in the environment for thousands of years. Although this is a crisis from an environmental standpoint, it is a possible boon for post-Anthropocenic communication. The durability of plastic also allows a direct imprinting of sound onto the medium. While vinyl records may be durable in this respect, the technology to make them audible is dependent on electricity or mechanical means to make them operate, rendering them potentially non-functional in a relatively short time.

Other passive methods exist that do not require such technology. Talkie Tapes - (a proprietary brand) encodes sonic messages directly onto strips of plastic by varying the space and density of raised ridges along one side. By rubbing a fingernail along this edge, a recorded sound can be heard (see Figure 3).

Figure 3. Talkie tape – close up and full view.

Processes such as these are ideal for far future communication as they require no external mechanism. Media artist Amanda Ghassaei published an open source version of the method for constructing similar tapes using free software and 3D printing hardware (Ghassaei). Like ceramic etched tiles, plastic ‘recordings’ such as these have the potential to be implemented across a wide portion of the current populace, increasing their potential for communication. Encoded plastics could be especially effective in recording the sounds of specific places onto the medium and then burying them directly beneath the place they were recorded. This could provide a direct acoustic representation of location - an aural ‘feedback loop’ of place that has the possibility of surviving into the far future.

The previous two examples also have the potential to address the desire to preserve an imagined linear connection between past present and future that is the hallmark of the modern era, but also allows for a passive recursion involving the ecology of place. By the act of burial, the sonic materials here become part of the immediate ecology they reflect, as well as allowing this very human action of recording and reflection to become deliberately caught up within a system whose temporal limits outstrip any direct connection with a specific artist. Furthermore, they have the potential to invite new
understandings of site-specific aurality that directly connect far-future inhabitants with the present, but allow for the recipients to form their own understandings and interactions with the sonic landscape present at the time of discovery.

5. SPACE AS RECORDED MATERIAL

5.1. From linear to cyclical

The aspect of shared sonic space need not be limited to the recording of specific performances or sounds. The slippery field of archaeoacoustics opens an area of possible futures. Archaeoacoustics explores the role that sound may have played in the location and construction of ancient sites like Stonehenge and the Great Gallery in Horseshoe Canyon, Utah. They postulate that the aural conditions of the environment may have been a deciding factor to the understanding of the site as being sacred places to their ancient builders (Garfinkel, 37).

If acoustic space as well as visual space was possibly modelled by ancient civilizations for the ages, why can we not do the same in the present? Constructed architectural paces already exist to this effect in whispering walls and galleries in which even very quiet reverberant sounds can be heard clearly at a distance, such as London’s St Paul Cathedral (Figure 4).

Figure 4. Whispering gallery acoustics at St Paul’s Cathedral (Wright).

In a reconceptualised archaeoacoustic gesture, the built structures of archival acoustic architecture seeks to preserve the sounds and noises of modernity as reflection of the possible aural commonalities with the post-Anthropocenic era. These are not made with any hierarchical assignation to sound and modernity, but as an effort to fold the archival sensibilities of durable architecture into an ephemeral sense of organic cycles. Thus, they stand in contrast to R. Murray Schafer’s preference of the natural ‘Hi-Fi’ soundscape over mechanized modern ‘Lo-Fi’ sound (Schafer, 71). The necessities of the separation of aesthetic valuation of the ‘natural’ as opposed to the ‘artificial’ is subsumed by a reverence for each. Thus, we can enact a space in which sound, when ‘frozen’ into space, can engender to post-Anthropocenic beings a critical and cultural reflection of the present moment. Far from isolating sound from collective experience, the archeoacoustic approach fuses the two together in a preserved, lived space.

5.2. Acoustic exteriors

Examples of contemporary archeoacoustic sound art approaches are currently extant. The following are some examples of artists and locations that exhibit characteristics of constructed space as record for designed sound.

5.2.1. Wave organs

Wave organs use the movements of the ocean upon the shore to power passive soundscapes. Of the three that currently exist worldwide, one of the most well known is in San Francisco and was created by Peter Richards and stonemason George Gonzalez (Figure 5). The Wave Organ was completed in 1986, placing a circuitous series of concrete pipes in the local jetty of the San Francisco yacht club. The tubes amplify and alter the rushing and gurgling sounds form the waves, responding to changes in the tide.

In addition, the organ used salvaged concrete and granite from the city and a local demolished graveyard, involving a visual and physical space of contemplation, memory and temporality in which sound is only a portion of the experience. The artist describes the sound as one that is “…a function of the relationship between … the Earth to the moon to the sun, which of course effects the weather, the seasons.” The human subject does not experience the piece form afar but becomes “…a part of the soundscape” in a physical and enacted manner (Richards).

Figure 5. Wave Organ by Peter Richards and George Gonzalez.

The Sea Organ in Zadar, Croatia by Nikola Bašić is another example of the sea organ as an architectural site-specific permanent sound piece. This organ was completed in 2005 in the Croatian town of Zadar, which after heavy damage from WWII hastily rebuilt its coastal jetty. Built for a revitalization of the jetty, the wave organ departs from the one in San Francisco in that it is deliberately designed with diatonic specific pitches utilized in the local tradition of male vocal ensemble singing (Stamač). The result is one that is more identifiable as ‘musical’ in the traditional Western sense.
and perhaps more deeply rooted in local tradition than in an engagement with the sound of the ocean per se.

A third organ exists in Blackpool, England. Built in 2002 by public artist Liam Curtin the Blackpool High Tide Organ is a more imposing structure than the other two, zinc, copper and steel structure standing at over 49 feet in height. The organ operates much in the same fashion as Bašić’s, but is less regular in its function. Whereas Bašić’s organ produces relatively constant tones, Curtin’s structure more directly reflects the action of the tide, wheezing a chorus of tones as the tide rises and falls, in a manner resembling a discarded bagpipe. The tones are more centered in the ‘natural’ phenomenon as well, sounding only with the high tide and spelling out 18 tones of the natural harmonic series rather than an even-tempered scale.

All of these spaces architecturally extend and alter the natural environment while remaining a permanent alteration of place. They do, however, seem to exhibit more anthropocentricity the more recent their construction. This may exhibit a necessity to meet the demands of the immediate expectations of local governments rather than focusing on heady ideas of permanence. This may be due also to the fact that the first to be built was commissioned by a museum rather than local governments. This can be seen in Nikola Baiae’s documentation of Bašić’s piece. As the acoustician responsible for making sure the technical aspects of the project went according to design, Baiae also presents public opinion polls of the project, indicating that public acceptance and attraction, rather than long scale time communications were the order of the day (Stamác). Thus, architectural sound spaces take on and reflect a variety of cultural and economic realities that the sound artist must grapple with.

5.2.2. Free-standing exterior interventions

The lithographs of Sardinia artist Pinuccio Sciola also use place and permanence as a site on which to enact a sonic palimpsest. This artist directly carves into massive blocks of basalt. The areas of stone left form matrices which, when brushed or struck create lush pan-diatomic and microtonal tones. The artist connects his work to events that coalesce the interaction between stones and human events, dedicating works at the site of a 1904 strike by miners that was violently suppressed. The sculptor embraces a sort of religious vitalism citing in a 2008 piece dedicated to St. Frances of Assisi that even as the saint was talking to the divine, that “…the sun, the moon, the stars, the animals, the stones were listening.” (“Ad Assisi…”). This kind of positioning of the artist foregrounds the non-human and inanimate while at the same time embraces a reverence for human suffering and experience.

5.3. Acoustic interiors

A similar gesture toward the archaeoacoustic architectural potential for the preservation of linear culture alongside passive, loopback activity from the local place can be found in the work of German artist Lukas Kühne, who installed a permanent structure in the fishing town of Seydisfjordur in 2012. Named Tvisonger, the piece consists of a series of domed rooms, each designed to resonate and amplify at a specific frequency present in traditional Icelandic pentatonic scales. Visitors can use their own voices or experience the ambient sounds as they excite the various tones.

This site exemplifies the dual imposition of linear and cyclical understandings of time. By its permanent nature, and intent to preserve an ephemeral cultural practice, it draws from the linear archival tradition. Its lack of directly recorded instructions and acceptance of possible misunderstanding future reinterpretation open it up to cyclical functions and meanings.

Figure 2. Tvisonger by Lukas Kühne.

5.3.1. Silent interiors

Negation, in this context, can be a highly effective technique. The creation of silence or Schafer’s ‘Hi-Fi’ soundscapes, in some ways highlights dissolution of sound as a reflection of the modern moment itself. To ward off indigenous sound is to impose control of and reject the agency of place. Silent space can only be truly accomplished with the most modern of substances: thick glass and artificial sound dampening materials. To this end, artistic gestures echoing John Cage’s 4’33” take on a renewed and extended meaning. Joris Hekkenberg’s piece Tacet is an excellent example of potentials that a shift in the understanding of silence can afford expressions of sound and time.

Figure 2: Tvisonger by Lukas Kühne.
6. CONCLUSION

If, as Christopher Small writes, a performance space "...dramatizes and makes visible certain types of relationships" (Small, 27), what can all this mean in terms of meaningful interactions with distant future listeners?

Small gives another indication of the notion of collective sound creation not only as the act of making music, or 'musicking', but as creating collective legends or 'mything' (Small, 101). This ritualistic mythical aspect of sound production offers perhaps a helpful perspective in the imagining of future sound spaces as wildly collaborative, open-ended and inherently mythic. Although Archaeoacoustic claims are difficult if not impossible to prove, one cannot deny the epic and mythical qualities of the imagined scenarios. To impart into an acoustic experience of Stonehenge a long dormant aural communication with long-dead peoples is to intone the voices of the dead into the standing stones - a mythical prospect indeed.

To pay forward this past sonic potential to future beings (human or otherwise) is an opportunity to pay respect to the linear archival gesture while understanding its limitations. In addition, the ephemeral nature of sound make it distinctly poised to introduce a performative impermanent feedback essential to life after the decline of the Anthropocene.

7. REFERENCES


THE AESTHETICS OF CAUSALITY

A descriptive account into Ecological Performativity: a creative research practice.

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ABSTRACT

This article presents some of the contextual frameworks that have located the author’s development into a creative research practice calls Ecological Performativity. This practice has evolved from a number of non-linear audiovisual works that are intrinsically linked to geographic and everyday phenomena. These works explore the relationship of environment, material, and process, and are derived from an intensive data gathering procedure and immersion within the respective environments. The project is situated in an ecological discourse that seeks to explore conditions and methods of for co-compositional processes between human and nonhuman bodies. This article negotiates the relational interplay between first person (my) experience in creative practice with that of the interdisciplinary influences that accompany it. These include a number of recent critical, theoretical, and philosophical discourses occurring in the humanities and social sciences generally referred to as The Nonhuman Turn. It is out of this relational interplay that the notion of Ecological Performativity has evolved.

1. INTRODUCTION

“As techno-science increasingly reaches into every aspect of life, formerly fast held distinctions between the inert and the active, the human and non-human life and matter are cracking.”

(Salter 2012: 17)

In April 2011 researchers from the natural and social sciences, the humanities, and a variety of creative practitioners gathered in Rotterdam, The Netherlands. Under the title The Vibrancy Effect: An Anti-Disciplinary Meeting, the focus was to discuss and “explore the aesthetic-political-technical-ethical effects of vibrant matter” (Salter 2012: 8). The term Vibrancy, here, is in direct reference to Jane Bennett’s concept of vibrant materiality or “thing-power” that, as Bennett claims, attempts to give voice to the energetic vitality intrinsic to matter and the active, earthy, and complex entanglements of the human and nonhuman (Bennett 2010: 3).

At this meeting, participants presented their unique understandings, approaches, and concerns for considering vibrant materiality, or, what sociologist of science Andrew Pickering calls “material agency”—“the material that comes at us from outside the human realm” (Pickering 1995: 6). The variety of disciplines, terms, crossovers, and paralleling conditions that each practitioner can be traced (Salter et al. 2012: 14) underpins the telos in which this meeting resonated—one of a transdisciplinary, or rather, “anti-disciplinary” 1 enterprise that focused on matters of human, nonhuman and material agency.

Jump ahead to May 2012 and a gathering of scholars at the University of Wisconsin, Milwaukee, this time under the rubric of The Nonhuman Turn, and similar to The Vibrancy Effect, the discourses to emerge explored the agency of the human and nonhuman. Bennett suggests the relevance of such a turn is “to find new techniques, in speech and art and mood, to disclose the participation of nonhumans in “our” world” (Bennett 2015: 224–225). As noted in the subsequent book from this conference, The Nonhuman Turn evolved from a variety intellectual and theoretical developments that occurred within the last decades of the twentieth century: Actor-network theory (Latour), Affect theory (Massumi), Animal studies (Haraway), Assemblage theory (Deleuze), New Materialism (Bennett), Speculative realism (Harman). Broadly speaking, the nonhuman turn can refer to objects such as “climate change, drought, and famine; to biotechnology, intellectual property, and privacy; to genocide, terrorism, and war” (Grusin 2015: vii). Such wide-ranging perspectives on what constitutes an object and nonhuman are, as Salter suggests above, a disruption of distinctions. But given the many concerns arising in the twenty-first century the turn towards the nonhuman has particular relevance to, as Timothy Morton suggests, “exit modernity—which the current ecological emergency seems to be demanding” (Morton 2013b: 80).

2. ISSUES OF AGENCY

“Thinking issues of agency through the experiential encounter with the ‘stuff of the world’ encourage a radically different vision of the world—dynamic, temporally emergent, contingent, and performative.”

(Salter 2015)

Thinking in terms of agency and performativity is nothing inordinately new, and in Western thought has evolved from a variety of philosophical, scientific and artistic research that took place over the last century (Salter 2010, 2015; Capra 2014). Of late, however, there

1 Pickering defines the undertaking of this meeting as a nonmodern ontology of “anti-disciplinarity” (2013: 209–220).
has been a reinvestigation into the notion of agency and performativity that, as Chris Salter suggests above... “is encouraging a radically different vision of the world.” From Karen Barad’s “intra-action” (2007) and Andrew Pickering’s “dance of agency” (1995, 2008) to Jane Bennet’s “thing-power” (2010), Tim Ingold’s “meshwork” (2007, 2011) and Timothy Morton’s “hyperobject” (2013a) a reconceptualization is taking place which challenges the long-standing narrative of human exceptionalism and our understanding of the geoconjugtures that make up life on earth.

As these thinkers grapple with the notion of agency in human and nonhuman bodies, a host of ecological, social, cultural, and political observations and concerns are being raised and challenged. The urgency of which is energized by what has now been embraced as the Anthropocene; the epoch in which the effects of fossil-fuel-burning humans have fundamentally altered the earth’s geological composition.

From the position of creative-research, the attentiveness to these emerging discourses provides an opportunity to ask new questions of the making-doing-thinking of artistic practice. I was specifically drawn to these discourses as a means to contextualize my own creative questions and concerns: What does making art from these lived and experiential encounters in the world do? In other words, what is the purpose of an art form relationally situated in time and place? Since the 1990s my creative practice has revolved around the exploration of the day-to-day situated encounters in the real world (Figure 1). These works were deeply embedded in time and space and explored the impact that human activities have had on the environment. Since then, this practice has evolved from a fixed-media format to one that explores non-linear systems using components such as weather, meteorological, and environmental data. My field recordings have taken place throughout North America, New Zealand, and Australia resulting in a catalogue of audiovisual works that are intrinsically linked to geographical factors and everyday phenomena.

But what is it about these experiential encounters with the “stuff-of-the-world” that has held my curiosity? What significance does it have on my mode of artist practice, and how does this practice motivate the conditions in which creative possibilities are activated, assembled, and processed? More specifically, what would motivate my collaborators and I to venture on field recordings that would place us in Death Valley at 53 degrees Celsius, the polluted wastelands of the Salton Sea in Southern California, the crowded sidewalks of Los Angeles, and the tourist-filled paved pedestrian trails in Sequoia National Park? The answer to these questions, I believe, resides in practice.

By reorienting my creative practice with these different “modes of thinking,” the process that I refer to as Ecological Performativity has evolved. Central to this idea are the fundamental questions: What tendencies emerge in the making-doing-thinking of creative practice when material agency is considered a co-compositional device? What capacities do these tendencies have on the creative process and how do they affect the resulting artefact? Might a broadened understanding of agency and performativity provide different vocabularies and networks of communication? Can this encourage an attunement to the reality of the coexistence of all things on Earth? And if so, as a creative practitioner, what, then, is my response and response-ability?

3. ECOLOGICAL PERFORMATIVITY

“The world is an open process of mattering through which mattering itself acquires meaning and form through the realization of different agential possibilities” (Barad 2007)

Open processes and different agential possibilities are central to the creative practice of Ecological Performativity. Ecological is located within the philosophical provocations of Brian Massumi and Erin Manning as being that of a relational experience: “Organisms-that-person agitate in the mix, but always in a witness of environment: a becoming ecology of practices” (Manning et al. 2014). Thus, this practice considers emergence and material agency as co-creative apparatuses. Accordingly, Performativity draws specifically upon Andrew Pickering’s notion of the “dance of agency” (1995, 2013). Here, agency and performativity are entwined in what Pickering posits as the performative idiom (2012). This is Pickering’s attempt

![Figure 1: The work Motion Parallax (1998) was the first large-scale audiovisual collaboration between Andrew Denton and I and was created using field recordings captured on a cross-Canada trip from Tofino, British Columbia to Cape Spear, Newfoundland. This photo was taken on the last day of shooting on top of Signal Hill, historical site located in St. John’s NFLD.](image-url)
to move away from the idea that agency is specific only to humans, or to what he refers to as “human exceptionalism” (2012). He suggests that the world, in all its heterogeneous multiplicity, is full of agency and processes of emergence. By exploring these processes and performative relationships between things, including those beyond the human realm, Pickering suggests that we invite the “possibility of a non-modern stance of revealing rather than enframing which, in turn, invites open-ended extensions” (Pickering 2010).

Similar to other ecologically-grounded creative practices, (Barclay 2013; Burner 2011; Di Scipio 2011; Keller et al. 2006; Opie et al. 2006) Ecological Performativity explores the relationships of environment, material, and process, and is derived from an intensive data-gathering procedure and immersion within the respective environments. Each work begins in a collaborative field recording process that often starts in a matter-of-fact manner (making sure all batteries are charged etc.). However, the effect these environments have on my collaborators and I become an operative agent—attunement of which takes time. According to Bennett it requires: “a cultivated, patient, sensory attentiveness to nonhuman forces operating outside and inside the human body” (2010: xiv). The agency of such forces is relational. Bennett’s discourse on “thing-power” surmises that: “Earthy bodies, of various but always finite durations, affect and are affected by one another. And they form noisy systems or temporary systems out of the material gathered; an acoustic musical improvisation as a mean to engage the agency of the post-production” (2016: 233). Of this my long time collaborator Andrew Denton writes: “Once time is taken to absorb [the location], I attempt to record material that communicates my sensations and experiences of being there” (2016). He reflects that by “letting go of a need to understand, comprehend, and categorize […] the intensity of the making-feeling-thinking [could] take over in the moment of capture, leave[ing] the reflection and reinterpretation for a later distanced encounter with the material during post-production” (2016).

There is a causal dimension that, as Morton argues, is “wholly an aesthetic phenomenon” (Morton 2013b). Accordingly, Morton proposes a wide-ranging account of aesthethical moments. “Aesthetic events are not limited to interactions between humans or between humans and painted canvases or between humans and sentences in dramas. They happen when a saw bites into a fresh piece of plywood. They happen when a worm oozes out of some wet soil. They happen when a massive object emits gravity waves” (Morton 2013b: 19).

3.1 The Ecology of Practice

The post-production exploration of materials is done in part through the development of specifically designed computational systems. These systems vary in construction and are intrinsically linked to the collected location data of audio field recordings, moving images and photos, as well as weather, meteorological, and environmental data gleaned from these situated encounters. Through research the techniques include computer vision processes, data sonification, live convolution, and improvisation as a mean to engage the agency of material and thus construct the non-linear audiovisual installations. What emerges does so in an iterative manner that affords an open-ended interaction in the “ecology of practice.” Similar to Massumi and Manning, Isabelle Stengers says:

 “[A]n ecology of practice is a tool for thinking through what is happening, and a tool is never neutral. A tool can be passed from hand to hand, but each time the gesture of taking it in hand will be a particular one—the tool is not a general means, defined as adequate for a set of particular aims, potentially including the one of the person who is taking it, and it does not entail a judgement on the situation as justifying its use. […] Here the gesture of taking in hand is not justified by, but both producing and produced by, the relationship of relevance between the situation and the tool” (2005: 185).

Approaching my research accordingly emphasizes the importance of a mode of practice that is situational, emergent, and able to diverge in the process of experimentation. I consider these three components tools and techniques in that the relationship of relevance (Stengers) draws forward the thinking-feeling that can traverse all movements of experience. Technique, as understood by Manning and Massumi, “belongs to the act” and are springboards that sets in motion “a practice from within” (2014: Loc 71) Here, then, the subjective and objective are not positioned on opposite planes but rather move in a relational field that mobilises and transforms the work. Manning and Massumi reflect: “Thought gathers in the work. It is the event of the work’s unfolding. Not into language, but painting, on a canvas that seeks to activate a new way of seeing, a new effort at participation” (Ibid). In my research, the canvas equates to the resulting non-linear audiovisual installations while the effort to participate is experienced in the field and in the act of making-doing-thinking.

Subsequently, this ecology of practice has come to involve the recording of live musical improvisations in response to the developed system. This has become an important component of Ecological Performativity.—which is within the iterative developments of these systems out of the material gathered; an acoustic musician is then invited into the process to respond improvisationally to the material. Recordings have taken place in live multimedia concert improvisations, studio settings, and the respective environments. What this provides is a cumulative database that in turn folds back into the final system. Motivated by the desire to explore non-linear systems, the installation platform provides a space where the constraints of beginnings, middles, and ends are eliminated. The artwork can then exist as a transformative apparatus.

Operating in this discursive register, from the core of creative research, provides a platform for experimentation-as-process that contributes to new ways of thinking by insisting that every practice is a knowledge that can speak and act through the differences and emerging possibilities.
4. Dark Ecology, the Sonic Potentials of Data and the Salton Sea

"With dark ecology, we can explore all kinds of art forms as ecological: not just ones that are about lions and mountains […]. The ecological thought includes negativity and irony, ugliness and horror" (Morton 2010: 17).

Anybody who has ventured into the writings of Timothy Morton will be familiar with the complexity of ideas spun on every page. From his book *Ecology Without Nature* and ideas of the “hyperobject” to his dark ecological thoughts, Morton’s philosophical ponderings purpose a way of thinking and being (of which he considers thinking, in and of itself, an ecological event) that embraces ambiguity, uncertainty and the uncanniness of the entangled mesh. Morton is a strong advocate for art, philosophy, and music stating that: “…art forms have something to tell us about the environment, because they can make us question reality” (Morton 2010: 8).

When considering Morton’s idea of the hyperobject, that of, “agents or objects so massively distributed in time and space as to transcend localization, such as the biosphere, global warming, or the sum of all the whirring machinery of capitalism,” (Morton 2013a: Loc 110) the creative practice of making works form field recordings and data becomes multifaceted. When one reflects on the interwoven interactions that occur in any given encounter; between what is seen and unseen, heard and inaudible to our human ears, the complexity of the mesh is immense. For Morton, “the mesh” substitutes words such as interdependence and interconnectedness (2010: 28). For Tim Ingold, the mesh is a metaphor for the relational interwoven lines of lived experience (2007: 103). Borrowing from philosopher Henri Lefebvre, Timothy Ingold defines meshwork as a “zone of entanglement [where] there are no insides or outsiders, only openings and ways through” (Ibid). In my creative research, thinking in terms of the mesh underpins the practice of *Ecological Performativity*. By engaging in a non-deterministic way with what is present in any given environment, “the poetic potential of locational data has the capacity to draw you to the multiplicity and complexity of the content” (Denton 2016).

This practice was put into play when collaborators Andrew Denton, Adrian McNaught and I recently embarked on an audiovisual collection process throughout the Southwestern drought regions of the United States. This three-week field recording session involved many extreme locations including Bombay Beach on the Salton Sea. Parking our vehicle and venturing into this environment, the odour itself stopped us in our tracks. The shoreline was littered with dead fish and birds and human objects in varying stages of decline, all of which were covered with a dusty white mixture of salt and dried thermal mud. This environment is the result of early 20th century weather systems and ensuing human activities.

In 1905, when the Colorado River swelled and breached its banks, the water ran into the Salton Sink, a geographical region 220 feet below sea level. After two years of continuous flow, a 15-by-35 mile lake formed that became known as the Salton Sea.5 Taking advantage of California’s newest and now largest lake, the Salton Sea became a favorite getaway spot for nearby Los Angeles and San Diego residents. During the 1950s and ‘60s, Bombay Beach, which is located on the lake’s eastern side, became a prosperous resort town filled with sunbathers, water-skiers, and yacht club parties. During the 1970s, however, it became apparent that the ecosystem of the Salton Sea was quickly deteriorating. With no drainage outlet and little to no annual rainfall, the inflow of industrial pollutants and untreated sewage began to increase the lake’s salient level and caused the water to deoxygenate. What had become an angler’s well-stocked paradise quickly transformed into a rotten layer of dead fish and birds (Paiva).

The indexical signs of the human and nonhuman now-litter Bombay Beach, which has been described as “the most depressing place in California” (Riggs 2010). Once Denton, McNaught, and I had adjusted to the initial shock of this environment, we proceeded to record these indexical signs. Denton and McNaught focused on the visual components, while I focused on the sonic environment. I became transfixed with the numerous objects scattered throughout: rusty metal objects sticking out of the ground, wooden refuse from dilapidated buildings, sections of concrete slab, plastic bags entangled and flapping in dead bushes, and a lone broken piano (Figure 2). Using contact microphones, I recorded the sonic textures and tones by tapping, plucking and playing these objects. Equally striking was the sound resounding at the waters edge. Primarily comprised of crushed fish and bird bones, the sonic quality activated by wave and human footsteps has a sharp percussive high-pitched resonance. I captured this using a hydrophone.

It was during this field recording I posed the question to my collaborators: what is the purpose of making art from these lived and experiential encounters? Beyond technical and aesthetic choices, the creative research nexus attends to the fraility, vulnerability and performative substance of time and place. Morton surmises “to be located “in” space or “in” time is already to have been caught in a web of relations” (Morton 2013b: 21). From

![Figure 2: Piano on Bombay Beach. Photo Adrian McNaught](http://www.sci.sdsu.edu/salton/Salton%20Sea%20Description.html)
a sonic arts practice Kim-Cohen suggests that: “Every work of art is a response to the conditions within which it is produced and received [...] the assumptions and problems inherent to its time and place” (Kim-Cohen 2013: Loc 100). Or, perhaps, by choosing to engage with the negativity, irony and ugliness of these environments—Morton’s dark ecology, the capacity to recalibrate the world through our practice is opened by drawing out the evocative and emotional that, in turn, provides the opportunity to see, hear and be in the world differently (Denton 2016: 64). The artwork becomes an apparatus of change.

5. REFERENCES


FROM TRAFFIC RISES: SITE SPECIFICITY AND THE COMPOSITIONAL PROCESS

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ABSTRACT

Architectural spaces can offer unique musical material for the compositional process. When unorthodox performance spaces become part of musical works and their performances, approaching these spaces offers rich soundscape and spatial possibilities, yet there are particular acoustic challenges for the composer in context-based composition of this kind. This paper examines one way to integrate the real world sound characteristics of an architectural space into the compositional process, and discusses how different levels of site-specificity may be engaged in this process. A pedestrian bridge was chosen for its soundscape and physical characteristics as well as challenges which required creating a pre-compositional testing and workshopping methodology. These experimental processes inspired an original composition titled From Traffic Rises, featuring eight acoustic musicians, four speakers and an electronic soundscape. This research also draws inspiration from literature in theatre and choreography that interrogates the way works can be linked to their particular site. In particular, Dr Fiona Wilkie’s scale of site-specificity for theatre provides a useful tool to gauge the level of site interaction. These creative influences are synthesised to form an alternative compositional process which begins, and is informed, by the context of a physical space as a musical starting point. From Traffic Rises demonstrates that the acoustic, physical design and spatial features of a real world physical space can become an integral part of a new work, providing an important contribution to the possibilities of acoustic music.

1. INTRODUCTION

We are surrounded by man-made structures and architecture, often passing them by without considering their musical potential. These functional, often mundane, spaces can offer the composer a new perspective or starting point in their compositional process. From Traffic Rises (Francis, 2012b), see sound example one, is a context-based, site-generic, spatial composition for eight acoustic instruments, four speakers and an electronically manipulated soundscape which developed from a pedestrian bridge. This paper outlines the chronological process of creating this new work, discussed here as a case study, beginning with the initial discovery of the site, the testing stages, sound experiments, compositional process, notation choices and the final performance.

2. SITE-SPECIFICITY

British performance theorist Fiona Wilkie looks deep into the degrees of site-specificity of site-based creative work. In her paper entitled Mapping the Terrain: a Survey of Site-Specific Performance in Britain she argues that there are varying degrees of site-specificity by asking the question ‘Does site-specific imply site-exclusive?’ (2003, p. 149). Wilkie’s paper goes on to provide useful definitions for when an art work is truly site-specific by offering a scale of varying degrees of site-specificity.

Figure 1. Degrees of site-specificity in music, adapted from Fiona Wilkie’s diagram in relationship to theatre (Wilkie, 2003, p. 150).

Figure 1 shows Wilkie’s five degrees of site-specificity from Inside a Concert Hall, which in this case refers to a traditional performance situation for music. Outside the Concert Hall, refers to a similar traditional performance situation but in a different location, for example a Symphony in the Park performance. Site-sympathetic refers to placing a new or existing musical work into a site that is sympathetic to the essence of the musical work. This degree of site-specificity deals with metaphors and connections to site that do not run as deeply into the physical, cultural or historical significance of the site as the last two degrees of the scale. Site-generic refers to works that are created incorporating characteristics of the performance site which could be found in other like sites. In a musical context this could be referred to as sites having similar acoustic characteristics, such as reverb. This would enable the work to be toured to similar sites with equal success while still maintaining that deep connection to the characteristics of the performance site. Wilkie’s final description, Site-specific, goes further again to a performance or work that is specifically generated from (or for) a selected site. For a work to be truly site-specific it must reference deeper layers of the site: historical, social or physical characteristics such as found objects or sounds. Site-specific, as referenced by Wilkie, must be so connected to a site that it cannot be performed in any other place.
From Traffic Rises is a site-generic composition, in relationship to Wilkie’s scale, because the traffic soundscape sourced from the pedestrian bridge could have been sourced from any traffic from any bridge, yet it is the translation of the chosen site into an immersive, circular concert hall listening environment and the complex relationship between the site and the sound that is the key to the work.

3. INTRODUCTION TO THE SITE

From Traffic Rises began with a personal experience standing on a pedestrian bridge near the Frankfurt Airport on a trip to Germany in July, 2012. While walking across this bridge I was immediately struck by the spatial definition of the immersive soundscape, created by the continuous but irregular pulse of the traffic passing beneath me, much like John Cage’s fascination with the sound of the traffic suggesting that ‘if you listen to Beethoven or to Mozart you see that they’re always the same. But if you listen to traffic you see it’s always different’ (Sebestik, 1992). The different sounds of each vehicle worked as sustained tones fading in and out and panning from side to side as they travelled under the pedestrian bridge, coming from both directions. The varying velocities, volumes and tones meant there was a constant soundscape but one with rapidly shifting textures and tones within an interesting listening frame.

On my return to Perth I found the Britannia Road Footbridge in Leederville which crosses the eight-lane Mitchell Freeway. I felt that this 120 meter long suspension bridge structure size and positioning of the bridge warranted a site visit for some active listening.

4. PRE-PRODUCTION

I spent an hour on the Britannia footbridge experiencing the site, as dance theorist and choreographer Victoria Hunter suggests: ‘just to enter the space alone and simply ‘be’ in the space in a series of moments’ (Hunter, 2005, p. 372). I was on the bridge at around 11:30am and the traffic was not dense. This meant that the vehicles were able to travel at their maximum speed, creating a much louder sound than if I was listening during peak hour and the vehicles could only travel slowly. The traffic was quite even in each direction which gave the site a balanced immersive sound while listening in the middle of the bridge. The closer I listened, the more musical detail I heard and the more interesting it became, a technique Cage speaks of in reference to boring things; ‘If something is boring after two minutes, try it for four. If still boring, then eight. Then sixteen. Then thirty-two. Eventually one discovers that it is not boring at all’ (Helm, 2014). This was true of this soundscape which had the same mesmerising feeling of listening and watching waves crash onto the shore. There was a comfort in the constant pulsating monotonous soundscape.

Some vehicles were louder than others and had unique sound qualities. Motorbikes pierced the soundscape with higher pitched and louder timbres, while trucks had a deeper humming sound quality. On one occasion an open tray vehicle passed carrying something wrapped in loose plastic which was vibrating very loudly creating an aggressive fluttering sound.

I spent this time listening, journaling what I heard and making field recordings. As in Frankfurt, I was struck by the musical potential of this site. It featured many qualities that I would use to create a composition - pitch, rhythmic gestures, textural variation, colour and dynamic shape. It was on this first active listening and field recording session that I noted ‘volume swells, panning effects, sustained tones’ (Francis, 2012a) in my journal. These elements would become the starting points for the composition.

Initially I wanted to compose this work so it could be performed live on the bridge, blending acoustic instruments with the natural occurring soundscape. To test this idea I invited two improvising jazz musicians to participate in some experiments on site. I took two collaborators of mine, Ben Collins on saxophone and Ricki Malet on trumpet, to the footbridge to document their responses to the soundscape and how they would express the site in their playing.

I asked the two musicians to focus on the sounds that surrounded them by guiding them through some active listening, pointing out the sounds and musical elements I had experienced at the site. I asked them to improvise, interacting with the sounds around them rather than each other. The result was sound imitation, responding to the sounds of vehicle engines, copying the dynamic shape of sounds approaching and disappearing, as well as altering instrumental timbre to imitate vehicle sounds. The musicians’ improvisational approach was a quieter dynamic to how they would play in a conventional ensemble allowing them to blend with the soundscape rather than dominate it. There was a real sense that they were playing with the space rather than just in the space much like Paul Horn’s 1968 solo flute improvisations in the Taj Mahal when he recalls that, “I listened and responded, as if I were playing with another musician” (Horn & Underwood, 1990, p. 200). It was that close connection between the musicians and the site that I was interested in and wanted to explore further.

5. PRE-PRODUCTION FINDINGS

From these improvisations, my own active listening sessions and field recordings, four strong compositional elements were created - sustained notes, volume swells, glissandi and bidirectional spatial movement. These four musical elements were derived directly from the sound of the traffic passing under the footbridge.

5.1. Sustained Notes/Continual Sound

This almost ever present, sustained soundscape was created by the continual appearance of vehicles on the freeway, ‘a flat continuous line in sound’ (Schafer, 1994, p. 78) made up of engine noise, the friction of the tyres...
on the road and the wind reacting with the size and shape of each vehicle.

5.2. Volume Swells
The volume swells are created as each vehicle approaches, fading in, and then fading away as the vehicle moves away from my position on the bridge. This position was also the loudest point for the listener. The combination of these continual and subtle effects make up the larger sustained soundscape mentioned above.

5.3. Glissando
Glissando in musical terms describes the slide from one pitch to another (Kennedy, 1994, p. 346) through the infinite number of microtones between the fixed notes of the tempered scale. Fretless string instruments are able to create this effect easily by sliding a finger up or down the neck of the instrument. The trombone is also able to produce an effective glissando between specific notes. The glissandi heard in the traffic soundscape is the result of what is known as the Doppler effect; a sound phenomenon created by the relationship of ‘movement between the sound source and the listener that provokes either a compression or an expansion of the sound wave’ (Augoyard & Torgue, 2011, p. 39). As a vehicle approaches the listener, the sound waves compress, bending the pitch upwards, sharpening it slightly, and then as it passes, the sound waves expand causing the pitch to bend downwards, flattening as it moves away. The effect of the pitch bending downwards was more prominent in this particular soundscape.

5.4. Bidirectional Spatial Movement
The effect of bidirectional spatial movement was created by the aural sensation of the vehicle sounds passing in different directions. It was best experienced by standing in the middle of the bridge and facing in the direction of the moving traffic\(^1\) so that each ear could evenly perceive both sides of the panning. The left ear hears the vehicles approaching from behind and the right ear hears them approaching from the front.

6. REFLECTION ON EARLY FINDINGS
After the testing, while the musicians and I reflected on the findings, the topic of rhythm and tempo and how they would be dealt with was raised. The soundscape from the bridge is a constant flow of sounds and pitches fluctuating subtly in what seems to be a random series of events. The musicians noted that they were constantly trying to superimpose tempos that would work with the random fluctuations in the traffic noise, rather than just freely responding and interacting. This characteristic made me think about creating a composition that avoided obvious metronomic tempo throughout - just like the soundscape. Then I began to wonder how I could best communicate such an idea to the musicians. I considered the possibilities of traditional notation systems, guided improvisation and graphic notation.

I considered the bridge’s relationship to be site-generic on Wilkie’s scale, as my compositional idea could work with any other footbridge soundscape to some degree. From memory, the Britannia Footbridge soundscape sounds almost identical to that of the footbridge in Frankfurt. While this piece does not rely on a specific footbridge to be successful, it does need the soundscape of a footbridge to create the piece, so the definition in regards to the compositional process and material is site-generic.

As the soundscape exists naturally without any interaction, that is, the performance of the musicians on the bridge did not alter the sound of the traffic for a listener on the bridge, I considered making the field recording of the traffic part of the work, combining acoustic instruments in a traditional performance space. The challenge was to find an effective way to reference the field recording in the work.

To translate the four musical elements (sustained sound, volume swells, glissandi and bidirectional spatial movement) to acoustic instruments, I adopted some spatial characteristics of the site in early tests. By overlapping the instruments sustain time, just as the vehicles approaching the bridge overlapped due to the multiple lanes, a long continual sound can be created. This was particularly useful for instruments limited by breath. Volume swells are used regularly to create dynamic shape in music through crescendo and diminuendo. However, the glissandi and bidirectional spatial movement required some further investigation, so I devised a series of tests to experiment with ways of creating these effects and sounds on acoustic instruments.

7. COMPOSITIONAL TESTING
I organised a test workshop of five musicians (three trumpets, alto sax and tenor sax) to meet off site to experiment with some of the musical elements discovered during the pre-production phase. The focus of this test was to recreate the soundscape of the bridge with acoustic instruments and to recreate the bidirectional spatial movement effect created by the passing vehicles.

7.1. Using the Soundscape
The first test required the musicians to imitate what they heard in the soundscape recordings, and to attempt to blend with it. On the first attempt it became apparent that the musicians were listening to each other rather than the soundscape. This resulted in them playing long chords together like they were being cued by a director. This effect was undesirable as it distracted from the flat line sound that was produced by the soundscape. I wanted the musicians to interact with the soundscape to enhance this idea of flat line sound rather than just playing over the top of it.

\(^1\) Australians drive on the left hand side of the road.
On the second attempt a much quieter and subtle overall texture was created. When the musicians’ focus was on listening to the soundscape, they played in a much calmer and focused way as they did not have the feeling of competing with the other musicians. Because the soundscape is quite monotonous in nature, with only subtle changes in the texture, it meant that the musicians had to acquire significant focus to develop or reflect a texture in the soundscape. Once everyone played more subtly, the music and the soundscape were able to breathe and the musicians had room to express their ideas.

Also during this play through, some of the musicians started using extended and textural techniques on their instruments, such as breathing air through the instruments creating a similar effect of wind friction as the vehicles were passing. Melbourne based trumpeter and improviser Peter Knight calls this technique ‘un-pitched breath sound’ (Knight, 2011, p. 56) and describes it as ‘a unique aesthetic using breath blown through the trumpet [wind instrument] almost exclusively’ (Knight, 2011, p. 56). This was a useful texture and it can be produced at a very low volume as no pitch needs to be produced. I thought that this could be a subtle way to introduce the sounds of the instruments into the composition without the production of pitches, while still being related to the soundscape.

The next test was to recreate the soundscape experience without the field recording, however I found that this experiment resulted in a sparse, empty ensemble sound. I wondered if a larger number of instruments would be able to create the full effect of the soundscape, but as I only had access to eight musicians for the project, I didn’t pursue further testing. This did make me aware of how much the recorded soundscape contributed to the overall texture, creating an overall ensemble sound, and reinforced the idea that the soundscape was an integral contributing member of the ensemble. From this point I decided that the inclusion of the field recording as part of the composition was essential.

7.2. Realising the Bidirectional Spatial Movement

The next test was designed to create the spatial sensation similar to that of traffic passing by the listener on the bridge with only acoustic instruments. The idea was to create the feeling, or sensation, of making a pitch travel from one side of the room to the other without the physical movement of the musicians, much like panning between speakers.

When I first experienced this sensation on the bridge, I was not sure how I could use it as a compositional tool but I did note that it had potential. When standing in the middle of the bridge, facing the freeway, it allowed both ears to evenly perceive both sides of the traffic travelling in both directions. I will be using the term bidirectional spatial movement to describe this sensory perception of sound travelling through space in opposite directions, divided physiologically by the median plane. This was the first time I had ever considered a spatial sensation as a compositional device in my own practice.

I initially tested the bidirectional spatial movement with two acoustic instruments, both trumpets, seated on either side of the room. I imagined trying to move a sound from one side of the room to the other like throwing a ball. I asked the first musician to play a single pitch and volume to gauge any kind of movement, but I could find none. I then asked Musician One to play the same pitch as before but to use a crescendo to give the pitch some movement through the space, as this what I heard in the traffic soundscape. The fluctuation in dynamics gave the pitch a sensation of physical movement within the space, travelling forwards and upwards when the volume was increased and downwards when the volume was decreased. While it did create some movement, it still largely sounded like it was coming from a single source in the space, rather than travelling across the room. The challenge was now to use that movement to pan the pitch to Musician Two on the other side of the space. We then experimented with Musician One creating a pitch, gradually crescendoing and then stopping as Musician Two attacked their note and then created a gradual decrescendo. This did not work as the transition between the two instruments was too obvious.

After some discussion and experimenting with note lengths, speed of crescendo and decrescendo, attack and dynamic range, I came to the conclusion that the transition worked best when Musician Two would anticipate the peak dynamic of the pitch and, in a way, initiate the transition by matching Musician One’s pitch, volume and tone, then panning the pitch to his side of the space with a gradual decrescendo. At this stage it was important for Musician One, after passing the note, to make sure that his decrescendo was even, but under the dynamic of the Musician Two.

This experiment involved the listener positioned at the side perceiving the pitch panning from left to right, in a somewhat two dimensional way. When this technique was performed correctly I could perceive, especially with my eyes closed, the pitch panned through the space from one side of the room to the other. The success of this experiment led to creating a more immersive sound with the pitch encircling the listener.

Since we could pan a pitch from one side of the room to the other, I wondered if we could create a sound that felt like it spun around the room. This idea was influenced by the immersive spatial sensation of standing on the pedestrian bridge. To perceive the sound spinning around the space I thought the ideal listening position would have to be in the centre of the ensemble, much like positioning myself in the centre of the bridge to experience the full spatial effect.

To start this experiment I followed on from previous tests. Instead of panning the pitch across the room, all five musicians stood in a wide circle and panned the pitch to the person standing next to them around the circle, using the techniques learnt in the previous tests. What soon became obvious was that to keep the pitch moving seamlessly, the attack of a note could not be heard as it distracted the listener away from where the focus of the pitch was in the space.
To address these issues I had to allow the musicians enough time to prepare and sound their note without an audible attack. This was done by allowing the musicians enough time to anticipate their entry, well ahead of when the note needed to be at its loudest. This meant that all five musicians were playing all together to create the illusion of a pitch spinning around the room. Figure 2 is a traditionally notated representation of this experiment with five musicians.

**Figure 2.** Musical representation of the circular spatial movement.

I also found that the decrescendo of the note was just as important as the crescendo as it supported and created the effect of the sound moving away. If a musician played their decrescendo too quickly it sounded like the pitch jumped abruptly to the next musician, rather than gradual panning. This was an important discovery, as I had been focused on the beginning of the transition and not always listening for the transition after the note was passed.

There was a difficulty with pacing when working with the ensemble on this idea of circular movement. In the beginning I tried to rely on the musicians listening to each other, but this became more and more problematic depending on the ensemble size and the space we were working in. I decided to direct the circular movement myself, by standing in the middle of the space and spinning in an anti-clockwise direction. I used my left hand to direct the musician to start their note and crescendo until my right hand was pointing at them. This direction informed the musicians of their entry point and the moment that their pitch should be at its loudest. They were responsible for the gradual decrescendo that followed. This idea for circular ensemble direction came from Schafer’s book, *Ear Cleaning*, where he instructs the conductor to work with a circular formation of students singing to create a similar circular movement in the space; ‘The student conductor with both arms outstretched slowly pivots so that only one portion of the class is heard singing the tone as it slowly moves about the room in a circle’ (Byrne, 2012, p. 10).

This technique of directing the ensemble was successful and did produce the best results so far. However, it was not practical to do over a period of time as I got dizzy and would need to be in the centre of the space, which is where the ideal listening position would be. It was at this stage that the importance of notating the piece came into the planning. I needed a way to communicate the piece to the musicians, which was free of tempo and without the use of a conductor to hold the ensemble together. Graphic notation seemed like the best way to communicate this musical idea.

7.3. Space

After some reflection on previous tests, I began to formulate some compositional scenarios to utilise what I had achieved in the last session, whilst maintaining the compositional context to the site. I was considering whether to perform the work live on the bridge, utilising the natural occurring soundscape, or to use the field recording and translate the work into a more formal performance setting. The audience logistics and inconsistency of the outdoor bridge venue made me lean towards using the soundscape field recording in a concert hall performance. This decision was also strengthened when I was able to hear how both the acoustic instruments and the field recording sounded in a rehearsal space. The spatial movement, especially in its circular form, would have been difficult to present on the bridge as it is not wide enough to create the ideal circle around the listeners.

7.4. Glissandi

The other compositional element found in the soundscape was glissandi, produced by the Doppler effect. A long glissandi is difficult to produce on most brass and woodwind instruments as the musician needs to press down keys or valves to produce their *in between* pitches. Strung instruments with no frets and instruments with slides are able to produce longer glissandi as they are able to slide between the set pitches. While most brass and woodwind instruments can’t produce long glissandi, they can produce a short one by adjusting their tuning with either their embouchure or half-valve techniques. Trumpeter Ricki Malet was so successful with his small glissandi that ABC presenter Stephen Adams assumed that Malet was playing a ‘¼ tone flugelhorn’ (2012). My thought was that I could create a long glissandi between all of the musicians by creating a series of very small glissandi while panning the pitch around in the circular formation.

For this test I used eight musicians (same as the final performance); three trumpets, two alto saxes, one tenor sax and two trombones. The focus for this test was to recreate the same circular bidirectional spatial movement exercise we performed the last time, but as the pitch panned to each musician they would slightly sharpen the pitch. The next musician would then listen to, match the pitch and then bend a bit further once it was their turn. Because the musicians were anticipating their notes ahead of time, to avoid hearing their attack, and crescendoing slowly, it gave them time to aurally match the pitch and continue to bend it. This produced a long glissandi over a much larger range than was easily possible for a single woodwind or brass instrument, however there were issues with the evenness of the glissandi because the musicians were finding it difficult to keep track of where the pitch was and when it was their turn to contribute. In some cases the pitch would arrive to a musician in between a pitch from the tempered scale, and depending on what instrument they were playing, this was not easy to pitch or create on their instrument. Some of the musicians asked if there was a way that I could notate this so that the glissandi could be
distributed more evenly over the ensemble. After some discussion I decided that a semi-tone could be divided between two musicians to allow a slow, deliberate glissando. We tried to do this without notation but again the same problems occurred as the musicians could not keep track of where the pitch was at any given time.

8. FIRST COMPOSITIONAL DRAFTS

8.1. The Soundscape

As this project progressed it became clear, with all the circular effects, that the ideal listening position would have to be in the centre of the ensemble. This would now affect how I would use the soundscape, as originally I was going to compose this piece to be played on the bridge with acoustic instruments. I now needed the right physical space to position the musicians around the listeners.

To make the relationship between the acoustic instruments and the soundscape more meaningful, I decided to manipulate the field recording of the soundscape to complement the spatial effects played by the acoustic instruments. To do this, I asked Perth based MaxMSP programmer, Dr Stuart James, to electronically manipulate my soundscape field recording live during the performance. James was able to separate, through the use of spectral noise reduction software, the environmental background noise from the traffic movement; a process which allowed the separation of ‘both sounds to be panned independently using a different kind of spatial motion: the vectorial spaces of the moving traffic and the panoramic space created by the background environment’ (James & Hope, 2013, p. 82). Once this was achieved, we were able to construct a soundtrack to accompany the score. This soundtrack was diffused in real time by James using MaxMSP, across four speakers with background noise ‘dispersed randomly around the space, surrounding the audience, and the moving sounds were spatialised using translations across the space spectrally in a bidirectional way synonymous with the flow of traffic’ (James & Hope, 2013, p. 82).

8.2. Notation

Other artists use graphic notation to communicate an experience, as Mace Francis does in his attempts at drawing the audio shapes of passing traffic through his preferred acoustic instruments in From Traffic Rises. (Hope, 2013)

Schaffer defines the notation of sound as ‘an attempt to render aural facts by visual signs’ (1994, p. 123). Music notation, including traditional and graphic, is ‘generally prescriptive – it gives a recipe for sounds to be made’ (Schaefer, 1994, p. 123). Perth composer and musician Dr Cat Hope defines graphic notation ‘as the representation of music through the use of visual symbols that do not make part of traditional music notation, or are used in conjunction with it’ (2013). From Traffic Rises was my first experience in creating graphic notation for a composition. I usually employ conventional notation systems but I found that because of the spatial, temporal and textural nature of this composition, it was necessary to communicate the score through graphic means. My score was hand-drawn using coloured pencils onto four pieces of A4 graph paper in the landscape format, scanned and then stitched together using Adobe InDesign computer software to create a long PDF version of the score which was then translated to the Decibel ScorePlayer (Wyatt, 2013). The Decibel ScorePlayer is an application (app) which ‘enables network-synchronised scrolling of proportional colour music scores on multiple tablet computers’ (Decibel, n.d), specifically the iPad (Wyatt & Hope, 2013, p. 206). The Decibel ScorePlayer provides a linear, time-based, visual scrolling score player that enables any image file to be read at any speed across a line indicating the point of performance. It allows the musicians to visually follow the composition in coordinated time without the feeling of an internal metric pulse allowing the music a rhythmic freedom which is what I was trying to communicate in From Traffic Rises. Each horizontal square of the graph paper represented one second of time passing, indicating the pace which the score scrolled by in the player. Each musician used individual iPads, which were networked together enabling coordinated synchronization of the scores, eradicating the need for a conductor. It also meant that each musician could be positioned anywhere in the performance space with no worry about being able to see each other or a conductor.

My score for From Traffic Rises, while graphic, did still indicate specific pitches. The advantage of the graphic score and the reading of it in the Decibel ScorePlayer was that the ensemble was able to play without the ‘traditional notions of rhythm and tempo’ (Wyatt & Hope, 2013, p. 202). This was what I had experienced in the soundscape and what I wanted to communicate to the ensemble.

The musicians were placed on the score in the order in which they were positioned in the space. Each instrument was to read the score from left to right along their horizontal ‘pitch line’ which was coloured for ease of reference. The order for the premiere performance was alto sax (pink), trombone 1 (orange), trumpet 1 (purple), alto sax (green), trumpet 2 (yellow), trombone 2 (red), tenor sax (brown) and trumpet 3 (blue). The musician’s entries are indicated when the Decibel ScorePlayer’s vertical red line joins up with the vertical black ‘entry line’ of the instrumental part. The example below (figure 3), although in black and white, shows the score players vertical line at the 1’16” entry for the alto sax (top line instrument). The alto sax then finishes playing when the score player’s vertical line gets to the end of the instruction.
8.3. Playing Instructions

The musician’s playing instructions are indicated before the entry line, allowing the musicians time to prepare for the next instruction before playing. There are only a few performance instructions in this piece to avoid confusion.

When the word AIR is seen before the entry line, the musician is asked to blow air through their instrument without creating a pitch. The first of these entries can be seen above in figure 3 at forty-five seconds, with trumpet one being asked to blow air through his instrument for three seconds.

The horizontal black block on the musician’s coloured play line indicates the length of the note, in the example mentioned above, three seconds. The black line below the coloured play line is for the dynamic instructions. In the figure 3 trumpet one part, it is a solid block which means keep at a steady dynamic. If the dynamic shape undulates, then the musician is asked to follow the dynamic contour.

The next performance instruction is ? . This asks the musician to improvise, imitating and interacting with what they hear in the recorded soundscape. These improvisation techniques had been workshopped with the musicians in numerous rehearsal sessions leading up to the performance. These improvisation sections were scored for the musicians to improvise in a way that had been rehearsed, but still allowed freedom for the musician to make informed decisions based on what was happening in the soundscape at the time.

The first of these improvisational entries happens at 1’15” (marked along the top of the score) in the trumpet 3 part, with the solid black block on the blue line indicating the length of the note and the dynamic contour is seen below the blue line.

Pitch names are indicated as English letters and given in concert pitch before the entry line. The arrows beside them indicate where the note is positioned in relationship to concert middle C. For example:

- E↑ E4: the E a major third above middle C
- E↑↑↑ E5: the E in the top space of treble clef
- A↓ A3: the A a minor third below middle C

If no instruction is given before the entry line then the previous instruction is assumed.

To create the Doppler effect and the ensemble glissandi section, it was necessary to coordinate the relationships between duration and tuning with each musician. Duration is indicated by the scrolling time, while the tuning of each pitch is indicated by a black line in relationship to the coloured play line. The coloured play line represents the pitch, in tune, which was indicated before the entry line. The distance away from the coloured play line and the curve in the pitch line instructs the musician to bend the pitch, within the semi-tone, depending on the direction.

When the pitch line above the coloured play line is curving upwards, this indicates either playing sharp or sharpening the pitch. When the pitch line is below the coloured play line or moving downwards, this instructs the musician to either play flat or flattening the pitch they are currently on. In figure 4 at 3’10”, the trombone 1 is instructed to play a concert C above middle C slightly sharp and then over the period of three seconds, flatten it back into tune while also playing a diminuendo to no sound.

9. PERFORMANCE

For the premier of From Traffic Rises The Roundhouse Theatre at Edith Cowan University was chosen as it was
the ideal space for performing this composition because of its very dry acoustics, which allowed the sound to move with clarity and no reverberation to diffuse the direction of the acoustic sounds produced. The round shape and the size of the space was the ideal performance situation, as it allowed me to position the musicians and the speakers in the very best position for the success of the work. The spacing between the audience and the musicians was approximately one metre further away from what we had been experimenting with in the early stages of testing, but this did not affect the listener’s experience at all.

Because of the space and the acoustic instruments chosen, I was able to get a good balance between the manipulated soundscape and the instruments. This was the key to the success of the piece as the listener needed to hear all the elements of both the electronic and acoustic parts clearly to perceive the spatial motion. It also reinforces the necessity of having a specific performance set up to facilitate this site-generic composition.

10. CONCLUSION

From Traffic Rises had taken me the furthest away from my usual composition practice than I had ever been. There was no real sense of traditional musical elements like melody, harmony or even rhythm and it was my first foray into using graphic notation. Even using an electronic element in a composition was new to me. Although I was dealing with a new compositional process using new sounds and musical elements, the process did not feel forced, as if I was trying to do anything new for the sake of it, because all the ideas began and grew from the context, development and exploration of the pedestrian bridge. It was a very satisfying process to begin with a physical site that did not necessarily offer any acoustic response as such, but rather a soundscape that exists in a real world space.

11. REFERENCES


SPLINTER AT MUNGO: THE ART OF COMMUNICATION

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ABSTRACT
In 2015, the Splinter Orchestra received an invitation to be part of Tectonics Adelaide in March 2016. Rather than fly directly to Adelaide, 21 members of the Sydney based orchestra decided to travel via land, rehearse and play on the way, and record for a number of days in Mungo National Park, NSW. This paper describes the working methods of the orchestra, their members’ conceptual pieces, and its approach to site specific elements and the environment during this epic week.

1. INTRODUCTION
The Splinter Orchestra, formed in 2002, is a large-scale ensemble, consisting of a fluctuating number of members with various backgrounds: improvisation, jazz, classical, electronic, electro-acoustic, visual art, sound art, environmental sound, acoustic ecology and field recording. Some of the members are highly skilled and conservatorium trained instrumentalists, others are conceptual thinkers playing a just found object for the first time. Despite its size (which can be 30+) the leaderless and conductor less orchestra usually hovers around minimalism, and is based on a social, democratic, gender equal, and non-egotistical view towards cooperation via improvisation, conceptual ideas and site-specific conditions. Over the years, the Splinter Orchestra has become a social and artistic meeting point and a way to test and recalibrate one’s own ideas.

From early 2015, Splinter resides in Tempe Jets Sports Club, near the Sydney airport, and rehearses weekly in various configurations in either their small studio or elsewhere on the premises: the bowling field, entrance hall or the parking lot. In January 2016, the month leading up to their departure for Adelaide, the orchestra celebrated their 15th anniversary with an approximately five hour long concert as the conclusion of the NOWnow festival in Sydney. During this concert, 102 (!) present and previous members were invited to play along within allocated time slots, related to the year of their involvement, either in the venue itself or via communication media (Skype, Google Hangout and even ‘good old’ ordinary phone). Eight computers provided an individual dedicated ‘voice’ for several members residing in Melbourne, Brisbane, New York, Tokyo, Berlin and elsewhere.

A large scale installation outside the building took place before and during the concert, adding yet another layer to the event.

Figure 1. The time slots, from 2003 - 2016, with allocated names of 102 participants for the performance during the NOWnow 2016 festival.

Figure 2. The Splinter Orchestra at the NOWnow festival 2016, showing the computers, used by members who were unable to physically attend.
2. CONCEPTUAL PIECES

During rehearsals the orchestra had condensed a number of ideas into two clear conceptual pieces, Microphony and Air Hockey, which were both programmed by the Tectonics Adelaide festival.

2.1. Microphony

As is usual with recording techniques, a finalized recording is a fixed balance of the involved instruments between left and right channel. The Splinter Orchestra utilizes an additional source by having one or more persons as ‘microphonist’.

By walking with a hand held microphone amongst the musicians, these microphonists can use their microphone as instrument to ‘magnify’ and enhance certain sounds. This technique can be used in a number of ways: to add perspective to two-dimensionality; or, more conceptually, by performing in one space and sending the microphonists’ output to a PA in a secondary space where the audience resides.

![Figure 3. Audience members amongst mattresses with cookies, listening to a dozen fishing rods with attached vibrators activating a number of bowls on the lawn bowling lawn.](image)

2.2. Air Hockey

In Air Hockey, a performance area (the ‘arena’) is defined beforehand. The participants go, in a more or less straight line, from somewhere on the borderline to another point on the borderline, whilst playing a more or less clearly definable sound. They alter their sound when ‘bouncing off’ the borders of the ‘arena’. Whenever two (or more) people accidently ‘collide’ they stop and play together whilst others join them to form a cluster of musicians creating a musical event. This process repeats itself multiple times during a performance in an improvisational fashion.

In this way, independent, individual sounds continuously occupy the space as a whole, and a clear overall musical form is generated via the ‘co-op clusters’ and their musical statements. During the rehearsals and recordings in Mungo National Park, this concept was used a number of times in a number of different spaces, mostly outside.

![Figure 4. The Splinter Orchestra at Tempe Jets Sports Club.](image)

![Figure 5. The timeline and ‘arenas’ for Air Hockey during Tectonics Adelaide.](image)

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1 Aside from this bowling field, the Splinter rehearsal room was turned into an “instant poetry” room with computer controlled turntables playing spoken-word LPs.

2 28/05/2015: Maasive Lates: The Absence Of... http://www.vividsydney.com/event/ideas/maasive-lates-absence-0.
The above picture shows the overall plan for a 70 minutes long performance of Air Hockey as the ‘kick-off’ of Tectonics Adelaide. There are three defined areas: 1: ground floor including outside the entrance; 2: 1st floor and balcony; and 3: the Auditorium (the main hall). Also the elevator (my personal favourite because of its ‘beam me up, Scotty’ factor) and other niches were used. These areas and time slots were guidelines only and morphed into one another, whilst rogue members, following their own inspiration, were part of the concept.

The performance was confusing for the audience (and sometimes ourselves) as it was not always clear what was part of the planned performance and what was part of accidental occurrences (such as an obtrusive pizza eating man and a person fainting and injuring his head). For the orchestra members, moving around in a straight line and clustering was challenging because of a large audience (400) occupying the same space.

The finale arrived when the orchestra after a state of consensus, standing against the walls surrounding the then seated audience in the main hall, started a giant turning wheel by walking anticlockwise around the outer edge.

So, what does this all mean and how has Splinter changed during this week?

3. LAKE MUNGO

When first arriving at Lake Mungo, I was completely struck by a unique mixture of extreme serenity and extreme harshness. Remains of both a cremated woman (Mungo Lady) and a man (Mungo Man) were found at Lake Mungo, proving that a human civilization has been living there for 50,000 years, making it one of the earliest human occupied places on our planet. Even though the ‘lake’ has been dry for approximately 15,000 years, I could still sense the history of water. The east outer area of Lake Mungo consists of large sand dunes in which I personally felt alien and secluded from the world. The present area is ancient in the sense that it looks the way it has appeared for thousands of years.

The trip from Balranald, the last option to buy the supplies needed for a stay in the Mungo National Park, to Mungo Shearers’ Quarters was a 150 km long dirt road during which my kidneys seem to circle through my insides a number of times. On the way we spotted a kangaroo, so badly injured that we had no other option but to kill her as mercifully and swiftly as possible, and hope her joey was old enough to survive. We had to deal with scorpions occupying the shower, and emus and feral cats as part of the landscape. I describe this to sketch how the orchestra had to come to terms with ‘down to earth’ life in cooperation with local climate, flora and fauna. Because of temperatures rising to 45°C during the day, the orchestra mostly recorded early in the morning and late during the evening, and listened to recordings during lunch.

Lake Mungo is full of juxtapositions to be drawn from when one is creating music within these site specific conditions, and when one is willing to ‘surrender’ and listen to the elements. In practice, when the orchestra was making sounds and music, I personally found it natural and easy to maintain a balance in between two extremes: focus in the moment versus letting things happen casually as part of an endless timeline.

Before producing sounds, the orchestra started with a few minutes of silence, tuning oneself to the place, and in this way connecting with the land and the sounds within, caused by native animals or the elements. We recorded and performed in a number of places: the huge woolshed, used by sheep shearers in the 19th century; the sand dunes; Zanci Homestead, an abandoned house with remains of chimney, toilet and agricultural machinery; and an airstrip in the middle of the ‘lake’.

![Figure 7. The Mungo woolshed, built in 1869.](image)

![Figure 8. The orchestra at Zanci Homestead, where they recorded a version of Air Hockey during sunrise in cooperation with accidental objects and local wildlife (e.g., aside from the inevitable flies, a butcher bird).](image)
4. EQUAL TEMPERED PITCH

During its voyage, the orchestra produced sounds based on their own inner logic and their relation to other sounds in an ‘un-hierarchical’ fashion. ‘Tuning’ is done in relation to oneself, others, the space, the environment and objects coincidentally present.

Although I am a pianist with a masters from the Amsterdam Conservatorium, have accumulated 35 years of experience in the music industry, and possess a PhD in composition from the Sydney University, it felt strange and confronting to arrive at the Adelaide Town Hall and hear the Adelaide Symphony Orchestra play a fixed composition in a tempered scale.

Music, lead by a single person and played in equal tempered scales, felt narrow to me in the sense that, within an octave, only a grid of 12 arbitrary pitches out of an infinitive amount were used, and only one person’s (the conductor) interpretation of the moment was allowed to eventuate.

What I used to perceive as being ‘in tune’ had become ‘dissonant’ and out of tune, and vice versa. During the days before the Adelaide event, my ears had been ‘sharpened’ and renewed, achieving an unbiased open state towards sound, regardless of origin, pitch and colour, and, perhaps most importantly, without hidden agendas.

5. SPLINTERS OF THOUGHT

"something was changed that changes everything"

I am not the only one in the orchestra who felt changed during the described week in my attitude towards sound and music in a social context, and as part of a simultaneous discourse with the strange, remote, unique, amazing, ancient places Australia has to offer when one is prepared to listen and hear.

When I emailed the orchestra the question “How (if at all) has this trip changed your attitude/approach towards music/sound/Australia?”, I received a number of diverse responses1:

“I was overwhelmed with emotions when we arrived in Adelaide and performed at the festival after our road trip and three days in Mungo. These emotions swirled through my delusion of self and identification with the collective Splinter. I felt large parts of me dissolved into the collective, and in that state it was easier to catch the mood of the world.

In Indian music there is the notion of early morning, afternoon, evening and night ragas - as if part of the job of a musician is to attune to more than just the space. I’ve largely played outside in Australia with small groups or solo, so the experience of tuning to the world with a large musical barometer was new to me. And I loved it.”

- Jim Denley.

“The trip has realigned me to the poetics of sound / making sound. The profoundness within the process (in this case, the process being the

1 Personal email exchange, various dates 17 - 24th March 2016. Listed here in the order I received them.
final and only performance) in opening up 'moments of synchronicity' was a rare reality that I enjoyed in the moment. And also now in hindsight. I'm sure this was the case for everyone else in their own individual way. Reflecting on the trip, for me it is only the poetics of it all that has remained. I have been left with an almost intangible feeling to keep exploring in life"  
- Shota Matsumura

"I feel like the deep silence of Mungo has made it easier to listen in the dense sonic space of inner-west Sydney - like an ear recharge. I also feel like the lasting bonds made between members of the Splinter Orchestra has expanded musical possibilities in our Sydney scene. I can also remember times of deep relaxation whilst playing music, as if I finally had the space to see some musical idea to its complete resolution. I remember the experience being bigger than music, as I walked around playing the room with a mallet. This profound space is easily remembered as I now play music, like something was changed that changes everything. I also learnt the importance of not getting stuck in profundity, coz the music just happens:"  
- Drew Bougeois

"Music: it has reminded me of the importance of improvised music; a medium where everything and everyone can be included and each moment lived, shared and appreciated. It is a rarity to be completely immersed in an experience. It was after witnessing the quintets' and experiencing what I can only describe as 'grace' I walk away with the intention to continue opening the doors for these kinds of experiences for myself and others in my work in music and across the arts.

Sound: I found an importance in finding the mid-point between self and ensemble during our plays which I feel I haven't given as much reflection on until working with Splinter. When we had our gigs in the Adelaide Town Hall I found myself the performer again but within a sound context and I was challenged to question my practise. I'm now finding it interesting where performative action is imbued with or leads to sound making.

Australia: I'd like to return to the red centre and make more music."

- Mel Eden

"Immersion together at Lake Mungo followed up by performance at Tectonics was very satisfying for me. I think to share these experiences together reminds us of the value of our work. Focussing for 3 days on our music at Mungo, I’m sure will provide ongoing research incentives. Playing immediately after this at the festival was timely. To be appreciated (or hated and perhaps a little controversial), as we were in Adelaide, gives a welcome boost to confidence and perhaps a spur to further delving into the potential of this group. It's also a reminder that what we do is a fascinating process not just for us.”  
- Tony Osborne

“The trip to Adelaide Festival via Lake Mungo with the Splinter Orchestra had a great impact on me spiritually and as an artist. I was able to connect with my Indigenous heritage which until recently had been oppressed due to the devastating impact of the stolen generations on my family, like many others. This led to the inspiration to create a body of work exploring this search for answers and identity in my own life, which I'm currently developing.

Playing as much as we did, created such a densely creative atmosphere within which I was able to explore some things on a deeper level than I have previously, and I came to understand more fully what makes me tick as a musician and improviser. I also found the social aspects of sharing and creating with the group to be very healing and conducive to really amazing sonic results.”  
- Sonya Holowell

“The Splinter trip made me think about why we make music and who it's for, but mainly I felt it was about the joy of the moment, the joy of community and the joy of making sound. The experience has enhanced so many positive feelings for me including my appreciation of Sydney, greater Australia and the people in it. It has left me with a happy desire to engage and explore and continue involvement with sound-making.”

- Romy Caen

“I think mostly I just wanted to recognise how much gratitude I feel for the fact of the trip existing at all. In so many other contexts Mungo and Adelaide couldn't happen. The incredible warm connectedness of playing, even in the city, after missing the outback², was once in a life time and completely unique. As such an ephemeral art, for me, the shock of being part of making the music we did, in light of the connections that we forged, is feeling how deeply the experience has settled permanently and shifted something within me. How that plays out remains to be seen but I am excited and open to it.”

- Prue Fuller

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¹ Aside from the two major pieces, Microphony and Air Hockey, by the orchestra, Tectonics Adelaide also programed two sets by quintets made up from members of the orchestra: TQM4F1 and TQF4M1.

² Prue was not able to travel by car, therefore she missed the Lake Mungo sessions.
“It’s difficult to define or describe any specific change, but this trip has certainly brought up lots of questions and considerations for me…
• Awareness of and sensitivity to space: physical surroundings, climate, social space, acoustic ecology of a place, its history…. How do I relate to and engage with vastly different spaces, musically? And to the people around me who share this space?
• Why do I play music / Who do I play for? An audience? Recording? Myself or fellow musicians? How does an audience, or lack of, effect how I engage with music and the people I make music with? Can I just ‘be’ with the music as a process without being concerned about an outcome?
• Music as a social activity: leading up to this trip and throughout, Splinter has spent a lot of time together extra-musically. It feels like this has had a positive effect on the music. Functioning harmoniously on musical and social levels...
• Playing outdoors, and in harsh dry conditions, prompted me to consider appropriateness of my instrument (clarinet) in such spaces: what’s the best way to bring this instrument into relationship with this land - far away from where it was designed to be played - and what new challenges are faced when returning to a ‘concert hall’ style setting?
• It was interesting to observe an increased tendency in the group towards singing and ‘sounding’ the space… does this approach seem more appropriate? Considering/acknowledging the strong history and tradition of song in this country of which, I admit, I know too little about. How do we reconcile what feels appropriate in new spaces with what we work in our regular comfort zones?
- Laura Altman

“Post splinter trip my approach towards music, in particular collectively authored music, has shifted focus slightly - I realise now the key to opening many doors in terms of what can be explored socially and politically is ‘the collapse of boundaries between the aesthetic and the social.’
If sound is equal to silence, then my approach to sound has changed. In Mungo I experienced a richer silence than I ever have.
My approach towards Australia has changed in two ways:
1) Going to a remote place made me understand why I live in a city - why splinter's music lives and thrives in a city - it is born of and sustained by dense community
2) Woolshed - ‘Walls of China’
In every engagement I had with(in) it the Mungo woolshed, although majestic in it’s own right, was utterly dwarfed by the majesty of the natural environment in which it has been erected.
This helped me to understand more the notion of the built environment as scars on the land.”
- Andrew Fedorovitch

The above answers (very personal and sometimes taking the form of new questions) show how the members of the orchestra speak of an ongoing process of realigning and connecting; simultaneously with yourself, the ensemble, history, and the land we walk on; and realized via sound, music, playing, silence and, above all, via listening: the art of communication.

6. THE MEMBERS OF THE ORCHESTRA
The following is a list of the 21 orchestra members, and their instruments/tools, who were involved in performing at Tectonics Adelaide:
Maximilian Alduca (double bass), Prue Fuller (recorder, voice, objects), Mel Eden (voice, electronics, objects), Jim Denley (prepared flutes), Axel Powrie (flutes, alto clarinet, objects), Bonnie Stewart (percussion), Shota (‘Umofos’: electric guitar, trumpet), Peter Farrar (alto sax, PVC pipes), Adam Gottlieb (guitar, objects), Drew Bourgeois (percussion), Sonya Holowell (voice), Romy Caen (harmonium, electronics, objects), Cor Fuhler (guitar), Laura Altman (clarinet), Joseph Derrick (trumpet), Melanie Herbert (violin), Jack Stoneham (alto sax), Marco Cheng (acoustic guitar), Andrew Fedorovitch (alto sax), Tony Osborne (vocals, electronics), WeiZen (little critter, objects).

Figure 12. A mirror with decorative deer: Prue Fuller’s unique setup at the Adelaide Town Hall during Tectonics Adelaide.

7. REFERENCES
Lake Mungo:
https://en.wikipedia.org/wiki/Lake_Mungo
A CLASSIFICATION OF MULTI-POINT SPECTRAL SOUND SHAPES

Stuart James
Western Australian Academy of Performing Arts
Edith Cowan University

ABSTRACT
Previous research by the author has involved the investigation of sound shapes produced by the multi-point spatial diffusion of independent spectral bands. Fundamentally two implementations emerged through this research: one that primarily dealt with only the diffusion of spectra (i.e. spectral spatialisation) and another further extension of this approach that accounted for unique frequency-space distributions unfolding through time (i.e. timbre spatialisation implemented in the frequency domain). Through the process of exploring these possible sound shapes, a range of multi-point distributions emerged making it possible to form a categorical set of distinct multi-point distributions. The classifications were informed by the writings of Gary Kendall, Francis Rumsey, Robert Normandeau, Ewan Stefani, and Karen Lauke on spatiality, writings by Albert Bregman on auditory scene analysis (ASA), writings on directionality and immersion within the field of psychoacoustics, writings by Denis Smalley on spectromorphology, spatiomorphology, spatial texture, contiguous space, and non-contiguous space (i.e. zones), writings by Gary Kendall on spectral correlation and decorrelation, and writings by Trevor Wishart on spatial motion.

1. INTRODUCTION
The spatialisation of the spectral content of a sound enables the musical exploration of spatial percepts to a degree unobtainable with traditional point-source spatialisation techniques. While sound spatialisation has always been a fundamental part of the language of electroacoustic music, spectral spatialisation enables new timbral identities and morphologies to be explored (Kim-Boyle, 2008, p. 1). Whether imagined or experienced, both Ewan Stefani and Karen Lauke have described such spatial gestures:

A cluster of tones (heard as a single timbre) in one area of the space (perhaps from a single loudspeaker) can be gradually decomposed into individual frequency components which are dispersed to individual zones separated by an appropriate distance within the listening space. (Lauke & Stefani, 2010, p. 257)

Lauke and Stefani refer not only to timbre, but also to the notion of spatial de-composition and re-composition. Spectral analysis and resynthesis techniques may be seen as analogous to this process, traditionally allowing for the deconstruction and reconstruction of sound based on its frequency content (Lippe, 2003); a process that has been linked to the term spectromorphology (Smalley, 1994; 1997). This process of ‘decomposition’ is also one of the four necessary criteria for electronic music composition discussed by Karlheinz Stockhausen (1978). Just as sound can be de-constructed in various ways, its re-construction can take not only the amplitude and phase of each frequency into consideration, but may also determine the spatial re-distribution of each frequency. Documentation of such a technique is not new. Robert Normandeau (2009) discusses a technique of decomposing a sound source into between 4 and 16 bands using bandpass filters, and spatialising these independently. David Tpper et al (2002) also adopted a similar process when de-composing the sound of an input source into eight separate bands, and again spatialising these independently. Other research projects have used spectral analysis as a means of de-composing an audio signal into separate frequency bands, and then spatialising these independently (Barreiro, 2010; Keyes, 2004; Kim-Boyle, 2006, 2008; Lippe & Settel, 1993, 1999; Torchia & Lippe, 2003).

In parallel to these explorations in spectral and timbre diffusion, and in a closely related application, Gary Kendall (1994; 1995) documents a perceptual theory and application of signal decorrelation, a method that has been described for its ‘volumetric’ modelling of acoustic fields (Kaup et al., 1999). Time-varying spectral decorrelation techniques adopt time-varying all-pass filters that are used to filter the input signal. Kendall describes the effect of dynamic (or evolving) signal decorrelation as a:

…spatial effect akin to the sound of an environment with moving reflecting surfaces or moving sounds sources, such as the movement of leaves and branches in a forest … and dynamic decorrelation imparts a quality of
Due to the complex constructive and destructive interference of different frequencies across a sound scene, due to phase differences, the obtained output signals are perceptually equal but statistically orthogonal (Kendall, 1995). What is more, Kendall highlights the effect of decorrelated audio on the creation of diffuse sound scenes without the use of reverberation stating that the advantages of such a technique results in a reduction of image shift from different listening locations, the reduction in perceptivity of combing and colouration due to constructive and destructive interference, and reduction of the precedence effect (Haas, 1951; Kendall, 1995). Spectral spatialisation, and timbre spatialisation in the frequency domain, can result in similar outcomes: both outcomes are immersive (James, 2015a), can contribute to a widening of the listener area or ‘sweet spot’ (Normandeau, 2009), are capable of creating diffuse sound scenes without reverberation, and can reduce the precedence effect.

The advantage of spectral spatialisation and timbre spatialisation over spectral decorrelation techniques is the ease from which the multi-point spatial diffusion can be controlled, as the spatial sound shapes can be highly directional, zone-like, or completely immersive, and may morph between these states with ease. Some of these spatial transformations, or spatiomorphologies (Smalley, 2007), may follow some of the scene-based transitions outlined by Trevor Wishart (1996) in his discussions on spatial motion. Some of these transitions discussed by Wishart include scene contraction and expansion, rotation, translation, swing, twist, spiral, and distortion, and these have each been applied to multi-point distributions of sound spectra by Stuart James (2015a). These transformations are linked closely with Smalley’s notions of spectromorphology and spatiomorphology (James, 2015b). However, in order to classify each sound shape, it is important to compare momentary instances of spectral distribution, and distinguish these sound shapes within the theory and context of spatial music practice, those being notions of spatiality and the field of psychoacoustics.

### 2. TERMINOLOGY AND CONTEXT

Gary Kendall (2007) argues that the spatiality of electroacoustic music still lacks a definitive vocabulary. This is confirmed not only by psychoacousticians but also by conceptual artists:

Although there has been much value written about spatial attributes and the role of space, mainly by composers, the thinking is somewhat scattered, and as yet there is no substantial, unified text on the topic, nor any solid framework which might provide a reasonably secure basis for investigating space. (Smalley, 2007, p. 35)

Although interest in psychoacoustics emerged in the late 19th century, it has only been in recent years that perceptual research has been able to clarify a vocabulary for spatial attributes (Kendall, 2010; Yost, 2014). In 1990, Albert Bregman, a Canadian professor and researcher in experimental psychology, cognitive science and Gestalt psychology, designed and conceptually organised a field known as auditory scene analysis (ASA). Deriving attributes from the framework of ASA, Francis Rumsey (2002) uses the three ‘dimensional’ attributes: spatial width, distance and depth. Gary Kendall and Andrés Cabrera (2011) also discuss the attributes of direction and height. The spatial attributes that relate to our perception of immersiveness in reproduced sound—as outlined by Rumsey (2002) and Sazdov et al. (2007)—are envelopment, presence/spatial clarity and engulfment. Research by Robert Sazdov, Garth Paine and Kate Stevens (2007) has involved a perceptual investigation into envelopment, spatial clarity, and engulfment in reproduced multichannel audio. These attributes are listed in Table 1, where they are classified according to their dimensional or immersive quality, and they are further illustrated in Figure 1.

![Figure 1. A visual illustration of auditory spatial attributes in relation to the listener. Note. Image source: Kendall, 2011.](image-url)

<table>
<thead>
<tr>
<th>Dimensional attributes</th>
<th>Immersive attributes</th>
</tr>
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<tbody>
<tr>
<td>direction</td>
<td>envelopment</td>
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<tr>
<td>distance</td>
<td>engulfment</td>
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<tr>
<td>width</td>
<td>presence/spatial clarity</td>
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<td>depth</td>
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<td>height</td>
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Note. Image source: Kendall, 2011.

1 Also referred to in literature within the field of psychoacoustics as soundfield, although a soundfield should specifically apply to Ambisonics.
2 Helmut Haas discovered that we can discern the sound source despite additional reflections at 10 dB louder than the original wave front, using the earliest arriving wave front. This principle is known as the Haas effect, the precedence effect or, in the psychoacoustic literature as the law of the first wavefront.
3 This is dependent on the control interface used, and the author has discussed this in-depth elsewhere. Refer to James, 2016A.
Interaural intensity differences (IID)\(^4\), interaural time differences (ITD) and spectral cues\(^5\) are responsible for determining the *directionality* of sound sources. Depth of field, and the perception of *distance*, is determined by an additional set of auditory cues.\(^6\) *Spatial width*\(^7\) is defined as the perceived spatial dimension or size of the sound source\(^8\) (Potard & Burnett, 2004). Scientific evaluations in the fields of acoustics and psychoacoustics often refer to *apparent source width* (ASW) (Keet, 1968; Morimoto & Mackawa, 1998; Sato & Ando, 1999).\(^8\) *Listener envelopment* (LEV) is an attribute that is used to define the sense of immersivity achieved in a reverberant environment, such as a concert hall, where sound seems to be arriving from all around the listener (Ando, 1998; Berg & Rumsey, 2001). Although LEV is largely treated as a 2D attribute, *engulfment* is an immersive spatial attribute associated with the sensation of being ‘covered by sound’, and is unique to 3D speaker configurations (Sazdov et al., 2007; Lynch & Sazdov, 2011). *Spatial clarity*\(^9\) has been also identified as an important spatial attribute (Nakayama et al., 1971), and is closely related to ‘directional selectivity’ as it is placed within the same subdivision and therefore can be interpreted as being linked to other established attributes such as sense of direction, localisation or source localisation (Gustavino & Katz, 2004).\(^10\)

In terms of the listening experience, *timbre spatialisation* challenges traditional notions of spatialisation, such as single point-source techniques, since the kinds of movements that result from such a process do not easily sit comfortably with existing written taxonomies of *spatial motion* such as those found in Wishart’s *On Sonic Art* (1996).

Although the processes by which this research explores *spectral spatialisation* and *timbre spatialisation* draw on panning algorithms that rely on the fundamental theories of sound localisation, these low-level processes, due to their polyphonic and multi-point nature in practice, give rise to a range of immersive spatial attributes including spatial width, spatial clarity and envelopment. The exploration of multi-point spatialisation of sound spectra allow for the exploration of all of these dimensional attributes and immersive attributes, that is the perceived spatial width, distance, direction, envelopment and spatial clarity of such distributions. Most importantly, in the process of spatialatisation, such multi-point spatial distributions can shift between dimensional attributes and immersive attributes.

Albert Bregman’s ASA provides a framework that proposes several key inference processes that may inform the way in which we, as listeners, perceive the kinds of sound shapes that *timbre spatialisation* produces; that is, a number of independently spatialised frequency bands, or *auditory streams*. The theory of ASA suggests how a listener can perceive multiple streams of musical information through the processes of stream fusion and stream segregation. Any similarity in auditory cue, based on their vertical or horizontal organisation as they extend through time (i.e. pitch, timbre, location), may ultimately subserve streaming. In other words, streams will thus favor the grouping together of sounds that are perceptually similar, and segregate sounds which are perceptually dissimilar (Moore & Gockel, 2002). Auditory streaming theory describes audio objects as sequences displaying internal consistency or continuity, and ultimately serving the purpose of clustering related qualities (Kubovy & Valkenburg, 2001).

David Kim-Boyle (2008) stated that for most practical purposes when researching *spectral spatialisation* he found little need to explore more than 256 bands of frequency as the various individual trajectories cannot be discretely perceived but instead tend to coalesce into complex spatial gestalts. This issue of auditory fusion versus segregation largely has to do with the level of spatial correlation. Taking any broadband sound source and decomposing it into several, spatially distinct, point sources, if the correlation of movement of these distinct point sound sources is high, the human auditory system perceives them as a single auditory event, the location being perceived to be at the centre of gravity. The position of the centre of gravity depends on the positions and intensity gains of the point sources. However, if the point sound source movements are highly uncorrelated or weakly correlated, the human auditory system perceives the point sources as distinctly separated auditory streams, and results in the perception of a spatially wide sound source. However, if the point sources are densely distributed, it might not be possible to distinguish every single point source as a different stream because the human auditory system produces a

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\(^4\) This has alternatively been referred to as interaural level difference (ILD) by some authors.

\(^5\) Introduced by the reflection of sound off the convolutions of the pinna, the shoulders and the upper torso (Kendall & Martens, 1984).

\(^6\) The perception of distance has been attributed to the loudness, the direct v. reflection ratio of a sound source, sound spectrum or frequency response due to the effects of air absorption, the initial time delay gap (ITDG) and movement (Howard & Angus, 2009). Further research in the multi-point spatialisation of spectra have accounted for distance cues by incorporating such auditory cues into the model. Refer to (James, 2016b).

\(^7\) Also referred to in psychoacoustic literature as spatial extent, source width or tonal volume. The spatial width of sound sources is a natural phenomenon; for example, a beach front, wind blowing in trees, a waterfall and so on.

\(^8\) It has been shown that the *apparent source width* (ASW) of a sound source depends on the value of the *interaural cross correlation coefficient* (IACC) (Morimoto, 2002), sound loudness (Boring, 1926), pitch, and signal duration (Perrott & Buell, 1982).

\(^9\) Also referred to in the literature as ‘clueness’. Letowski (1989) as part of his multilevel auditory assessment language classifies ‘clarity of sound texture’ as a subdivision of ‘distinctiveness’.

\(^10\) Catherine Gustavino and Brian Katz refer to spatial clarity in their colouration attribute. This makes use of the terms ‘muffled’ and ‘clear’ when rating spatial scenes, making it a timbral attribute (Sazdov et al., 2007).
final impression of a single, spatially large, sound source (Potart & Burnett, 2004). In the case of densely distributed streams, Topper et al. (2002) suggest that a listener experiences a ‘persistence of audition’ in that they are aware that auditory objects are moving, but are not completely aware of where and how. Bregman (1990) notes that conditions can be altered to make localisation easier or more difficult, so that “conflicting cues can vote on the grouping of acoustic components and that the assessed spatial location gets a vote with the other cues” (p. 305). This distinction is shown visually in Figure 2.

Figure 2. The variety of sound shapes created through timbre spatialisation has some relationship with decorrelation processes. The independent spatialisation of frequency bands generates multiple auditory streams. Beyond a threshold, the brain begins to fuse these separate streams into a single, yet spatially wide, sound scene. The numbers represent suggested loudspeaker distributions.

In addition to exploring the nature of spatial extent and immersion through the number of simultaneous auditory streams, a similar process of auditory assimilation was observed as a result of the global rate of change of the system. In this research the spatialisation is controlled by processes computed at audio rates, the potential rate of spectromorphology and spatiomorphology is considerably faster than if the system were using control rate signals, which are commonly used in spatial music practice. A pertinent example of audio-rate spatialisation is in Karlheinz Stockhausen’s Sirius (1975–77) where the sound moves so fast in various spatial trajectories that it seems to stand still, yet it has a motion that has been described as pulsation and vibration (Schmele & Gomez, 2012):

> It is an entirely different kind of sound experience, because you are no longer aware of speakers, of sources of sound—the sound is everywhere. When you move your head even the slightest bit, it changes colour, because different distances occur between the two sound sources. (Schmele & Gomez, 2012, p. 26)

Spatial texture, as described by Smalley (1997, p. 124) is concerned primarily with how the spatial perspective is revealed over time. Such pulsating, vibrating or fluttering spatial textures are classified by the author as high-frequency spatial texture. Rates of change that occur at haptic rates tend to coalesce in a different way, as the rate of change allows the listener to discern the unfolding sequence of sound shapes in animation. These have been classified as low-frequency spatial texture. Results of both high frequency and low frequency spatial texture can be classed as being contiguous or non-contiguous depending on their spatial distribution, but are also ultimately concerned with the perceived fusion or segregation of multiple auditory streams.

The use of methods such as spectral spatialisation and timbre spatialisation allow for diverse range of spectromorphologies and spatiomorphologies to emerge. The following sections present the visualisation and categorisation of these sound shapes.

3. VISUALISATION

The visualisation of such processes requires a frequency–space representation, where colour conforms with frequency, and the spatial position is analogous to the auditory localization of each point. These are represented as colour plots over 2D horizontal speaker configurations. Figure 3a does indicate a speaker configuration, as numbered. The colour coding applied to these frequency–space plots follow the colour scale defined in Figure 3c.

Figure 3a. A frequency–space distribution over an eight-channel equidistant speaker configuration that only involves differences in azimuth. Lower frequencies (red) are displaced differently to the upper (blue) frequency bands in order to make the distribution of spectra as clear as possible. The numbers represent suggested loudspeaker distributions.

Figure 3b. A frequency–space distribution over any arbitrary speaker configuration involves azimuth and distance over a 2D speaker configuration. Whilst this is not so easily visualised on the page, this can also include elevation for sound shapes across 3D speaker configurations.

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The use of methods such as spectral spatialisation and timbre spatialisation allow for diverse range of spectromorphologies and spatiomorphologies to emerge. The following sections present the visualisation and categorisation of these sound shapes.
4. SOUND SHAPES

Sound shapes and attributes that emerged through this research tended to fall into specific groups outlined by the framework established herein.

4.1. Single Point Source (Traditional Panning)

Single point-source spatialisation is possible with spectral spatialisation where all spatial coordinates mapped to all spectral bands are folded into a single point in space as shown in Figure 4a. This single point may be spatially transformed by translation across the Cartesian coordinate space (i.e. traditional point-source spatialisation), but other transformations like rotations of this point about its centre of gravity have no effect.

Whilst spectral spatialisation will result in all spectral bands folded into a single point in space, timbre spatialisation on the other hand may also fold this spectrum into a single frequency or band of frequencies. These frequencies would most conventionally be contiguous, highly localised. Such sound shapes are considered to be generally non-contiguous, have a degree of spatial width (and are hence more enveloping), and depending on the distance of specific frequency bands, depth of field may be achieved where some frequencies are virtually placed closer to the listener than others.

4.2. Spectral Zones and Multiple Point Sources

Multiple point-source spatialisation is possible using the technique of spectral spatialisation where spatial coordinates are segregated into a small finite number of spatial locations and mapped accordingly to all spectral bins. This process results in certain regions of the spectrum being located in specific zones of the sound scene as shown in Figure 4b. This would be considered to be a non-contiguous treatment if the separate zones are distinct enough to be perceived as separate auditory streams. These multiple groups of spectra may be spatialised individually to create effects like Normandéau has achieved by spatialising distinct bands of separated frequency across the sound scene. Spatial transformation may also be applied to all of these zones of spectra as a group, those transformations being contraction and expansion, rotation, translation, swinging, twisting, spiralling, and distortion across the Cartesian coordinate space.

In terms of timbre spatialisation, this process may also be applied to narrower bands of frequency such that the full spectrum of the audio input source is not reproduced. Such sound shapes are considered to be generally non-contiguous, highly localised, but can also incorporate attributes of spatial depth if different zones of sound are reproduced with varying perceived distances.

4.3. Spectral Diffusion (No Folds)

Spectral diffusion not only includes multiple groups of spectra placed in zones across the sound scene, but the exploration of spatial width encourages the possibility of spectra being ‘spread’ across space in a line (or potentially some other more abstract contour) as shown in Figure 4c. The simplest of this ‘spreading’ is a single linear distribution of frequency bands from low to high frequency across the sound scene. Spatial transformations may also be applied to this entire spectral distribution, those being contraction and expansion, rotation, translation, swinging, twisting, spiralling, and distortion across the Cartesian coordinate space.

Such sound shapes are considered to be contiguous, have a degree of spatial width (and are hence more enveloping), and depending on the distance of specific frequency bands, depth of field may be achieved where some frequencies are virtually placed closer to the listener than others.

4.4. Spectral Diffusion (One Fold)

Another possible sound shape is determined through the ‘folding’ of the frequency spectrum such that a number of frequencies are overlayed across space as shown in Figure 4d. This produces a further distinct shape that again may consist of a linear or non-linear distribution. Spatial transformation may also be applied to this entire spectral distribution, those being contraction and expansion, rotation, translation, swinging, twisting, spiralling, and distortion across the Cartesian coordinate space.

Such sound shapes are considered to be contiguous, have a degree of spatial width (and are hence more enveloping), and depending on the distance of specific frequency bands, depth of field may be achieved where some frequencies are virtually placed closer to the listener than others. The spectral folding increases the sense of envelopment, as perceptively each point in space is characterised by two distinct bands of frequency.

4.5. Spectral Diffusion (Multiple Folds)

When extending the ‘folding’ of the frequency spectrum such that a large number of frequencies are overlayed across a sound scene as shown in Figure 4e. Again such sound shapes are considered to be contiguous, have a degree of spatial width (and are hence more enveloping), and depending on the distance of specific frequency bands, depth of field may be achieved where some frequencies are virtually placed closer to the listener than others. The spectral folding here generates a further sense of envelopment.

Again spatial transformation may also be applied to all this spectral distribution, those being contraction and expansion, rotation, translation, swinging, twisting, spiralling, and distortion across the Cartesian coordinate space.

4.6. Low-Frequency Spatial Texture

Depending on the rate at which spectra are transformed, this will have a bearing on how spectromorphologies and spatiomorphologies are
perceived. Slower rates of change (i.e. haptic rate) result in slowly unfolding spectromorphologies across the sound scene as shown in Figure 4f. The continuous or discontinuous nature of these transformations will determine whether these spatial gestures are perceived as connected or disconnected. In these cases the spectromorphologies produced can either present smooth or jagged contours, characterised by the author as low-frequency spatial and spectral texture. These smooth or jagged contours may be timbrally and spatially distinct enough to be perceived as being fused or segregated auditory streams.

4.7. High-Frequency Spatial Texture

Depending on the rate at which spectra are transformed, this will have a bearing on how spectromorphologies and spatiomorphologies are perceived. Faster rates of change (i.e. audio rate changes of spatial attributes) result in pulsating and fluttering sound scenes that present a high degree of immersion as shown in Figure 4g. Due to the vast number of frequency bands, and the speed at which the location of these bands are determined, such sound shapes are perceived as being fused spatial images, but often feature some spatial movement reminiscent of those discussed in literature pertaining to spectral decorrelation. Noisy distributions (the use of white noise to determine spatial distribution) has some similarities to spectral decorrelation in that the results sound perceptively equal but are statistically orthogonal.

4.8. Other

Other attributes that appeared to be relevant included spatial width, spatial height or elevated spatial width or height ASW\textsuperscript{11}, spatial depth, immersion, spectral quality, and spectral width. The spatial width of the sound shape can be confined to a smaller region of a sound scene, and may be modified by a scaling transformation applied to all spatial coordinates as shown in Figure 4h. For systems where elevated speakers are used, the same principle of spatial width can be applied to the elevated dimension to explore the attribute of elevated ASW. The spatial depth of the sound scene is determined by the incorporation of multiple distance cues as shown in Figure 3b. Immersion is most prevalent in sound shapes that exhibit the layering and spreading of spectra across space, and may also be enhanced through high-frequency spatial texture, increases of apparent source width (ASW), and increasing the folding (particularly using non-linear and random distributions) of spectral bands across the sound scene. Spectral quality is ultimately determined by the instantaneous state of how spectra are distributed spatially across the sound scene. Spectral width is determined by the range of frequency used. The way in which these evolve over time may be influenced by spatial transformations and by the exploration of low- or high-frequency spatial texture.

\textsuperscript{11} It is worth noting here that Dr Hyunkook Lee at the University of Huddersfield is currently researching the perceptual rendering of vertical image width for 3D multichannel audio as part of an EPSRC-funded research project.
5. CONCLUSION

Previous research by the author involved inquiry into the sound shapes produced by the multi-point spatial diffusion of independent spectral bands. Through the process of exploring these possible sound shapes, a range of multi-point distributions emerged making it possible to form a categorical set of distinct multi-point distributions related specifically to the spatial attributions outlined by Kendall, Rumsey, Szadov et al., Smalley, and Wishart. Delineation has been made based not only on the contiguous versus non-contiguous nature and the correlated versus de-correlated nature of these sound shapes, but mention has been made of their perceptive attributions with respect to audio scene analysis and Bregman’s theory of auditory streaming; that is, whether the sound shapes are perceived as comprising of separate streams through a process of stream segregation (i.e. non-contiguous sound shapes comprised of spatial zones), or whether these fuse together to form a single spatial image (i.e. contiguous sound shapes). Relevant spatial attributes are also tabulated as means of expressing the spatial domain from which these shapes can be transformed by spectromorphology and spatiomorphology. Whilst this article presents a pragmatic categorial list, future research would benefit from blindfold listener evaluations of such distributions in order to further clarify the delineation of such sound shapes with respect to cognitive awareness and auditory perception, and further refine the language used to define such distributions.

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AURALROOTS: Cross-modal Interaction and Learning

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ABSTRACT
AURALROOTS is a media sculpture that combines viewer interaction with inspirations from tactile and aural sensory perception. The sculptural form is based on the functions and forms of the stereocilia, tiny hair cells on our auditory nerves of the inner ear in the cochlea. The content of AURALROOTS is about how we learn through sounds from being embodied in different environments: a) as a growing embryo in the womb, b) as a daughter listening to her mother and finally c) as a female artist communicating with auditory scientists.

1. INTRODUCTION
AURALROOTS offers a metaphorical learning experience that scales down the viewers into miniature characters and places them inside the inner ear where they can trigger acoustic reactions. By touching or moving two sets of these sculptural models, based on volume and harmonics, the viewers can mix and manipulate up to 54 sound tracks to be heard on wireless headphones. A viewer/listener can choose different pitches that relate to these learning experiences, by touching an animated visualization of the cochlea on a screen. This action triggers three sound compositions. A) Low pitch compositions 1: in the womb, (B) medium pitch compositions 2: in the environment and (C) high pitch compositions in the science lab. (1-technique) All three sound compositions in AURALROOTS encourage the viewer to learn through a combination of touch, sound and the embodied experience.

1.1 Sound Composition A: Hearing as an Embryo in the Womb
The viewer can hear as a foetus might hear: mostly in the low pitch range. She hears her mother’s digestion but also traffic noise outside, the blood cells rushing through the mother’s veins. but also a refrigerator motor. Do the lungs breath, steadily or is that the sound of a river rushing along on the outside of her mother’s body? She differentiates between a heart pumping and the beating of a base drum. She can hear her mother swallow, or the low pitch syllables from her singing voice while she is playing the piano.

1.2 Sound Compositions B: Daughters listening to their Mothers
Speech occurs mostly in the mid-range of our frequency response. Many communities practice oral storytelling: the passing of knowledge from one generation to the next. In this composition, oral “herstories” are told by Australian indigenous women to their daughters about how to gather plants and roots for survival and for medical conditions. Due to colonialism this knowledge is slowly disappearing. When we talked with our indigenous advisors at the Koori Radio Station in Sydney about this form of knowledge transfer, they said that it requires extensive personal contact, regular interaction and trust: ”At this stage if another person we trust wants to tell it let them tell it”. To construct eight accurate scripts for the actors to re-tell; we sourced talks, interviews and written information by community elders and indigenous researchers. [1] The characters are not based on actual people, however, the names of plants; how they were collected and used plus the environmental sounds in which they are located are directly source able. [2]
1.3 Sound Composition C: A female artist listing to scientists

This composition is based on high pitch frequencies and sound recordings based on my own subjective experience when I worked as an artist-in-residence inside two audiology labs in order to learn about hearing. High pitch frequency response is the first part of our hearing capabilities that decrease with age. I shadowed the experiments of researcher Helmy Mulders and her team, where knowhow transfer is based on a horizontal level of communication. Here the pathways from the ears to the brain are audified by a method called “Electrophysiology”, which measures the midbrain’s response milliseconds after tones are fed to the ears of anesthetised Guinea pigs. I recorded the firing sounds of single neurons in the midbrain and learn that the stereocilia are one of the few human cells that do not regenerate. I record their tests with researchers on the hearing impaired and witness a surgical operation of a cochlea implant. In audiology, there are more female than male scientists, but more men suffer from hearing problems at an older age than women. Statistics show that among women, teachers in day-care institutions suffer the highest incidences of Tinnitus [3]. It seems that the stereocilia is not only damaged by acoustic trauma but also by the filtering of constant noise.

Fig 2. AURALROOTS, 2015, Jill Scott, interactive screen composition A: Hearing as an embryo in the womb, Copyright Scott.

1.4 Technique

AURALROOTS is programmed with Max MSP with C++. The stereocilia swing on balls that are connected to Joysticks and all positions on a 120° degree axis are sent from these joysticks to a c++ program on a Minimac computer, where 54 sound tracks are stored in three compositions. Manipulation of the inner cells in the cochlea, produce harmonics while playing with the outer hair cell set produce volume. The soundtracks are all equalized and composed in real time.

Fig 3. AURALROOTS, 2015, Jill Scott, interactive screen Composition B: Daughters listening to their mothers, Copyright Scott.

Fig 4. AURALROOTS, 2015, Jill Scott, interactive screen composition C: A female artist listening to scientists, Copyright Scott.

2. Examples of Learn by Listening Experience

Here I give two more concrete examples of the learning experience based on what the viewers actually hear in composition 2 and 3.

Composition B: Daughters listening to their Mothers. The viewers can listen to these stories re-told by actors and match them with sound from the according landscapes where the plants come from. Some of this knowledge is lost – some is retold here! JACK tries hard to remember about how SILKY HEADS (cymbopogon-obtectus) was used for ear infections. He explains how this knowledge was only passed on from mother to daughter. DARRA talks about BRACKEN FERN (pteridium esculentum) and BUNGWALL FERN (blechnum indicum). The roots and leaves of both plants...
can be used against stings and tics or prepared for eating. APANI, a young girl, describes the myth of the relationship between the GYMEA LILY (doryanthes excels), a source of minerals, and THE BULRUSH (typha orientalis, typha dominigensi) used by hunters for bodily stamina and to keep leeches away. KALINDA describes to young women, how to locate and gather LONG YAM (dioscorea transversa) and PENCIL YAM (vigna lanceolata), main sources of minerals and starch. CORREEN tells a story about how many women often come together to collectively hunt for BUSH ONIONS (cyperus bulbosus) - a good source of minerals. TATYA explains how to wash, cook and make a cast for a broken leg or arm or out of the roots of DEAD FINISH BUSH (acacia tetragonophyllea). LYN tells us how to prepare and harvest the roots of the CUNJEVOI (alocasia brisbaniensis) and use it for stings, burns, and to take the poison out of it for eating. MARGARET talks about the WILD BUSH ORCHID (cymbidium canaliculatum), a great preparation for dysentery and bowl problems.

By comparison Composition C is based mostly on what I learnt from listening to auditory scientists. An auditory lab is always full of tests and sounds particularly in the high pitch range. The viewers of AURALROOTS can hear and mix simulations of the behaviour of inner ear stereocilia compared to the outer stereocilia, as well as sounds from the lab and test tones to identify Tinnitus. They can test themselves by listening to the sounds from the actual hearing tests on people who have a wide range of hearing problems. These tracks are tainted with my own subjective experience of learning about the audified firing of the stereocilia from Electrophysiology", and other sound waves extracted from music and tunings in the same environment.

3. Conclusion

All of these modes require the accumulation of tactile and sound knowledge from the purest forms of embodiment - either from inside the body, from being in the environment or from learning in the laboratory. By presenting this content, AURALROOTS encourages less formal, codified or explicit forms of knowledge. Composition A is a combination of sound, tactile and tacit information: this kind of knowledge is difficult to transfer to another person by means of writing it down or verbalizing it. In Composition B, the holder of information must be integrated into a network or a community of practice for survival. Here tactile and sound transfer is related to beliefs, ideals, values,
schemata and mental models -a more cognitive dimension of information that shapes the way we perceive the world. Finally, Composition C explores how different forms of information always exist in dialogue with other forms of knowledge and are transferred in a horizontal way: one that is dependant on co-productive participation.

Therefore, AURALROOTS presents the viewer with three levels of knowledge acquired from listening and illustrates that the transfer of this knowledge is aided by immersing the learner in each particular environment. The content of the soundtracks also encourages viewers to learn more about sound history from a feminist perspective. The viewer becomes an active participant by “placing” him or herself inside the cochlea to explore the acoustic qualities of harmonics and amplitude. As far as I know, this is the first time that a media sculpture has been built that uses the scale and behavior of the stereocilia as a metaphor for an auditory sensual experience in three different physical immersive environments. AURALROOTS invites the viewer to interact selectively, deeply listen and be contemplative, by exploring in ones’ own space and time.

Acknowledgements

AURALROOTS was generously supported by Pro Helvetia, The Swiss Arts Council.

Programming: Nikolaus Völzow
Sound: Jill Scott and Olav Lervik.

The sounds from the womb are based on recordings with contact mics places in the uterus at by Les Gilbert: http://www.magian.com/projects/ Also from neuroscience research: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4256984/

Actors and researchers’ credits: Koori Radio / Gadigal Information Service, Sydney, Australia, produced by King Street Studio with indigenous actors: Fred Copperwaite, Khi-Lee Thorpe, Wandjina Smith, Lillian Crombie, Elaine Crombie, Jinny Smith, Lyn-Paulette Whitton, Lily Shearer. The researches were Jill Scott, Tess Corino and Marille Hahne.

This project was made possible by a residency at SymbioticA at the University of Western Australia, Auditory Laboratory at the School of Anatomy, Physiology and Human Biology and The Laboratory of Experimental Audiology, University Hospital, Zurich.

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SOUNDSCAPE ANALYSIS FOR EFFECTIVE SOUND DESIGN IN COMMERCIAL ENVIRONMENTS

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ABSTRACT

This paper reviews analytical literature concerned with retail and other commercial environments for the purposes of identifying effective sound design for ambient media including digital signage. The paper details the background to a proposed design project for the audio augmentation of digital signage in student services facilities on a university campus. In the paper, the term soundscape is used as a conceptual tool to explore the various dimensions of the experience of the acoustic environment that may be manipulated or accounted for in such a design.

1. INTRODUCTION

Sound design is considered here in relation to the problematic surrounding the definition of ‘sound’ (Grimshaw 2015) and the complex and unstable nature of the construct of ‘soundscape’ (ISO 2014). Therefore, the pragmatic notion of the sound effect (Augoyard and Torgue 2005, Stevenson 2015) is used as a basis on which to build a sound design practice. Proposed methods for the evaluation of effectiveness are considered in terms of branding, information delivery and the construction of an acoustic community (Schafer 1993; Truax 1996, 2001). A method that uses measurements of visual attention as a means of evaluating, or as a proxy for auditory attention is considered.

The concept of ‘soundscape’ is used to describe the multi-dimensional phenomenon associated with the "perception, experience or understanding" (ISO 2014) of the acoustic environment, its architecture and the sound sources it comprises; responses both psychoacoustic and cognitive; and the cultural and environmental context in which these factors play out. While individual responses to the perceptual construct of soundscape as set out in ISO standard 12913-1:2014 may be inherently unstable and unpredictable, over the longer term and across larger populations certain outcome trends may result for a given community. In the construction of soundscape experience, the physical, cultural and personal context are significant. The structure of the context is influenced by responses within the process of the perceptual construct of soundscape and it is this inherent feedback path that underlies the fundamental relationality of sonic experience, referred to by Augoyard as sonic effect.

2. ANALYSIS/EVALUATION

Soundscape analysis typically employs several simultaneous approaches in an attempt to achieve triangulation (Lercher and Schulte-Fortkamp 2013; Schafer 1993, p. 123; Truax, 1984 p. 75). Lercher and Schulte-Fortkamp provide an overview of several models that incorporate the expertise of inhabitant participants, soundscape researchers, and acousticians. These approaches include methods such as questionnaire/survey, narrative interview/focus group, and acoustic measurement. The advantage of this approach is that it pairs the values and perceptions of inhabitant groups—so-called inhabitant expression (Augoyard 2007)—with the objective measures of noise and other audible features.

An initial phase in the analysis of indoor spaces may include an architectural functional and material analysis combined with temporal mapping of acoustical measurements. An example of this approach applied to a large retail space and a university student services building is presented by Dökmeci and Kang (2011). The advantage of this approach is that it takes into account the designed and actual use of the spaces and their functional requirements, for example, to support social engagement or quiet study, or to promote shopper experience and retail sales. In addition to this, the focus on architectural design considers the articulation between spaces, the materials of construction, and the circulation patterns of the people using the space. In Dökmeci and Kang’s study, binaural sound recordings were taken, and post-processing of these recordings produced time-series and statistical descriptions of sound pressure level, loudness, roughness, and sharpness. These measures were compared with the functional usage to provide a base-line description of the soundscapes of the sites over the period of a day incorporating an assessment of acoustic comfort and noise annoyance.

Studies such as these can be augmented by more detailed sound source classification employing taxonomies of semantic description such as that offered by Brown, Kang & Gjestland (2011) which details "places, categories and sound sources". Unlike studies of noise annoyance, in this model sound descriptions are...
"carefully chosen to avoid value judgments, or connotations, regarding these sound sources, irrespective of the type of place" (p. 390). An application of this type of standardised taxonomic classification is shown in figure 1.

![Figure 1. Taxonomy of the acoustic environment of the Bankstown Cafe.](image)

While advances in automated sound classification are progressing rapidly (Rychtarikova & Vermeir 2013), they may not yet be useful for preliminary analyses without being augmented by semantic description. However, these methods could be trained to provide ongoing monitoring of the quality of designed sounds environments to evaluate the long-term validity and operation of a given design.

### 3. DESIGN CONSIDERATIONS

The concept of soundscape as it has developed over the past almost 60 years (Schafer 1969/67), and specifically as summarised in the 2014 ISO standard, is highly nuanced. What it lacks in coherence, it makes up for in subtlety. This standard has been arrived at with some difficulty on the part of the researchers involved (see Brown, Kang & Gjestland, 2011, for an overview of the process). It proposes that soundscape is a "perceptual construct" as represented in figure 2 (ISO 2014). This implies a sort of top-down model of human auditory perception. Soundscape is set up in contradistinction to the physical phenomena of the acoustic environment which comprises "sound at the receiver from all sound sources as modified by the environment" (ISO 2014). The standard also highlights the significance of context which is "the interrelationships between person and activity and place, in space and time" (ISO 2014). The standard goes on to unpack these five complex relational concepts in terms of the following three forms of "influence" on soundscape, which in turn are influenced by various factors.

![Figure 2. Elements in the perceptual construct of soundscape ISO 12913-1:2014.](image)

#### 3.1. Auditory sensation

"Auditory sensation is a function of neurological processes that begin when auditory stimuli reach the receptors of the ear. This is the first stage in detecting and representing the acoustic environment" (ISO 2014). Auditory sensation is primarily influenced by the acoustic environment but also by psychoacoustic processes such as temporal, spectral and spatial masking. On the one hand, environmental factors such as meteorological conditions influence the acoustic environment, and on the other factors such as "hearing impairments and hearing aids" influence their reception.

Interestingly, the problematic notion of ‘representation’ (Dietrich 2007), resulting from auditory sensation, is invoked. This representation is presumably closely related, if not partly identical, with the soundscape, which must somehow, in turn, be represented to consciousness for subsequent interpretation and response.

#### 3.2. The interpretation of auditory sensation (auditory perception)

The bottom-up narrative given above must be squared with the "perceptual construct" which stands for the acoustic environment. Several factors influence the interpretation of auditory sensation. These include the
"attitude to the sound source and to the producer of the sound" plus their "experience and expectations including cultural background, [and their] intentions or reason for being at a place" (ISO 2014). Interpretation is multi-modal encompassing "sensory factors, like visual impression and odour" (ISO 2014).

Interpretation "refers to unconscious and conscious processing ... to create useful information, which may lead to awareness or understanding of the acoustic environment. Awareness of the acoustic environment, in context, represents an experience of the acoustic environment" (ISO 2014).

This ‘experience’ is exactly what the sound designer is aiming to facilitate. However, the description given above suggests just how precarious this endeavour is. If attitudes to the sound source and its producer can affect its interpretation or even its perception, and these attitudes can easily be manipulated or affected by various means, what chance does the sound designer have in the selection and presentation of such sounds? Many sound designers, however, embrace this challenge and many of the features identified in this definition of soundscape such as multi-modal factors and the role of the unconscious are represented in the writings of professional sound designers. Commercial sound designers such as Beckerman (2014), Soars (2009) and Treasure (2007) are usually content to accept two sometimes opposing groups of factors that influence the interpretation of sounds within the soundscape. The first group of factors relies on a model of a universal listener defined by uniform cross-cultural responses to sound. The second group suggests that interpretation is largely place, culture, demographic or sub-culture specific. What all three authors agree on is that responses to sound are usually formed by sub-conscious or pre-conscious processes, and this leads to the third and final influence that context may have on soundscape.

### 3.3. Responses to the acoustic environment

The first point to note regarding responses to the acoustic environment is that they form a feedback path into the context that influences soundscape. This feedback path is foundational to the complexity and unpredictability of soundscape phenomena. As the ISO standard states: "responses include short-term reaction and emotion, as well as behaviour, which may change the context". Responses, in turn, may be influenced by "time of day, lighting and weather, emotional state, psychological and physiological resources to deal with the situation, perceived ability to control one's exposure to sounds, as well as personal activities and those of others". Not only are these responses unpredictable but they are difficult to manipulate from a design perspective.

One important aspect of soundscape that designers such as those cited above agree on is that objective methods of evaluating sound design interventions are unlikely to provide useful measures if they rely on participants to predict or describe their responses using instruments such as survey, questionnaire or interview. These methods rely on the expression of opinions or attitudes based on conscious and reasoned responses. However, as the ISO definition and conceptual framework suggests, the experience of soundscape as a perceptual construct in all its subtlety and complexity is likely to be too illusive to be rendered by such evaluative interventions. There is therefore a problem at the heart of formalised soundscape methods, and this has been noted by soundscape researchers themselves. As Brown and colleagues (2011, p.389) point out, the "measurement of preference ... is premised, to a large extent, on people being aware of the sounds around them and consciously attributing the particular outcome directly to the soundscape". They go on to note that "the soundscape of a place may enable certain outcomes/activities, without people consciously dissecting why it is that the environment of a place provides so well for that activity". Nevertheless, a range of formalised methods including sound walks, focus groups, simulation and others have been employed (Davies, et al 2013).

Most interestingly, nowhere in the ISO standard is the notion of a listener invoked. In fact, the description of soundscape seems to explicitly dissolve the listener into a network of relations and processes in which the boundaries of the organism are penetrated by culture and context in groundless complexity. Whether this seemingly post-modern situation arose from the dynamics of the standards committee process or if it is inherent in the very notion of soundscape is unclear. However, from the perspective of this paper, it seems a most appropriate outcome.

Ultimately however, sound designers are called on to manipulate aspects of the acoustic environment with a view to modifying listeners’ attitudes or behaviour. In the design context, certain outcomes are valued over others. The ISO standard recognises that soundscape can be a key determinant in outcomes such as the development of "attitudes, beliefs, judgments, habits, visitor/user experiences (e.g. activities, actions and mental states), health, well-being and quality of life, as well as reduced social costs for society". When soundscape concepts are operationalised in the context of specific designs; attitudes, beliefs and importantly actions and habits must be attributed to specific populations within a given physical context.

Much of the soundscape research in recent decades has situated itself as focused on "the positive aspects of sound environments" in distinction to earlier work on annoyance related to noise complaints (Brown, Kang & Gjestland 2011). However, it seems that within certain indoor environments noise may have more positive aspects. Music has long been used to enhance indoor environments, with mixed results, and some research
(Mehta 2012) suggests that there may be a "sweet spot" for ambient noise levels based on their impact on "creativity" and purchasing decisions. Mehta and colleagues propose that moderate noise levels (70dB) increase cognitive processing difficulty compared to lower noise levels and that this invokes a higher construal level resulting in increased abstract thinking. Higher than moderate noise levels (85dB), however, may result in cognitive processing difficulty at a level which impedes creative thinking. This observation suggests that total reduction in ambient noise levels may result in 'killing the vibe' in certain indoor environments and that working with reasonable background noise levels in some contexts may be worthwhile.

Clearly adding more competing sound material in environments where background music is already being used in environmental design or spatial branding must be done with considerable care. Methods should be selected that account for both variations in ambient sound level over time and the spectral content of the sound environment both in terms of perceived loudness and from the point of view of potential masking effects between competing sources. This suggests that signal-based measurements such as those used by Dökmeci and Kang (2011) may be adapted for use in real-time for both level control and material selection rather than for description and evaluation.

Conventional approaches to information delivery based on existing audio-visual advertising strategies are unlikely to succeed in contemporary urban environments. Typical designs employing an animated or live-action picture track plus dialogue, music and effects audio tracks are presented with two problems. Firstly, there may be too much information contained in these four tracks, and secondly, contemporary audiences have already demonstrated their increasingly habituated responses to these design strategies resulting in reduced uptake of free-to-air television (White 2015). Competition for the limited attention of an audience in an indoor environment in which other activities take place is a useful tool to conceptualise a novel approach to sound design in urban environments.

The visual design employed in the current brand strategy is highly structured and focuses on text, brand logo and a limited palette of photographic images. This approach is in contrast to earlier visual design material employed in the signage network that exhibited the use of graphics and a greater variety of colours and content. In some ways, the current design approach is highly repetitive, presumably with the intention of effecting brand familiarity (Campbell & Keller 2003).

While repetition may work well for visual elements such as logos, in situated audio-visual media, repetition can have a negative effect (Belch 1982). Sound track elements in audio-visual media can have several functions. Primarily a voice or dialogue tracks are used to convey semantic information. Voice quality and characterisation can project brand image. Music in the form of jingles or sonic brands can play a roll in brand reinforcement whereas background music in advertising can influence attitude, attention and arousal (Huron 1989). Less is known about the effect of non-speech or non-musical material, however, some work has shown that "congruent" sound material that is spatially located near product displays can have a positive impact on attention, awareness and preference (Shen and Sengupta 2014). Furthermore, ambiguous sounds can activate a "conceptual network" that draws in visual stimuli and context and can operate across sensory modalities (Özcan and Egmond 2009). The use of non-obvious but congruent sound elements with a wide variety of individual sounds can avoid unwanted repetition effects such as annoyance and fatigue. It can also help avoid unexpected associations given the dynamic nature of the audience and their associated soundscape attitudes.

Many of these forms of sonic experience have been characterised as sonic effects in the research of Augoyard and his colleagues (2005). The sonic effect is located by Augoyard on a scale somewhere between the sound object and the soundscape. The sound effect is a form of jingles or sonic brands can play a roll in brand reinforcement whereas background music in advertising can influence attitude, attention and arousal (Huron 1989). Less is known about the effect of non-speech or non-musical material, however, some work has shown that "congruent" sound material that is spatially located near product displays can have a positive impact on attention, awareness and preference (Shen and Sengupta 2014). Furthermore, ambiguous sounds can activate a "conceptual network" that draws in visual stimuli and context and can operate across sensory modalities (Özcan and Egmond 2009). The use of non-obvious but congruent sound elements with a wide variety of individual sounds can avoid unwanted repetition effects such as annoyance and fatigue. It can also help avoid unexpected associations given the dynamic nature of the audience and their associated soundscape attitudes.

4. CONTENT AND OBJECTIVES

The proposed approach to the audio augmentation of indoor digital signage fits within a larger brand strategy. An existing digital signage network provides information delivery, and event and service promotion. In recent times, this network has been employed to more effectively deliver structured branding. Branding is targeted at staff, students, partners and future prospective students. It asserts the institution's aspirations for quality and intellectual leadership in the region and globally. Branding is explicitly used to foster a sense of community with shared identity and aspirations. This notion of community mirrors the concept of acoustic community defined by Truax as a medium for shared meanings and "as a system within which acoustic information is exchanged" (Truax 2001, p. 178). This community is seen as dynamic and in a state of transformation rather than as something fixed.

While repetition may work well for visual elements such as logos, in situated audio-visual media, repetition can have a negative effect (Belch 1982). Sound track elements in audio-visual media can have several functions. Primarily a voice or dialogue tracks are used to convey semantic information. Voice quality and characterisation can project brand image. Music in the form of jingles or sonic brands can play a roll in brand reinforcement whereas background music in advertising can influence attitude, attention and arousal (Huron 1989). Less is known about the effect of non-speech or non-musical material, however, some work has shown that "congruent" sound material that is spatially located near product displays can have a positive impact on attention, awareness and preference (Shen and Sengupta 2014). Furthermore, ambiguous sounds can activate a "conceptual network" that draws in visual stimuli and context and can operate across sensory modalities (Özcan and Egmond 2009). The use of non-obvious but congruent sound elements with a wide variety of individual sounds can avoid unwanted repetition effects such as annoyance and fatigue. It can also help avoid unexpected associations given the dynamic nature of the audience and their associated soundscape attitudes.

Many of these forms of sonic experience have been characterised as sonic effects in the research of Augoyard and his colleagues (2005). The sonic effect is located by Augoyard on a scale somewhere between the sound object and the soundscape. The sound effect is a set of pre-paradigmatic relations that produce a listening subjectivity and a specific ambience. Sound effects may be associated with discrete sound events or a more complex sonic milieu. In Augoyard's urban ambience research model the status of a given sonic effect is accounted for under a number of disciplinary perspectives or domains of reference including acoustics, psychology, sociology, architecture, musicology, and text and media studies. The sonic effect is a useful tool to conceptualise a novel approach to sound design in urban environments.

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1 Note that a lack of reference level or weighting cited in this publication may bring the methodology and results into question.
5. DESIGN SOLUTION

A novel design solution is proposed that accounts for several important factors highlighted by soundscape research and aspects of professional practice. The design may be summarised by a series of requirements.

1. The design approach should incorporate automatic level control as part of a broader automated control of background music to suit variations in use of the space over the period of a day. In addition to amplitude-based control, a method of spectral selection should be used to adaptively fit audio material into available spectral niches within the acoustic environment.

2. Sound material should be designed not for arousal or for information delivery, but rather to engage attention and spatially direct visual engagement with signage.

3. The design should avoid repetition.

4. The design should not aim to simulate a voice track or music track but rather, should focus on suitable sound objects or "effects".

5. While principles of association may provide a basis for sound selection, this can not be relied upon as the notion of an acoustic community in a state of flux, and the unstable and unpredictable nature of soundscape are likely to override these effects.

6. Sound should be used sparingly at a rate to be determined by ongoing audience response measurement, so as not to add to an already crowded acoustic environment.

6. EVALUATION

Methods that elicit verbal responses are of limited value in the evaluation of a sound design intervention of this type. Therefore this proposal incorporates video-based audience measurement techniques to identify audience gaze and dwell times targeted at digital signage units (Ravnik and Solina 2013). In this approach, looking is understood as a proxy for listening where listening does not necessarily involve hearing. Audience measurement can be used to analyse the effectiveness of particular sound elements in the context of both the state of the acoustic environment at a given time, and the visual content of signage display. The success of the overall strategy can be observed over the medium term to identify audience habituation and to guide continuing modification to the sound design intervention.

7. CONCLUSIONS

The concept of soundscape is useful for exploring aspects of sonic experience and for critiquing accepted notions of source-receiver models of acoustic communication. However, soundscape analysis methods may not be appropriate where sound is used to influence unconscious behaviours and responses. Effective sound design for ambient media such as digital signage may incorporate novel approaches to the selection of sound material avoiding the conventions of traditional audiovisual media and there-by contributing to the information delivery and branding objectives of an institution. Ongoing automated acoustic and audience measurement are key to evaluating such a strategy and to keeping the design fresh and appealing.

8. REFERENCES


Stevenson, I. 2015. The Sound Effect: a study in radical sound design. (PhD), The University of Sydney.


HEXADECIMAL COMPOSITIONS – USING HEX DATA TO SONIFY IMAGES OF THE FOUND ENVIRONMENT

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ABSTRACT

There have been numerous efforts to explore the relationship between the visual and aural, in particular in relation to converting one medium into another. The interchange between music and images can create powerful, evocative, multi-sensory and immersive narratives for both the audience and the artist. One method of relating the aural and visual is through data composition, where data from the visual is used to create the aural. This paper will discuss the usage of hexadecimal data in relation to the artist's own practice and experiments in sonifying the found environment. This practice combines music created from converting field footage and photographs into hexadecimal data and music visualisation, to offer multiple perspectives of a specific scene. The resultant works from this process are audio-visual pieces where both the aural and visual are intertwined. This paper will conclude with some examples of work.

1. INTRODUCTION

Combining the visual with music, and exploring the interchange between musical and visual inputs have been steady preoccupations in many fields, including composition and the visual arts. The combination of both the visual and aural in a work can create powerful, evocative, multi-sensory and immersive experiences for the audience. For artists, linking the visual and the aural offers powerful tools in conveying the narrative of their works. In more recent years, there has been a move towards a synthesis between digital sound and image, and creating analogous relationships between the two mediums.

There have been numerous excursions into the concept of using images as the source for music in order to create multimedia works. Some methods centre on the use of colour to sonify images. One such method is the sonART software, which is a program that uses images to map pitch, time, spatial coordinates and timbre (Yeo, Berger and Lee, 2004). For instance, sonART allows artists to map tones according to colour (i.e. red is 440Hz, green is 530Hz, blue is 580Hz, yellow is 550Hz), or to map pitch and loudness according to colour intensity and graduation area.

Another method of using colour to sonify images is Wave Terrain Synthesis, where colour can be used to map the direction of the sound i.e. red for the left channel, blue for the right channel (James, 2005). Designed for sonifying geographical maps, Wave Terrain Synthesis works on the interplay between the spectrogram of an image and the colours of a contour map.

Other methods of using images as a source for composition involve analysing the data held within the image itself. This can involve elements of the appearance of the image, or the format in which the image is held. One method involves mapping the contours of an image, and using that as a basis for graphical notation of scores (Vickery, 2015).

Inverse spectrogram mapping is another way by which images can be sonified. This is a fixed method of scanning the data elements within an image where the speed cannot be arbitrarily modified during the sonification process (Yeo and Berger, 2005). Other methods involve probing the data elements of an image, where the pathing of sonification can be modified during the process.

Yet another method involves using hexadecimal data. Hexadecimal (HEX) is a positional numeral system with a base of 16. HEX involves usage of the symbols 0-9 and A-F, with the latter representing numbers 10-15. The most commonly-seen usages of HEX are as a way of holding computer data, and also as a format to render colours on websites (for instance, #FFFFF is white, #000000 is black, #FF000 is red). Using this method, field footage is converted into HEX, and the HEX then converted into musical notation.

HEX, when combined with field footage (still and moving), field recordings and music visualisation, can be used as a data element to sonify the found environment, by creating multiple perspectives of the environment into the work. It also strengthens the connection between the aural and the visual by creating links between both mediums. In a sense, this form of practice demonstrates a nexus between visual and aural.
2. SONIFICATION VIA HEX

HEX was utilised as a compositional method of creating a dynamic interplay between images and music. This exploration was sparked by an initial desire to combine music and photographs and to discover further ways of connecting these mediums. The intent behind this desire was to create meaningful relationships between the two mediums, in order to create works where both practices were intertwined in the result. Another consideration was the desire to convey multi-sensory responses to the found environment.

On the surface, HEX lends itself well to music composition because base-16 correlates to 16 notes, or two octaves of the musical scale. Therefore, it is a straightforward process to map HEX to notes using the following conversion table:

<table>
<thead>
<tr>
<th>Pause: 0</th>
<th>D 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 1</td>
<td>E Hex-A</td>
</tr>
<tr>
<td>D 2</td>
<td>F Hex-B</td>
</tr>
<tr>
<td>E 3</td>
<td>G Hex-C</td>
</tr>
<tr>
<td>F 4</td>
<td>A Hex-D</td>
</tr>
<tr>
<td>G 5</td>
<td>B Hex-E</td>
</tr>
<tr>
<td>A 6</td>
<td>C Hex-F</td>
</tr>
<tr>
<td>B 7</td>
<td></td>
</tr>
<tr>
<td>C 8</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1. HEX-to-music conversion table.**

In HEX, each binary digit (aka pairing of HEX symbols) equals one byte. For instance, FF is equal to a whole byte. The above table uses each half-byte, or 'nibble' (aka a singular F) as a basis for conversion into music.

Various software exists for converting images - or any other form of digital media - into HEX. One such program is Notepad++, a free program that has an add-on HEX editor.

<table>
<thead>
<tr>
<th>Address</th>
<th>0 1 2 3 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0015a670</td>
<td>24 e3 3c f1 4a</td>
</tr>
<tr>
<td>0015a680</td>
<td>0e 0b cc 02 1b</td>
</tr>
<tr>
<td>0015a690</td>
<td>05 dd 79 91 1d</td>
</tr>
<tr>
<td>0015a6a0</td>
<td>34 ea 80 f3 07</td>
</tr>
</tbody>
</table>

**Figure 1. Partial HEX from an image that has been converted using Notepad++.**

As an example, the first four nibbles in Figure 3:

2 4 e 3

Can be mapped to the following notes:

D F B E

3. LIMITATIONS OF HEX-TO-MUSIC

The main limitation of HEX is the comparative lack of ways to control the duration of time. Beyond 0 being used to denote a pause, there is no other way of denoting the duration of notes using HEX. There is also no ready method of denoting the tempo of a data set from the HEX source. It became quickly evident that a level of intervention from the composer on the data was required, or otherwise a HEX composition tended to sound like a pure stream of meaningless notes.

The above illustrates a broader issue with using data as a basis for sonification. The nature of sound itself utilises time as a parameter for other aspects of the composition - such as duration of each tone, and the duration of the sound itself. As data from images are not organised in time sequences, nor do they contain time-relevant information, then finding ways of relating time to such data can be difficult (Yeo and Berger, 2005).

Overcoming time-based limitations involves exploring and expanding the role of the composer in data-based compositions. For instance, there has been research into creating data-based music where the composer manipulates the output or while interacting with the computer. This creates a more interactive and flexible means of creating music from data, and allows some form of time to be interjected.

One such method involves a program that sense the output from a user and creates music from the output, essentially creating a feedback loop between composer and computer (Obrenovic, 2005). Such a program relies on measuring everyday interactions between the user and the environment and using that data as a form of music. This method is passive, but with the option for the composer to take manual control. In this example, the composer introduces the notion of time to the data through the existence of the feedback loop, as all everyday actions involve an element of time. The option of manual control also creates that extra element of time control and introduction.

A similar feedback process between the composer and data occurs in live coding, for instance through Supercollider. This involves active manipulation by the composer with the data, with the composer essentially coding and creating the piece on the fly. In live coding,
a composer has full control over the pitch, sound, length and loudness of each note. Essentially, the composer introduces both improvisational and aesthetic elements into the data, with the data being used as an evocative springboard for aural concepts.

Both these models assume a level of interaction by the composer with the data elements to introduce the element of time. Through exploring these avenues, active manipulation of the data from the composer in order to introduce the mechanics of time in compositions became part of the process of sonifying with HEX. This approach expanded to include intuitive elements as a way to explore further ways of incorporating time.

One way for the composer to interact with the data was to firstly select a random section of HEX from a photograph or field footage to convert into notes. The sections of HEX were then used according to subjective judgment on their aesthetic value, rather than following a strict, sequential interpretation of the data. A further consideration as to what sequences were used, and in which order, was whether the sound produced from the converted data accurately represented the emotive and narrative responses to the found environment. However, while the order of the sequences were changed, the note order of each sequence was preserved.

With this method of using HEX, the composer additionally dictates the pitch and duration of notes, and the tempo of composition. These decisions were also made largely on an aesthetic level, and how they would affect the intended narrative of the piece.

Another decision made to incorporate HEX in compositions was to group the notes in sets of four, rather than six or six in HEX format. There were two reasons for this - firstly, it helped introduce an element of time to the general data set by grouping them into 4/4 time, and secondly, it divided each line of HEX more evenly in a musical context.

An additional question arose regarding the use of percussion in composition. This method of using HEX did not lend itself to the generation of percussive scores. Adding percussion to pieces required the use of public domain samples.

### 4. HEX AS PART OF AN AUDIO-VISUAL WORK

Converting an image or piece of field footage into HEX produces a sheer mass of data, and to attempt to use all the data in a composition would be overwhelming. Therefore, a selective use of data is required in order to create a workable selection of notes to use. However, focusing on a section of the data comes at the expense of losing the data within the overall context of the work. Therefore, there was a need to convey the connection between the source visual material and the aural element of the piece.

One method of resolving this issue is to situate the composition in the context of an audio-visual work, where the source image and the composition are linked via a music visualisation. Using a music visualisation creates an additional layer of reactivity between the source image and the audio, and acts as a additional visual cue for audiences.

This process – of combining the field footage with the composition and the music visualisation - essentially situates the works on a nexus between the aural and the visual. Without the source footage, the audio cannot exist. Without the audio composition, the music visualisation would not exist.

The music visualisation component of the work can be incorporated into the composition in different forms - as the main visual component of the work overlaid on a static field footage, or as a stand-alone section accompanying a diptych or triptych video of field footage.

The music visualisations are created through a combination of Adobe AfterEffects (a video and visual effects software) and the Trapcode Suite (a set of third-party programs for Adobe AfterEffects, specialising in 3D effects). Two products from the Trapcode Suite that are particularly useful for making music visualisations are Trapcode Sound Key, which creates keyframes from audio, and can be used as a trigger for Trapcode Particular which is a particle effect creator. Another...
product, Trapcode Form, can also be used to make visualisations through the audio react option for the visual layers. With Trapcode Form, it is possible to have a visualisation respond to a certain frequency, as well as loudness.

5. DISCUSSION

Through exploration of using HEX in composition, it was found that it was better served as part of a structural process that informed the parameters of a composition. For a practice that is heavily based towards the narrative, the process of how the data is utilised becomes less important than the evocative nature of the overall work.

Rather than use HEX exclusively to generate a composition, HEX became used as a means of gathering and generating compositional materials, with created works being a composed sonification in response to the environment. With this method of practice, the composer/performer is controlling the outcomes of the resultant work.

The active manipulation of data meant that data was being interpreted largely on an aesthetic, rather than numerical level. The data became the basis of a composition, but was not necessarily the whole composition. The selective use of data (in order to make the data set workable for the composer) also meant that not all elements of a data set would be used, which reduced the emphasis of HEX in the overall composition.

A more philosophical consideration that arose from these explorations is the concept of data integrity, particularly in regards to this form of practice. What does 'data' mean in this context, and how much of the compositions are actually derived from 'data'? How much does the concept of data integrity matter?

If data integrity is regarded as preserving aspects of the original data into the work, then some data integrity exists in that the order of notes themselves are not being modified, even if the order of the sequences are altered. It can be argued that data integrity may not matter in the work as whole, since the work is more focused on the narrative and aesthetic elements of the found environment and the images produced by said environment. In this approach, what matters more is the evocative nature of the overall work, rather than how specific elements are used.

This method is perhaps more of a demonstration of how data elements can be used in the creation of structured, composed soundscapes, with the focus on the response of the composer to the found environment, with less emphasis on the data itself. The focus then becomes less about the process of translating data into music, and more about the ways in which a composer uses these elements as part of a narrative statement.

6. EXAMPLE WORK 1: WALYUNGA

Figure 3. Field footage from Walyunga, used for the composition.

Walyunga [2016] is a piece created during a visit to Walyunga National Park, north-east of Perth. The piece incorporates field footage and field recordings into the work, as well as a composition created from HEX converted from the video. In Walyunga, the music visualisation occurs after the field footage, with the former used to set the narrative scene while the visualisation provides the abstraction and visual movement.

Walyunga is a piece that incorporates the environmental and historical elements of the area. The visualisation, as shown in Figure 4., is intended to be an abstraction of the Avon River as it flows through Walyunga, with the steady, pulsating shifts in the visualisation reminiscent of the steady flow of the river.

Walyunga begins with a diptych of field footage from two sections of the Avon River. The diptych is 30 seconds long and is accompanied with a field recording. The field recording is intended to act as an audio cue to orientate the audience.

A diptych video format is visually interesting for two main reasons – firstly, it adds motion and interest to the beginning of the composition. Secondly, it effectively sets the scene of the piece by offering multiple perspectives of the found environment. Having a diptych video can be an effective method of helping the audience relate the piece to the source environment, without being too obtrusive or distracting.

The field footage and recording then fades out into the music visualisation. The rest of the work is more of an evocative response to the found environment using HEX as a compositional base, and is used to set the tempo, pitch and type of instruments used. The music was composed using Ableton 9.

The music visualisation was created using Trapcode Form in Adobe AfterEffects. Multiple audio react levels and a change in camera angle were used to achieve the final effect. The various audio react levels responded to...
a certain frequency (i.e. 1000Hz) with a change in the shape of the form (i.e. disperse level). An additional aspect regarding Trapcode Form is that the particles do not have a set “time of life” - that is, they will last the duration of a piece. This allows for precise control over the behaviour of the particles – as well as the disperse level, Trapcode Form allows for modifying their shape (i.e. strength of spherical and fractal fields).

Figure 4. Music visualisation for Walyunga, made using Adobe AfterEffects and Trapcode Form.

The audio at the end of the work features a reiteration of the field recording, to act as a bookend.

7. EXAMPLE WORK 2: THE ALL-ENCOMPASSING

The All-Encompassing [2015] was a work created during a Supported Residency at the Bogong Centre For Sound Culture in Victoria. The work involves a series of photographs and video of the area, along with field recordings and two guitars playing separate parts of sections of HEX that was converted into music. This is an example of data elements being played and recorded using live instruments.

The video was initially assembled using a series of photographs and field footage, and the completed video was converted into HEX. The HEX was then converted into music and played on guitar.

The first half of the work features still images of the forest in the Bogong region with three excerpts from field recordings of a lyrebird that were taken in the area. There is no instrumentation during this half; the focus is on the evocative pairing of the field recordings with the images.

Figure 5. Screenshot from the first half of The All-Encompassing, showing a photograph from the forest around the Bogong region.

The second half features a diptych of moving clouds with two accompanying guitars playing the composition. There is no music visualisation, with visual movement instead being portrayed by the diptych of the moving clouds.

Figure 6. A screenshot from the second half of The All-Encompassing, featuring shifting clouds.

8. EXAMPLE WORK 3: THE SHADOWS

The Shadows [2015] is a work featuring a music visualisation laid over a static field image, with no field recording present. The work was created from a photograph taken at Angkor Wat, Cambodia in April 2015. The work is based on the concept that spirits and memories remain alive in areas, with echoes of events lingering in the background. The visualisation represents these echoes that remains within the walls of Angkor Wat. The visualisation was created using Adobe AfterEffects and Trapcode Particular.

When overlaying a music visualisation over a still image, a line or point in the photograph is used to anchor the visualisation. This also helps incorporate the visualisation into the photograph, by using a point of the photograph as the start and end points. In The Shadows, the anchor point is roughly at mid-point between the two central pillars.
Unlike Trapcode Form, the particle effects in Trapcode Particular have a set “life span” - that is, the particles are only visible for a certain length of time. This allows for the creation of constantly-shifting effects, with the visualisation changing shape every few seconds. Trapcode Particular allows artists to set parameters regarding colour and opacity over life, creating the addition of shifting colours and visibility, as well as movement.

The Shadows also features a mix between HEX-based composition and improvised instrumentation. The guitar in this piece is a response to the composition. When performed live, this piece highlights how live performers can interact with the underlying HEX-based composition.

9. FUTURE POSSIBILITIES

There is still much to explore with regards to HEX-based compositions and where these compositions are situated in relation to other forms of composed sonification. There are also possibilities with creating interactive installations, as well as improving on live performances of these works. HEX-based compositions offer an interesting avenue to explore the relationship between the aural and the visual, and the aesthetic relationship between composer and data.

There is currently a heavy visual element to this work and there is potential to take the visual elements further. One future possibility is creating HEX-based works that actively engage with viewers and the performer, such as creating responsive installations and projections. For instance, through using OpenFrameworks – an open-source software for creating reactive applications – and Arduino, an open-source prototyping platform, there is the possibility of creating projections and objects that respond to a user's movement and/or sound, or for movement to trigger different lines of a composition.

Currently in live performance, improvised guitar lines are played over the composition, with the projection in the background. There is the potential for all the lines to be played by live musicians, in combination with improvisation, to create more organic interpretations of the data.

The current mapping system can be modified and expanded to introduce accidentals into the composition. By expanding the mapping system, this will introduce greater complexity in sonic possibilities. At present, there are no accidentals in the compositions. One way of introducing greater complexity to the compositions is mapping the the HEX letters (HEX A, HEX B, etc.) to represent accidentals rather than the continuation of the octave scale. Another area to explore is mapping HEX to specific scales, such as pentatonic major and minor scales.

Another possibility is to combine HEX with other forms of data-based composition methods, such as converting DNA from organisms from the found environment into music, or using the contours of the landscape as the basis for a percussive score. With these methods, more facets of the found environment can be incorporated into the composition.

Regarding the issue of incorporating time into compositions, an alternative method is to use the tempo of the field recording as the main method of denoting time. That way, the tempo of the composition would more accurately reflect the rhythm of the found environment. Changing the groupings of the sequences is another way of introducing different elements of time into a work – for instance, grouping sequences in groups of six to approximate 6/8 time, or in groups of three to approximate 3/4 time.

10. REFERENCES


ABSTRACT

This paper discusses recent works incorporating field recordings and acoustic instruments by four Western Australian composers: Sam Gillies, Josten Myburgh, Michael Terren and Lindsay Vickery. In particular, the paper investigates their approaches to issues and techniques of spectral analysis, sonification, coordination of live and prerecorded elements, transcription, resynthesis, transformation and ecostructural considerations. The discussion is framed by an examination of the evolution of the practice of combining field recordings and acoustic instruments as a genre in the context of ideological and technological advancements and impediments. The works are placed in the framework of emerging digital technologies deployed in similar work by James O'Callaghan, Aaron Einbond, Joanna Bailie and Chaz Underriner.

1. INTRODUCTION

Although non-anthropogenic audio was first recorded as early as 1889 (Ranft 1997), the inclusion of environmental recordings into mainstream “concert music” has been slow and piecemeal. The question of how to define the sounds of the environment in relation to ‘music’ has had at least an equally tortuous journey. Perhaps key to this question are the expansion of the ideological framework of “music” and the development of audio technologies that have eroded the distinction between natural/artificial and representational/abstract dichotomies in music.

The use of field recordings in conjunction with, in parallel with, or in counterpoint with acoustic instruments implies a divide between extra-musical, non-aesthetic nature; and the musical, aesthetic human. This human-nature binary, which implies a fundamental typological segregation of humans from nature, informs much of the twentieth century theorisation on the experience of sound and listening.

The steady advances of recording technology have achieved an intrinsic levelling of the listening experience, that has habituated listeners to Cage’s formerly experimental goal “to let the sounds be themselves” (Kostelanetz 1988 p. 42). However, composers and performers were impeded from interaction with ‘extra-musical’ (O'Callaghan 2011) sounds by ideological constraints arising from Modernism.

The manner in which humans have emulated the ‘extra-musical’ sounds of the sonic environment as composers and as performers is perhaps the best illustration of the changing ideological framework in which they have been heard. The shift has seen an attempt to elevate the structure and morphology of natural sounds beyond the manipulations of human-derived aesthetics and formed the basis for what Opie and Brown define as an Eco-structural approach in which structural data derived from environmental sound sources “are used as the dominant material for creating the musical composition” (2006).

In 2014 composer Joanna Bailie asked “If we are not to simply present the sounds of the world to an audience as a kind of musical fait accompli (…), what in fact are we to do with them?” (p. 101). This paper describes a number of techniques developed by four Western Australian composers to answer this question.

2. THEIDEOLOGICAL AND TECHNOLOGICAL EVOLUTION OF FIELD RECORDING PRACTICE

It appeared that when Russolo declared in 1913, “we must break at all cost from this restrictive circle of pure sounds and conquer the infinite variety of noise-sounds (1913 p. 6), that the barriers between music and “noise-sound” were irrevocably breached. However, Futurism’s ideological opposition to the pastoral preoccupations of Romanticism disfavoured the emulation of all but the most active-negative sounds: his examples include, “shouts, screams, snorts, wails, buzzings, percussive noises, howls, death rattles, sobs” (ibid. p. 10). Indeed, Russolo states the “nature is normally silent” (ibid p. 4). Perhaps unsurprisingly, it was Respighi, a remnant of the Romantic Era, who first employed a field recording in conjunction with acoustic instruments in the
The inclusion of a gramophone recording of a nightingale can best be described as decorative and even as such was criticized at the time for eschewing the adaptation into ‘musical’ language: “composers should credit their hearers with brains and a little fancy.” (Reilly 1960 p. 248).

The Second World War brought the new technology of magnetic tape and in the hands of Schaeffer, Henry and other Musique Concrète composers, a new bridge between composers and extra musical sound might have been expected. However a new ideological impediment arose, that of abstraction. While the acousmatic concepts developed by Schaeffer were arguably necessary and welcome, “they emphasized the ‘formal or ‘intra-musical’ aspects of sound, eschewing sound-identities as ‘extra-musical’ elements which hinder the somehow more refined process of ‘reduced listening’” (O’Callaghan 2011 p. 57).

The use of what would now be termed field recordings comprised of recognizable sonic objects in early works such as Étude Aux Chemin de Fer (1948), quickly gave way to what was literally a ‘Veil of Orpheus’ (1952): acousmatic works comprising abstracted recordings shorn of the relationship to their sonic origin. So strong was the magnetism of the Avant Garde, that Schaeffer and Poullin initially developed a keyboard-controlled device capable of replaying tape loops in equally tempered steps (Behnen 2008). However Musique Concrète did much to lift the constraints of the metrical/chromatic grid imposed by traditional music notation and led to a re-evaluation of acoustic instrumental performance. In the “Musique Concrète Instrumentale” of Lachenmann that sought to illuminate “instrumental sounds as mechanical processes” (Lachenmann 1996 p. 212) and Free Improvisation (Bailey 1993) a new space was opened for the emulation of natural sounds with “extended techniques” that exponentially expanded the timbral pallet of acoustic instruments.

The breakdown of Avant Garde dogma in the late 1960s that issued in the Postmodern era arguably dissolved the final barrier to the embrace of “extra-musical” sound. The rupture is dramatically illustrated by Ferrari’s Presque rien ou le lever du jour au bord de la mer (1967–70), which he claimed consisted of an “unretouched recording of morning in a fishing village by the Black Sea” (Drott 2009 p. 145). Normandeau describes the incredulity with which it was greeted: “And everyone was shocked. It was a big debate: Was that music? Where does it stop? Where are the boundaries?” (Woloshyn 2011). The boundaries at which “music stopped” were shifting. In Acousmatic music and in instrumental music the “two-dimensional lattice” (Wishart 1996:23) on which music had been hung was dissolving.

Robert Erickson (1917) was perhaps the first to propose a path forward for the genre with his works Pacific Sirens [1968] and 9 1/2 for Henry (and Wilbur and Orville) [1970] both for instruments and field recordings of the ocean and human transportation respectively, and scores based on spectrographic analysis of their sonic features. In 1987 he wrote of the process that the stimulus for his music “is usually some noise or some non-music sound composing the environment in which I live, its sounds, its ambience, noting that many others “Compose against it, or in spite of it or never-the-less” (Dunbar and Erickson). His Sound Structure in Music (1975) was one of the first extended discussions of the spectrogram as a means for analytical engagement with the timbral complexity of sound.

Pacific Sirens employed proportional notation, with an external time source (stopwatches), together with a transcription of sound/frequency morphologies (presumably taken from a spectrogram) and directed the “improvising” performer’s to “listen into” “the spectral complexes of the environmental noise and appropriately blend and protrude” (Mackay 2007 p. 27). Timbral and spatial qualities of the sound are not scored and the frequencies of the field recording are overlaid against a staff that, in part as a result of the filtering processes applied to the field recording, does not include sharps of flats (Fig. 1).

Likewise, Alvin Lucier’s (1931) (Hartford Memory Space (1970), continuing the trajectory of “Musique Concrète Instrumentale”, invited the performer to enter into and later return to an “inside performance space” and emulate the ‘language’ of “urban, rural, hostile, benign” ‘extra-musical sounds’ (Lucier and Simon 1980).

In 1972 R. Murray Schafer (1933), Hildegard Westerkamp (1946) and Barry Truax (1947) created the Vancouver World Soundscape Project (1972) at Simon Fraser University, identifying field recordings as artworks in themselves. This was perhaps reflected the ideological the resurgence of the Environmental Movement following the publication of modern foundational texts such as Rachael Carson’s Silent Spring (1962) (dealing with the effects of man-made pollutants on wildlife) and Paul Ehrlich’s The Population Bomb (1968) – (concerned with the impact of the exponential growth of the human population). The term “Soundscape” was invented in 1967 by Schafer (Schafer 2006) and his colleague Westerkamp noted that compositions based on soundscape recording should be “rooted in themes of the sound environment” (Westerkamp, 2002: 53).

This is an important distinction, elevating the structure and morphology of natural sounds beyond the manipulations of human-derived aesthetics, signalling...
engagement with identifiable ‘extra-musical’ sounds in field recordings on their own terms rather than abstraction of them into pre-existing ‘musical’ schemas. It is not a coincidence that this final ideological shift coincided with the advent of the Postmodernist era and rejection of Modernist dogma. The shift from analog to digital recording also provided crucial new tools for analyzing field recordings with a grid finer than that of human perception. The spectrogram allowed for the analysis and visual representation of sonic events that were extremely difficult to capture with traditional notation, and for much more precise emulation of continuous timbral features with acoustic instruments through “instrumental synthesis” (Grisey 2000). Although not specifically concerned with field recordings, Spectral Music, “deriving fields of musical relations from sound itself” (Pressnitzer 1999 p. 3) was perhaps more predisposed to the investigation of environmental sounds. The alignment of ideology and technology that had occurred by the 1990s provided the foundation for what can be considered contemporary practice in this genre and formed the basis for what was later termed Eco-structuralism in which “structures must be derived from natural sound sources” (Opie and Brown 2006). Barry Truax’ Dominion [1991] for Chamber Orchestra and two digital soundtracks combining field recordings, spectral analysis, granular synthesis and instrumental transcription is perhaps the seminal work for contemporary practice, which aims to allow complex human interaction with the ‘extra-musical’ soundworld.

3. APPROACHES TO COMBINING INSTRUMENTS AND FIELD RECORDINGS

Since the advent of the music involving live instruments and fixed media Bruno Maderna’s Musica su due Dimensioni (1952) (Neidhöfer 2007) composers have faced the issue of the absence of interaction between performer and tape, in which live performance nuances cannot be accommodated and performative visual cues found in ensemble playing are lacking. Field recordings can be particularly problematical to combine with live performers with for a number of reasons including the absence of metrical sign posts, free temperament, diversity of timbre and sonic morphology and particularly in the case of non anthropogenic sounds, extremes of frequency, and polyphonic and spatial density.

The role of human performers, even when they are performing with instruments designed to replicate environmental sounds, for example the bird and insect calls of Kagel’s Bestiariurn [1976], is at best emulative and mimetic in such works. Field recordings are always innately ‘human music’. They are ‘framed’ both physically by the technology that has excerpted them from the sonic environment and ideologically by the ideological frame (Goffman1975) with which they are perceived by the human listener. Finally, field recordings are always ‘human music’ because they are perceived, by human listeners, through the pre-semantic grouping and streaming filter of the auditory system (Bregman 1990). Di Scipio describes these circumstances as “irreducible listening” (Di Scipio 2015).

In music in which the intention is the placement of instruments as a component of a field recording’s sonic world (as opposed to those in which instruments are deliberately placed in juxtaposition to it), the methods of coordination, transcription, resynthesis and transformation of the field recording are crucial, “as modifying these can either break the sound into two or more streams or merge it with other streams, which can be distracting and reduce ecological validity (Mechtley 2013 p. 57). Development of techniques for enhancing and expanding this interaction is still in progress. A number of works by Western Australian composers exploring these issues are discussed here.

3.1. Coordination, Transcription and Notation

Composers have developed a number of practices to resolve the problem of synchronization between acoustic instruments and fixed media. Barry Truax’ Dominion [1991] (Fig. 2) for Chamber Orchestra and two digital soundtracks uses proportional traditional notation, temporally partitioned into 6 second “measures” and coordinated by a conductor using a “timer”. Principle sonic events are annotated (often with traditional notation) with descriptions of their source together and some indications of elements to emulate with extended techniques. Joanna Bailie’s Trains for solo cello and tape (2014) (Fig. 3) employs traditional notation with defined tempo/meter in conjunction with onset times for each phrase, while Chaz Underriner’s nocturne series: 1 for two electric guitars and field recording (2012) (Fig. 4) simply provides onset and duration times for notated musical events. Traditional notation has also been used by composers such as Hildegard Westerkamp Fantastie for Horns II [1979], in which equally tempered, metrical music is placed in the context of a field recording and more recently by Aaron Einbond whose Sonic Postcards series (2012-14) (Fig. 5) attempt to capture the complexity of the sonic environment through extended techniques, coordinating the performance via click-track.

Myburgh’s works a window in Sicily [2016] for guitar and electronics and a painted mirror of nothing [2016] (Fig. 6) for clarinet and electronics, both influenced by the reductionist Wandelweiser composers employs the same method as Underriner (who is a member of that group). In Myburgh’s works the pitches and their ordering is chosen by intuition and temporally placed at defined periods in small groups. In a painted mirror of nothing, the instrument is an ‘eraser’ for the tones; as a tone is near disappearance, the instrument plays the same tone, and as the instrument disappears one becomes aware that the tone has disappeared as well. In a window in Sicily, because the tones and guitar are playing the same pitch, when the guitar enters its almost imperceptible: the sound of the guitar ‘colours’ the tones with a faint vibration, almost acting less as a sound in itself and more of a disturbance in the air. Richer
harmonies are used to create the impression of single tones emerging out of denser ones. These techniques focus the listener on sonic events as they appear and disappear.

While the electronics have an active role in this piece, much of the work can be performed like a ‘tape work’, there are opportunities to engage in improvisation, which are particularly important especially at the end. The guitarist is also asked to improvise with both melodic and noise-based material, and also needs to use an bow and a small speaker. Myburgh argues that this approach results in fictional, yet somehow plausible, soundscapes created through obfuscating the (imaginary) source material.

Shelter began as a tape composition before being adapted to include acoustic instruments. The resulting score is coordinated via the Decibel ScorePlayer which is proportionally notated to respond to the slow changes in the fixed electronics. The electronics were analysed for pitch and partial content using the IRCAM software Orchids (Carpentier et al. 2012) that provided clusters of tonal materials that were selected and arranged for the selected instrumentation of bass clarinet and electric guitar. Open notation is utilised to try to reduce the potential ‘musicality’ of a performance, and attenuate the performers to interacting with the sound world of Shelter. The notation centres a drone or constant pitch – the most relevant pitch or overtone evident in the electronic material, with optional pitches separated and placed throughout the score to provide the performers with different performance options, and the ability to exert a degree of control over which elements of the sound world are reinforced (Fig. 7).

Michael Terren’s As Rendered for flute, bass clarinet, piano, violin, cello and laptop (2014) (Fig. 8), Gillies Shelter for three instruments and electronics [2015-6] and Vickery’s works small waves raised by the evening [2016] for bass clarinet, electric guitar and harp and electronics, and nature forms II [2016] for flute, clarinet, viola, cello, percussion, hybrid field recording and electronics, bascule [2016] for ensemble and electronics utilize proportionally notated scores. The instruments are coordinated via synchronised scrolling
presentation in an iPad application, the Decibel Scoreplayer (Hope et al.), allowing the instrumentalist to see a visualisation of the sounds before they are performed (and sounded).

The notation in As Rendered is graphical and proportional, consisting of figures representing approximate pitch vertically. The sounds are colour-coded according to different timbral sonorities: red indicates a maximally noisy timbre, with no defined pitch; purple indicates a pure tone, played with as little noise as possible; brown-shaded figures are partially noisy, while retaining its tone; and pink figures indicate key noise or other small incidental noises.

In Vickery’s nature forms II (Fig. 9) the frequency/amplitude morphology of features of the field recording to be emulated by the performers is communicated by extracting shapes directly from the spectrogram, a process has previously termed the “spectral trace” (Vickery 2014b). The colour-coded parts are annotated with pitch, dynamics and articulation indications. The percussion part uses notation created by Vickery’s generative software work The Semantics of Reduction (2014), detected accents in the field recording, (in the case of this work the chirping of crickets) generate graphical symbols of varying vertical position, size and colour, determined by the frequency, amplitude and timbre of a speech recording at the accent point.

In Shelter, Gillies aimed to limit formation of the spatial ‘sweet spot’, a phenomenon that confines the optimal listening position for the audience to a small region that is equidistant from each speaker in the array. His approach was to adopt a microsound aesthetic (Roads 2004), in particular drawing from Demers’ characterization of sound “recorded at soft volumes, so much so that playback at what one considers to be a normal volume is often inaudible” (2010, p.74).

Gillies’ focus was an inversion of this idea expressed by Roads in Microsound that as sounds become briefer, their amplitude must be increased for them to register audibly (2004, p. 22). The sound materials used vary from unprocessed field recordings to artificially created sounds using Max/MSP. SPAT was used to artificially place sounds in an artificial space, creating the impression of distance and then reduced them to extremely soft volumes, ranging from -20db to -55db. In this way SPAT was used to treat the sounds in a deliberately acoustical way, a process inspired by Francis Rumsey’s SpatialAudio (2001, p.35). The result was a very complex, very soft noise, consisting of many layers that the audience must utilize selective listening to navigate through.

The largest sounds in the piece (field recordings of a rainy courtyard) were the most obscured. By placing these sounds at a great distance and facing them away from the audience, via SPAT, Gillies was able to turn a signifier of location and space into indeterminate background noise: the closest sound to the audience was also the smallest - a DSP click. This popping sound creates a frame of reference for the audience's comprehension of the other sounds in the piece and each repetition is quickly masked by a granular treatment of the same sound at a much lower volume.

The second half of the work follows after a sharp cut to digital silence. Gillies initially planned to cut to harsh noise, however after reading Richard Chartier's discussion of digital silence: “The advent of digital audio has greatly increased what composers can do in terms of using the aspect of silence as a compositional element Where it really is silent ... With digital silence there's nothing. An absolute zero - no code.” (Boon 2002). It was decided that silence could, in this context, be just as shocking and carry the same intensity as a blast of noise. One of the familiar drones continues on to with a great deal of precision (albeit an octave lower) (Fig. 10).

These works explore varied aspects of what O’Callaghan terms “mimetic instrumental resynthesis”: Not only do these works use ‘extra-musical’ source materials as the starting point of their analyses, but they also attempt to preserve aspects of the source sound through the transcriptive process to engage in a mimetic discourse (O’Callaghan 2015).

3.2. Resynthesis, Transformation and Spatialisation

The issue of emulating spatial qualities of the environment, in which there may be literally thousands of spatially distributed sound sources, within the frame of a musical work is particularly challenging.

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to give a connection to the first half, however we also have the introduction of new material is also introduced that occupies the hitherto unexplored bass range. Bass frequencies were deliberately chosen for their quality inside the EMS 8-channel studio - the greater wavelength of bass frequencies makes it much harder to gain a sense of directionality within the studio space, creating a fullness and intensity without adding more sound.

Ultimately, Shelter seeks to engage with a microsound aesthetic to create an equal listening environment for every audience member. By working with softer volumes, the importance is shifted to the audience’s own listening process, thereby reducing the importance of listening in a more central position. In both a painted mirror of nothing and a window in Sicily, Myburgh uses three basic materials: field recordings, noise, and sine tones. Although the temporal integrity of the field recordings in both works is retained, the recording is heavily processed in a painted mirror by a high-pass filter running through the distortion/wave-shaping iZotope’s logic plug-in Trash2.

Pink and white noise is run through various chaotic processes (of the composer’s design), complex wave shaping or both. The noises the sounds at the extremes of complexity, whilst the oscillators and recordings exist in the simplest form possible.

Terren’s As Rendered was an attempt to create a notional, chimeric ecological soundscape using traditional classical instruments and a chaotic computer-synthesis framework. Inspired by Brian Eno's thought experiment of learning a field recording “exactly as one would a piece of music” (Toop, 1995 p. 129), the work is loosely structured yet highly determinate, using Terren’s own field recordings and noise improvisations as semiotic material. As Rendered cautiously embraces an element of fantasy in the representation of a plausible acoustic ecology, in which the medium of its transmission obfuscates its realistic qualities.

Using field recordings and noise improvisations as loose material for acoustic instruments to play, there is inevitably a distortion brought about by this transmediation process, and this distortion undeniably has a degree of complexity across time akin to the dialogue surrounding mid-20th century developments in chaos theory.

In As Rendered Terren uses a laptop generating a chimeric, slightly fantastical soundscape as a supplement to the soundscape created by the acoustic instruments. This sound is synthesised in Max for Live in five morphologically distinct components. The process for generating the sounds was primarily inspired by the functional iterative synthesis as described by Agostino Di Scipio (Di Scipio 2002).

Vickery’s nature forms II used a number of approaches to sonification/resynthesis to produce “copies” of the field recording of bird sounds and a rusty gate, that were to different degrees timbrally varied but morphologically similar: the self-devised software Sinereader, which uses additive synthesis to resonify spectrogram images (Vickery 2014); Ring Modulation synthesis, where the strongest sinusoidal component detected each 40ms of the recording was then ring-modulated according to the currently detected spectral brightness of the recording; Subtractive synthesis using frequency and amplitude data detected in the recording to bandpass filter white-noise; and “spectral freezing” of components of the field recording to create spectrally derived chords from features of the recording.

Similar methods were used to process the live signals from the three performers for example shaping “coloured noise” (Eimert 1955) into the sonic structure of the field recording using subtractive synthesis. The final work uses the source recording and its resynthesised copies as a means of generating structure based upon timbrally distinct sections (Fig. 11).

A less interventionist approach was taken in Vickery’s small waves, which combines components of the field recording of bullfrogs spectrally frozen, using Eric Lyon’s thrasher object to highlight amplitudinally prominent frequencies, with the source recording.

This approach draws on the concepts underpinning Peter Ablinger’s “Phonorealists” works in the Quadraten series (Ablinger 2011), in which spectral analysis data from recordings is “reconstituted in various media:

![Figure 11. Visual representation (inverted) of temporally proportional alignment of multiple resynthesis (a.-d.) and notation (e. – f) versions of the recording in nature forms II (excerpt): a. field recording spectrogram; b. ring modulation resynthesis spectrogram; c. subtractive synthesis spectrogram; d. spectral “freeze” sonogram/score; e. percussion score; and f. instrumental score.](image-url)
instrumental ensembles, white noise, or computer-controlled player piano" (Barrett 2007).

Spatial depth was emulated by separating sonic features in different frequency bands into multiple channels with associated frequency tracking patches developed by the composer in MaxMSP. As no actual spatial data was derived from the stereo field recording, the channels were then spatialised to conform to their frequency (azimuth) and amplitude (distance) in the object ambipanning~.

A number of approaches to frequency tracking were explored: manual frequency tracking, by annotating the spectrogram with multiple function objects and then retrieving the data by inputting the position of the audiofile as reported by snapshot~ to control the centre frequency of bandpass filters (Fig. 12); Automated frequency tracking controlling the bandpass filters’ centre frequency via frequencies derived from spectral analysis conducted using the s<igmund> object; and “ecological niche” tracking drawing on Krause’ theory which asserts that “animal and insect vocalisations tend to occupy small bands of frequencies leaving “spectral niches” (bands of little or no energy) into which the vocalisations (fundamental and formants) of other animals, birds or insects can fit.” (Wrightson 2000 p. 11). This theory would suggest that band passing at particular frequencies will tend to capture divergent features of the sonic environment, Audacity’s Plot Spectrum function (Mazzoni and Dannenberg 2002) was used to determine the niche frequency bands in the recording and then bandpass filters were applied separately to each band. These frequency tracking processes are similar to conventional Audio Expansion, however the complexity and the uniform spread of amplitudes from increasingly distant sources that are common in most field recordings, render poor results from conventional expansion. Perhaps unsurprisingly then, the manual method for frequency tracking proved to be the most effective of those explored.

It could be argued that manual designation of the band pass frequencies adds a ‘human’ layer to the process in contradiction to the eco-structural aims of deriving all data from the environment itself. However, the process is no less of an intervention than choosing sonic features to be emulated by acoustic instruments and indeed, in this case, was achieved through similar means: visual detection of features from a spectrogram. The approach is perhaps analogous to the ‘Cocktail Party Effect’ (Pollack and Pickett 1957) a feature of the human auditory perception in which conscious auditory attention allows for pre-semantic attenuation of signals in a complex environment.

3.3. STRUCTURAL CONSIDERATIONS

Gillies’ Shelter aims to render the complex environmental phenomena of rainfall in a manner to an audience, essentially through two alternate resonifications.

In a window in Sicily, the intention is to portray the field recording like a three-dimensional shape that is viewed from six different perspectives. Each recording is from the same area in Palermo, Sicily, and in each recording one can hear distant echoes of the sounds that are the feature of other recordings; an announcing voice in a speaker rings distantly in one and in close proximity in another, different parts of a marketplace and different ‘characters’ can be heard as they loudly shout over one another, with each recording offering a new perspective on the space by attending to another individual source of sound. It is arranged in ten ‘moments’, all of which overlap, and range in duration from just over a minute to just under twelve.

In this way the field recordings attempt to allow one to listen to what is purely fascinating about the sonic situations in one place, but have a sort of ‘prismatic’ structure and the possibility for a narrative mode of listening across the piece; the listener can assemble a low-resolution image in their head of a larger location, rather than hearing one continuous field recording through the whole piece.

In this way the fact that the recordings are from Palermo is not as important as the way they are recorded; the unique location of the recording only offers the possibility for specific listeners to emotionally connect to the sounds in specific ways. The technique of changing ‘perspective’ offers a formal option that is incredibly difficult to effectively achieve with more abstract sounds.

In a painted mirror of nothing, the field recording is an extension of the noise; it is processed with similar wave shaping and faint elements of voices and sounds peer out of something more chaotic. The work is also all sourced from a single field recording sourced from the
performer. Myburgh was influenced here by the idea that there’s a distinct difference between composing with downloaded samples and one’s own field recordings, due to the experience and association one has with the latter. This was made ‘justifiable’ by the fact that the composition’s structure was derived at large from a painting by George Ward Tjungurrayi, so the individual details of each sound, and my relationship with them, only had partial influence over the direction taken by the piece as it followed the structural course outlined by the painting (Fig. 14).

As Rendered does not have an explicitly identifiable form. In sonifying environmental sound, Terren aimed to create an ecology whereby the sounds were wholly unpredictable at a micro level, but at a macro level were rather predictable and prosaic. The work starts and finishes without any fanfare—like a field recording, in which the recording device is turned on, then after twelve minutes, turned off (or with a short fade-out, as happens in this work). 

4. CONCLUSION

We have argued that although the opportunity for composers and performers to engage with the extra-musical sounds of field recordings existed from the advent of sound recording, this sonic world was ideologically antithetical to Modernism and for the most part remained unexplored until the advent of the anti-doctrinaire Postmodernist period. It was also argued that technological developments, not least the changes wrought by recording on the act of listening, significantly set the stage for the exploration of field recordings that has occurred since the 1970s. The processes employed by the composers that are described in this paper constitute a set of possible approaches to engaging with field recordings in an eco-structural manner through machine and performative means. They provide a range of methodologies for interaction and manipulation field recordings through spectral analysis, processing and synchronisation of visual and sonic elements of the work. As investigation into means of interacting with ‘extra-musical’ sound proceeds, it can be expected that interaction and engagement with field-recording will continue to deepen.

5. REFERENCES


Figure 14. Tingari – Karrkurritinytja by George Ward Tjungurrayi
SONIC ENVIRONMENTS - ACMC2016
ABSTRACTS AND POSTERS
Of Earth and Sun: Generative Soundscape Composition and Biophilic Design

Abby Aresty
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ABSTRACT
Despite well-documented benefits experienced by communities and individuals with easy access and direct exposure to nature, many individuals spend a majority of their working hours indoors. The field of sustainable design has tackled this issue through biophilic design, which strives to elicit a positive, valued experience of nature in the human built environment. But while biophilic design principles are increasingly employed within the visual domain, auditory applications of these principles are underutilized and underexplored. I examine sonic approaches to biophilic design in my generative soundscape installation, Of Earth and Sun.

In 2013, the Phipps Conservatory and Botanical Gardens in Pittsburgh, PA, commissioned Of Earth and Sun, a permanent sound installation for the public atrium of the Center for Sustainable Landscapes (CSL).

This project is part of its Biophilia Enhanced Through Art (BETA) initiative, which uses art to remind people about nature’s beauty and the connections between humans and the natural world. Of Earth and Sun is a dynamic sound installation that evolves throughout the day and with the seasons. The systems at the CSL respond to environmental input in order to reduce its ecological footprint. Similarly, Of Earth and Sun uses data from the CSL’s on-site weather station to dynamically control the sounds and processes that will create the installation. Sounds and soundscapes gathered from throughout the Pittsburgh region are stored in a local database, processed, and played back through transducers placed on windows throughout the CSL’s atrium.

I am installing the fourth and final iteration of this project in the late summer and early fall of 2016. In this paper, I describe the project goals, processes, and outcomes of the various project iterations. I also examine listener experience and propose models for enhancing listener engagement in soundscape composition using diverse models of community engagement and user interface design.

Biosphere Soundscape: Exploring the art and science of listening to UNESCO Biosphere Reserves

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ABSTRACT
Biosphere Soundscape is a large-scale interdisciplinary research project underpinned by the creative possibilities of acoustic ecology, ecocoustics and rapidly emerging fields of biology concerned with the study of environmental patterns and changes through sound. This project is designed to inspire communities across the world to listen to the environment and explore the value of sound as a measure for environmental health in UNESCO biosphere reserves. The project is delivered through immersive residencies with artists and scientists, research laboratories, intensive masterclasses and a diversity of creative projects spanning four continents.

Biosphere reserves are sites recognised under UNESCO’s Man and the Biosphere Program (MAB) to promote innovative approaches to sustainable development. There are currently 669 biosphere reserves in 120 countries comprising terrestrial, marine and coastal ecosystems. Each biosphere reserve is designed and managed in a different way, but all seek to reconcile the conservation of biological and cultural diversity. They differ from world heritage sites in that they encourage active community participation and are ideal locations to test and demonstrate innovative approaches to ecosystem monitoring and sustainable development.

Biosphere Soundscape draws on the inherently interdisciplinary nature of sound to explore cultural and biological diversity through accessible audio recording technologies, interdisciplinary creativity and environmental engagement with local and global communities. This paper introduces the framework and methodology for Biosphere Soundscape and explore the ecological, social and cultural contexts of UNESCO Biosphere Reserves through sound. This presentation will also introduce the potential role of acoustic ecology in the Lima Action Plan (2016-2025) adopted by UNESCO at the 4th World Congress of Biosphere Reserves in Lima, Peru in March 2016. Biosphere Soundscape sits at the intersection of art and science, with the recordings providing valuable scientific data for biodiversity analysis and incredible source material for creative works that can bring awareness to these environments through new technologies. This project is designed as a platform for artists, scientists and global communities to collaborate and expose the creative and scientific possibilities of environmental sound to a global audience.
TAMBOURINE BAY

Damian Castaldi

http://damiancastaldi.net/

ABSTRACT

Tambourine Bay is a multimodal work for large scale, interactive video projection and live electroacoustic performance. It can be seen and heard as a window into the local weather patterns experienced in the Tambourine Bay Reserve, situated on the Lane Cove river, Sydney and represents a transition or dramatic shift in the climate over a 16 day period. Additional audio and text combine with this to reflect on more severe weather patterns across the east and west coast of Australia leading up to the Australia day long weekend.

The work is scored for 51 percussionists and 100 tambourines. Additional instrumentation includes a percussive/string instrument with audio sensor interface using a Raspberry Pi Model B+, six fast vibration sensor switches, wire / aluminium frame, clear acrylic housing & miscellaneous electronic components; electronic & acoustic drums; cymbals & tambourines (see Figures 1 & 2).

1. INTRODUCTION

The video component of Tambourine Bay was first programmed for installation at the Balance-Unbalance International Conference 2013 in Noosa, Queensland, Australia from the 31st of March to the 2nd of June 2013. The single channel video work was presented in the ‘Earth to Earth’ sound venue throughout the conference proceedings. After participating in this event I started working on a larger scale version of Tambourine Bay for performance and it is the development of this work that I will discuss in this paper.
2. CONCEPT
The performance is in three parts and is visually represented through processed urban video footage, altered in its duration, hue and perspective and situating the viewer inside an apartment room looking out over Tambourine Bay. Parts 1 & 2 of the video/performance are visually saturated in a red and orange hue intended to illustrate and highlight the unusual weather patterns experienced in this inner city suburb, the ongoing shifts in local weather patterns and what this might indicate in terms of broader climate change (see Figures 3, 4 & 5).

Throughout the performance the audience witnesses the systematic pounding of the Tambourine Bay Reserve as it is severely struck by thunder and lightning. It then transitions from late evening into an overcast midday with a forecast of further showers, storms and bush fires. The final scene is late afternoon interspersed with sunshine and heavy cloud cover and again with further predictions of wild weather.

Spiralling text created in the application Processing and adapted from the typography sketch “kinetic_type” by Zach Lieberman (Lieberman 2014) fuels the narrative of the video and performance. Using the daily weather broadcasts transcribed from ABC news radio throughout January 2012 the narrative builds and repeats itself in an upward movement passing in front of the window frames from which the video was shot. The constantly moving cyclone of text is both readable and sometimes not, providing snippets of news, which can be distinguished at random throughout.

A second layer of text also created in Processing is projected onto a screen placed within the audience. This secondary text is manipulated by the musicians on stage in real time using long range, infrared sensors to alter the speed and direction of the spiralling text. The secondary text is constantly changing and is sourced from real time news feeds broadcast online as weather news in the vicinity and at the time of the performance.

The two layers of text provide contrasting data between the shifting weather patterns over a period of time ranging anywhere from the 10th of January 2012 to the current day’s performance date and data.

The second layer of text’s Processing sketch is still in development. A prototype sketch using a simple turn switch with an Arduino Uno R3 to manipulate the speed and direction of the spiralling text is shown below.

2.1. Score Soundtrack timeline (@ 30 fps):
00:00:00 to 06:23:00 - scene 1 RED
06:23:00 to 09:48:00 - scene 2 ORANGE
09:48:00 to 14:50:00 - scene 3 BLUE

2.2. Prototype Processing Sketch
import processing.serial.*;
import cc.arduino.*;

int fps = 30;
Arduino arduino;
short portIndex = 1;
String[] theText;
int index;
int lineLength;
PFont font;
Line ln;
Line lns[];
PImage bg;
int potPin = 0;
int potValue = 0;
int potnumber = 0;
3. SOUND DESIGN

3.1. Design

The sound design is layered and includes multi tracked, processed location sound recordings, recorded oral snapshots, live percussion and electroacoustic performance. The location recording (thunder, lightning and birds) / intense bursts of synth pipes / manipulation of frequencies using EQ and sound relationships created by dynamic mixing are the main production components.

The performance soundtrack will include oral snapshots yet to be recorded by aboriginal clan elders, some of the oldest inhabitants of this Sydney region, from the ‘Guringai’ Aboriginal language/tribe. As discussed in the Aboriginal Language Group and Clan Names - Aboriginal Heritage Office in their publication, Filling a Void: A Review of the Historical Context for the use of the Word ‘Guringai’, they are from the ‘Guringai’ and not ‘Kuringga’ Aboriginal connection or identity (Aboriginal Heritage Office 2015). The aboriginal elders will speak of their environment and reflect on this in the historical context of their clan.

The work is scored for 51 percussionists and 100 tambourines. Fifty percussionists (two tambourines per percussionist) play in unison throughout the performance accompanied by one multi instrumental percussionist.

3.2. Instrumentation

- String instrument with audio sensor interface - Raspberry Pi Model B+, six fast vibration sensor switches, wire / aluminium frame, clear acrylic housing & miscellaneous electronic components (See Figure 6);
- Macbook Pro w/Logic Pro & ProTools;
4. ACKNOWLEDGEMENT

The original video component and soundtrack of Tambourine Bay was first programmed for exhibition at the Balance-Unbalance International Conference 2013 in Noosa, Queensland, Australia from the 31st of March to the 2nd of June 2013. The single channel video work was presented in the ‘Earth to Earth’ sound venue throughout the Conference proceedings. The artist would like to thank Dr Ricardo Dal Farra (Chair & Conference Convenor) and Dr Leah Barclay (Conference Co-Convenor).

5. CREDITS

Original concept, video production, score & soundtrack by Damian Castaldi.

Acknowledgement for the sketch “kinetic_type” by Zach Lieberman and code adaptation by Solange Kershaw.

Drum & cymbal recording engineered by Ganesh Singaram.

6. REFERENCES


Figure 6. Detail - Percussive/String Instrument
LISTENING TO DESERTS IN THE AMERICAN SOUTHWEST:
GARTH PAINE’S EXPLORATIONS OF SONIC PLACEMAKING

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ABSTRACT

Thanks to their fierce nature and potential for metaphor, deserts have long fascinated musicians. Edgard Varèse, Olivier Messiaen, Luc Ferrari and Peter Sculthorpe created works inspired by deserts around the world, but they had only a tenuous connection with these places. In contrast, David Dunn, Richard Lerman, Maggi Payne and Garth Paine have strongly identified with deserts and paid tribute to them in numerous works, compelling examples of sensitive engagement with these places. This paper centers on Australian-born composer and sound artist Paine. I will analyze and contextualize his large-scale interdisciplinary and collaborative Listen(n) Project, his acousmatic work *Becoming Desert* (2014) and live-electronic flute piece *Forest* (2015) which have been inspired by deserts in the American Southwest and draw on field recordings made with ambisonic recording technology. I will explain how they reflect Paine’s environmental philosophies and concepts of sonic placemaking in the context of composition, virtual reality experiences, community art and citizen science projects.

1. REFERENCES


ABSTRACT
Over the past 20 years or more I have been mostly involved in the world of design, creating functional soundscapes in public spaces; zoos, memorials, architectural precincts and more. To assist my own comprehension of my activities I contend that design is about working with materials and art is about working with ideas. This distinction, while artificial and notional, recognizes the very different qualities and performance parameters pertaining to each domain. This presentation intends to exemplify these differences in a discussion about the creation of the sound work, ‘What U might have heard.’

1. INTRODUCTION
‘What U might have heard..’, the Sound Work, is a re-envisioned version of an ambient electroacoustic soundscape installation for the public areas of the Australian Centre for the Moving Image (ACMI Soundscape), Melbourne, in 2000. While not what I would consider a pure work of art the piece does go some way in that direction once emancipated from its functional role at ACMI.

The original project was a site specific work carefully designed into this unique precinct and public space. It functions in a number of ways; to help orientate visitors within a highly dynamic architectural space, as an aesthetic overlay and to extend the presence or image of ACMI the institution into the acoustic domain. The Sound Work intends to relive the experience of visiting that space through creative composition rather than simply as documentation.

2. CONTENT AND LICENCE TO PERFORM
Any sound heard is a function of time; the fusion of content and performance. Content can be developed independently and silently however when it is performed in public, in order to be environmentally responsible, all sounds must conform to what might be considered a licence to perform.

While the ACMI soundscape may be ever present and able to be heard within the precinct it, by necessity, is not designed to be listened to. Its inherent texture of background and midground layers can be punctuated occasionally with dynamic foreground sounds. Cogniscent of how people are inhabiting the building the interonset times of such ‘alerting’ events must be programmed carefully. Foreground sounds can be created either as loud(er) sounds or of a character which jumps out of the environment and causes attention. This introduces a somewhat playful mode or interplay between what is real and what is not real. A kind of augmented aural reality.

The same texture is present in ‘What U might have heard..’ however the licence to perform is completely emancipated from any functional role and responsibilities. The sound materials are free to be heard in much greater detail and across a much wider dynamic range. Without the physical presence of the building the playful sense of what might or might not be real is lost. As will be described later, there is another similar kind of interplay within the sound materials that can be playfully explored.

3. DIFFERENTIATING
In the two versions of the soundscape, let’s call them the design (ACMI soundscape) and art versions (Sound Work), the content remains fairly consistent. It is in the performance where the two versions are completely differentiated. In the design version people are free to move about from place to place thereby creating their own ‘performance’. The temporal structure is therefore free and arbitrary. The art version would have the audience remaining in one position, perhaps seated in a concert situation, with the piece ‘spatialised’ around them. In a sense the physical building itself becomes a virtual artefact - or ghost. The temporal structure in this case is predetermined or composed. The composer is required to make critical decisions about how time passes. For a sound designer, unused to dictating terms on how a soundscape will be heard, this poses the first of a number of challenges.

4. UNDERLYING SONIC STRUCTURE
The sonic layout plan for ACMI was derived from the orientation of the building on Melbourne’s CBD grid, or more generally, on the cardinal directions NESW. Each
cardinal point is characterised by the placement of one of five iconic sound sources or themes. In the North zone where the building fronts the city streetscape, soundmarks of Melbourne such as trams and trains are performed, reflecting the origins of the site as a public transport hub. Sounds derived of nature, reflecting the perspective of the leafy suburbs and nearby hills to the East of the city were sent into the building’s eastern atrium. The sounds of water, notionally connecting the wet areas of the building to the nearby river and ultimately the ocean were delivered within the toilets to the West. Sounds reflecting on celebration and festivities perform in the Southern plaza where ACMI meets Federation Square.

The sound of footfall or footsteps representing the habitation of an urban space were delivered into stairwells. And, in recognition of the cultural institution housed within the building, the sound of a hand clap, was the basis for sounds generated for the central atrium - for it has been said that in 1932 an audience erupted into spontaneous applause when they heard the well-known sounds of Australian birds in the soundtrack of one of the first ‘talkies’ to be shown in Australia, Cinesound’s ‘On Our Selection’.

This schematic is maintained as a structural element in the Sound Work. Unlike the visitor wandering freely around the building, for the Sound Work the composer must decide and commit to a specific path through this structure. The chosen trajectory begins in the central atrium and stairwell, moves through a transition air lock and out onto the street to the North. The listener is then taken back into the building and down a corridor to the toilets on the ground floor. The trajectory passes back through the atrium and to the three levels of the eastern stairwell and ultimately out to the southern plaza. These decisions are guided by the need to create an overarching narrative which includes periods of contemplation, transitions, forward impetus and a sense of recapitulation and departure.

5. GENERATING AND PERFORMING THE CONTENT

An image of an acoustic space can be created using the scientific technique of the impulse response. A short impulse is sounded in the space and the response is recorded as the sound reflects off the structure and decays over time. For the project ‘iconic’ sounds of Melbourne, rarely heard in their prime form within ACMI, are departure points (impulses) for the creation of the content both in terms of inspiration as well as the actual production of a large library of sound materials. The impulses themselves are very short sounds, a hand clap, a train horn, a tram bell, a bird call or a drip of water each lasting for only a few seconds. An ambient soundscape running for 12 hours a day or more will demand great variety and a non-repetitive duty cycle. The ‘response’ sounds are the product of extensive DSP manipulation of the impulses using granular synthesis, time stretching, multiple echo and convolution reverb effects.

In the ACMI soundscape a computer programme randomly selects sound files from the library and streams them into the various areas of the precinct. It is highly unlikely that a visitor will hear any sound repeated in the time they will be in the building. It is even less likely that they will hear one of the prime sounds. This unpredictability is essential for maintaining a sense of freshness over months and years of operation. In a 25 minute sound composition such randomness may be desirable for compositional reasons however it is not a requirement.

Within ‘What U might have heard..’ all of the prime sounds are performed unaltered at some point in the composition. They are embedded into the layers of related processed sounds so that the relationship between the real and unreal can be explored by the listener. In the same way that one may wonder if that tram bell heard out on the street is from an actual tram, one may also question whether those bird like sounds are actually a bird or some other unknown source. The use of granular synthesis is particularly useful for generating a vast array of sounds from a small fragment or prime sound. A single short magpie call can generate sounds across a wide range that are either clearly derivative or almost unrecognisable from the original. This interplay is exploited much more overtly within the ‘contemplative’ sections of the piece than would ever have been possible in the original soundscape.

In order to create a balanced and well structured composition a number of other devices were adopted. The piece is punctuated with dynamic surprise sounds such as a loud bell, wild applause or sounds with a very wide frequency range. These sounds could never be performed so overtly in a public space such as ACMI. They are, however, perfectly acceptable with the bounds of the concert hall.

The selection and layup of sound files within the digital studio (Digital Performer) was often informed by the rhythmic elements within the sound files. Such control over rhythm would not be possible in the random file selection process in the ACMI soundscape. Any resulting rhythmic structure would be the result of pure coincidence.

Finally, in order to master the piece into an 8 channel format for a concert diffusion system, the output was spatialised using convolution reverb processing. The desire was to attempt to replicate or create a sense of the precinct of ACMI and its soundscape delivered from 48 channels and 120 hidden loudspeakers.
6. CONCLUSION
This paper concentrates on the challenges of moving from the modality of design to that of art. It has been proposed that many elements such as content may remain essentially unchanged. However the performance of that content will require a whole new set of considerations in order to be successful. The physical realisation of all sound needs to conform to a performance licence. Such a licence is derived through careful assessment of the physical and functional requirements of any given space. The freedom of a controlled space such as a concert hall cannot be transferred into a public or urban precinct or that of an institution such as ACMI, Melbourne. A designed soundscape may not perform well as a sound art work without thoughtful reworking of numerous performance parameters.

What U might have heard is a piece commissioned for the RMIT Sonic Arts Collection

Sonic Environment in Vanuatu: Exploring Water Music TRACES

Sally Ann McIntyre
Independent Artist

ABSTRACT
Huia Transcriptions: re-collecting Colonial era witness accounts of extinct birdsong
In classical acoustic-ecological conceptions of the soundscape, the technological preservation of a sound mark might be understood to positively relate to the preserving of memory of place. But what of the sounds beyond (recorded) memory, that are already missing? Might there be value in suspending the fantasy of a natural plenitude of sonic fecundity, and its status as a potential recorded totality, to adequately acknowledge this haunting, or gap; to hear the past and present withdrawal of sound from an ecosystem and its soundscape, through ecological destruction?

And once we have listened to this silence, how best to memorialise this loss? In a series of works focusing on what Dugal McKinnon has termed “ecological silencing” I explore the possibility for practice based research to investigate the lost birdsongs found within New Zealand colonial narratives, asking what it might mean to re-collect, through interventions into archival records, notation, and other material traces, the songs of bird species lost before the invention of recording technologies, and then to situate these lost songs back into hearing, including placing them back within what might be now listened to, and represented in phonographic or field recording practice, as the ‘natural’ soundscape
TRACES IN/OF/WITH SOUND: AN ARTIST’S EXPERIENCE OF AUDIO-VISUAL SPACE

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ABSTRACT

Traces in/of/with Sound was an audio-visual performance series, instigated as part of the author’s practice based PhD research into the process of sound arts practice (Garrelfs 2015). The initial idea for the project resides in the realm of visual music and an interest in the influence that the relationship between sound and image has on the music that is produced within performance. The research employed a modular methodology that includes creative practice as a key space - or in-vivo laboratory - in which the process of this practice can be studied.

As a piece of creative work, Traces in/of/with Sound made use of a field of juxtapositions: a projection of recorded and digitally mediated drawings with improvised and digitally processed voice; notions of archetypes across sound and vision; a range of complex conceptual concerns with a performative experience. In its inception, several strands of thought combined. These included recognising a similarity between Norman McLaren’s images (Barbeau 2005) and some of the author’s drawings (see Figure 2); a concern with movement - as explored in her previous locative mobile phone pieces override (2011) and In A Day’s Work (2011) - that transferred onto the relationship between the eye’s movement and still images (Brown 2006). In addition, the notion of archetypes expressed through line drawings (Ingold 2007) and vocal expression met with digital processing techniques.

Between 2011 and 2013, six performances and one installation took place, each with a different audio-visual spatial configuration, ranging from mono sound / single screen video to eight-channel sound / two screen video. Each of these versions brought with it adaptations of the core material, as a response to the preceding incarnation.

What remained stable was the method of performing: sound used live improvised voice, manipulated and diffused across a multichannel system (where applicable) via Cycling 74’s Max software. This sound material was created as an improvised response to a pre-prepared “film” of digitally manipulated drawings using Adobe Creative Suite packages Photoshop and Premiere. As the series developed, working within this complex field of juxtapositions led to a change of focal points. Whilst the project began by essentially considering movement and a contrapuntal relationship between sound and vision as a property of time, it shifted to an exploration of a joint audio-visual spatiality, understood as a perceptual experience established by the interlaced movements of both sound and vision.

This paper will chart the development of the piece over a two-year research period from 2011-2013, including the presentation of relevant stereo extracts and the work’s relationship with theoretical concerns and wider creative praxis. Within this narrative it will pay particular attention to the author’s emergent experience of a speaker & screen based audio-visual spatiality. Some conclusions as to strategies that may promote experiential coherence or disunity in the perception of an audience with respect to screen based audio-visual space will also be put forward.

ACKNOWLEDGEMENTS:

The author gratefully acknowledges the support of the UK’s Arts and Humanities Research Council in funding her PhD research.

REFERENCES


1 Documentation is available from http://irisgarrelfs.com/traces-in/ofwith-sound
Huia Transcriptions: re-collecting Colonial era witness accounts of extinct birdsong

Sally Ann McIntyre
Independent Artist

ABSTRACT

In classical acoustic-ecological conceptions of the soundscape, the technological preservation of a sound mark might be understood to positively relate to the preserving of memory of place. But what of the sounds beyond (recorded) memory, that are already missing? Might there be value in suspending the fantasy of a natural plenitude of sonic fecundity, and its status as a potential recorded totality, to adequately acknowledge this haunting, or gap; to hear the past and present withdrawal of sound from an ecosystem and its soundscape, through ecological destruction? And once we have listened to this silence, how best to memorialise this loss? In a series of works focusing on what Dugal McKinnon has termed “ecological silencing” I explore the possibility for practice based research to investigate the lost birdsongs found within New Zealand colonial narratives, asking what it might mean to re-collect, through interventions into archival records, notation, and other material traces, the songs of bird species lost before the invention of recording technologies, and then to situate these lost songs back into hearing, including placing them back within what might be now listened to, and represented in phonographic or field recording practice, as the 'natural' soundscape.

These works have re-collected the distress calls of birds such as the extinct huia, by placing notation of their songs written in the late 1800s back into the audible world, situating them within mnemonic technologies that are not current, but classifiable as 'heirloom' media. These technologies are not focused on as technological fetishes or museum pieces, but as functional material witnesses to the birds themselves, and include the wax cylinder and the programmable music box, they have facilitated the making-audible of the bird songs and have allowed them to be placed back within the soundscape of New Zealand bird sanctuaries, and other environments including galleries and radio programmes.

This paper will focus on these issues through a discussion of the works, and also explore how they articulate a tension between the need to memorialise such loss in the veneration of individual species, and the recognition that the lost remain as traces within the wider physical and acoustic environment, drawing together the current soundscape and museums and archives, notation, written narratives and other recordings, in an attempt to historicise the practice of listening to nature. Just as George Gibbs relates in his book *Ghosts of Gondwana* that the Moa is still visibly present in the New Zealand landscape through the defence mechanisms of the Lancewood tree's juvenile stage, might we also be able to locate a sonic equivalent in the after-echoes of the songs of the Huia within the songs of extant species? Perhaps, as John C. Ryan suggests in his essay, *Why Do Extinctions Matter?* “A more tenable ecological conceptualisation of mourning needs to consider connectivity, rather than unified subjectivity, as a tool for exploring the deep channels of grief over the loss of the more-than-human.”

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ON SOLO – A PROGRESS REPORT

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ABSTRACT

This paper reports on an ongoing research project around Karlheinz Stockhausen’s historical work Solo (Solo, für Melodie-Instrument mit Rückkopplung 1965-6).1 Together with Dr. Juan Parra Cancino from ORCIM Ghent, we are teasing out the consequences of the (nowadays common) software replacement of the elaborate tape delay system that was used at the time of the work’s inception. Many of the technical elements (e.g. in and output levels, delay feedback level, output levels) were operated as prescribed by the score by no less than three technicians. These roles have now been integrated into software patches (e.g. MaxMsp or PD (Sluchin 2000)) but also an app for i-Phone and pad (Petrolati 2016). Software approaches integrate and automate the score to different levels, with one version going as far as integrating the soloist’s sound source into the digital domain (Esler 2006).

Even though this work’s score is strongly prescriptive, like many of the composer works, performances and recordings of Solo have been augmented in different ways, most notably the addition of a layer of electronic music in the work’s first recording with trombonist Vinko Globokar (from 1969). Another freedom provided in the score for this work is the choice of different timbral modes (e.g. a choice of mutes in the case of brass players).

Where the proto-affordance of analogue tape is reproducibility, the proto-affordance of a computer simulating a tape system is much richer, with its ability to compute and facilitate interaction. At the same time, a computer these days implies a network, commonly the Internet. To simply reduce the computer to a simulator of older technologies and not exploring what digital technology affords seems to go against the grain of this influential work, and of electronic music performance.

In our research project we attempt to pull apart the distinct layers of input (soloist), delay system (software), level of control and loudspeaker system output (usually four channels). We have produced some concerts with these four layers performed either in the same venue, or in different venues (and even countries).

Computer network connections are used to share timing information and distribute audio between different performers and audiences. For instance, by having the soloist in a different venue than the public, the mixer (i.e. sound projection and level control) and loudspeakers, we can query the technological and human agency, of each of these steps. An additional research element of using network audio connections is that, not dissimilar to the build-up of noise in a tape-loop system and other analogue tape trademarks, the digital sonic artifacts (e.g. network ‘sounds’) become an audible element of the performance. In a way, those instances give a voice to the, ordinarily auditory hygienic, digital processing.

In addition to a series of concerts, the project comprises of interviews with some of the key players in early performances and integration with our respective research interests: the role of loudspeakers (Mulder 2013) and the performance practice of computer music (Parra Cancino 2014). The academic outputs of this project consist of a number of conference performances/papers and a journal article.

1. REFERENCES


1 Website: researchcatalogue.net/view/250950/250951
LISTENING FOR PRESENCE

Dr. Garth Paine
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ABSTRACT

The question of sound as experience is critical to discussions about environmental listening. I have come to think of sound as a viscous material, a vibrating energy field that has texture and density and a physicality that is unlike most other media. I arrived at this view through a combination of several experiences and practices. The first being a process of duration environmental listening and the second, an invitation to be part of an Australian indigenous dreaming ceremony at Bundanon in NSW. These experiences brought me to a point of knowing that everything is part of an N dimensional vector field - where by energy fields can be attracted together to form a presence in the world. I came to think of sound in these terms. Sources move, perhaps in relation to each other and in relation also to environmental forces, all making up a manifold and complex morphology, a rich and largely invisible to me interconnectedness. This interconnectedness is an experience I have sought increasingly deeply through durational listening where I ask myself, “what does it mean to be truly present”, is it possible to continuously deepen that sense of presence through repeated practice?

1. REFERENCES


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Sonic Placemaking in the American Southwest: The Listen™ Project

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School of Music

ABSTRACT

Sound gives life to our environment. Sound heightens our experience of place. Initiated in 2013 by composer Garth Paine, the Listen™ project capitalizes on the vibrancy of environmental sound in the American Southwest. As indicated by its title and superscript n, the project explores multiple ways of listening, promoting listening in physical and virtual locations. It is collaborative and interdisciplinary, combining science, media art, technological innovation, and community engagement. This presentation provides insight into Listen™’s fieldwork in parks of the American Southwest to create, with ambisonic recording technology, the largest online database of geo-located field recordings representing these places.

Light is shed on a series of compositions crafted from these recordings and community workshop. Attention is also drawn to virtual reality experiences of place created through the pairing of desert sounds with 360-degree photographic panoramas of the sounds’ place for display on the Oculus Rift headset (EcoRift) to allow distant communities to be remotely present in a landscape. Listen™ builds on acoustic ecology-based research and art and sound mapping (Biosphere Soundscapes, Nature Sound Map, Living Symphonies), but it is unique in its scope, extended time span, multi-platform design and engagement of local and global communities.
WHAT CAN WE LEARN FROM LISTENING TO NATURE?

Andrew Skeoch

Listening Earth
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ABSTRACT

Natural soundscapes provide a wealth of information, both to the casual listener and the research scientist. This ranges from aesthetic pleasure, to identification of species repertoire and behaviour, and measures of ecosystem health. When we consider repertoires in an evolutionary context, we can understand sonic strategies as not only shaping behaviours and survival adaption, but being fundamental to speciation itself. This has been documented in certain insects, and can be speculated upon in higher animals. This leads to an enquiry into the possible role of sonic communication in hominin development, and the suggestion that rhythmically synchronised communication (music) may be viewed as a biological rather than cultural phenomenon, unique to humans, of great antiquity, the result of which has been a gradual development of the higher brain functioning and eusociality distinctive to the hominin lineage. While sound and acoustic communication may have shaped us, we are changing the natural soundworld at the very moment we are beginning to study and appreciate its richness. Natural sonic environments are coming to be seen as in need of preservation, and healthy soundscapes important for our wellbeing too.

Listening has been described as the universal sense. If music is culturally important as more than simply entertainment, personal taste or product, then it needs to address the challenges of our time; to help us find our human place in the natural world.

1. REFERENCES


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Sonic Environment in Vanuatu: Exploring Water Music TRACES

Sandy Sur
Leweton Cultural Group

ABSTRACT
Sandy Sur’s research focuses around the Water Music of Vanuatu and its connection to the environment. Water connects everything on earth and is essential for survival. At a time when the world is facing so many environmental challenges it is more important than ever before to deeply understand the role of water in our life. Understanding the sound and rhythm of Vanuatu Water Music allows us to explore the environment in new ways and develop a deeper understanding of the role sound plays in the environment. The Water Music of Vanuatu is site-specific and deeply inspired by the surrounding environment. This inspiring tradition is now evolving in response to rapidly changing climates that are affecting island communities.

Sandy is one of the only people in the world holding the knowledge to lead research on water music and over the last decade he has directed a wide spectrum of research projects designed to bring water music to the world. Sandy’s research showcases this tradition as a way for understanding the environment at a time when we urgently need to listen to nature. His research is realised as live performances, films, recordings and web based media designed as tools for reaching the world.

Sandy Sur is the Manager of the Leweton Cultural group. While the water music of Vanuatu is a once-in-a-lifetime performance that needs to be seen (and heard) to be believed – the Leweton Cultural group deliver a range of customary artisanal performances and workshops including dances, weaving, carving, mixed-media/found objects, environmental art, and instrument-making. Sandy coordinates residencies for the group at international festivals and events with deep connections to people of place. The Leweton Cultural Group has stunned audiences at World Expo 2008 in Zaragova, several European Union diplomatic functions, the Rainforest World Music Festival in Borneo, the Bellingen Global Carnival, Queensland Music Festival, and the Floating Land Festival in Australia and the Lukaotem Gud Santo Festival in Vanuatu. Sandy is a ranked man and leader from Merelava in Vanuatu. A skilled carver, weaver, craftsman, and curator Sandy is adept at using elements of the natural world as well as found objects and ubiquitous technical items such as wire, rope, etc to create functional and beautiful objects.

This research paper explores the sonic environments of Vanuatu and the role of Water Music.
The Piano Mill

Vanessa Tomlinson
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Queensland Conservatorium

ABSTRACT
It has been suggested that as many as three out of four Australians may have had a piano by the end of the nineteenth century. (Rose 2008). In fact, between 1788 to 1888, Australia possessed more pianos per head of population than any other country. But how did the parlours, pianos, and their players, translate to the Queensland bush? The Piano Mill is in part an investigation of this story that connects place and music. The Piano Mill is a purpose built structure and musical instrument in the Granite Belt near Stanthorpe, Qld. A collaboration between architect Bruce Wolfe and composer Erik Griswold, this structure houses 16 found pianos over 2 levels. The audience listens to the “mill” from outside, unable to view the workers (16 pianists) as they interpret Griswold’s score, Alls Grist That Comes to the Mill

The Piano Mill, examines the pioneering history of Australia through the gaze of now discarded pianos; celebrating place, community, environment and above all, listening. This was constructed as a one-off performance event, probing ideas of nostalgia, transformation of land and function and the sheer joy of creativity.

This presentation will weave together the perspective of the architect, the composer, audience members, performers, and directors, to gain a kaleidoscopic view of the event that was the Piano Mill. As a piece of architecture, a sounded building, and an integral part of a larger artistic vision, this multi-dimensional approach is necessary to glean something of the intense joy that has gathered in and around the mill.

1. REFERENCES

Exploring Internet Environments in Sound Arts

Ian Whalley
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Arts and Social Sciences

ABSTRACT
Contemporary environmental sound art is often linked with geographically dispersed local cultural practice and/or natural environmental sound. And recently explored in tandem, the development of telematic sound arts are dominated by linking electroacoustic music studios and/or concert halls. Yet urbanised life often involves inhabiting bodies, local environments and digitally interconnected global environments including people, computer-based agents, and aggregates real-time informational data streams.

Current eResearch suggests this new environment will increase through: connectivity, greater bandwidth and processing power; smart/embedded technology and the Internet of Things; artificial intelligence and automated decision-making; data streams and making knowledge out of information with machine learning. What role can sonic art practices play in navigating increasingly complex relationships, represented particularly in multiple aggregated information flows?

Recent work on radical embodied cognition, reacting against older computational views of intelligence using symbolic processing and absent bodies, suggests human cognition is situated and time-pressured, is environmentally relational, used for action, and that much offline cognition is body-based. Accordingly, while current data streams, such as news feeds, can be rendered visually, we partly interpret these through mood, metaphor and movement, similar to music reception.

A meeting point for telematic sound arts and networked life that practitioner might further explore is in affective composition/performance models coupled with the sonification of real-time information streams. This involves further amalgamating research on the affective dimension of electroacoustic music with real-time data sonification techniques to extend performance-based electroacoustic music languages. And this process could further be automated with the integration of emerging research that adopts machine learning techniques in the gestural mapping of sound, together with the application of intelligent-agent decision making technology used in sound arts, thus enhancing rendering efficiency.

This allows for the sonic exploration of our place in a matrix of increasingly networked and non-linear relationships with dynamic meanings through creating new knowledge. And we may find new patterns in data streams only possible through aural means, allowing us reimagine our networked presence and relationship with place.
SONIC ENVIRONMENTS - ACMC2016

ARTIST TALKS
Camilla Hannan: F words: Feminism and field recording. Independent Artist

Is there such a thing as the female ear? What role does gender play in the genre of field recording? If the field recordist objectifies the landscape in the same way that women are conventionally objectified, how is this reflected in the genre of field recording and associated sound art? And what are the implications when a woman becomes the protagonist in the landscape? A gendered relationship between recordist and landscape impacts not only on the field recording process but also on the resulting project. It also reveals broader implications for the genre. Hannan will discuss her own practice in light of these considerations of gender. She argues that her preferences for site specific and radiophonic works are a result of these relationships.

REFERENCES
Chris Watson Outside the Circle of Fire (Touch Music. 1998 TO:37)
Francisco Lopez Wind (Patagonia) (AND/OAR 2007AND027CD)
Camilla Hannan. Inside Outside – A radiophonic commission for ABC RN Soundproof. First broadcast March 2016
Camilla Hannan Melt. Site Specific Installation at Jewell Railway Station, Melbourne with Martine Corompt

Mara Helmuth: Sonic Refuges
University of Cincinnati

Sonic Refuges are aural environments with internal interactions and logic that create individual gestures and organic textures with contextual and spatial dimensions. These refuges have a relationship to natural environments and may be based on source sounds from nature or synthesized algorithmic sounds. A “refuge” might be a peaceful soundscape for relaxation and deep listening, and a place for achieving balance and perspective on the complexities of life, from afar. It might also be a place where stimulating and unusual sounds can interact according to their own processes.

Programming compositional and performing interfaces and granular synthesis instruments, allow me to construct dynamic imaginary sound spaces, some of which reveal or involve aspects of natural sounds. MaxMSP and RTcmix are the primary music programming languages used.

I will discuss these recent projects:
1) Sonic Refuges - This project is an algorithmic sound space generator, which creates aural environments based on recordings made in parks and Buddhist temples in China and Japan, from natural environments such as those inhabited by loons, from synthesized metamorphising timbral spaces. The refuges are designed to encourage deep listening, awareness and imagination.
2) from Uganda - a series of works based on sound and video from Ugandan parks using MaxMSP and RTcmix:
from Uganda - for laptop ensemble, for solo performer, or for fixed media
from Uganda: Safari - for fixed video and 8 channel audio
out of Uganda: in-progress iPad app
3) Hidden Mountain – installation based on time spent in a Tibetan Buddhist monastery in Yushu, Qinghai province of China, and other Asian travels. The space reacts to participants’ movement by playing Tibetan service recordings, video of folk singers. Participants can also play bowl gongs and other instruments with inlaid sensors to create sounds processed by MaxMSP and Rtcmix.

Demonstration of the Sonic Refuge software, and excerpts from Uganda and Hidden Mountain installation recordings will be played.
Jordan Lacey: Sonic Rupture
Vice-Chancellor’s postdoctoral fellow in the School of Architecture & Design, RMIT University.

He is a practising sound-artist and musician, whose research is focussed on urban sound design. His practice might be considered post-acoustic ecology, insofar as he seeks to apply acoustic ecology practices to noisy urban environments. His recently released book (Bloomsbury) and coming paper (Organised Sound) both emphasize what is for Lacey the most important aspect of his own practice: the possibility of creating in everyday life encounters that encourage imaginative, poetic and even mythic responses from the public. Lacey has created multiple sound installations in Melbourne. In each of these installations he applies a methodology he calls noise transformation. Noise, considered a homogenous material, is ruptured, not by introducing new sounds, but by recreating our impressions of what already exists. As such we are invited to engage with the world not as it is, but as what it could be. Lacey is presently working with Transurban to investigate the possibilities of noise transformation approaches in motorway parklands; thus applying his practice to corporately managed lands. His recently released book, published with Bloomsbury, titled ‘Sonic Rupture: a practice-led approach to urban soundscape design’ is an invitation to rethink the original tenets of acoustic ecology by considering a new relationship with the noises of global cities. Rather than remonstrating against the proliferation of noise, Lacey considers noises as cultural and political expressions that can be redesigned to afford new everyday experiences. Lacey completed an international field trip at the end of 2015 investigating eleven permanent American and European sound art installations that have become features of the urban landscape. His paper ‘Sonic Placemaking: ten attributes and three approaches for the creation of enduring sound art installations’, which describes the trip, will be published in the coming edition of the international journal Organised Sound. The paper uses artist interviews, sound recordings and on-site observations to suggest a number of attributes that can be discerned in the visited installations. His work also extends into collaborations with Australian Indigenous people including the Yolngu, Barkindji and Wurundjeri, with who he has produced a number of cross-cultural sound works. In these works Lacey seeks to be affected by mythic expression, by combining sounds with the stories he encounters. It is here that his practice overlaps with Acoustic Ecologists’ search for the mythic ‘ur-sound’; but rather than emphasizing its loss, he instead calls for a sonic activism that will rediscover such imaginative possibilities within the urban. Lacey has stereo recordings of all his installations and performances. He also has multi-channel works of pre-installation sound materials that can act as immersive pieces. He has the capacity to play these works in combination with an artist talk on his post-acoustic ecology practice. It is possible, presuming the organisers are interested, that Lacey could combine his artist talk with a book launch for ‘Sonic Rupture: a practice-led approach to urban soundscape design’, given that the book’s intentions are closely aligned with conference themes.

Department of Arts, Northumbria University, Department of Computer Science and Digital Technologies, Northumbria University and Department of Chemistry, Durham University

This paper presents the research surrounding the audiovisual installation, Stars Beneath our Feet (2015) by Louise Mackenzie. It introduces the concept of alchemical sensing to describe the layered use of scientific technology in the context of an audio-visual art installation as an alternative frame of reference that attempts an embodied understanding of the unseen organism. The process of translation through layers of technology is considered as alchemical in reference to the ancient Greek and Egyptian origins of the tradition. Not alchemical in the sense of seeking immortality or turning metal into gold, but alchemical in the anima mundi sense of seeking out the ‘essence’ of matter. Referencing the development of the field of sonification, the acoustic artwork of Joe Davis and Katie Egan and of Anne Niemetz and Andrew Pelling, the use of Atomic Force Microscopy, Python, Photosounder and MAX MSP were employed to construct an embodied audio sense of the micro-organism, Dunaliella salina. Movements detected were translated using both sonification and audification techniques into sound files that were used to form the audio component of Stars Beneath Our Feet: an installation as part of Lumiere Durham 2015, a four- day international light festival produced in the UK by Artichoke. The video component of the installation was made using a
combination of dark field microscopy and DSLR camera to produce moving images that focus on a perspective of micro-organisms that is other to that commonly used within scientific research. The objective of ‘looking at’ the organisms in this expanded manner and ‘listening to’ the sounds of data obtained via technological interpretation of the movement of micro-organisms in the context of an art installation adds a broader sensory dimension to our understanding of the unseen organism, one which encompasses their being in the world without consideration of their use as resources. https://vimeo.com/147120645

Peter Mcilwain: The Phonozoa Project
Independent Artist

Peter will present recent work and discuss the theoretical aspects of his current project Phonozoa which is part of his ongoing exploration of imaginary sonic worlds and draws on ideas derived from affordance theory with particular emphasis on sound as a signifier of gesture. The Phonozoa project is a kind of pseudo-science enterprise where a zoology of imaginary creatures, called collectively phonozoa, is created in software. The juxtaposition of an imaginary world and scientific enterprise situates the work within a surrealist aesthetic. The creatures are designed with specific behaviours that generate motion, visual gesture and sound simultaneously and specific processes are used that make a tight coupling of these elements. An example of the phonozoa can be found at:

The talk will present examples from the project and related work, show some of the relevant technical aspects with particular reference to generative art practice and make comment on the broader aesthetic implications of the work. The presentation will include video examples as well as demonstrations of relevant code and generative techniques.

Goldsmiths, University of London

lines is a sound installation using microbial fuel cells (MFCs) powered by yeast. This sonic space has some sonic spots, and the sound is different depending on the visitor’s position in the same space. The texture of the sound is created by the environmental conditions. The concept of this work is to express the action of internal microorganisms. The power generation by the MFCs is translated to sound, and this signal is transmitted to eight ultrasonic speakers in the gallery. The speakers are rotating around to make sound reflections between the walls, like after images of sound. Although the sound is coming out from the speakers, the visitors are able to perceive the yeast’s activities in the space as environmental sound.

acoustic cluster. A number of pipes of different lengths suspended within a space each contain a microphone and are equipped with a freely movable speaker assembly beneath them. The distance between each speaker assembly and microphone is expressed in the "howling" acoustic response. Having divided the space with pipes, moving the speaker assemblies closer to the spaces within the pipes amplifies the otherwise insignificant howling in the space outside the pipes, producing a sound like that of a wind instrument.

The pitch of these responses varies with the spatial properties of each pipe. This series of phenomena seeks to make audible the normally inaudible material of space. Moreover, this work goes beyond transforming sound into information or data to imagine its exploration through a physical filter. This work employs space itself as an acoustic material representing people’s physical presence and makes it possible to experience a series of musical works by understanding the transformation of spatial properties as musical performance.

floating sound. We release extremely subtle sounds from inside our bodies which are hard to perceive. Although the sound is made by the body, it cannot be heard because of the limited audible range that a human being can hear. This work is a composition using the sound of the composer’s bloodstream as a sound source. All the sounds were created from the sounds of the bloodstream recorded mainly in an anechoic chamber. The purpose of this work is to deconstruct and reconstruct the components of personal biological information via computing. These sounds were composed to express another reality beyond the boundary of the animate / inanimate.
SONIC ENVIRONMENTS - ACMC2016
CREATIVE WORKS
CONCERTS
LUNCHTIME CONCERT - Basil Jones Orchestral Hall

_Echolocation Suite_ - Alice Bennett

Three short pieces for flute and micro-bats (world premiere).
This work uses data collected by Australian environmental scientist, Dr. Lindy Lumsden, in her research of native Australian micro bats. It uses data from bat-detecting devices: ultrasonic recording devices that recognize bat calls and transpose them down to the human hearing range. The data is analysed in the form of a spectrogram, and each species of bat is discerned by the shape and range of the calls. This piece uses the pitch and rhythm of bat calls as source material for the structure of each movement, and also uses the transposed calls throughout. The recordings are triggered at certain frequencies and dynamics of the flute via Max MSP, setting bats flying across the room (in 4 channels). The flute mimics different types of bat calls, triggering and reacting to the recordings and using its inherent flexibility to create a different voice in each register.

I. Victoria Circa 5.’ There are 21 species of native bats in Victoria, all with unique calls above human hearing range. Like birds, these calls occur in different frequency levels so that different species of bat may co-exist without disturbing each other. A bat’s call bounces off the objects around it allowing it to ‘see’ at night, creating a beautiful cacophony that no one ever notices.

II. Melbourne Circa 5.’ Did you think that bats only live in the bush? 17 of the 21 species of bats in Victoria can be found in metropolitan Melbourne, roosting in the hollows of our 100+ year-old trees. These fascinating creatures go largely unnoticed by all except the odd cat due to their size (most adult micro bats fit into a matchbox), speed, and auditory range (only a few species can be heard by humans, including the White-striped Freetail Bat). These bats are insectivorous and without them we’d be inundated with mosquitoes and bugs.

III. Southern Bent-Wing Bat Circa 6.’ Very little is known about this curious endangered species other than its secretive breeding place in a cave somewhere in South-West Victoria. These bats can be found all over Victoria, but unlike any other species of bat, they travel hundreds of miles to breed in one place. No one knows how the young bats know where to go, without flying in flocks like birds there’s no way for them to follow each other, so how do they know where to go? This is one of the questions that Dr. Lindy Lumsden hopes to answer in her research.

Along the Eaves - Benjamin O'Brien

"along the eaves" is part of a series that focuses on my interest in translational procedures and machine listening. It takes its name from the following line in Franz Kafka’s “A Crossbreed [A Sport]” (1931, trans. 1933): “On the moonlight nights its favourite promenade is along the eaves.” To compose the work, I developed custom software written in the programming languages of C and SuperCollider. I used these programs in different ways to process and sequence my source materials, which, in this case, included audio recordings of water, babies, and string instruments. Like other works in the series, I am interested in fabricating sonic regions of coincidence, where my coordinated mix of carefully selected sounds suggests relationships between the sounds and the illusions they foster.

Rainwire - David Burraston

Rainwire encompasses the investigation of rainfall & its application as a medium for artistic, cultural & scientific exchange. The Rainwire project includes development of a prototype Acoustic Rain Gauge using suspended cables (long wire instruments), and subsequently expanded through various collaborations in a range of creative & environmental contexts. Rainwire is an experimental approach at technological appropriation of agricultural based objects for art and science, with particular emphasis on climate change issues and agriculture. This performance will present a live laptop mix of environmental sonification recordings from the newly built Rainwire prototype. Previous work on Rainwire has been conducted on shared instruments, this performance will be an opportunity to present the newly built dedicated Rainwire prototype in public for the first time in Australia. Long-wire instruments are made from spans of fencing wire across the open landscape. Rainwire developed from using contact mic recordings of rainfall “playing” the long wire instruments for my music compositions. This enabled a proof of concept study to the extent that the audio recordings demonstrate a wide variety of temporal & spatial rain event complexity. This suggests that environmental sonification has great potential to measure rainfall accurately, & address recognized shortcomings of existing equipment & approaches in meteorology. Rain induced sounds with long wire instruments have a wide range of unique, audibly recognisable features. All of these sonic features exhibit dynamic volume & tonal characteristics, depending on the rain type & environmental conditions. Aside from the vast array of creative possibilities, the high spatial, temporal, volume & tonal resolution could provide significant advancement to knowledge of rainfall event profiles, intensity & microstructure. The
challenge lies in identifying distinctive sound patterns & relating them to particular types of rainfall events. Rainwire is beyond simple sonification of data, it embeds technology & data collection within cultural contexts. With rainfall as catalyst to draw inspiration from, artists, scientists & cultural groups are key to informing science & incite new creative modalities.

**Elephant Talk - Vicki Hallett**
The Elephant Listening Project from Cornell University is the basis of Elephant Talk/Elephant Listening Project music performances. They present not only logistical difficulties but musical difficulties. It was 2-3 years of attempting to confirm the possibility of the project with Cornell University. The researchers and contacts of course, were deep in Africa recording the sounds for their research. Threats of poaching are a reality and in one instance, although the researcher reached safety, the elephants weren't so lucky. Cornell University use a variety of technological platforms for their research both recording and processing of these recordings. The music created also uses a variety of technological and compositional methods to both utilise the sounds and to create something that is inspiring, innovative and become a whole listening experience. Through using different format types of sounds, for example: infrasonic sampled so that humans can hear them as well as regular files, the aim is to create relationships between the natural environment of the forest elephants, the other recorded acoustic occurrences while incorporating various instruments to create a conversation between the sonic environment, performer and listener.

**NOISA Étude 2 - Juan Carlos Vasquez and Koray Tahiroğlu**
"NOISA Étude 2" is a second set of performance instructions created to showcase compelling, evolving and complex soundscapes only possible when operating the NOISA instruments, integrating the system’s autonomous responses as part of a musical piece. The multi-layered sound interaction design is based on radical transformations of acoustic instruments performing works from the classical music repertoire. This second "étude" is based entirely on interaction with spectrum-complementary Phase Vocoders. The system is fed with variations of a fixed musical motif, encouraging the system to recognise elements of the motive and create its own set of different versions emulating a human musical compositional process. Also, the Myo Armband is used in a creative way as an independent element for dynamic control, using raw data extracted from the muscles’ tension.

**Hyvät matkustajat - James Andean**
Hyvat matkustajat (2014) (Finnish for 'Dear Travellers', but also for 'The Good Travellers') began life as a "sonic postcard from Finland", using soundscapes field recordings from around the country. This turned out to be only the first stop on its journey, however. The original material was later further developed as material for sonic exploration and spectral transform...

**EVENING CONCERT - Basil Jones Orchestral Hall**
**Coral Bells Movt.2 2016 - Brigid Burke**
Coral Bells explores the diverse overtone, microtone sounds and origins of the Federation Hand Bells and Bass clarinet into the visual with discrete sounds of the ecosystems of coral from Fitzroy Island Northern Australia. This creation brings a new life to the Federation Hand Bells providing deepening connections with the Australian landscape. It is the conversation of between the audio and dead coral from that accentuates the audio-visual reflecting both the translucent Federation Bell sounds, Bass clarinet, glass and dead coral. The acoustic resonators vibrate with the coral and are recreated into visuals of moving glass objects. These sounds transform into acousmatic sounds. The colors and texture within the visuals are layered white/grey, sepia, hints of pastel colours, burnt reds, yellows and gold images that are layered to create a thick timbral texture to form the video voice. The sounds of subtle high pitched Bells and gritty sand sounds with the Bass clarinet periodically joining the drones with discordant multiphonics and flourishes of notes dominate throughout. Subsequent acoustic and visual motifs capture and emerge sonically/visually creating timbre layers of the interpreted coral and glass reflections.

**On Solo - Johannes Mulder**
The performance is part of the ongoing research project into Karlheinz Stockhausen’s historic work Solo (Solo, für Melodic-Instrument mit Rückkopplung 1965-6). Together with my colleague Dr. Juan Parra Cancino from ORCIM Ghent we are teasing out the consequences of the (now common) software replacement of the elaborate tape delay system that was used in the time of the work’s inception.
Shelter - Sam Gillies
Working almost exclusively at a very soft volume, Shelter inverts the relationships between the source sound material and its experience in the real world, placing very large sounds (sourced from field recordings) at the threshold of audibility while audio artifacts are brought to the forefront of our focus to act as recognisable musical material. By utilising a soft dynamic, all audience members are able to hear each channel more equally, regardless of their position in the performance space. This new version for bass clarinet, electric guitar, and electronics expands the original electronic composition into something more lively and environmentally focused. The compositional intentions of the original Shelter remain at play here - this version still seeks to address the assumptions of multichannel listening, while affecting an environment of sound in preference to an experience of sound. However, this electroacoustic version adds a little bit of much needed chaos, allowing performers to interact and manipulate this sonic environment.

Ground Interference - The Listen(n) Project - Leah Barclay
Ground Interference draws on short recordings from each location I visited in spring 2014 with a particular focus on Joshua Tree National Park, Jornada Biosphere Reserve, Mojave Desert, and Death Valley National Park. These fragile desert environments are inhabited by thousands of species all part of a delicate ecosystem that is in a state of flux induced by changing climates. The transfixing acoustic ecologies of the southwest deserts demand a stillness that encourages a deeper environmental awareness and engagement. In many instances during our field trip we struggled to find locations without human interference. The distant hum of highway traffic and relentless airplanes under the flight path from LAX were expected, yet we also encountered unexpected sounds interfering with the acoustic ecologies of the land. These range from an obscure reverberating vending machine in Death Valley National Park to rattling power lines in the Jornada Biosphere Reserve that were so loud I could feel the vibrations through my feet.

Becoming Desert - The Listen(n) Project - Garth Paine
Becoming Desert draws on the experience of sitting or lying down silent in the desert for several hours at a time to make sound recordings. The field recordings I made in four deserts of the American Southwest are the basis of this work. When listening to the desert sounds through headphones at the time of recording, one is aware of a kind of hyper-real sonic environment. The amplified soundfield in the headphones is surreal in its presence and accuracy and multiplies my direct experience of listening many times.

Nature Forms II [2016] for flute, clarinet, viola, cello, percussion, hybrid field recording and electronics - Lindsay Vickery
Nature Forms II is an eco-structuralist work, maintaining what Opie and Brown term the “primary rules” of “environmentally-based musical composition”: that “structures must be derived from natural sound sources” and that “structural data must remain in series”. Nature Forms II explores the possibility of recursive re-interrogation of a field recording through visualization and resonification/resynthesis via machine and performative means. The source field recording is contrasted with artificially generated versions created with additive, subtractive and ring modulation resynthesis. Interaction between the live performers and the electronic components are explores through “spectral freezing” of components of the field recording to create spectrally derived chords from features of the recording bird sounds and a rusty gate which are then transcribed into notation for the instrumentalists and temporal manipulation of the recording to allow complex bird calls to be emulated in a human time-scale.

Basaur - Stephan Moore
Basaur is a structured improvisation for software, microphones, and objects, performed through a multichannel sound system. Using simple, readymade household devices as the primary sound source, Basaur unfolds as a guided exploration of the small mechanical drones and noises that occupy the edges of our quotidian sonic awareness. Using both pre-recorded and live-performed sound sources, textures are layered and connected, building to a richly detailed environment of active sounds -- background becomes foreground, and the everyday annoyances of modern convenience take on a full-throated presence that is by turns lyrical and menacing.
INSTALLATIONS

Queensland Conservatorium Foyer

Aural Fabric: Greenwich - Alessia Milo

Aural Fabric: Greenwich consists in an interactive textile pieces hosting the experiences from some soundwalks in Greenwich, London. These soundwalks are part of the research project Aural Character of Places, investigating how people with different experience and familiarity attribute meaning to soundscapes, while raising awareness on how architecture influence the creation and spread of sound.

Aural Fabric: Greenwich is made of the sonic life of the area from which is inspired, and colours, materials, signs, shapes collected during the collaborative research experience. The recordings are placed on a symbolic map representing the area of Greenwich, whose layout is informed by the discussion with the walk participants and previous research on and in the area. The interaction with the piece is of an exploratory nature, designed for every location and route according to the feel of the place and its ambiance.

The field recordings collected are stitched together in a composition which has no beginning and no end, but the sensory experience with the map itself. Conductive threads, soft and tangible sensors and buttons, textures of different density and grain, coexist in the space of a piece of fabric, releasing sounds of everyday life in ever-changing ways, according to the pace of the multi-sensory manipulation of the different materials and their different details and thresholds.

The interaction is supported by Bela, an embedded system for real-time audio, allowing excerpts to be processed and mixed together according to the form of the interaction. Touching and stretching the fabric, binaural recordings from a pair of dummy ears held by the author while leading the walk will be blended with the recordings of the same scene from the listening perspective of a sound artist wearing binaural microphones and windscreen.

The piece is the first of a series of interactive tangible maps based on rediscovering aural meanings and is profoundly inspired by the work of the pioneers in acoustic ecology, the soundwalkers, the aural architects, and those who still care about acoustic design and its importance for our everyday life. This work is part of the PhD research of the author on the Aural Character of Places, supported by EPSRC within the Media and Arts Technology Programme and the Centre for Digital Music, Queen Mary University of London, with the collaboration of Chris Wood, sound artist, Andrew Hill, composer and lecturer in Sound Design at the University of Greenwich, Josh Reiss and Nick Bryan-Kinns, supervisors.

Reversed Masking - Mauricio Iregui

The installation is composed of two juxtaposed sound layers: One in real-time and another that has been dislocated from its original time-space qualities. The first layer happening in real-time is defined by all of the sound elements that encompass the soundscape of the Conservatorium’s foyer. The second ‘installed’ layer is a composed soundscape is made up of sound ‘identities’ characteristic to the outdoor surroundings of the building. This juxtaposition challenges the way we perceive, understand and relate to the occupied space and underlines how our perception is abruptly distorted when be exposed to sound elements that are otherwise representative of contrasting sonic environments. The installation also reverses the common discourse that looks at the auditory masking suffered by the natural environments being invaded by the noises of the ‘urban modernity’, and looks at the opposite scenario where a natural outdoor space is presented as the ‘invader-perpetuator’ and the urban indoor space as the victim, thus emphasizing their conflicting interaction. The idea is that the dislocated sound elements are placed in a way that the spectator is unable to identify if the sounds are actually there.

Room 2.16 (Level 2)

A’varitia - Silent Greed - May Wing Joy Chang

There is a silent sound, like sitting in a natural scenario. In the silence, they are addicted to the comfort zone, and to turn around in the bottle endlessly. While they want to get closer to this attractive light even though they could be killed in a second. We may desire to fall into a pit of infinite depth, and by doing so exhaust ourselves in an endless effort to satisfy the desire without ever having gratification.

Room 2.30 (Level 2)

Flight Variant - Teresa Connors

Flight Variant is one of a series of ongoing audiovisual installation projects by Teresa Connors and Andrew Den-ton, which respond to the Anthropogenic climate and geo-logical change. The work emerges from data collection processes that took place in Southern California in 2014 and 2015. These
include high-speed and HD video jet streams recordings (see figure 1, 2) and audio recordings from and around the Los Angeles airports. The resulting installation is a generative work that is driven by an algo-rhythm based on 2015 aviation statistical data. Additional components include flight data streamed from the Internet, sampled vocal clips from YouTube, TV, and the Radio, real-time convolution of acoustic instrument improvisation with field recordings.

**Room 2.26 (Level 2)**

“It is impossible to know about Earth... so we must hear her voice in our own way” - Johann Diedrick

This project is a series of sound/photography diptychs that document my experience listening to hidden sounds. In particular, the sounds I am searching for are usually the least audible sounds in the environment. With the use of my original mobile listening kit, I am able to amplify subtle sounds and make them audible. Through my acoustic explorations, I have found sounds that would have usually gone unnoticed, as well as discovered ways to activate spaces and surfaces to generate new sounds that wouldn’t have existed otherwise.

These diptychs share with visitors my experience by providing visual and sonic documentation of my discoveries. The series documents explorations of New York City and Yale University. Some of these diptychs include the reverberations of street life transduced through a hollow pole, the buzzings of a graffiti-covered ATM machine, and the soft patterings of light February snow. Most of the sounds currently included in this series are urban in nature, yet the urban city should still be seen as any other natural environment, available for exploring unheard sounds. The series currently focuses on New York City, but will extend into other environments in the future with further development of this project.

Each diptych is made up of a photograph taken with a disposable camera, and a microcomputer that plays back a short loop of the sound I recorded as shown in the photograph. The medium of disposable photography is important for me in this project because I want to advocate for a similar way of recording sounds that is thought of as disposable. My practice has been around creating affordable tools for artists to explore sounds, and I want to emphasize an artistic process that uses disposable elements in order to encourage a similarly-minded recording practice: one that emphasizes casual, experimental and informal ways of engaging with sound in the environment. By combining these two forms, I am advocating for a sound art that uses tools and techniques that make it easier for artists to try new things, interrogate conventions that are taken for granted, and experiment in ways that would be too expensive — monetarily, technically and conceptually — if not without tools that can be used freely.

Any contrast between the image seen and the sound heard highlights how inadequate images can be in describing an environment, and how important it is to listen towards sounds for new perspectives about our surroundings. My work has been focused around shifting people's perception to the sounds around them, and this work both documents my experiments and demonstrates how even the most mundane, everyday scenes contain exciting, unexpected and poetic sounds waiting to be discovered — if only we took the time to listen.

**Queensland Conservatorium Research Centre  (Room 3.44, Level 3)**

**Delta Soundings** - Adam Molinski

Delta Soundings was a project originally funded by the Geraldine Knight Scott Traveling Fellowship in the Department of Landscape Architecture and Environmental Planning at the University of California, Berkeley. The project stemmed from a frustration with the lack of understanding landscape architects, urban designers and urban planners have of the acoustic realm. The project’s aim was to use binaural recordings to build an interactive library documenting sound in public space. Overtime this library could serve as a body of evidence to be mined for the research of sound in public space.

While the eventual goal is to gather binaural recordings all over the world, the initial project was constrained to river delta regions. This was because river deltas are by their nature at a confluence: a confluence of ecologies, cultures and economies. A cross section of global river deltas allowed for a large diversity of urban forms, transit systems, cultures, and ecologies while retaining a geomorphic commonality.

Over the course of four months binaural recordings were taken in the Pearl River Delta, the Mekong Delta, the Ganges Delta, the Nile Delta, the Rhine-Meuse Delta and the Mississippi Delta. Each one of these 387 recordings were geotagged and photographed. They were uploaded into a interactive online map that allows listeners to zoom into different locations and listen to recordings at the locations they were taken. This allows listeners to begin to examine relationships between place and sound. As listeners make
their way through Guangzhou, Cairo and Rotterdam relationships between the acoustic realm and city form, transportation policies, ecology and culture begin to surface. If listeners want to dive deeper into a specific recording the geotagged link gives access to a page showing a photo of the place where the recording was taken alongside the recording itself and its geotagged location. Through the photo this second layer reveals material, spatial proportion, and cultural context.

The Holy Well Suite - Dallas Simpson
Natural freshwater springs have been venerated in the distant past, and still are in present times.
This work consists of a delicate environmental improvisation on the shore in the vicinity of The Holy Well, near Eastbourne, UK - a point at which fresh water emerges from the chalk cliffs onto the beach next to a wooden groin, which is also featured in the improvisation. This is a delicate and respectful improvisation using footsteps, and only objects and surfaces found at the location including stones, a limpet shell, various seaweeds and water.
The work consists of six movements that merge continuously:
1) Prelude: Walk-in
2) Invocation: Chalk Cliff and Stones
3) The Holy Well: Communion
4) Anointing Wood Metal and Stone
5) Chonchoidal Resonances
6) Epilogue: Pebblestroll (Walk-out)
Recorded 15th August 2015, 6:45am in a single take. No windscreen, very light breeze, slight earwind noise included for atmosphere.

Listening Earth - Andrew Skeoch
Become immersed in pristine field recordings from UNESCO Biosphere Reserves across Australia with Andrew Skeoch from Listening Earth in a new collaborative project with Biosphere Soundscapes.

“EcoRift Virtual Reality and The Listen(n) Project” - Garth Paine and Sabine Feisst
The EcoRift presents a virtual reality experience of being in the desert. EcoRift links together full 360 spherical visual and acoustic recordings using the Oculus head tracking feature to provide synchronized an auditory and visual Point of View (POV) so the user can look around the environment as if truly present. Along with the other rich media tools developed by the Listen(n) project, EcoRift directs community awareness to issues of sustainability, environmental engagement, critical enquiry and interpretative discourse around questions of how digital technology and rich media environments can be used to deepen value systems around these precious, yet fragile ecosystems. Given the ongoing need to increase ecological consciousness, the EcoRift is designed to provide new virtual immersive environmental engagement cultivating environmental awareness and community agency.

“3D-Sound and VR-Audio Demo” - Sabine Breitsamer
Interfacing specific sound dramaturgies and new perceptional paradigms with 3D-Sound demonstrations.

vanuatu Women’s water music - Sandy Sur and Tom Dick
Sandy Sur is a community leader and researcher from the remote tropical Island of Merelava in Vanuatu. His research focuses around the Water Music of Vanuatu and its connection to the environment. Sandy believes water connects everything on earth and is essential for survival. At a time when the world is facing increasing environmental challenges, it is critical to deeply understand the role of water in our life. Investigating the dynamic sound and rhythm of Vanuatu Water Music allows us to explore the environment in new ways. Sandy’s research aims to develop a deeper understanding of the role sound plays in the environment and our communities. The Water Music of Vanuatu is site-specific and deeply inspired by the surrounding environment. This cultural tradition is now evolving in response to rapidly changing climates that are affecting island communities. Water Music can be a call to action.
Sandy Sur is one of the only people in the world holding the knowledge to lead research on Water Music. Over the last decade he has directed a wide spectrum of research projects designed to bring Water Music to the world. Sandy’s research showcases this tradition as a way for understanding the environment at a time when we urgently need to listen to nature. His research is realised as live performances, films, recordings and web based media designed as tools for reaching the world. He understands the possibilities of emerging technologies and international collaborations in bringing
wider awareness to his research. At Sonic Environments, delegates can experience the Vanuatu Water Music through a dynamic film.

**Consortium VR Experiences - QCRC Music Technology Research Focus Area Group**

The Music Technology focus area at the Queensland Conservatorium Research Centre is currently investigating the possibilities of immersive sonic environments for mobile virtual reality using Samsung Gear VR and Google Cardboard. While virtual reality has been an active field for a number of years, it is only now that it is becoming a viable opportunity for arts, sciences and humanities projects to truly explore the possibilities of this innovative technology. Immersive media installations using 3D surround sound technologies are argued to have substantial evocative potential and communicative power in inspiring behavioural change such as enhancing environmental stewardship and climate change adaptation. While many artists have pioneered techniques in various mediums, virtual reality provides perhaps the greatest opportunity to create truly immersive experiences. These demonstrations will showcase projects featured in the upcoming ‘Immersive Sonic Environments in Mobile Virtual Reality’ Lab hosted at the Queensland Conservatorium Research Centre in 2016.

“*The Kaleidophone – a sonic collage of the Leweton Cultural Experience in Vanuatu*” - Toby Gifford and Kate Genevieve

This is an augmented reality audio installation, experienced through a prototype technology called the Kaleidophone that allows the listener to navigate through different sound-worlds via head rotation. The installation comprises 6 sonic scenes recently recorded in Vanuatu of Kastom ceremonies from the Leweton community in Espiritu Santo.

The Kaleidophone is a prototype augmented reality audio technology using hyperreal / surreal spatial audio driven by head pose. Instead of a background (actively spatialised) realist atmos soundscape, the Kaleidophone allows ‘placement’ of sound-objects at different compass headings with a hyperreal focus – so that these objects are only heard for a small arc around this heading, and the sense of angular motion of the head is amplified – i.e. a small change in head pose produces a sense of one sound-world whizzing off and another whizzing in.

The prototype exists currently as a mobile-phone-plus-computer application. A standalone mobile-phone app that integrates with 360 video playback is in development (projected to be complete by July) and also an open-source ‘ear-muff’ all-in-one solution based on the BelaBoard interactive audio platform, and compatible with any set of headphones, is under development (not projected to be complete by July).

The mobile phone based implementations (existing and under development) demonstrate one advantage of the hyperreal / surreal approach of the kaleidoscope: tracking systems with high latency (such as my HTC phone’s compass) give poor results for realist augmented reality audio, but can still be effective using hyperreal / surreal approaches, avoiding the uncanny valley.
SONIC ENVIRONMENTS LISTENING ROOM
Music Technology Area, Room 3.36

Floating Sound - Mari Ohno
We release extremely subtle sounds from inside our bodies which are hard to perceive. Although the sound is made by the body, it cannot be heard because of the limited audible range that a human being can hear. This work is a composition using the sound of the composer’s bloodstream as a sound source. All the sounds were created from the sounds of the bloodstream recorded mainly in an anechoic chamber. The purpose of this work is to deconstruct and reconstruct the components of personal biological information via computing. These sounds were composed to express another reality beyond the boundary of the animate / inanimate.

Nero ipogeo - Roberto Zanata
“Nero ipogeo” is the third of my acousmatic cycle of compositions dedicated to the colour “nero” (the first one “Nero metropolitano” [2014] and the second “Nero siderale” [2015] are published on a CD edited by “Taukay Edizioni Musicali”). It is mainly designed with the open source software supercollider. The sources of “Nero ipogeo” are audio gestures of high frequencies (not dissimilar to the whistle) and underground sounds on the verge of audibility or inaudibility. The principle of the compositional fragmentation and of the compositional reduction is taken to the absolute extreme. I sculpted a kind of sub-atomic composition that pick up the sounds from the crevices between one quantum event and the next one. The intention is to lead the listener to the most attentive and perceptive kind of listening.

Les chants de la mer (Songs of the Sea) - Gilles Fresnais
The sea isn’t actually the silent world that Cousteau described. If you’re willing and able to listen to the life there, a whole world appears; you’ll hear calls to travel, calls from fellows or rallying cries. I was fascinated by the life and the musicality of this world, so I tried to put it into music using almost entirely sounds recorded underwater. These sounds truly reveal the incredible diversity of the inhabitants of the deep.

1916 - Daria Baiocchi
This work is dedicated to the memory of First World War (1914-1918). In particular this project takes its cue from the 1916 abolition of Dublin Mean Time and introduction of GMT, at that time strongly opposed by Countess Markievicz. The main element of this composition is the sound of a flute that “gives voice” to Markievicz. I recorded 25 flute sound-fragments and 12 flute rhythmic-fragments (DMT) : the sound fragments refer to the C, G, M notes that are the initials of the name of the Countess while the rhythmic sounds recall the sound of a clock. The contest of this historic event has been created with flute sounds that has became, with an electronic interpolation, sea and ship landscapes. A special thanks to the flautist Mauro Baiocchi.

Apax - Alexis Langevin-Tétrault
Apax reflects a creative process marked by a desire to disconcert my usual composition reflexes. The workpiece consists essentially of different variations of a single sound. It demonstrates a search for variation in continuity with the gradual changes of timbre and spatialization. The composition process is inspired by the phenomenology of time and by the reading of The Dialectic of Duration, Intuition of the Instant and The Poetics of Space by Gaston Bachelard. The piece was originaly created for an octophonic sound system with the multi-channel tools developed at Montreal University by Robert Normandeau's research group.

usedlost - Roger Alsop
Translating the word usedlost from Czech to English renders three possible meanings: homestead, holding, and location. usedlost puts an emphasis on the environment as holding resonances that are often exposed through text and an ineffable and internal experience of spatial location. usedlost was created using eight computer generated translations and computer readings of descriptions of locations in Prague. It explores linking new and old information distribution technologies, and the idea that a sense of location can be experienced and possibly understood through virtual representations of varying histories and languages. It was rendered through a bespoke program developed to explore 8-speaker shifting spatialization and harmonic systems, which created shifting musical and spatial locations. usedlost was first presented at the SoundKitchen 2015 as part of the Prague Quadrennial 2015 at the New Stage of the Czech National Theatre.
Inhabited Places Part III (Three Degrees of Inner Motion) - Jones Margarucci

Inhabited Places is a series of three pieces based on the concept of algorithmic composition. Although the general shape of these pieces has been determined in a conventional way, every sound that one can hear are selected in real time by different algorithms written in SuperCollider. These algorithms choose randomly audio files from different folders and play them at different speeds (time stretching) and in different moments. This pseudo-random process was also applied to the spatial domain, in fact in this case the amount of reverb was determined randomly between a minimum and a maximum value, and the movements of sounds - elevation and pan position - were determined by a noise generator. The sound materials used come mainly from different records and processing of my improvisation with guitar and/or electroacoustic devices and sounding objects. These pieces have been composed at the EMS studios in Stockholm.

“Reverie of Solitude” - Kyle Vanderburg

The piece serves as both an exploration of and a invitation to reverie; providing a space wherein the listener is asked to reconsider their idea of what it means to daydream. At once immersed in a familiar crowd hum, lost among the multitude, it is easy to believe that this daydream is not an expression of solitude, but rather a longing for solitude. And so the piece suggests the pattern of a day dream: the crowd noise giving way to a train, a lazy lawn sprinkler, a contemplative rain storm, a frothing river which becomes a bucolic afternoon on the lake. Each vignette is a self-contained narrative wherein to consider solitude in a natural context. The metaphor of water and the alternating themes of movement and respite invite the listener to reflect on the purpose of a daydream: to escape, to pacify, or to enrich a perfect moment. After having their attention turned to the daydream they themselves have been lulled into, the listener is returned to the crowd hum having established a personal sense of solitude within the piece and within the audience.

A Small Timequake // Of Shifts And Currents - Cissi Tsang

A Small Timequake // Of Shifts And Currents is an audio-visual piece combining field footage and field recordings with music created from converting the footage into hexadecimal data, and music visualisation. The work explores the ways in which the found environment can be sonified using data, and how such data can be used to create evocative narratives. Through combining music created from converting field footage into hexadecimal data (HEX) with field footage, field recordings and music visualisation, the process can offer multiple perspectives of a scene. The resultant works from this process are pieces where both the aural and visual are deeply intertwined.

HEX, when combined with field footage (still and moving), field recordings and music visualisation, can be used to sonify the found environment by creating multiple perspectives of the environment into the work. It also strengthens the connection between the aural and the visual by creating links between both mediums. With this form of practice, neither element can purely exist without the other. In a sense, this form of practice demonstrates a nexus point between visual and aural.

‘What you might have heard..’ - Nigel Frayne

‘What U might have heard..’, 2015, is a re-envisioned version of an ambient electroacoustic soundscape installation that was commissioned for the public areas of the Australian Centre for the Moving Image (ACMI), Melbourne in 2000. This original project was a site specific work carefully designed into this unique precinct and public space. ‘What U might have heard..’ is conceived as a 'virtual' representation of the original soundscape, now taking the form of a sonic exhibition. Rather than the physical experience of walking through ACMI and thereby composing one's own version of the soundscape the exhibition would have the audience remaining in one position with the piece 'spatialised' around them. The 8 channel work is best performed over a multichannel diffusion system that would intend to deliver a realistic virtual environment featuring the same structural orientation as the original site work at ACMI. When exhibited in this format, an 'archived' experience of the original soundscape is created. However, the roles played by the physical structure of the building and the transparent illusive quality of sound is now reversed. The physical building itself becomes a virtual artefact - or ghost. Now freed of its functional role within ACMI, the soundscape becomes the subject of attention and is more dynamic. The ears of the listener move closer into the unique sonic materials that comprise the composition. However they never stray far from the precinct of ACMI or the environs and cultural life of Melbourne. A sonic layout plan for ACMI was derived from the orientation of the building in Melbourne’s CBD grid and the placement of five iconic sound sources or themes into specific areas of the building.
so-called ‘impulse’ materials, including the soundmarks of Melbourne such as trams and trains, reflect the origins of the site as a public transport hub. These were placed in the North zone where the building fronts the city streetscape. Sounds derived of nature, reflecting the perspective of the nearby hills to the East of the city were sent into the building’s eastern atrium. The sounds of water, notionally connecting the wet areas of the building to the nearby river and ultimately the ocean were delivered within the toilets to the West.

The sound of footfall or footsteps representing the habitation of an urban space were delivered into stairwells. And, in recognition of the cultural institution housed within the building, the sound of a hand clap, was the basis for sounds generated for the central atrium - for it has been said that in 1932 an audience erupted into spontaneous applause when they heard the well-known sounds of Australian birds in the soundtrack of one of the first ‘talkies’ to be shown in Australia, Cinesound’s ‘On Our Selection’.

Within the ACMI soundscape these iconic sounds are rarely heard in their prime form and are actually departure points (impulses) for the creation of the content both in terms of inspiration as well as the actual production of the sound materials. The ‘response’ sounds are the product of extensive DSP manipulation of the impulses. These materials form the basis of this 25 minute composition.

Cúige (Province) - Cáthach Ó Nuanán

The name of the piece refers to the four provinces (or cúigi) of Ireland. The native folk music of Ireland, much like its dialectical language, has distinct territorial styles, that not only informs the ornamentation and instrumental technique of its practitioners but also the repertoire. Over the course of time, the exact boundaries of stylistic distinctions between the regions becomes blurred through musical interaction and cross pollination.

Using samples of instrumental music, Irish language radio broadcasts and environmental field recordings from key regions, this real world weaving of sound and music is mimicked in a computer composition through digital synthesis and processing. In the first part of the piece a fiddle performance of a slow “air” or lament is decimated beyond recognition by feeding it through a Max/MSP patch that captures input and triggers short buffers at playback speeds 1/10th of the original. In the second half more fiddle performances are deconstructed using a 4 channel granular synthesis environment also built in Max/MSP.
IMMERSIVE INSTALLATIONS
Music Technology Area, IMERSD Live Room

Fluctuant - Mauricio Iregui and Toby Gifford
Fluctuant is an installation that explores the primitive functionality of sound in human perception. Naturally, we have an immediate tendency to look at a perceived vibrating source and to change our listening position accordingly. This sensory stimulus is challenged by exposing the listener to an immersive sound environment, which transforms itself and reacts against the listener’s sitting position.

XIRMINJA NAHPY BERRY - Pablo Sanz
XIRMINJA NAHPY BERRY is an immersive sonic environment composed on the basis of a series of durational field recordings (plus 12 hrs each) made over a 6-weeks period at multiple flooded rainforest sites within the Mamirauá and Amaná Reserves in the Central Brazilian Amazon Region in 2015. The work consists of a multichannel installation (8-ch) evolving through cycles of ca. 4-hours which follow the chronological passage of the 24-hour night/day periods.
AUGMENTED REALITY SOUNDWALKS

Ambulation - Tim Shaw (Sound Walk)
Drawing upon the Situationist International’s game of the derivé and incorporating performance, walking and sound art practices, Ambulation offers a sound responsive journey through urban space, immersing the audience into a familiar yet abstracted environment. The piece, which concerns the sonic through space, allows the audience to navigate through a variety of composed and ‘naturally occurring’ environments facilitated, processed and remediated by the artist.

During a 30-minute walk through a specially chosen area of Brisbane, 10 participants each wearing wireless radio headphones will receive an audio feed of live recordings, locational radio broadcasts and electromagnetic energy from their immediate environment. Sounds are processed, layered and reintroduced live by the artist using a specially made system, and played back directly into the participant’s headphones as the walk continues. Using a radio receiver, electromagnetic pick up coils and a variety of different microphones a diverse range of sonic material will be revealed, collected, processed and broadcast live. An animated improvisation with the immediate soundscape, unique each time it is performed, Ambulation plays with memory, intuition and impulse.

“Tour(ist)” - James Partaik, Luc Lévesque and Hernando Barragan
The App TOUR(IST), is a mobile experience, an augmented soundwalk through the urban landscape. The User can take interactive “sound tunnels”, urban shortcuts revealing a series of acoustic ambiances creating a stimulating listening experience, a mobile audio voyage through the urban environment.

“What I'm proposing, to myself and other people, is what I often call the tourist attitude - that you act as though you've never been there before. So that you're not supposed to know anything about it. If you really get down to brass tacks, we have never been anywhere before.” – John Cage

The word tour is derived from the Latin, 'tornare' and the Greek, 'tornos', meaning the movement around a central point or axis. The suffix, –ist denotes 'one that performs a given action'. Playing with the usual codes of spatial representation, the App TOUR(IST) is an augmented soundwalk. TOUR(IST) offers urban shortcuts, virtual displacements and an immersive experience in a new acoustic space and ambience. By unveiling a series of 3D ambisonic recordings, TOUR(IST) creates “sound tunnels”, trajectories emanating from the actual location of the User. TOUR(IST) reveals a series of acoustic ambiances that incrementally create a whole new way of experiencing the city. Amidst the new urban soundscape thus created, the User develops a new sensory rapport with his or hers immediate environment. A new urban cartography is developed, a hybrid space in which the mobile User generates in real time, a listening experience while walking through the urban environment around the main gallery space.

Sampling sounds from buildings and the urban space surrounding the gallery, data is captured to create a virtual tour of the neighbourhood. This series of recordings, made in straight trajectories, are like “core samples” from drilling; they reveal simultaneously the various occurrences of sound phenomena of the urban core, from the infra-perceptible to the ephemeral sound event. The samples present the User with a series of related soundscapes from the area surrounding the main gallery explored by foot by the User.

Tour(ist) takes advantage of the integrated compass, GPS, tactile screen and binaural sound processing capabilities of the iPhone, enabling the User to move through the “sound tunnels”, either travel towards specific place in the city or generate a 360-degree sound experience, a total-field collage of sound just beyond his immediate location. These tunnels carry the User through obstacles from space to space, encounter to encounter. The User is like tourist (according to John Cage), like a wave, travelling through space and matter, confounding normal movement and penetrating both private and collective spaces.

Our approach focuses on the imagination of urban sites, their materiality, usage and memory. By interfering with what is normally a given “state” of operations, the intervention reveals an “augmented everyday soundtrack” leaving the field open to exploring the potential of the sounds of the city, the interaction with urban spaces and objects and the diverse interpretations of what surrounds us.

CANOPY: Rainforest Listening 2.0 - Leah Barclay and Toby Gifford
Rainforest Listening is an augmented reality installation that layers rainforest soundscapes in urban environments to inspire ecological engagement. Listeners access the sounds via mobile devices and sculpt their own experience by triggering geolocated soundscapes as they walk through iconic locations across the world.

Rainforest Listening launched during Climate Week 2015 in Times Square, New York City and has since featured at global events, including COP21 in Paris where the Eiffel Tower was transformed into a sonic rainforest. Listeners can hear the rich biodiversity of insects and birdlife and those who venture
deeper into the global sound maps can discover the endangered Amazon River dolphins or elusive howler monkeys hidden throughout cities. Rainforest Listening explores the value of sound in contributing towards environmental awareness and engagement. As the recent documentary Racing Extinction highlights: if we can bring the sights and sounds of the natural world to humans who would otherwise never think about them, they might be motivated and inspired to alter their habits enough to take action and respond to the ramifications of climate change. Creativity combined with innovative technology has a clear opportunity to inspire environmental stewardship through empathy and community engagement. Many suggest it is the most valuable tool we have to elicit an emotional response.

While many suggest smart phones disconnect us from nature, they also have the potential to reconnect us to natural environments in innovative ways. As the next billion people come online through accessible mobile devices in the next five years, there are clear opportunities to harness the power of mobile technologies for community empowerment at local and global levels in response to the ramifications of climate change. Rainforest Listening explores the sonic potential of mobile technologies and engages our auditory perception to inspire climate action.