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Vernacular Sound Technologies

Experimenting with reverb in isiXhosa Choral Recordings

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Abstract

In this thesis, I show how the application of convolution reverb in isiXhosa choral music recordings might engender notions of space in choral music which are acutely linked to issues of identity. To deal with the multitude of music's spatiality, I turn to two spatial theories of listening, namely, R. Murray Schafer's notion of schizophonia, in which recorded sound is thought to be separated from its spatial context, and Eric Clarke's ecological listening, in which sound is intricately bound up with its environment. I present these as two opposing theories which can be used to explain spatial thinking in music technology and suggest that the latter might be more productive in considering recorded sound.

Using this ecological notion of spatial listening, I investigate reverb as a marker of spatial identity for isiXhosa choral music and develop in response to this an experimental vernacular reverb technology which might be more keenly attuned to the performance sites of this music. Five objectives underpin this overarching aim. The first is to develop a theoretical framework for considering vernacular sound technologies, specifically reverb. The second objective is to illustrate these theoretical considerations in the practices of choral composers and sound engineers who have recorded this genre of music. The third objective is to develop a set of experimental reverb presets as a response to the theoretical considerations and their manifestations in practice. The last objective is to test these experimental presets in a feedback session with choristers.

This research is divided into two parts: theoretical and empirical. Part I considers theories of listening and reverb to develop the notion of vernacular sound technologies. In this section, I draw on secondary literature from sound studies, music perception, music technology, and cultural studies. I theorise here a notion of vernacular reverb by problematising the relationship between space and recording technology currently used in the postproduction of choral music. Part II is concerned with empirical research in three parts employing empirical qualitative research methodologies. The first is an illustrative section in which data is collected on how composers and sound engineers think about acoustics in isiXhosa choral music. The second part of the empirical research synthesises and applies the data through experimentation. In this section, I use the data collected from interviews read against the earlier theoretical review to produce three convolution reverb settings, which are simulated acoustic signatures of local spaces in which Xhosa choral music might be performed. The acoustic signatures are recorded from venues local to the Seven Fountains and Assegaaibos community, situated just outside Makhanda, Eastern Cape. The third section of the research is the collection and analysis of feedback from a focus group interview with a local choir. The focus group interview focuses on the thoughts of the choristers on identity and acoustics in music when presented with recorded songs produced with the vernacular reverbs.

In conclusion, I argue that the recordings at Seven Fountains and Assegaaibos show that acoustic space is a technological marker of identity, and indigenisation also has to do with the acoustic characteristics of the spaces of choral music performance.

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Chapter 1: Introduction

This thesis considers the intersection of sound technology, choralism, and identity in recording isiXhosa choral music. South African choral music broadly has been a site of rich discussions in music studies around issues of identity, music's global mobility, and tensions in the geopolitical divides in a global world order created by European colonialism.[1] At the heart of these issues sits an acknowledgement that much of the choral music heard in South Africa is a product of a missionary education system that valued Western art music above indigenous forms of music-making. However, indigenous composers' use of Western music is complicated when they simultaneously assert a claim to an authentic African identity. For most of the twentieth century, these issues hinge on a global imbalance that assumes that Western musical values are universal while indigenous forms of music-making are inferior. However, in recent times, composers like Mzilikazi Khumalo have tried to address this imbalance in pursuit of choral music, which is identifiably South African, by attempting to merge African and Western traditional musical elements.[2] Whether these composers have been successful is not the focus of this thesis. Still, their pursuit raises an interesting question of whether the sound technologies used to record and disseminate this music have or even could become equally attendant to debates around indigenous forms of expression.

This question, in part, stems from the fact that the roles played by sound technology – especially composing, recording, and post-production technologies – have seldom been raised in South African choral music. Only recently have discussions around recording indigenous music emerged in, for instance, David Langemann's work on recording the music of bow player, Mantombi Matotiyana.[3] Similarly, questions around the indigenisation of music technologies have only recently emerged in a systematic research programme undertaken by the Indigenous

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[1] See, for instance, Grant Olwage, 'John Knox Bokwe, Colonial Composer: Tales about Race and Music', *Journal of the Royal Musical Association* 131, no. 1 (2006): 1–37; Grant Olwage, 'Singing in the Victorian World: Tonic Sol-Fa and Discourses of Religion, Science and Empire in the Cape Colony', *Muziki* 7, no. 2 (2010): 193–215; Christine Lucia, '"Yet None with Truer Fervour Sing": Coronation Song and the (de)Colonization of African Choral Composition', *African Music: Journal of the International Library of African Music* 10, no. 3 (2017): 23–44; Christine Lucia, '"The Times Do Not Permit": Moerane, South Africa, Lesotho, and Fatše La Heso', *Muziki* 16, no. 2 (2019): 87–112; Austin C Okigbo and Bellarmine A Ezumah, 'Media Health Images of Africa and the Politics of Representation: A South African AIDS Choir Counter-Narrative', *Journal of Asian and African Studies* 52, no. 5 (2017): 705–21.

[2] Ndwamato George Mugovhani, 'The Role of Indigenous African Choral Music in the Search for Identity: With Special Reference to Mzilikazi Khumalo's Music', *Muziki* 7, no. 1 (2010): 61.

[3] David Langemann, 'On Recording "Songs of Greeting, Healing and Heritage"', *Herri*, no. 1 (n.d.), https://herri.org.za/1/david-langemann/.

Music Technologies working group hosted at Rhodes University, of which I have been a part.[4] This is, of course, not to say that these issues have not been part of the living practice of artists for many years, which it certainly has been. Rather, it is to say that there is a gap in the academic literature on how music technologies respond to the cultural politics of the South African music scene.

In addressing this gap, this project investigates how identity in South African choral music, particularly in isiXhosa choral music, challenges the sound technology used today in recording practices. To do so, this thesis develops the notion of vernacular recording technologies in music. Of course, theories of the vernacular can be problematic because they sometimes exclude modernity, rendering vernacular cultures and languages as static, if not relics of a museum.[5] Replicating this tendency is not my aim in this thesis. Instead, the perspective on vernacular technologies presented here acknowledges the fact that cultures are constantly in a process of evolution and change.

Choralism

While this thesis does not focus on the histories of choral music, it is partly situated in Southern African choralism discourse. Thus, some introduction to this field is required. Grant Olwage and other authors have shown that this form of music-making is tied up with forms of discipline and power introduced by the Victorian missionaries.[6] This can be seen in a review article in the *Grahamstown Journal* of 1863 proclaiming the 'success' of introducing choral music to the local black communities, which proved to 'tame' the 'savages' into a state of 'civilisation'.[7] According to Olwage, this success was the birth of musical colonisation in South Africa, and choralism was thus used as an evangelical colonising tool in the country.[8] However, during this process of musical colonisation, a few black composers trained in Western music integrated traditional African elements into their compositions, and their works can also be understood as a form of resistance.[9] Joshua Pulumo Mohapeloa (1908-1982) was one of the black composers

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[4] For more on the working group's activities, see https://indigenousmt.com/.
[5] Mark Crinson, 'Dynamic Vernacular – An Introduction', *ABE Journal. Architecture Beyond Europe*, no. 9–10 (2016), https://doi.org/10.4000/abe.3002.
[6] Grant Olwage, 'Discipline and Choralism: The Birth of Musical Colonialism', in *Music, Power, and Politics*, ed. Annie J. Randall, 1st Edition (New York: Routledge, 2004), 26.
[7] *Ibid.*
[8] Grant Olwage, 'Music and (Post) Colonialism: The Dialectics of Choral Culture on a South African Frontier' (PhD Thesis, Rhodes University, 2004).
[9] Mollie Spector Stone, 'Black South African Choral Music and the Struggle against HIV' (D.M.A., United States -- Illinois, Northwestern University, 2015), 3.

who composed music that contributed to this resistance.[10] According to Akin Euba, this drawing together of African and Western traditional elements presented not only resistance but laid the foundation for a type of African art music.[11] Other terms for this form of cross-cultural composition have also emerged. Markus Detterbeck, for instance, refers to it as African eclectic compositions.[12] Some of the most notable early Southern African composers whose compositions can be identified as African art music are Tiyo Soga (1829-1871), John Knox Bokwe (1855-1922), and Enoch Sontonga (1873-1905).[13] Mzilikazi Khumalo (1932-2021), a later exponent of this style, tried to incorporate traditional Zulu musicking in his compositions in pursuit of choral music that is identifiably African in the broad sense. Khumalo, in the quest for choral music that takes more of a traditional African approach, has greatly advanced this genre. Mugovhani states, for instance, that

> it is up to [Khumalo's] generation, and those which will follow, to pursue this trend and, perhaps, eventually to produce new genres and forms in South African indigenous choral music in order to establish a recognisable South African choral music identity.[14]

In the pursuit of choral music that is identifiably South African, the role of technology in composing and disseminating this music, however, has seldom been addressed in the academic sphere. While many scholars have produced research on choralism that provides strong historical and contextual arguments around the relationship between indigenous and imported cultural practices and identities, the role of sound technology in this discourse has yet to be included.

Vernacular

To draw together questions of identity and technology in South African choralism, I turn theoretically to the notion of the vernacular in this thesis, which I discuss at length in Chapter 4. Several authors have considered musical vernaculars in different ways. John O'Flynn defines vernacular to include relatively distinct musical communities and more fluid networks and

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[10] Christine Lucia, 'Composing towards/against Whiteness: The African Music of Mohapeloa', in *Unsettling Whiteness*, ed. Lucy Michael and Samantha Schulz (Brill, 2014), 217–30.
[11] Akin Euba, 'Criteria for the Evaluation of New African Art Music', *Transition*, no. 49 (1975): 46–50.
[12] Markus Detterbeck, 'South African Choral Music (Amakwaya): Song, Contest and the Formation of Identity.' (PhD Thesis, University of Natal, 2002).
[13] Mugovhani, 'The Role of Indigenous African Choral Music', 61.
[14] *Ibid.*, 73.

scenes.[15] Under this term, he mainly refers to popular and traditional music and the potential relationship between these in educational contexts.

For this study, I will apply the idea of the vernacular as it refers to local cultural norms to choralism and sound technology. To do so, I turn to the notion of vernacular technologies. Drawn from discourses in architecture, vernacular technologies refer to forms of architecture that socially represent the belief systems and cultural values of certain communities closely. Vernacular technologies draw on different forms of knowledge which are used to create buildings to meet the livelihood needs and cultures of these communities, which are directly linked to their environments and available resources.[16] Ono and Sloop argue that the vernacular is a discourse that resonates within its local communities. It also refers to culture, which is formed by music, art, dance, and architecture of local communities. The vernacular thus refers to a way of making specific to a certain community.[17] By considering vernacular discourse in this way, elements of popular culture can be combined to form a unique approach that challenges the mainstream technological discourse either implicitly and (or) explicitly. At the same time, it can create or affirm the community that produces it.[18] Technology and cultural norms within the choral sphere have evolved, especially regarding recording and production. As these systems evolve, new traits become part of the normalised practices of making music. In this study, the vernacular is used to articulate a normative localised context for the choral and sound technology spheres.

Post-Production Technologies

This thesis contributes to a growing discourse on the indigenisation of choral music by considering its recording and production technologies. While authors such as Louise Meintjes and Michael Drewett have looked at the politics of recording in South Africa in the early 1990s, their studies failed to interrogate the geopolitics of the actual technologies of recording within the country.[19] The construction of these technology systems is based on an understanding of music drawn almost exclusively from a Western paradigm. From presets for artificial

[15] John O'Flynn, 'Vernacular Music-Making and Education', *International Journal of Music Education* 24, no. 2 (2006): 140.
[16] Mihaela Hărmănescu and Cristina Enache, 'Vernacular and Technology. InBetween', *Procedia Environmental Sciences*, ECOSMART - Environment at Crossroads: Smart Approaches for a Sustainable Development, 32 (2016): 414.
[17] Kent A. Ono and John M. Sloop, 'The Critique of Vernacular Discourse', *Communication Monographs* 62, no. 1 (1995): 20.
[18] *Ibid.*, 23.
[19] Michael Drewett, 'Shifty Records in Apartheid South Africa: Innovations in Independent Record Company Resistance', *SAMUS: South African Music Studies* 34, no. 1 (2015): 29–62; Louise Meintjes, *Sound of Africa! Making Music Zulu in a South African Studio* (Durham: Duke University Press, 2003).

reverberation plugins to the development of Digital Audio Workstations (DAWs), I argue that many of the fundamental technological functionalities of recording and dissemination in South African music are determined by Western parameters of music. These systems, for instance, are based on the equal tempered tuning system that much of Western music is based on. This proves problematic for musicians who want to produce music using indigenous tonal systems from their communities. This has recently been highlighted in a different context by Khyam Allami, who seeks the decolonisation of music technology, which starts for him by reconfiguring digital recording systems.[20] Like Allami's, my project will also add to the nascent movement of 'decolonising electronic music [that] starts with its software'.[21] This movement is about having music systems supporting non-Western music forms. This thesis takes a similar stance in that it considers new post-production processes for the recording of isiXhosa choral music, which respond to local conditions.

In particular, the aspect of the post-production process that I focus on is the application of reverb. In the context of South African choralism, acoustics, as the field that most determines reverb parameters, in choral music is also seldom addressed. Acoustics can be treated in two senses: room acoustics and sound-source acoustics.[22] In this study, the former description is primarily considered. Sound technology software, such as plugins for DAWs, uses different algorithms to recreate room acoustics closely. However, these algorithms are still largely dominated by Western-centred notions of space. For instance, they reproduce the acoustics of buildings such as concert halls and cathedrals, which conform to Western typologies of space. To contribute to the growing discussion of sound technologies and vernacular expression, I consider local acoustic environments to be used in the post-production of isiXhosa choral music.

Space

Before going further, I want to pause and consider the concept of space in music in the broad sense. In doing so, I aim to set the ground for the spatial theories of listening discussed in the chapters to follow. Space in music has a long history in discourse, but in this thesis, I am particularly interested in how space is produced in recording and reproduction technologies. An example of how drastically these technologies change how we perceive the space of music

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[20] Tom Faber, 'Decolonizing Electronic Music Starts With Its Software', Pitchfork, 25 February 2021, https://pitchfork.com/thepitch/decolonizing-electronic-music-starts-with-its-software/.
[21] *Ibid.*
[22] Ronald Lewcock et al., *Acoustics*, Grove Music Online (Oxford: Oxford University Press, 2001), https://doi.org/10.1093/gmo/9781561592630.article.00134.

can be seen in the development of stereo playback. This development saw monophonic speakers change to stereophonic speakers, expanding the musical spatialisation from single-channel to two-channel output. Kees Tazelaar quotes Roelof Vermeulen, who was part of the Philips company from 1923 until his retirement in 1959, and states that

> the reproduction of music through a single loudspeaker remained a serious limitation: monaural sound offered the listener not more than a virtual hole in the wall of the space in which the music was performed.[23]

For Vermeulen, the monaural speaker offered only an impoverished virtual environment in which music was performed. With the development of stereophonic outputs, sound reproduction suddenly gained an unprecedented spatiality which mimicked how our binaural hearing captured our world.

This simple but drastic development shows how one example of space manifests at a technical level in our listening experience. However, from a sociological point of view, music itself creates space. Different cultures use music as a marker of identity, but musical activities also become a site in which that identity is performed. Take, for instance, Crossley and Bottero's description of the formation of a subculture based on musical consumption practices.

> Alienated from both the dominant culture of the middle class and the working-class culture and networks of their parents, the Centre for Contemporary Cultural Studies argued, working-class youths carve out their own culture, networks and spaces; and appropriation of and identification with particular types of music play a huge role in this process. Teds, punks, skins, hippies, bike boys and mods were all distinguished by the music they listened to (amongst other things). Music was a totem of their respective tribes.[24]

Music also provides the space for cultural identification and association. An example of this can be thought of as what Elina Seye describes as a third space. In this context, through the collaboration of different cultures, a mixing space is created that is neither of the primary

[23] Kees Tazelaar, 'Roelof Vermeulen at Philips : A Search for Space in Music', *Musicologica Brunensia* 52, no. 1 (2017): 17.
[24] Nick Crossley and Wendy Bottero, 'Social Spaces of Music: Introduction', *Cultural Sociology* 9, no. 1 (2015): 5.

culture nor of its other. In the case of Seye's argument, the collaboration of African and white Finnish musicians created a third space.[25] Paul Simpson considers street music and

> advocates an understanding of the role of sound in the on-going production of social spaces based upon a reciprocal mediation between 'macropolitical' matters related to identity and other social formations and the "micropolitics" of the affects that such sound and music bring to bear for those exposed to it.[26]

Music becomes the space and medium to better understand social practice. From the compositional perspective, space forms part of the parameters. According to Nicolás Arnáez, in the latter half of the twentieth century, space was realised as a technological parameter in composition. Arnáez further states that 'advances in technology offered tools to create the sensation of sound moving through space by the variation of loudness of the source in different speakers arranged in different locations'.[27]

From these different perspectives on space in music, it becomes apparent that the spatiality of music is linked to the physical, cultural, and aesthetic aspects of music. In the following thesis, I draw on all these conceptions of space and, in doing so, acknowledge that space is not a single, quantifiable aspect of music: it is not only evoked in physical performance, nor is it simply a matter of acoustics, nor is it only a question of form or musical content. Space in music encompasses all these and more issues. To deal with the multitude of music's spatiality, I instead turn to spatial theories of listening in this thesis. Most importantly, I consider R. Murray Schafer's notion of schizophonia, in which a recorded sound is thought to be separated from its spatial context, and Eric Clarke's ecological listening, in which sound is intricately bound up with its environment, as two opposing theories which can be used to explain spatial thinking in music technology.

Research Aims

In this thesis, I aim to investigate reverb as a marker of spatial identity for isiXhosa choral music and to develop in response to this an experimental vernacular reverb technology which might be more keenly attuned to the performance sites of this music. This overarching aim is underpinned by five objectives. The first is to develop a theoretical framework for considering

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[25] Elina Seye, 'Music as a Third Space? – African Musics as a Field of Collaboration in Finland', *Ethnomusicology Forum* 31, no. 3 (2022): 353–72.
[26] Paul Simpson, 'Sonic Affects and the Production of Space: "Music by Handle" and the Politics of Street Music in Victorian London', *Cultural Geographies* 24, no. 1 (2017): 89–109.
[27] Nicolás A. M. Arnáez, 'The Attribute of Space in Music: Three Examples' (Master of Music Thesis, University of Alberta, 2014), ii.

vernacular sound technologies, specifically reverb. The second objective is to illustrate these theoretical considerations in the practices of choral composers and sound engineers who have recorded this genre of music. The third objective is to develop a set of experimental reverb presets as a response to the theoretical considerations and their manifestations in practice. The last objective is to test these experimental presets in a feedback session with choristers.

Research Design

This research is divided into two parts: theoretical and empirical. The first part of the thesis considers theories of listening and reverb to develop the notion of vernacular sound technologies. In this section, I draw on secondary literature from sound studies, music perception, music technology and cultural studies to develop a theoretical framework in which the universality of Western space in music production technologies is problematised and instead an ecological conception of post-production technology is presented.

In the second part of this thesis, I turn to three stages of research employing empirical qualitative methodologies. The first is an illustrative section in which data is collected on how composers and sound engineers think about acoustics in isiXhosa choral music. This data is collected through the use of semi-structured interviews. This data collection technique is appropriate for this part of the study because it can provide access to the composers' and engineers' opinions, thoughts and feelings.[28] This kind of interviewing gives participants a certain degree of freedom to explain their thoughts, and it also allows me, as the researcher, to question certain responses in depth, which is crucial for collecting valid data on an issue as complex as cultural perceptions of acoustics.[29] The data presented in this section is collected using a purposive sample of two sound engineers and two composers. The chosen sampling technique is suitable for the study as it allows me to handpick participants more likely to provide relevant information aligned with the research objectives.[30] Composers were chosen because they are often responsible for the generative notions of acoustics in choral music. Sound engineers also were selected because, in the process of recording this music, they are

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[28] Siw Elisabeth Hove and Bente Anda, 'Experiences from Conducting Semi-Structured Interviews in Empirical Software Engineering Research', in *11th IEEE International Software Metrics Symposium (METRICS'05)* (11th IEEE International Software Metrics Symposium (METRICS'05), Italy: IEEE, 2005), 10.
[29] Joanne Horton, Richard Macve, and Geert Struyven, 'Qualitative Research: Experiences in Using Semi-Structured Interviews', in *The Real Life Guide to Accounting Research*, ed. Christopher Humphrey and Bill Lee, 1st ed (Oxford: Elsevier, 2004), 340.
[30] Ilker Etikan, Sulaiman Abubakar Musa, and Rukayya Sunusi Alkassim, 'Comparison of Convenience Sampling and Purposive Sampling', *American Journal of Theoretical and Applied Statistics* 5, no. 1 (2016): 1–4; Steve Campbell et al., 'Purposive Sampling: Complex or Simple? Research Case Examples', *Journal of Research in Nursing* 25, no. 8 (December 2020): 652–61.

ultimately responsible for creating a sense of musical space in post-production processes. The goal was to select participants with at least five years of experience in their respective fields, as their experience would be the primary source of interview content. Even though individuals with less than five years of experience may possess some experience in issues of acoustics, this illustrative section required reflection on longer standing conventional practice.

The second part of the empirical research synthesises the data gathered from the composers and engineers with the theoretical consideration discussed in Part I and applies this thought to a set of experiments with reverb. In this section, I use the data collected from interviews, and the earlier theoretical review to produce three convolution reverb presets, which are simulated acoustic signatures of local spaces in which Xhosa choral music might be performed. The acoustic signatures are recorded from venues local to the Seven Fountains and Assegaaibos community, situated just outside Makhanda, Eastern Cape. The local venues recorded in this thesis include the Assegaaibos SDA Church, Seven Fountains community hall, and Seven Fountains sports club. Following the recording of acoustic signatures of these local venues, a recording of a choir local to Makhanda is created. During the post-production process, I apply the experimental reverb presets. Here, I specifically use the application of artificial reverb, which is one of the commonly used effects in the post-production of many forms of music, including isiXhosa choral music. It is applied to resemble the reverberations of different environments, and when added to recorded material, the recording can closely resemble sound recorded in a real environment.[31] Reverb presets created in the experimentation section using impulse responses from local venues are reverbs used in the post-production process.

The third section of the research is the collection and analysis of feedback from the focus group interview of the choir. The focus group interview of the choir focuses on the thoughts of the choristers on identity and acoustics in music. Furthermore, this is done in relation to the recorded and mixed-down songs presented to the choir with preset reverbs applied. The two recorded songs are *Hamba Kahle Mkhonto* and *Indodana*. *Hamba Kahle Mkhonto* is a South African struggle song arranged by Sabelo Mthembu, and *Indodana* is a traditional IsiZulu/IsiXhosa song arranged by Michael Barrett and Ralph Schmidt. Both were adapted by the choirmaster in collaboration with the choir, forming part of the choir's African repertoire. The use of a focus group will allow for an in-depth discussion of vernacular sound technologies and give participants the opportunity to share their opinions regarding issues such as identity

[31] Roey Izhaki, *Mixing Audio: Concepts, Practices and Tools*, 2nd ed (Amsterdam; Boston: Focal Press, 2012), 401.

in music.[32] Like with the semi-structured interviews, data was collected from a purposively sampled choir. The choir was selected because it is local to the music department, and my prior engagements with the choirmaster allowed for convenient accessibility.

Thesis Outline

This thesis comprises eight chapters, including the introduction and conclusion, organised into two parts. Part I starts with Chapter 2, in which I introduce the concept of schizophonia coined by R. Murray Schafer, which I read against Eric Clarke's ecological approach to listening. The chapter explores the basic concepts that underpin schizophonia and the ecological approach to listening, but in presenting these ideas, I develop a critique of schizophonia as an inadequate means for addressing the spatiality of music and suggest instead that ecological listening might provide a better model for thinking about the ways we perceive music as resonant within acoustic space. Chapter 3 explores reverberation, specifically artificial reverberation. In this chapter, I present a brief history of artificial reverb, followed by a discussion of two forms of artificial reverb, namely what I will call generic artificial reverb and convolution reverb. In Chapter 4, I draw together the considerations of ecological listening and convolution reverb by situating them within a discourse of vernacular technologies. Here, I develop a proposition for vernacular sound technologies as a critique of a type of Western-centric universalism which exists in music technology discourse.

Part II of the thesis then starts with Chapter 5, in which I present an analysis of semi-structured interviews conducted with composers of choral music and sound engineers who have worked with choral music in the capacity of recording and engineering choir recordings. I read in these interviews tropes of ecological thought and more problematic assumptions around the use of reverb in recording practices. Chapter 6 is the heart of this thesis. It is here where I present an experiment in creating impulse responses of local venues, which are used to develop reverb presets as vernacular sound technologies. In this process, I also document the practice of recording a choir and using the presets in the post-production of the recordings. In Chapter 7, I reflect on these recordings by considering the input of a focus group comprising members of the choir that was recorded as part of the experiment. The last chapter of this thesis draws together conclusions from across the research, reflects on some of the limitations of the research, and suggests possible improvements for future research in this area. In the appendix

[32] Isabella McLafferty, 'Focus Group Interviews as a Data Collecting Strategy', *Journal of Advanced Nursing* 48, no. 2 (2004): 188.

to this thesis, I provide links to the recordings produced as part of the experiment detailed in Chapter 6.

Part I

Theorising Vernacular Sound Technologies

Chapter 2: Spatial Theories of Listening

Introduction

In this chapter, I interrogate two spatial theories of listening, namely, schizophonia and ecological listening. Listening in music and psychology discourses is a complex phenomenon which has been explored in various ways. Authors such as Jean-Luc Nancy, for instance, have considered listening as a deeply epistemological phenomenon which is crucial to our understanding of ourselves but also of the world around us.[1] In this sense, listening is also a key modality for phenomenological philosophy and plays a significant role in the work of figures such as Martin Heidegger and Maurice Merleau-Ponty.[2] Equally, there exists a wealth of literature on listening in the psychology of perception, with the two most dominant schools of thought being the cognitivist approach to listening, in which the listener makes sense of a chaotic environment, and the ecological approach in which the environment is structured, and the listener exists in a mutual relationship with this environment (both discussed at length below).

Yet while there exists a multitude of listening theories, in this thesis, I am particularly interested in theories of listening that help explain the relationship between sound and space, and particularly how this informs our relationship with both concepts. In pursuing this line of thought, I have identified schizophonia and ecological listening as two important theories, which, although concerned with the relationship between space and sound, offer two opposing possibilities for the conception of the relationships between listener, space, and sound. More importantly, both these theories have been used in an attempt to describe the relationship between sound and space in audio recordings. This is significant because audio recordings present a problem in the discussion of space and music. They offer two spatialities: that of the original recording in the form of a virtual spatiality and the spatiality of their playback.

In pitting these theories against each other, I recognise that schizophonia has never been conceived as an empirically sound theory of perception. However, it has been important for describing the spatial dislocation of music, especially through Steven Feld's seminal work on

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[1] Jean-Luc Nancy and Charlotte Mandell, *Listening* (New York: Fordham University Press, 2007).

[2] Maurice Merleau-Ponty, *The World of Perception*, trans. Oliver Davis (London and New York: Routledge, 2008); Martin Heidegger, "The Origin of the Work of Art," in *Off the Beaten Track*, trans. Julian Young and Kenneth Haynes (Cambridge: Cambridge University Press, 2002).

schizophonic mimesis as a description of the strategies of global music circulation.[3] In this sense, it is an important theory for describing our anxieties about committing sound to a medium which enables its infinite and exact reproduction. Ecological listening is somewhat underexplored in the context of recordings, but it is strongly grounded in empirical research on aural perception. What both these theories have in common, however, is that they propose something about the importance of the context of sound – its immediate space – which I will aim to use in developing a framework for thinking about the stakes of vernacular sound technologies.

Schizophonia

Schizophonia was first coined by Canadian composer and sound artist R. Murray Schafer to describe the disconnect of sound in the process of audio recording from unrecorded sounds of everyday reality. His interest in soundscape recordings led to the invention of this term. Through his project of developing the notion of soundscapes as artistic media, Schafer wanted to bridge what he perceived as a separation between humans and their real environments that would occur from the increased use of technology. As Randolph Jordan has argued, the intention behind Schafer's soundscape project can be articulated as 'the fundamental fear… that we will lose our grounding in the context of the here and now'.[4] This loss of here and now will then be replaced 'with "machine-made substitutes" for 'natural sounds […] providing the operative signals directing modern life'.[5] This fear resides at the centre of the schizophonic experience. In Schafer's words, schizophonia is described as follows:

> *Schizophonia* The Greek prefix *schizo* means split, separated; and *phone* is Greek for voice. *Schizophonia* refers to the split between an original sound and its electro-acoustical transmission or reproduction.[6]

Seen by him as a unique development of the twentieth century, Schafer introduced the term schizophonia with the intention of creating an aural analogue for schizophrenia with its nervous

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[3] Steven Feld, 'Pygmy POP A Genealogy of Schizophonic Mimesis', *Yearbook for Traditional Music* 28 (1996): 1–35.
[4] Randolph Jordan, 'The Schizophonic Imagination: Audiovisual Ecology in the Cinema' (PhD, Concordia University, 2010), 29.
[5] *Ibid.*
[6] R. Murray Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World*, reprint (Simon and Schuster, 1993), 103.

and dramatic connotations.[7] In explaining this analogue, it is useful to consider Thomas R. Insel's description of schizophrenia. 'Schizophrenia', he argues,

> is a syndrome: a collection of signs and symptoms of unknown aetiology, predominantly defined by observed signs of psychosis. In its most common form, schizophrenia presents with paranoid delusions and auditory hallucinations late in adolescence or in early adulthood.[8]

Schizophonia, in Schafer's description, does share many of the descriptors of schizophrenia. As Schafer writes,

> I coined the term schizophonia in *The New Soundscape* intending it to be a nervous word. Related to schizophrenia, I wanted it to convey the same sense of aberration and drama. Indeed, the overkill of hi-fi gadgetry not only contributes generously to the lo-fi problem, but it creates a synthetic soundscape in which natural sounds are becoming increasingly unnatural while machine-made substitutes are providing the operative signals directing modern life.[9]

The main comparison between schizophonia and schizophrenia is in the idea of the delusion or hallucination. For Schafer, the schizophonic sound is not the sound of reality, but an artificial reality which pathologically undermines the reality of sound. Importantly, however, Schafer's definition plays on the schizophrenic separation of reality and delusion by suggesting that the act of separating sound from its original source is similar to the loss of perception in schizophrenia. With the loss of perception, reality becomes an unnatural environment and the relationship between reality and virtual space changes. For Schafer, it is a problem of fidelity. Schafer states that schizophonic recordings shift sound from being high fidelity to low fidelity. Robin Parma quotes Schafer and explains this dichotomy highlighting the nervous nature of the fidelity issue in schizophonia:

> a hi-fi environment is one in which sounds may be heard clearly without crowding or masking whereas a lo-fi environment is one in which signals are overcrowded, resulting in masking or lack of clarity.[10]

[7] *Ibid.*
[8] Thomas R Insel, 'Rethinking Schizophrenia', *Nature* 468, no. 7321 (2010): 187.
[9] Schafer, *The Soundscape*, 91.
[10] Robin Parmar, 'The Garden of Adumbrations: Reimagining Environmental Composition1', *Organised Sound* 17, no. 3 (2012): 204.

There are four core themes in Schafer's schizophonia which need to be addressed, namely, separation, source, sound, and context. In the following section, I consider these four themes as a way to dissect Schafer's theory. In doing so, I aim to develop a critique of schizophonia which shows that Schafer underestimated the power of sound's relationship with the multiple contexts in which it can exist and retain or generate new meaning. In doing so, I suggest that schizophonia does not actually reflect how we listen to recorded music and suggest instead that within the spatial paradigm of listening, the notion of ecological listening in which sound and context is always intimately intertwined might be a more productive framework for thinking about the relationships between recordings and their acoustic spaces.

Separation

As mentioned before, the separation of sound from its source is central to the notion of schizophonia. According to Parma, by identifying this separation, Schafer 'wishes to rebuild a (perceived) lost connection' and this rebuilding would be done with the 'preservation of soundmarks, repairs to the soundscape, imaginative excursions into utopia, encouraging nature to speak for itself, and the recovery of silence as a positive state'.[11] He later adds to this and states that,

> [Schafer's] goal is to knit together the physical and acoustical once again into a whole of sign and referent, by way of careful ear training and attention to sound.[12]

In proposing this reparational strategy, which has to do with identifying the context of sound through sonic markers, Schafer betrays a certain naivety about the various other factors which determine and at times, maintain, the separation of sound from source in the recording process. Schafer, for instance, does not speak to the social nature of the mobility of sound recordings nor about the ways in which the separation of sound and source has impacted a number of communities. By way of illustration, consider the work of Noel Lobley on the archival recordings from Hugh Tracey's Sound of Africa series housed at the International Library for African Music. In his research, Lobley highlights the case of one recording in this series linked to the Xhosa people of the Eastern Cape of South Africa. The separation of this recording from its source community was not only due to the technological processes of recording. As Lobley writes,

[11] *Ibid.*
[12] *Ibid.*

> I began by asking friends in the townships whether they would be interested in hearing archival Xhosa recordings from the 1950s. Yes, of course, I was told, but most people said that they did not want to come to a library to listen to them. Their reluctance was usually caused by a general feeling that the resources of Rhodes University were entirely inaccessible to people from the townships.[13]

Lobley's observation shows that the separation between the sound recordings found in Hugh Tracey's Sound of Africa series and the people recorded occurs due to several factors. These include a sense of economic and spatial inequality marked by the difference between the township and the university and a type of alienation which emerges from the view of Rhodes University as an elitist institution inaccessible to the everyday person.

While issues of social and economic access indeed do perpetuate the schizophonic separation of source and sound, I argue throughout this thesis that there is an even deeper social separation which does not manifest in the material conditions of communities, but in the nature of the technology used in the sound recordings themselves and, more specifically, in the relationship between recording technology and music of the Global South. While I return to this argument at length in Chapter 4, it is important to state here that this argument does not hinge on the social-material nature of recordings, but stems from the thought, practice, and aesthetics of recording technology.

In developing this argument, it is important to consider more closely the place of technology in Schafer's schizophonia. According to Steven Feld, Schafer's 'scheme is straightforward: Sounds once were indexically linked to their particular times and places, sources, moments of enunciation, and human and instrumental mechanisms'.[14] The early technological development 'for acoustic capture and reproduction', Feld continues, 'fuelled a pre-existing fascination with acoustic dislocations and re-spatialization'.[15] This sense of historical re-spatialization is evident in Schafer's own writing when he states that

[13] Noel Lobley, 'Taking Xhosa Music out of the Fridge and into the Townships', *Ethnomusicology Forum* 21, no. 2 (2012): 186.
[14] Steven Feld, 'From Schizophonia to Schismogenesis: The Discourses and Practices of World', in *The Traffic in Culture: Refiguring Art and Anthropology*, ed. George E. Marcus and Fred R. Myers (University of California Press, 1995), 97.
[15] *Ibid.*

> the desire to dislocate sounds in time and space had been evident for some time in the history of Western music, so that the recent technological developments were merely the consequences of aspirations that had already been effectively imagined.[16]

The aspirations for dislocating sound are for Schafer those that made way for public-address systems, radio expansion, and the tape recorder after the second world war. It was particularly the latter which induced much of the anxiety underlying Schafer's project in that the tape recorder enabled sound manipulation such as 'cutting and splicing tape, varying speed and frequency range, [and] reversing sounds', which led to 'unrecognizable transformation and distortion of original sounds'.[17]

According to Nabeel Zuberi, the techniques such as 'cutting and splicing audiotape and mixing two sound sources spurred this development earlier in phonographic history', but it is also these techniques that with their corollaries in digital technology 'intensify "schizophonia"'.[18]

There is, however, a contradiction at the heart of Schafer's thinking here, which has to do with the direct association of recording technologies and the loss of sounds' contextual meanings. This contradiction is foregrounded by Heikki Uimonen, who argues that

> Schafer's somewhat disillusioned conclusion implies that even if a record or tape collection contains items of diverse cultures and historical periods they might seem meaningless to a person from any century but our own. However, this notion contradicts his actions in the World Soundscape Project (WSP), founded to research, document and archive diverse sonic environments with appropriate indexing and contextual metadata.[19]

What Uimonen's critique shows is that it is perhaps too simplistic a conclusion that technological recording and reproduction of sound invariably or uniquely destroy the contexts of sound. Instead, by highlighting Schafer's perseverance with his project and importantly the addition of indexing and contextual metadata for these recordings, Uimonen's critique perhaps suggests that what schizophonia draws our attention to is precisely the need for thinking about sound recordings and the related contexts of sound.

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[16] Schafer, *The Soundscape*, 103.
[17] R. Murray Schafer, *The New Soundscape; a Handbook for the Modern Music Teacher* (Don Mills, Ont.: BMI Canada, 1969), 45.
[18] Nabeel Zuberi, 'Is This the Future? Black Music and Technology Discourse', *Science Fiction Studies* 34, no. 2 (2007): 283.
[19] Heikki Uimonen, 'Schizophonia', *The SAGE International Encyclopedia of Music and Culture*, 2019, 2.

Sound

To develop this point more fully, it is worth pausing on the nature of sound as Schafer frames it within the discussion of schizophonia.[20] It is worth mentioning in this regard that by asserting that sound can be separated from its source, Schafer posits a theory that sound can, at some point in its transmission, be regarded as abstract and that in the schizophonic process invoked by technology, sound and source become two separate entities. Indeed, Schafer writes that 'we have split the sound from the maker of the sound. Sounds have been torn from their natural sockets and given an amplified and independent existence'.[21] The tearing of the sound from its 'natural socket' might be understood in the phenomenological sense of what Edmund Husserl calls *epoché*, or the removal of the phenomenon from prior meanings it might carry. Put differently, as Ulf Holbrook does, *epoché* refers to the

> practice of 'bracketing out' a sound, of removing information which is external to the object, enables a study of the object itself.[22]

While his theory is perhaps attractive within certain schools of thought,[23] it seems to be contradicted in more recent thinking prevalent in sound studies, which posits sound as a far more relational phenomenon. As a representative of this more recent thinking, Brandon LaBelle, for instance, argues that

> sound is intrinsically and unignorably relational: it emanates, propagates, communicates, vibrates, and agitates; it leaves a body and enters others it binds and unhinges, harmonizes and traumatizes; it sends the body moving, the mind dreaming, the air oscillating. It seemingly eludes definition, while having profound effect.[24]

In LaBelle's argument, it becomes apparent that sound can, in fact, not be thought of as an abstract phenomenon which can be completely separated from its source. Instead, what LaBelle's definition offers is the idea that a specific sound is not ontologically dependent on a singular source, but that sounds create multiple connections between sources and perceivers.

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[20] It is worth noting for the following discussion that sound is dealt with here phenomenologically rather than aesthetically. If thought of in terms of sound art, which Schafer was clearly invested in, its representation becomes far more complex. However, for the purposes of my argument, it is important first to consider it as a phenomenological event, which is also how Schafer supports his argument.

[21] Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World*, 103.

[22] Ulf A. S. Holbrook, 'Sound Objects and Spatial Morphologies', *Organised Sound* 24, no. 1 (April 2019): 22.

[23] The idea of sound gaining some form of independence in the recording process is particularly important for Pierre Schaefer, for instance, who early in the twentieth century developed the notion of the 'sound object' to describe the abstract sonic phenomenon.

[24] Brandon LaBelle, *Background Noise: Perspectives on Sound Art*, Book, Whole (New York: Continuum International, 2006), ix.

In this sense, the relationality of sound to source is not broken in the recording process. Rather, new relations are formed between sources and sounds through the mediation of technology. Returning to Schafer's anxieties around the advent of manipulating tape recording, then, one could argue that the tape recorder techniques offered by Schafer create new relations to sound by presenting a new form of the sound.

This entanglement of sound with multiple sources allows perhaps for a more acute diagnosis of the fear underlying Schafer's notion of schizophonia, which has to do with the authenticity of sound. The invention of technology that transmits and stores sound brought ambiguity to the understanding of the relationship between sound and the original source of sound. Schafer gives an overview of how this relationship worked before the invention and introduction of technology:

> originally all sounds were originals. They occurred at one time in one place only. Sounds were then indissolubly tied to the mechanisms that produced them. The human voice travelled only as far as one could shout. Every sound was uncounterfeitable, unique.[25]

The introduction of technology meant that sounds not only lost their connection to their source but also lost their originality. They now can be counterfeited or lose their supposed uniqueness. Now sounds can be captured, stored, and retransmitted, and in these processes they are re-mediated through multiple technological sources. In LaBelle's estimation, however, this is not a form of loss which stems uniquely from sound's relationship with technology. It is instead an aspect of sound which would exist irrespective of technology given that sound is essentially relational.

Source

Following the relational definition of sound, however, does not address the loss of the information of the source in the process of schizophonia. Indeed, if we follow Schafer's concern with schizophonia carefully, then it would seem that technology entirely erases the sonic index of the source. Put differently, once a sound is mediated by recording technology, Schafer seems to argue, we are unable to accurately relate it to its source. To a certain extent, his argument seems correct. With the advent of sound recording technologies, the singular source of sound multiplies. For example, in a public announcement setting, the transducing loudspeakers become, in theory, the source of the sound for the perceiver. The use of

[25] Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World*, 90.

microphones, cables, mixers, and amplifiers make this possible. The microphone picks up the sound from the announcer, and by routing eventually through an amplifier, the speakers amplify this sound for the audience. From the perspective of the perceiver, the speakers are the primary source of the sound. That said, from the perspective of the live sound engineer, the source of the sound will be more complex. The sound from the microphone will be fed to a mixing desk which then feeds the sound to the monitoring headphones. The source then becomes the monitoring headphones. For the speaker, of course, the source remains their vocal cords. The same sound gains different sources with each perspective, and thus it becomes apparent that the simple one-to-one relationship between sound and source is eradicated, as Schafer says.

Of course, Schafer's concern is more with issues of recording and not live sound production, but I have purposefully used the live sound example because it reveals a flaw in Schafer's argument around the source of sound, namely, that the idea of sound having only an 'authentic' source is reductionist. In the case of recording, we might equally be able to identify the speakers over which a recording is played back as an authentic source enabled by an interface between recorded data and transduced soundwave. In other words, if one listens to a recording of a bird call, the headphones one uses are no less an authentic source than the bird which was recorded in the first place.

Decontextualising and Re-Contextualising Sound

If multiple authentic sources for a sound are possible, then perhaps the larger issue resides with the context of the source. The recording of the bird call described before shows how the sound and its source are split, and the perceiver of the sound receives it in an altered form, but also in a different context to the original sounding. Recording technology thus makes it possible for sound to be inserted into a context from the original context where the sound was captured. As Uimonen, drawing on Schafer, writes,

> with recording technology, any sound can be detached from its source and attached to any number of new contexts, thus, any sonic environment can become any other sonic environment.[26]

This shift in context is perhaps what lends recorded sound the sense of independence or abstraction which I discussed before, but it is worth thinking about this moment as a

[26] Uimonen, 'Schizophonia', 2.

proposition, on Schafer's part, of a type of decontextualisation of sound. The anxiety around the decontextualisation of sound is, for instance, seen acutely when Schafer writes that

> vocal sound, for instance, is no longer tied to a hole in the head but is free to issue from anywhere in the landscape. In the same instant it may issue from millions of holes in millions of public and private places around the world, or it may be stored to be reproduced at a later date, perhaps eventually hundreds of years after it was originally uttered. A record or tape collection may contain items from widely diverse cultures and historical periods in what would seem, to a person from any century but our own, a meaningless and surrealistic juxtaposition.[27]

Schafer argues here that the recording technology of the time would enable the storage of sounds, thus removing them from their original context of time and space. An example of this lurks in Lobley's discussion of creating access to Xhosa recordings from the 1950s mentioned before and more generally in the archive collection found at the International Library for African Music.[28] Recording technology made it possible for the sounds to become independent and decontextualised from their original contexts and become recontextualised within Rhodes University, which is seen as an inaccessible space by those whose cultural heritage is represented in the recordings. Yet more and more we see how these same recordings are again recontextualised when they are used in contemporary African music or presented in educational projects as part of the 'living archive'.[29]

This is what recording and storage technologies have made possible. In these moments of recontextualisation, however, it seems that Schafer's claim that recorded sounds become 'a meaningless and surrealistic juxtaposition' is overdrawn.[30] In fact, it also seems to contradict some of his own thinking regarding the 'space' which is created by transmitting recorded sound. It is useful, in this regard, to consider Schafer's thought on the development of the radio. According to Schafer, the radio made it possible for acoustic space to be extended. He writes, for instance, that radio is a form of 'extended acoustic space', which he describes with the following allegory:

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[27] Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World*, 103.
[28] Lobley, 'Taking Xhosa Music out of the Fridge and into the Townships'.
[29] Lizabé Lambrechts, 'Performing the Aporias of the Archive: Towards a Future for South African Music Archives', *Historia* 61, no. 1 (2016): 132–54.
[30] Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World*, 103.

> a character in one of Jorge Luis Borges' s stories dreads mirrors because they multiply men. The same might be said of radios. By 1969, Americans were listening to 268,000,000 radios, that is, about one per citizen. Modern life has been ventriloquized.[31]

Each household in the United States at the time was an extension of acoustic space. This extension of space, in turn, made it possible for sounds to be recontextualised. Considering the number of listeners of radio at the time, the source of sound (the radio) for the listeners was different from that of the maker of the sound (the originator of the sound which was then recorded), but it is perhaps incorrect to say that the recordings in this extended acoustic space were 'meaningless'. After all, radio becomes one of the most important sonic markers of modernity and becomes an important site of meaning in definitions of culture and technological identity in the twentieth century.[32]

While his anxieties around the decontextualisation of sound and the concomitant loss of meaning might thus be overdrawn, the treatment of schizophonia does suggest that Schafer was proposing a novel spatial theory of listening. Sounds, for him, exist uniquely within a certain space and lose something of their meaning when they are moved to a different space. His theory, moreover, also draws attention to the notion of the recording as a disconnected or abstracted space. For all that, the idea, presented before in LaBelle's thought, that sound has a way of continuously connecting with its immediate environment undermines the theory of schizophonia, and betrays an over-reliance on the reductionist singularity of the source. However, I want to suggest that there is still a valuable lesson to take from Schafer's idea of schizophonia, namely that it perhaps describes what happens when the spatial and contextual nature of sound is forgotten in the recording process.

Ecological Listening

While schizophonia might thus not be a compelling theory for describing the perception of sound spatially, its shortcomings suggest that a spatial theory of listening might be more accurate if it focuses on the various relationships between sound and environment, or the types of connections which LaBelle argues are made by sound. Such thinking is perhaps best exemplified by the ecological approach to listening, which has been explored in particular by Eric Clarke. Clarke has dedicated a book, *Ways of Listening*, to the ecological approach to

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[31] Schafer, 91.
[32] René Wolf, 'Radio and Modernity', in *The Undivided Sky: The Holocaust on East and West German Radio in the 1960s*, ed. René Wolf (London: Palgrave Macmillan UK, 2010), 17–45.

listening, which provides a strong outline of the fundamentals of ecological listening.[33] William Gaver has also provided shorter contributions to this field and explored ecological listening by shedding important light on cognitivist approaches against which ecological listening responds.[34] Importantly, both Clarke and Gaver build on James Gibson's work on the ecological theory of perception. Gibson published his seminal *Ecological Approach to Visual Perception* in 1979. He provided here the framework for understanding perception as that which occurs between what an environment affords and the resultant action the perceiver might take.[35] This significant contribution rests on the notion that the perceiver's environment affords them something and it is perception that allows the perceiver to act on these affordances. The relationship between environment and perceiver is what Gibson calls the theory of affordances, which later becomes the basis of Clarke's and Gaver's work on ecological listening. In the following section, I explore ecological listening as an alternative to schizophonia as a spatial theory of listening. My argument is that, unlike schizophonia, which ignores the affordances of a sound's environment other than those of its initial source, ecological listening shows how intimately the space of a sound is bound up with our perception of it.

Ecology

As a point of departure in the following discussion of ecological listening, I first want to consider the notion of ecology. Doing so is helpful in showing the underlying logic of Clarke's theory and Gaver's subsequent engagement with it. As Gaver states, 'according to the ecological approach, perception is usually of complex events and entities in the everyday world. [… A]ccording to the ecological account, the study of perception should be aimed at uncovering ecologically relevant dimensions of perception and the invariant perceptual information for them'.[36] What is important here is that ecological listening is developed on a model of interaction that foregrounds the relationships between environment (space) and the objects and organisms which inhabit that environment. The Ecological Society of America defines ecology in this manner,

> ecology is the study of the relationships between living organisms, including humans, and their physical environment; it seeks to understand the vital connections between

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[33] Eric F. Clarke, 'Introduction', in *Ways of Listening*, online edn, Oxford Academic (New York: Oxford University Press, 2008), 3–16.
[34] William W. Gaver, 'What in the World Do We Hear?: An Ecological Approach to Auditory Event Perception', *Ecological Psychology* 5, no. 1 (1 March 1993): 1–29.
[35] James J. Gibson, *The Ecological Approach to Visual Perception: Classic Edition*, 1st ed. (New York: Psychology Press, 2014).
[36] Gaver, 'What in the World Do We Hear?', 4.

> plants and animals and the world around them. Ecology also provides information about the benefits of ecosystems and how we can use Earth's resources in ways that leave the environment healthy for future generations.[37]

This definition of ecology is adopted from biological sciences, but what is crucial here is the notion of the relationships between organisms, which in this study might be thought of as perceivers, and their environment. The emphasis on the relational way of thinking is proposed in Clarke's definition of the ecological approach. He posits that

> ecology is the study of organisms in relation to their environment, and the approach to perception presented in [*Ways of Listening*] is characterized as ecological because it takes as its central principle the relationship between a perceiver and its environment.[38]

Like that of the Ecological Society of America, Clarke's definition holds the relationship between the population and the environment at its centre. The environment produces information from events that occur. How the population of the environment responds to the information of the environment describes the relationship between inhabitant and environment. These relationships can take many forms, but Clarke usefully divides these into three main categories, namely, affordances, adaptations and resonance.[39] While I return to each of these at length later, it is important to note at this point that these three categories differ significantly from the relationships that exist between perceiver and environment proposed in earlier cognitivist approaches to perception.

It is useful to draw out a comparison between these two approaches. At its base, the ecological approach holds that the environment is structured. Clarke states that 'the ecological approach emphasizes the structure of the environment itself and regards perception as the pick-up of that already structured perceptual information.'[40] This view of the environment opposes the notion of the environment presented in cognitivist approaches to perception. According to Gaver, the cognitivist approach considers the environment as a noisy construct, where the perceiver gathers information from the noise and consolidates it together. Gaver argues that

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[37] 'What Is Ecology? – The Ecological Society of America', accessed 8 January 2023, https://www.esa.org/about/what-does-ecology-have-to-do-with-me/.
[38] Clarke, 'Introduction', 2.
[39] Eric F. Clarke, 'Perception, Ecology, and Music', in *Ways of Listening*, online edn, Oxford Academic (New York: Oxford University Press, 2008), 17–47.
[40] Clarke, 2.

> cognitive accounts see information as a kind of stuff to be conveyed piecemeal from domain to domain. The task of the perceptual system, from this point of view, is to extract information from noise, supplement missing pieces of information, and reconstruct a coherent account of what is perceived on its basis.[41]

Clarke and Gaver describe the cognitivist approach in similar ways. According to Clarke, the cognitivist approach proposes that the environment is chaotic, and the perceptual system organises this into structured information.[42]

The ecological approach to perception proposed by Clarke, however, draws on a notion of the environment which foregrounds the unification rather than the noisy disarray of various objects and events contained within it. Clarke writes, for instance, that

> the environment described [in the ecological approach] is that defined by ecology. Ecology is a blend of physics, geology, biology, archaeology, and anthropology, but with an attempt at unification. The unifying principle has been the question of what can stimulate a sentient organism.[43]

The shift from noisy and unordered environment to structured ecology marks an important difference between cognitivist and ecological approaches to perception. This difference, however, was first proposed by Gibson who argues that

> the environment consists of an interpenetration of natural and cultural attributes: the brightness, distance, weight, loudness, or heat of things in the world are continuous with the ways in which human beings have made those things and organized them into systems and practices.[44]

Both of these definitions view the environment as a comprehensive site that is systemically functional. By this, I mean that the environment is not only perceived as a set of basic environmental features but it also is defined by the culture of the perceiver. The notion of the interpolation of culture into the environment is equally important for ecological listening. In his article, *The Impact of Recording on Listening*, Clarke summarises the ecological approach to the environment and states that 'the environment is highly structured' and in addition to this

[41] William W Gaver and Donald A Norman, 'Everyday Listening and Auditory Icons' (PhD, San Diego, University of California, 1988), 21.
[42] Eric F. Clarke, 'The Impact of Recording on Listening', *Twentieth-Century Music* 4, no. 1 (2007): 48.
[43] Clarke, 'Perception, Ecology, and Music', 2.
[44] Clarke, 'The Impact of Recording on Listening', 3.

the 'perceivers become highly attuned to that structure'.[45] Clarke writes that the environment is also influenced by 'the profound impact of human beings and their cultures; and that in a reciprocal fashion perceivers are highly structured organisms that are adapted to that environment'.[46]

Following from the proposition that the environment itself is structured, the ecological approach to perception argues that the information, which includes sound, that comes from or is produced by the environment is also structured. As Gaver argues, 'sound is also structured by and informative about the environment in which the event occurs'.[47] Furthermore, Gaver states that,

> much of the sound that reaches us from a source has reflected off various other objects in the environment, which color the spectrum of reflected sound just as light is colored by the surfaces it strikes.[48]

Sound, thought of ecologically, is thus an event bound up with the environment, and it is shaped by the environment, the objects that exist in it, and the cultural configuration of that environment. In this sense, the ecological approach to listening almost diametrically opposes Schafer's schizophonia, which holds that not only sound and source can be split through recording, but that sound can lose its context in the process of recording. In the way that ecological listening conceives of the environment, we see that this split is impossible: sound is always bound up structurally with *an* environment, or more accurately, sound is always ecological.

Affordance

In the description of the ecological approach to listening and that of human ecology, the environment is at the forefront. The study of the environment is important because that is where the population – perceiver – resides. This makes it important to study the structure of the environment to better understand the relationship between the perceiver and the environment. Yet it also suggests that there are specific types of relationships that exist between perceiver and environment. As mentioned before, Clarke proposes three useful categories of relationships, which I discuss in the following section.

[45] Clarke, 2.
[46] Clarke, 'Perception, Ecology, and Music', 2.
[47] Gaver, 'What in the World Do We Hear?', 7.
[48] *Ibid.*

Among the most important of these categories, especially for the understanding of the ecological approach to perception, is the category of affordances. The term affordance was first coined by James Gibson in his book entitled *Ecological approach to visual perception*.[49] Clarke quotes Gibson's definition of affordance and writes,

> [Gibson] coined this word as a substitute for values, a term which carries an old burden of philosophical meaning. I mean simply what things furnish, for good or ill. What they afford the observer, after all, depends on their properties.[50]

Eleanor Gibson and Anne Pick paraphrase James Gibson's definition and describe affordance as it 'refers to the fit between an animal's capabilities and the environmental supports and opportunities (both good and bad) that make possible a given activity'.[51] For them, affordances are 'properties of the environment as they are related to animals' capabilities for using them'.[52] These properties show the specific relationship between the inhabitant and object in an environment. For example, a chair in a classroom is fit for sitting for a student, but the same chair would not be fit for an infant because the motor capabilities of the infant are not at the level of a grown person. The classroom chair thus affords the student a perch in the way it does not afford the infant a perch. Yet affordances are not only the providence of objects in the environment. Gibson and Pick state that

> affordances are also offered by events, including social events such as a looming, loving, or angry face […] To perceive an affordance is to detect an environmental property that provides opportunity for action and that is specified in an ambient array of energy available to the perceiver […] Since an affordance is an objective property of the environment, it exists whether or not it is perceived or realized.[53]

The perceiver's awareness plays a role in identifying affordances, which are an environmental property. The perceptual sensitivities of the perceiver lead to the kind of action they take.[54] Take, for example, a misplaced applause in a Western art music concert when in one of the pieces you misidentify the end of a piece and clap. In this case, the environment provided events which you were unable to correctly identify which then led to an awkward clap. This

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[49] Gibson, *The Ecological Approach to Visual Perception*.
[50] Clarke, 'Perception, Ecology, and Music', 14.
[51] Eleanor J. Gibson and Anne D. Pick, *An Ecological Approach to Perceptual Learning and Development* (Oxford: Oxford University Press, 2003), 2.
[52] Gibson and Pick, 2.
[53] Gibson and Pick, 2.
[54] Clarke, 'The Impact of Recording on Listening', 48.

shows two things, affordances are always present and the task of identifying them resides with the perceiver.

While Gibson and Pick assert that affordances are objective properties of the environment, it is important to note that affordances are equally determined by the perceiver. The perceiver identifies affordances of an environment based on their perceptual sensitivities. Clarke, who contradicts Gibson and Pick, expands on affordances when he writes that,

> the affordances of objects and events are not fixed, objective properties, but are a consequence of the mutualism of environmental properties and the perceivers' perceptual sensitivities: the wooden ledge that to me affords sitting on may afford hiding under to a child; and while a hip-hop track affords pleasurable dancing to someone, a recording of Xenakis's cello piece *Nomos alpha* may afford either captivated amazement or fidgety irritation to that same listener.[55]

In this sense, it becomes apparent that the awkward applause used in the example before is not a result of the perception of the 'wrong' affordance. Rather, it shows that in the moment when the perceiver decided to clap, the music afforded them a sense of ending which warranted, in their mind, applause. The important relationship here is not one of right or wrong engagement with the environment, but the identification by the perceiver of a musical event which instigated an action. As Clarke summarises, affordances describe 'in the most general terms, when people perceive objects and events, they perceive what they can do with or about them'.[56]

Resonance

What is important in the discussion of affordances is the act of becoming aware of the affordance. This act is called resonance, which is the second category used to describe the relationship between perceiver and environment. Resonance describes the identification of affordances of an environment and the resultant response to them. In other words, and as Scott Spiegelberg argues,

> in ecological theory, resonance is the active engagement of a person with [their] environment, shown by actions spurred by perceptions. Turning towards a sound,

[55] Clarke, 2.
[56] Clarke, 48.

> focusing on an object, these actions are caused by perceptions and help sharpen the perceptions in an interactive loop.[57]

Resonance with an environment in this sense describes actions that are incited by perceptions. It is important to note, however, that perception in this theory is not a passive capacity of the perceiver. Clarke instead describes perception as the act of 'seeking out sources of stimulation in order to discover more about the environment'.[58] How one perceives an environmental event thus can lead to a resonance with the environment. For example, returning to the Western art music concert, the misidentification of an ending of a piece would mean that there is resonance between the sense of cadence and the perceiver's will to seek out an ending. Clarke explains this by stating that an 'organism needs to have a perceptual system that resonates to the information' within the environment.[59] Drawing on Gibson, he further asserts that

> instead of supposing that the brain constructs or computes the objective information from a kaleidoscopic inflow of sensations, we may suppose that the orienting of the organs of perception is governed by the brain so that the whole system of input and output resonates to the external information.[60]

The aggregation of the input and output systems of perception into the single term resonance highlights another issue with the schizophonic model of listening. Here, it is assumed that the perceiver passively receives the decontextualised sound recording and is subsequently unable to recontextualise it within their own (physical and cultural) ecological environment. However, if we follow the ecological theory of perception, we see that the perceiver is actively recontextualising audio stimuli by creating environmental resonances. A decontextualised sound received by a passive perceiver in this model thus is not possible.

Adaptation

The third category of relationships between perceiver and environment in the ecological theory of listening concerns adaptation. Adaptation is an exceedingly important term within ecological theory more broadly. Henne Mawhinney states that 'a fundamental assumption of human ecology is that adaptation proceeds through the formation of interdependencies among

[57] Scott Spiegelberg, 'Eric Clarke, Ways of Listening: An Ecological Approach to the Perception of Musical Meaning', *Empirical Musicology Review* 1, no. 2 (2006): 1.
[58] Clarke, 'Perception, Ecology, and Music', 3.
[59] Clarke, 3.
[60] Clarke, 2.

members of a population'.[61] In Clarke's ecological theory of listening, adaptation is equally important. He describes adaptation as a product of an organism's interaction with its environment which engenders a 'goodness of fit'.[62] In other words, adaptation is what the organism does, through an evolutionary process, to better respond to its environment.

However, adaptation does not only describe the changes in the organism in this relationship. Instead, it describes for Clarke both the changes to the organism and to the environment.[63] For Clarke, adaptation takes on the same mutualism which marks affordances and resonance. Spiegelberg, commenting on Clarke's work, shows that 'adaptation in ecological theory is not just changes in the perceiving organism. Instead, adaptation describes the interactive changes in the perceiver and in the environment'.[64]

In this sense, Clarke shows how perception, particularly listening, is both a response to a specific environment on the part of the perceiver, but also describes the ways in which the environment is shaped by perception. It is worth quoting Clarke at length on this point.

> Human beings have exploited natural opportunities for music making (the acoustical characteristics of materials and the action-possibilities of the human body) and have also adapted themselves to those opportunities, and enhanced those opportunities, through tool-making of one sort or another – from drilled bones, through catgut and wooden boxes to notational systems, voltage-controlled oscillators and iPods. Once made, all these artifacts help both to sustain existing musical behaviors (i.e., they help to perpetuate the musical ecosystem) and to make new behaviors possible. This mutual adaptation between human beings and their (musical) environment is neither reducible to conventional evolutionary principles, nor is it independent of them: culture and biology are tangled together in complex ways, but nonetheless constitute a single connected system.[65]

Considering, as Clarke does, the ways in which perceivers then insert objects such as instruments or playback devices such as iPods into their environment, it becomes apparent that there is as much an active shaping of the environment on the part of the perceiver as there is a

[61] Hanne B Mawhinney, 'The Microecology of Social Capital Formation: Developing Community beyond the Schoolhouse Door', *School as Community: From Promise to Practice*, 2002, 8.
[62] Clarke, 'Perception, Ecology, and Music', 4.
[63] *Ibid.*
[64] Spiegelberg, 'Eric Clarke, Ways of Listening: An Ecological Approach to the Perception of Musical Meaning', 1.
[65] Clarke, 'Perception, Ecology, and Music', 4.

shaping of the perceiver on the part of the environment. This shaping, or more specifically adaptation, however, is possible because organisms are able to learn from their resonant environment. Clarke, again drawing on Gibson, calls this perceptual learning. He argues that

> perception is a self-tuning process, in which the pick-up of environmental information is intrinsically reinforcing, so that the system self-adjusts so as to optimize its resonance with the environment: 'A system 'hunts' until it achieves clarity,' wrote Gibson [in 1966], a little like the scanning of a modern digital tuner, a device Gibson never encountered.[66]

To return to the example of the awkward clapper in the Western art music context, perceptual learning might be observed in a few key moments. First, at some point in our audience member's life, they learnt that clapping their hands is an appropriate display when a piece of music finished. Whether they had the language for it or not, they also learnt that this type of music signals its end through a cadence of some sort or through the body language of the players gesturing some finality. What they perhaps had not yet learnt was that the particular piece in question has multiple movements and that social convention is only to clap at the end of the final movement or even that the piece in question does not actually end where they perceived it to end. By strange looks or even noises around them indicating that they should keep quiet, they might have also learnt through perception that what they thought constituted an appropriate place to clap is, in fact, not an appropriate place to clap. The adaption might occur in the future where this particular audience member does not clap until other audience members clap.

Conclusion: Ecological Listening and Recordings

In this scenario, the various relationships between perceiver and environment are clear: the music in the concert environment affords the clapper feelings of joy, perhaps, but also the social setting in which showing appreciation for such an affordance might be expressed by clapping. Equally, there is a resonance between the clapper and the music: they are drawn into listening and they are compelled to clap at the false signal of finality. Lastly, there is adaptation through perceptual learning when they are shunned for clapping in the wrong place. We also see how complex this environment is as it comprises objects and events (players on stage and sound waves moving through the concert hall), but also how culture codes this environment, seen in

[66] Clarke, 3.

the aesthetic values associated with the music and the social norms associated with such an environment.

But is the theory equally applicable to recorded music, which is the issue at the heart of Schafer's schizophonia? At various points during my discussion of ecological listening, I have shown that Schafer's supposition of sound being split from its context is implausible, mainly because sound needs to take on its immediate context. That said, there are a number of important differences between recorded and live music which need to be acknowledged. In his discussion of ecological listening and recorded music, Clarke shows that sound recordings have four important differences from live music, namely, they are acousmatic, portable, repeatable, and fixed.[67] Most important for the current discussion is the first, the acousmatic character of recordings. On this point, Clarke shows that recordings are stripped of all forms of perceptual data except for auditory data. In this sense, they present an 'impoverishment of information', paradoxically leading us to listen to them with an increased auditory attention and involvement.[68] Yet this is not the same as the decontextualisation feared by Schafer. In his analysis of a number of recordings, Clarke shows that we are still able to identify certain referential signifiers, both musical and non-musical, in a recording, even if they may be relatively obscure.[69] In fact, he goes on to argue that while recording technologies have changed many of our listening habits around music, it has 'dramatically increased the 'interchange between the specific environment of musical sound and the wider environment of everyday sound'.[70] Moreover, recording technologies have made possible a type of listening mobility that would not otherwise have been possible. As Clarke argues,

> contrary to gloomy pronouncements on the destructive effects of recordings on both listening and creative practices, recordings – understood as a resource rather than a prescription or dogma – have provided people with an unparalleled opportunity to enter into, and learn from, musical cultures from every part of the world.[71]

That is, perhaps in stark contrast to Schafer's gloomy predictions, recordings – thought of ecologically – have not erased our understanding of the world but have indeed made us more attuned to the various sonic environments we inhabit. Moreover, it is this sense of being attuned ecologically which is of interest to the current project. My proposition in this thesis is that

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[67] Clarke, 'The Impact of Recording', 68.
[68] *Ibid.*, 50.
[69] *Ibid.*, 53-5.
[70] *Ibid.*, 68.
[71] *Ibid.*

isiXhosa choral music recordings should be approached ecologically. In other words, I am interested in how in the recording process greater attention can be paid to the ecology of this music, and particularly the sites or environments of its performance. The ecology of this music, if we follow Clarke and others, includes the cultural and physical environments of its performance, and it is this entanglement which I want to propose should be reflected in recording practices, but specifically in the case of this project, in the post-production practices. In opposition to schizophonic notions of listening, I will pursue a line of thought and practice here which reassigns the value of this music ecology in the recording process. The ecology which I am particularly concerned with here is the physical site of performance, which has led me to focus on reverb and artificial acoustics in the post-production process. Reverb, as I show in the following chapter, is for me a major point of articulation in the ecology of recordings, but it also becomes important in pronouncing the ecology of the recorded sound.

Chapter 3: Reverberation

Introduction

In 1979, James Moorer wrote that most recorded ‘music is heard these days either in the comfort of one's home (or car), or in a university auditorium, both of which have generally short reverberation times’. [1] It is for this reason, he continues, that ‘most recordings of music already have some amount of reverberation added before distribution either by a natural process (i.e. recordings made in concert halls) or by artificial processes (plate or spring reverberators)’.[2]

Moorer’s observation speaks directly to one of the central issues of the reproduction of recorded music, namely, the control of the acoustic sense of the music when it is played back in a space different to that in which it was recorded. Indeed, this acoustic sense is mediated by human experiences as much as it is mediated by the original recording environment because the reverberation of sound, or reverb as I will refer to it, is present everywhere, be it the natural reverb from the places in which we find ourselves such as public transport, restaurants, offices, libraries, and churches, or as reverb in music recordings themselves.[3] All these different places have some level of reverb, even if the exact reverb times, which I will define below, differ. The fact, however, remains that as William Gardner has observed, ‘our lives are for the most part spent in reverberant environments’.[4] The development of sound technology has brought with it attempts to create greater control over the experience of reverb for listeners, and often the songs we listen to on our phones are likely to have artificial reverb added to them by sound engineers to achieve a certain acoustic sense for listening in a different sonic environment.

Reverb thus is a highly complex phenomenon which is entangled in the human experience and consumption of recorded music as well as in the spatiality of the production of recordings. In the following chapter, I will define reverb and map its development in music technology. I am particularly concerned here with the development of artificial digital reverb, which I divide into two categories: generic artificial reverb and convolution reverb. My central argument here

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[1] James A. Moorer, ‘About This Reverberation Business’, *Computer Music Journal* 3, no. 2 (June 1979): 13–28.
[2] *Ibid*.
[3] Listening to music in public spaces differs remarkably, perhaps from the modes of musical consumption mentioned by Moorer above, but Michael Bull has shown that listening to mobile music devices such as iPods and the subsequent mediation of space and time enacted by listeners has its initial impulse in domestic media consumption. See Michael Bull, ‘No Dead Air! The IPod and the Culture of Mobile Listening’, *Leisure Studies* 24, no. 4 (2005): 343–55.
[4] William G Gardner, ‘Reverberation Algorithms’, in *Applications of Digital Signal Processing to Audio and Acoustics* (Springer, 2002), 85–131.

is that, despite its limitations, convolution reverb offers a model that more closely reflects the ecological mode of listening described in the previous chapter. My aim in thinking through this form of reverb is also to set up the basis for the experiments in vernacular reverb, which I describe in Chapter 6.

To develop this argument, it is useful to consider three definitions of reverb presented by James Moorer, Jonathan Sterne, Jean-Marc Jot and Antoine Chaigne first. Moorer suggests that 'when music is performed in a concert hall, a torrent of echoes from the various different surfaces in the room strikes the ear, producing the impression of space'.[5] For him, reverb is thus an impression of the space of music as a product of echoes which emanate from the sources of the sound and which affect the ear of the listener. His notion thus situates the listener as a somewhat passive body that receives this 'torrent' of sound. Jonathan Sterne suggests that '[reverb is a] sonic signature of a room or a simulation or reproduction thereof: a series of echoes so dense they meld together into a shared ambiance for listeners.'[6] Sterne's definition also draws on the notion of echoes but usefully, for the purposes of this thesis, introduces the notion of a sonic signature of a room, which could be understood as a type of identity of a room. Sterne's definition also highlights two other important aspects of reverb: firstly, he differentiates (to some degree) between the signature of the room and its simulation and thereby draws attention between natural and artificial reverb. Secondly, Sterne's suggestion of a 'shared ambiance' indicates a type of connection between listener and environment that is more active than the passive body in Moorer's definition; for Sterne, reverb suggests perhaps a making of space in which the listener responds to their environment. This sense of sharing, which originates in the connection between source and listener, is described more fully by Jot and Chaigne, who argue that the reverb process is formed by 'the existence of multiple acoustical paths from a source to a listener placed in an enclosure [which] results in a dense pattern of echoes'.[7] Again, echoes are important in this definition, but the notion of paths highlights the ways in which reverb suggests a connection between source and listener via the environment of listening.

Reading across these definitions, it becomes apparent that reverb comprises a number of important micro-phenomena within the broader phenomenon of listening, namely, the echo of the source sound, the environment of the sound, and the connection the echoes create between

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5 Moorer, 'About This Reverberation Business', 13.
6 Jonathan Sterne, 'Space within Space: Artificial Reverb and the Detachable Echo', *Grey Room*, 2015, 110–31.
7 Jean-Marc Jot and Antoine Chaigne, 'Digital Delay Networks for Designing Artificial Reverberators' (Audio Engineering Society Convention 90, Paris, France: Audio Engineering Society, 1991), 16.

listener, source and environment. The relationship between source and echo has been usefully expressed as a function of time, as seen in the figure below.

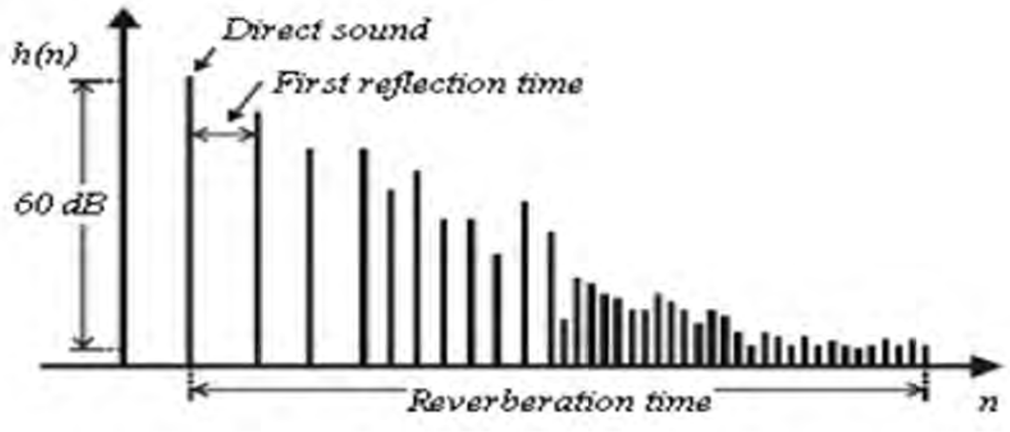

Figure 3.1.1 Visual representation of reverb time.[8]

Direct sound is the sound that excites the space, or the source sound. The time between the direct sound and the first reflection is also known as pre-delay and determines, in some sense, the total length of time between direct sound and first reflections of the sound. The 'time in which the reverberating sound level decays by 60 decibels of the dissipation of these reflections' is what Manfred R Schroeder, drawing on W. C. Sabine's original theorisation, defines as reverberation time.[9] This dissipation of sonic reflections is one way we can understand the echoes mentioned in the definitions of reverb above.

However, as suggested particularly by Sterne, reverb comprises more than the measurement of time between reflections of sound: it is something shared and something which creates a connection between listener and environment. Following this idea, I want to consider reverb from the social point of view. To do so, I argue that reverb should be thought of within a system of ecological listening. As shown in the previous chapter, in ecological listening the relationship between the environment and the perceiver is foregrounded. Reverb, as I will argue, animates this relationship. More specifically, reverb is directly related to the notion of resonance, which in ecological listening describes the way in which a sound draws the listener's attention to space. Indeed, as Walter S. Gershon has argued, 'resonances in motion are

[8] Irina Dornean, Marina Topa, and Botond Sandor Kirei, 'Digital Implementation of Artificial Reverberation Algorithms', *Acta Technica Napocensis* 49, no. 4 (2008).
[9] Manfred R Schroeder, 'Natural Sounding Artificial Reverberation', *Journal of the Audio Engineering Society* 10, no. 3 (1962): 219–23.

reverberations'.[10] Yet resonance is also a social category: as much as in ecological listening resonance describes the way in which organisms attune to their environments, it also describes the ways in which we attune to each other.

To develop this argument, I set up a comparison in this chapter between generic artificial reverb and convolution reverb. Both of these are forms of artificial reverb in that they are introduced to a recording through the use of digital software in the post-production process. However, convolution reverb, as I will show later in this chapter, reproduces the sonic signature of a particular space, which I want to suggest differentiates it from other forms of artificial reverb, which reproduce a generic notion of space. This latter use of reverb I call generic artificial reverb.

In setting up this comparison, my aim is to show how convolution reverb accounts more fully for the types of affordances, resonances, and adaptations described in ecological theories of listening and, thus, how this form of reverb can help us think more carefully about the ways in which issues of identity are part of environmental reverberations. Creating the connection between environment and identity through reverb will then form the theoretical basis from which I attempt to address issues around the reconstruction of space both as a theoretical concept and in practice in the soundscape of the Global South, which, as I argued in the introduction to this thesis, have long been mediated by Western notions of reverb and acoustics. This mediation, in some sense, is exacerbated at the level of reverb, and more so in the production of artificial reverb, which, as I will show, erases any exact sense of place and replaces it with a generic notion of space. However, this generic space is still underpinned by Western norms of the spaces of musical performances which do not necessarily create the affordances of the spaces of isiXhosa choral music.

Reverb in Post-Production

Before I turn to the comparison between generic artificial and convolution reverb, it is useful first to consider why reverb is applied as an effect in music post-production, and especially in the post-production of choral music recordings. Firstly, it should be said that reverb can be added as an effect in post-production for a number of reasons ranging from aesthetic to practical, and it is often situated in the highly subjective realm of taste. However, as a result of close-miking techniques[11] often used in lower-budget choral music recordings to capture the

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[10] Walter S. Gershon, 'Reverberations and Reverb: Sound Possibilities for Narrative, Creativity, and Critique', *Qualitative Inquiry* 26, no. 10 (December 2020): 1164.

[11] Close-miking represents a widely employed practice of placing a microphone close to the sound source.

finer details of the vocals and to avoid unwanted room noise, the sound lacks ambience and depth, or, in other words, becomes dry. The addition of reverb to vocals adds the ambience and depth that is lost due to close-miking by artificially adding the reverberant room echo.[12] The addition of reverb thus makes the vocal track wet. What engineers and producers often aim for in this process is the dry-wet ratio, which Sterne describes as follows:

> the "dry" part is the sound, separate from any echo; the "wet" part can be all echo, all space, or it can refer to the sound with a mix of echoless and reverberated components.[13]

Sound engineers control the dry-wet ratio of sound effects added to tracks. This control allows the engineers to meet different acoustic tastes and aesthetic needs of artists. Barry Blesser describes these needs as he compares the roles of audio engineers and acoustical architects.

> Audio engineers who design digital reverberators are serving the same role as acoustical architects building performance spaces. Both provide the mechanism of presenting to the listener a musical performance in a space. Both must accommodate diverse types of music and the divergent values of listeners. Both are serving clients who define acceptability and quality. Cultural evolution, which changes entertainment goals, aesthetic values, artistic forms, and performance venues, forces a continuing adaptation among the different disciplines; musicians, scientists, and engineers are also part of their culture. It is not a static story.[14]

Blesser's argument shows that the choices around the use of reverb are complex, but what is important to note is that the use of reverb is not governed by universal acoustic laws. Rather, it functions within the sphere of culture. Furthermore, Blesser's suggestion of specifically cultural evolution suggests a certain underlying notion of adaptation. This sense of adaptation is again suggestive of ecological listening. As a main proposition of ecological listening, adaptation, according to Scott Spielberg, describes the interactive change between the perceiver and their environment.[15] Similarly, the cultural evolution of reverb might be thought of as a similar adaptation, albeit at a macro level across multiple perceivers. Thought of as such, choices around the application of reverb can be understood as animated first, on a micro level, as a choice between individual perceiver and their environment. As such, reverb is more

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[12] Izhaki, *Mixing Audio*, 402.
[13] Sterne, 'Space within Space: Artificial Reverb and the Detachable Echo', 117.
[14] Barry A. Blesser, 'An Interdisciplinary Synthesis of Reverberation Viewpoints', *Journal of the Audio Engineering Society* 49, no. 10 (1 October 2001): 869.
[15] Spiegelberg, 'Eric Clarke, Ways of Listening: An Ecological Approach to the Perception of Musical Meaning'.

resolutely situated within the realm of subjectivity and, more importantly, within the realm of cultural values of the artist or engineer.

Yet at the same time, not all cultural views are accommodated within the parameters available within standard DAWs. While I will propose a technical reason for this below in my discussion of artificial reverb, it is worth noting upfront that the standard plugins for some of the most popular DAWs suggest predominantly Western notions of space. Consider, for example, the presets of rooms available in Steinberg Cubase 11, Apple Logic Pro, Avid Pro Tools and Audacity DAWs presented in Figures 3.2.1 and 3.2.2 and Tables 3.2.1 and 3.2.2.

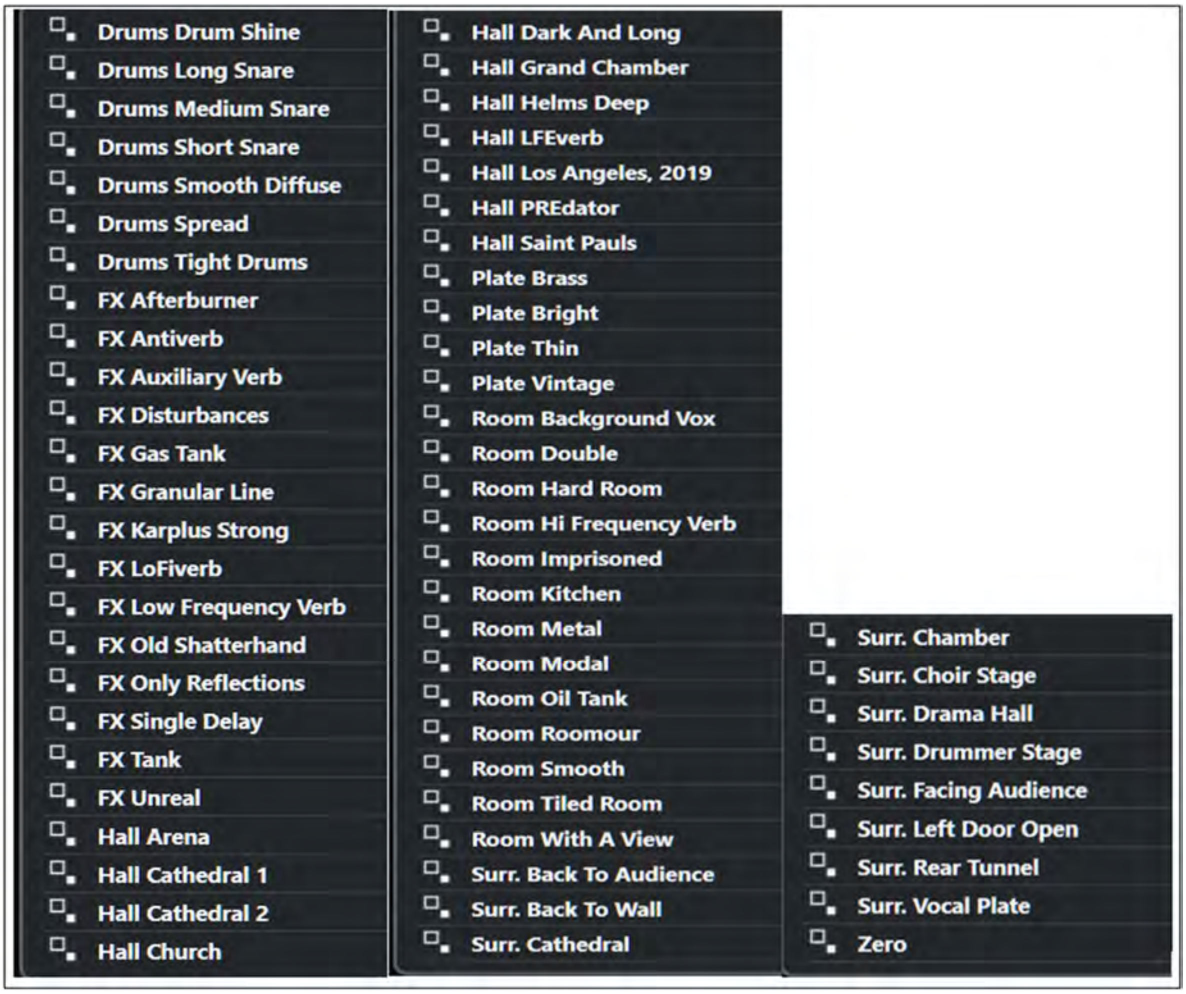

Figure 3.2.1: Reverb presets available in Cubase RoomWorks SE plugin Cubase.[16]

[16] Steinberg Media Technologies GmbH, ‘Cubase 11’ (Steinberg Media Technologies GmbH, n.d.), https://o.steinberg.net/en/support/downloads/cubase_11/cubase_pro_11.html.

Room Type	Description
Room	Natural-sounding room with a rapid build-up of dense reflections.
Chamber	A punchy reverb that emulates a small to medium room. It has a fast attack and high echo density with low coloration.
Concert Hall	A large space with long delays in the initial sound, a slow build, minimal high end response, and moderate diffusion build.
Theater	A medium to large dry room with medium reflection density.
Synth Hall	Wider than the Room model with the sparsest reflections of all room types.
Digital	A medium room with midrange reflection density. It has a slower attack than the Room model. The decay is brighter and creates a lush-sounding chorus-like reverb. It has a dense reverb tail, with extended high and low response.
Dark Room	A small to medium sized, dark sounding, less dense room reverb.
Dense Room	A small room with a dense reflection pattern that builds very quickly.
Smooth Space	Smooth sounding reverb that emulates a medium size space.
Vocal Hall	A medium to large, smooth vocal hall with a midrange number of reflections.
Reflective Hall	A medium to large, highly reflective hall reverb with a low reflection density.
Airy	A large space with sparse reflections.
FX - Strange Room	A medium space with midrange reflection density and a distinct color.
FX - Bloomy	A large space reverb with moderate reflection density that creates blooming decays.

Figure 3.2.2: Logic Pro ChromaVerb Plugin room types.[17]

[17] Apple Inc., 'Logic Pro Effects' (Apple Inc., 2022), https://help.apple.com/pdf/logicpro-effects//en_US/logic-pro-effects-user-guide.pdf.

Avid Pro Tools plugins	Presets
D-verb	Hall, Church, Plate, Room 1, Room 2, Ambience, or Non-linear.
Reverb One	Room, Club, Stage, Theatre, Studio, Hall, Soft, Church, Cathedral, Arena, Plate, Build, Spread, Slapback, Echo
ReVibe II	Studios, Rooms, Halls, Theatres, Churches, Cathedrals, Plates, Springs, Chambers, Ambience, Film and Post, Large Spaces, Effects, Vintage Digital

Table 3.2.1: Reverb presets available in three Avid Pro Tools plugins[18]

Audacity Reverb Factory Presets
Defaults (the default settings), Vocal I, Vocal II, Bathroom, Small Room Bright, Small, Room Dark, Medium Room, Large Room, Church Hall, Cathedral

Table 3.2.2: Factory Presets available in the Audacity Reverb.[19]

In surveying these presets, one can infer two main categories, namely fairly culturally independent spaces such as ‘room’ (in various sizes), ‘bathroom’, and ‘club’, and spaces which are culturally coded such as ‘Church Hall’, ‘Cathedral’, ‘Concert Hall’, and ‘Hall Saint Pauls’. These categories suggest that either reverb is coded by Western normative values (as seen in the latter category) or that there are no normative values encoded in space (as in the former). Put differently, the options provided by these presets are to recreate either Western musical spaces or non-musical spaces. This cultural evolution of this technology thus presents a view which does not accommodate cultural views of the other, and in this case, precisely the view on musical spaces of the Global South.

The way sound effects interact with the choral voices of the Global South might thus then be considered schizophonic in the sense that context is forgotten. In the absence of attention to

[18] Avid Technology, Inc., ‘Audio Plug-Ins Guide’ (Avid Technology, Inc., (“Avid”), 2022), https://resources.avid.com/SupportFiles/PT/Audio_Plug-Ins_Guide_2022.4.pdf.
[19] Tony Oetzmann et al., ‘Reverb - Audacity Manual’, reference, Audacity Reference Manual, 27 December 2022, https://manual.audacityteam.org/man/reverb.html.

context, one can see how easily a (false) like-for-like substitution might be made in which the spaces of Western choral music are substituted for the contexts of indigenous South African choral music. In this case, a Cathedral preset might be used, which brings ambience and depth, but in doing so, negates the affordances of local performance spaces. Considering again Blesser's assertion above regarding the accommodation of diverse needs in recording, we see in contradistinction that the standard tools which are meant to meet the needs of the client are not equipped to handle cultural needs outside of the Western view adequately. To further investigate this issue, in the following sections I will discuss generic artificial and convolution reverberation. These two reverb sound effects are used in the recordings' post-production. I consider these from the perspective of schizophonia and ecological listening.

Generic Artificial Reverb

Artificial reverb is considered one of the oldest sound effects in music technology. According to Blesser, artificial reverb has been around since the early days of broadcasting and music recording and was developed first in an attempt to restore the room acoustics lost in the process of using close-miking techniques (as one had to) for recording.[20] He shows how the Radio Corporation of America (RCA) 'was one of the largest broadcast companies in the industry', and they developed the chamber artificial reverb in 1926.[21] With this early form of reverb, as Thomas Wilmering et al. have argued, it was possible to recreate some room characteristics in a recording, which was 'mainly done when recording classical music to give the listener the acoustic impression of being transported into the performance space'.[22]

In doing so, artificial reverb is generally meant to reproduce a perceptual equivalence reverberation effect innate to all forms of architecture, otherwise known as natural reverb. According to Sterne, artificial reverb's use of algorithms creates a perceptual effect of the reflections of the early reflections of a room. Furthermore, the late reflections are then based on algorithmic randomness. This move to create a perceptual equivalence of a room proved to be more viable than an algorithmic reproduction of a room's exact reflections. The complexity of reverb reflections makes it difficult to reproduce. Artificial reverb comes in two forms: analogue and digital. The latter form is commonly used today because of its accessibility through DAWs and the way it provides its users easily adjustable parameters.[23] Analogue

[20] Blesser, 'An Interdisciplinary Synthesis of Reverberation Viewpoints', 869.
[21] *Ibid.*
[22] Thomas Wilmering et al., 'A History of Audio Effects', *Applied Sciences* 10, no. 3 (2020): 6.
[23] Blesser, 'An Interdisciplinary Synthesis of Reverberation Viewpoints', 891.

reverb, of course, predates digital reverb, and early forms of this technology were predominantly developed by hardware engineers.[24]

While Enzo De Sena states that artificial reverberators exist to provide an alternative to 'full scale room simulation',[25] artificial reverb has a number of different applications and can be used to various differing ends. Blesser, for instance, argues that the 'designer of an artificial reverberator faces a choice of creating a system that produces high-quality generic ambiance or one that duplicates a particular seat in a specific performance space'.[26] William Gardner suggests that artificial reverb has found 'another application in the field of virtual environments, where simulating room acoustics is critical for producing a convincing immersive experience'.[27] Yet whether to simulate a specific seat in a performance space or create a convincing virtual reality, artificial reverb creates a sense of space for a recording of a musical performance. The nature of the space created by artificial reverb, however, is less well defined. In trying to understand the nature of the spaces created by artificial reverb, it is worth considering both technical developments in analogue and digital reverb. It is in the nature of the spaces created with this form of reverb, I will argue, that the cultural values inscribed in reverb come to the fore.

Analogue Reverb

As one of the earliest forms of artificial reverb, the RCA created chamber reverberation which was used to 'artificially replace the missing reverberation energy' in recordings.[28] This process required that a recording, often made in an acoustically deadened room, be played back in a reverberant room and the resultant sound was then re-recorded. The Bell Telephone Laboratories also created their own artificial reverberator based on telephony technology from the early 1920s. This reverberator was an electromechanical delay line that used helical springs, which simulated the delay that occurred in long-distance telephone calls.[29] This development was added to the first model A-100 Hammond organ, which was first sold in 1959.[30] Spring reverb, however, was widely adopted over the next two decades. Wilmering et al. describes spring reverb units and states that

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[24] *Ibid*.
[25] Enzo De Sena, Huseyin Hacihabiboglu, and Zoran Cvetkovic, 'Scattering Delay Network: An Interactive Reverberator for Computer Games' (Audio Engineering Society Conference: 41st International Conference: Audio for Games, London, UK: Audio Engineering Society, 2011), 1.
[26] Blesser, 'An Interdisciplinary Synthesis of Reverberation Viewpoints', 890.
[27] Gardner, 'Reverberation Algorithms', 86.
[28] Blesser, 'An Interdisciplinary Synthesis of Reverberation Viewpoints', 869.
[29] Wilmering et al., 'A History of Audio Effects', 11.
[30] *Ibid.*

> these spring reverb units usually consist of two or more springs, characterised by their wire gauge, coil diameter, and metal composition, as well as their tension and length. A damping mechanism may be added to adjust the decay tie of the reverberated signal. Although (or as a result of) not producing a natural sounding room or hall simulation, spring reverberation became a typical sound in music of the 60s and 70s, particularly its use with the electric guitar.[31]

These forms of reverb are still in use. Wilmering et al. states that 'even today, [spring reverb] is still a sought-after audio effect. However, there are techniques to produce more natural-sounding spring reverberation'.[32]

As much as spring reverb was widely adopted, other forms of reverberators would soon present more convincing simulations of room acoustics. As Blesser argues,

> over the next 50 years there was a continuous stream of artificial reverberators, each based on the available electromechanical technology. Although the steel plate gained wide acceptance, the gold foil finally produced the necessary quality.[33]

Plate reverberators offered an important development in adding a 'reverberant effect to recorded sound'.[34] In 1957, the German company Elektro-Mess-Technik (EMT) brought forward the first plate-reverberator.[35] Wilmering et al. explains the design of the plate reverb and states the following:

> instead of a spring, a thin metal plate was suspended under tension with a transducer attached to its centre. Due to the more complex vibration pattern, the plate reverb produces a denser, more natural-sounding reverberation effect. Plates of different materials were used, with steel plates preceding thinner gold plates, that allowed smaller designs with improved high-frequency response. Plate reverberators also often included a damping system to control the reverberation time.[36]

Digital reverb

The introduction of computer systems made way for the development of digital reverb. In the early 1960s, the first digital reverberation was developed by Manfred Schroeder, a German

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[31] *Ibid.*
[32] *Ibid.*
[33] Blesser, 'An Interdisciplinary Synthesis of Reverberation Viewpoints', 869.
[34] Udo Zölzer, ed., *DAFX: Digital Audio Effects*, Second Edition (Chichester, West Sussex, England: Wiley, 2011), 496.
[35] Wilmering et al., 'A History of Audio Effects', 11.
[36] *Ibid.*

physicist who developed an algorithm for artificial reverberation.[37] The algorithm was designed to simulate the natural reverb of a concert hall.

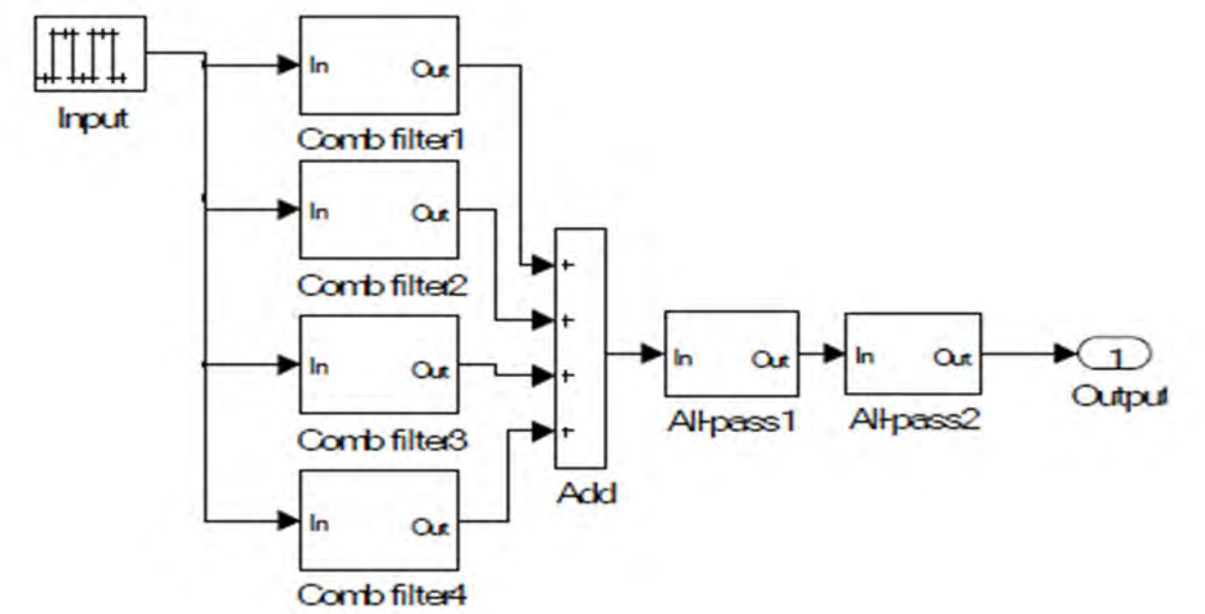

Figure 3.5.1: Schroeder's first reverberator.[38]

The figure above is a visual representation of Schroeder's first reverberation algorithm. According to Dorean et al., this reverberator has parallel comb filters linked to all-pass filters.[39] A comb filter creates a delay of the signal it receives, and an all-pass filter allows all frequency content to pass through but produces a flat amplitude response which results, as Schroeder suggested, in a 'colorless' reverb. Nathaniel Sjarif summarises how Schroeder's algorithm works:

> it [Schroeder's algorithm] employed the use of Infinite Impulse Response (IIR) comb filters, because of their property of exponential decay, and all-pass filters to create a sufficient density of reflections needed for realistic reverberation (around 1000 per second).[40]

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[37] Nathaniel Sjarif, 'Digital Audio Systems Review', 2012.
[38] Dornean et al., 'Digital Implementation of Artificial Reverberation Algorithms', 3.
[39] *Ibid*.
[40] Sjarif, 'Digital Audio Systems Review', 1.

In this model, it is the delay lengths generated by the comb filters which suggest the room size, but tellingly, the algorithm cannot reproduce anything more accurate than a generic (if somewhat metallic sounding) concert hall.

Schroeder improved his design with a second reverberator. This later design consists of a series of all-pass filters. The use of all-pass filters also made it possible for the diffusion of high frequencies. According to Craig Szwec, ‘using an all-pass filter the phase of the signal is being changed’ and this phase shifting ‘is particularly noticeable at high frequencies and this creates diffusion’.[41] Szwec further adds that ‘a higher order all-pass filter will have a greater shift in phase resulting in longer delays and a wider sounding reverb’.[42] Schroeder’s second reverberator uses all-pass filters in succession. The figure below shows a visual representation of Schroeder’s second reverberator.

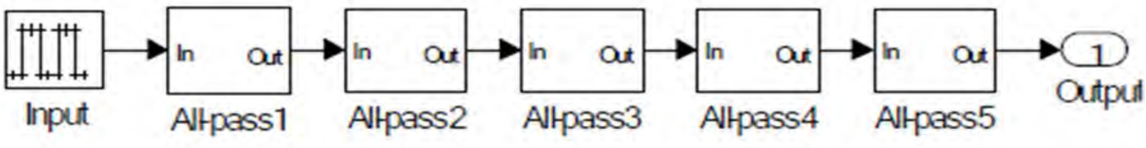

Figure 3.5.2: Schroeder’s second reverberator.[43]

Another important early pioneer in digital reverb was James Moorer who made improvements on Schroeder’s first reverberator. The modifications made the reverberator more natural with the introduction of a low pass filter that emulates the way in which higher frequencies are absorbed by the air in a room more readily than low frequencies.[44] As Dorean et al. state,

> the first change was the increase of the comb filters from four to six. It caused longer reverberation times and kept unmodified the modal density. The second change was the introduction of a low pass filter (LPF) in the reaction of the comb filter. The cut off frequencies of the LPF were based on physical considerations about the air sound absorption. By adding an LPF, the reverberation time decreases at high frequencies and the sound looked more real.[45]

The diagram below shows a visual representation of James Moorer’s reverberator.

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[41] Craig Szwec, ‘Reverberation’, 2014, 5.
[42] *Ibid*.
[43] Dornean et al., ‘Digital Implementation of Artificial Reverberation Algorithms’, 3.
[44] *Ibid*.
[45] *Ibid*., 2.

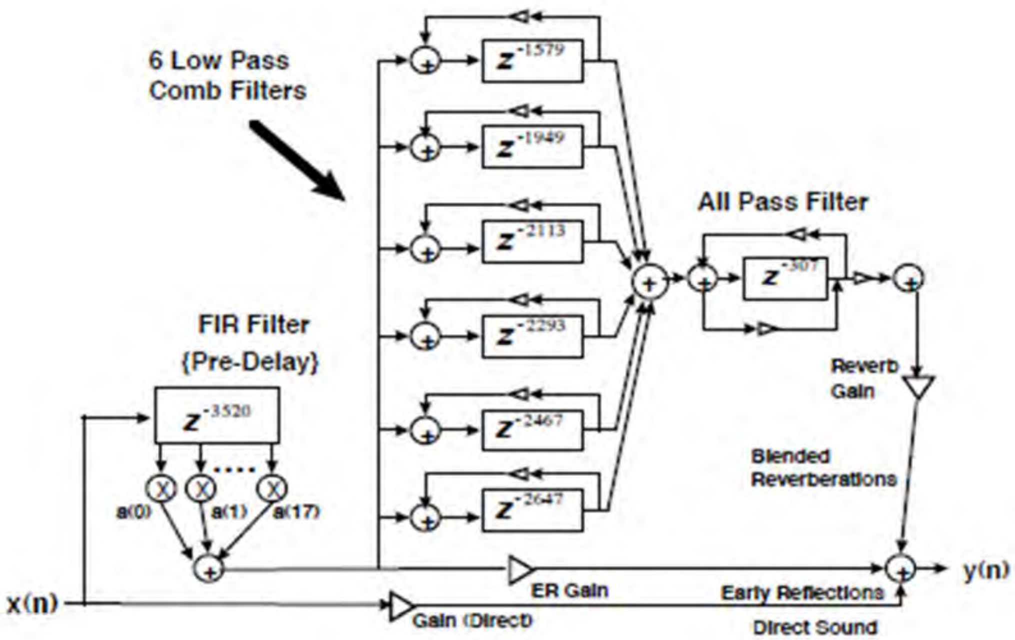

Figure 3.5.3: James Moorer reverberator.[46]

The third important pioneer of digital reverb was William Gardner. According to Dornean et al., Gardner developed a reverberator algorithm based on nested all-pass filters. What was particularly important in this design was the designation of three structures that simulated different room sizes. In the figure below, the nested all-pass filters are seen in a configuration that produces a medium room reverberator.[47]

[46] Sjarif, 'Digital Audio Systems Review', 2.
[47] Dornean et al., 'Digital Implementation of Artificial Reverberation Algorithms', 3.

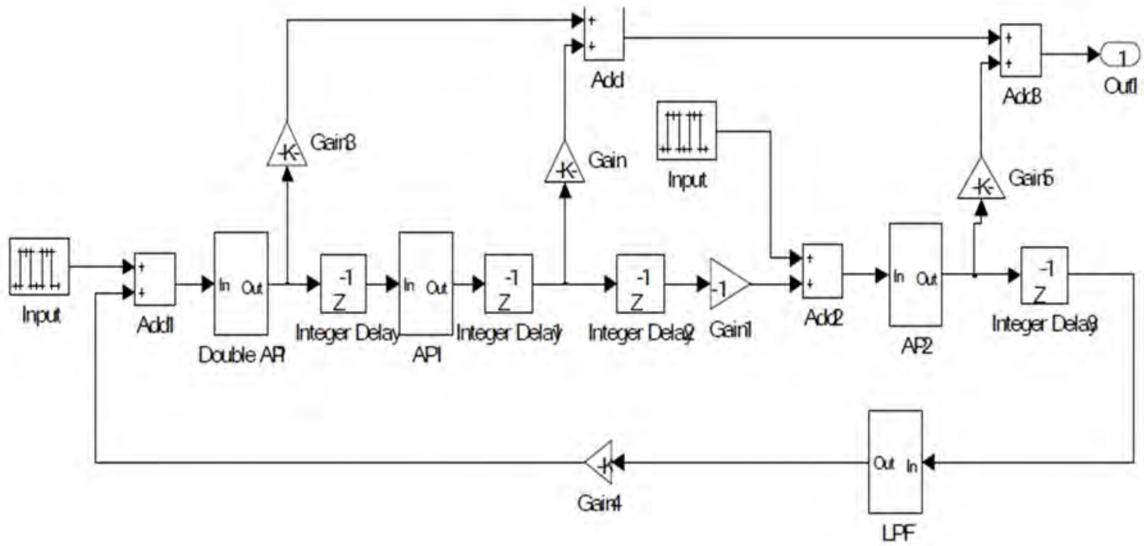

Figure 3.5.4: Gardner reverberator.[48]

Feedback Delay Network

While Gardner's model allowed a certain level of flexibility with regards to changing the room's parameters in the reverberator, it remained fixed to three predetermined spaces. This problem was addressed through the development of the feedback delay network (FDN) reverb, first developed by Michael Gerzon.[49] According to Fan and Smith, the FDN reverb allows for more control of parameters by separating the control of decay characteristics and frequency response. Fan and Smith summarise how the feedback delay network reverberator works.

> [A] standard FDN is a recursive filter, consisting of N parallel delay lines, a feedback matrix and gain control at the input and output. Typically with a higher number of delay lines N, the echo density and smoothness of the reverberation is higher.[50]

[48] *Ibid.*, 3.
[49] M. A. Gerzon, 'Synthetic Stereo Reverberation, Parts I and II', *Studio Sound* 13(I), 14(II) (n.d.): 632-635(I), 24-28(II), 1971(I),1972(II).
[50] Senyuan Fan and Sarah Smith, 'Integrating Vibrato Into Artificial Reverberation' (Audio Engineering Society Convention 151, online: Audio Engineering Society, 2021), 4.

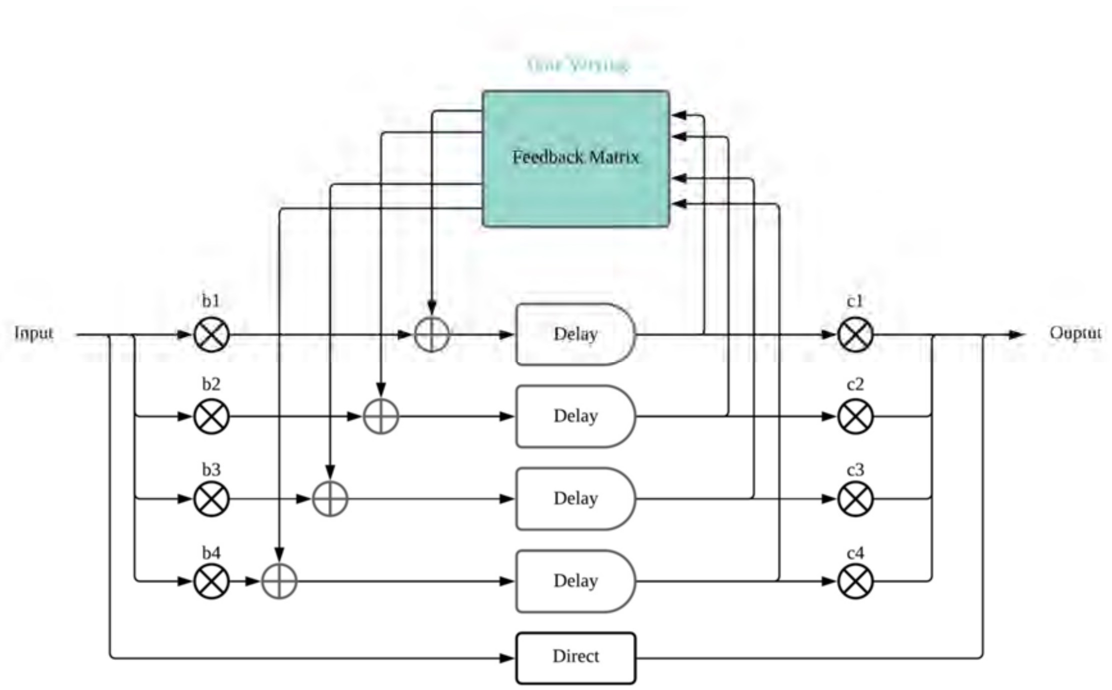

Figure 3.6.1: 4-FDN with time-varying feedback matrix.[51]

One of the most important early developments in FDN reverb was Grezon's introduction of an orthogonal matrix to allow for the cross-coupling of comb filters rather than relying on the series configuration mentioned before. The matrix was then further developed by John Stautner and Miller Puckette, who introduced an artificial reverberation which was based on delay lines which were connected in such a way to create a feedback loop.[52] The figure below is a visual representation of the structure created by Stautner and Puckette.

[51] *Ibid.*
[52] Zölzer, *DAFX*, 186.

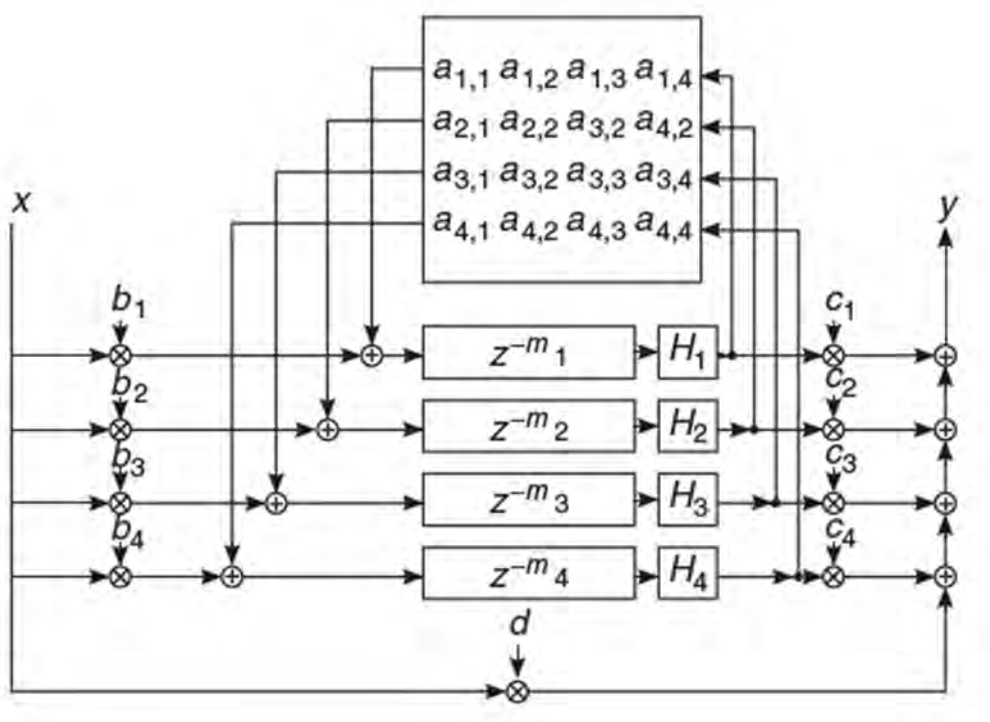

Figure 3.6.2: Fourth-order feedback delay network.[53]

Limitations

While the development of generic digital reverb has allowed for significant advances in music technology, it does also present certain limitations. According to Jeremy Wells, digital and analogue reverbs struggle to provide a true simulation of natural reverb.[54] This is due to a number of factors, but according to Wells, one of the central issues is presented by the

> limitations in the algorithms, which are often constrained in their complexity by design processes and the available computing resources available for them to run on.[55]

Indeed, as Jonathan Sterne has argued, 'artificial reverberation represents and manipulates sonic space to produce a sense of spatiality'. However, this modelling of space has limitations. Sterne states that the simulation of natural reverb 'is never a perfect model of physical space' because it cannot account for the complexity of, for instance, the varying air pressure and temperature fluctuations in performance space.[56]

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[53] *Ibid.*

[54] Jeremy J Wells, 'Modal Decompositions of Impulse Responses for Parametric Interaction', *Journal of the Audio Engineering Society* 69, no. 7/8 (2021): 530.

[55] *Ibid.*

[56] Sterne, 'Space within Space: Artificial Reverb and the Detachable Echo', 114.

Yet the complexity of simulating reverb is not only constrained to issues of physics. I want to argue that it is also constrained by issues of culture and geopolitics. As Castanheira has shown, music technology and its scholarship has been dominated by techno-colonial assumptions that innovation and design in technologies are driven by musical practices of the Global North.[57] This means that technological developments often cater for Western notions of musical aesthetics. This can in some sense be seen in the development of digital reverb discussed before, and particularly in Schroeder's early models, which sought to replicate the reverb of a Western concert hall. The desire to replicate this space was in some sense less clearly articulated in subsequent digital models, but since many of the algorithms were built on his work, it could be understood that the concert hall remained as a technological trace (which perhaps takes concrete form in the combination of comb and all-pass filters) in the subsequent development of digital reverb.[58] Thought of in this way, the simulation produced by digital reverb has been underpinned by performance spaces for music of the Global North.

This underlying yet unarticulated trace of the Western concert hall foregrounds a lack of diversity in the development of digital reverb. With its narrow focus on Western performance spaces, the technology does little to represent or serve the simulation of performance spaces of the Global South, unless these happen to resemble those of Western performance spaces. Indeed, considering the ways in which the generic simulation of a concert hall is transposed to recordings which might never occur in such a space, I want to posit that this form of digital reverb is schizophonic by design. It requires a splitting of sound from source not only in the sense of a recording which captures a source and reproduces it elsewhere. Instead, the form of schizophonia here occurs because the source of the sound, which includes the space in which the source originates, is replaced here by a generic (yet unarticulated Western) simulation of space. Returning to isiXhosa choral music as an example, schizophonia emerges when recordings of this music from the Global South is placed artificially in generic Western spaces; in this moment the original site of recording is erased.

Yet while the most readily available forms of artificial digital reverb induce this schizophonic effect, there does exist a form of digital reverb which could circumvent, to some degree, the simulation of a generic Western performance space, and in doing so, can perhaps create an ecological sense of reverb which more closely draws out the affordances of the musical

[57] José Cláudio Siqueira Castanheira, 'Studio Sounds: Digital Tools and Technocolonialism', *Border-Listening/Escucha Liminal. Radical Sounds Latin America In* 1 (2020): 107–19.
[58] Ramya Srinivasan and Ajay Chander, 'Biases in AI Systems', *Communications of the ACM* 64, no. 8 (August 2021): 44–49.

environment. I want to propose that convolution reverb might better enable a form of ecological listening.

Convolution Reverb

Convolution reverb is a type of reverb which codifies the acoustic character of a specific space by using a recording of that space excited by an impulse. As Fons Adriaensen explains, the impulse response, which is effectively the sonic signature of the space, can be used for the emulation of that space creating a convolution reverb.[59] Sam Kantorik provides a useful description of how convolution works:

> [Convolution] allows the user to replicate the acoustics of any space using an impulse response. Taking an impulse response, or IR, is the act of capturing the acoustic properties of a space using some kind of sonic impulse. The information derived from the IR can later be interpreted by a convolution reverb plugin and turned into a brand-new plugin preset.[60]

According to Nathaniel Sjarif, convolution is 'still the most accurate, natural and real sound reverberation available in the digital world'.[61] However, in comparison to forms of generic digital reverb, this form of reverb requires a high degree of central processing unit (CPU) power for its signal processing.[62] The reason for this resource-heaviness can be discerned from the simplified formula for convolution: $x[n]*h[n] = y[n]$.[63] This formula describes, according to Sjarif, how the input signal ($x[n]$) is multiplied by an impulse response ($h[n]$) to produce the output of the convolution ($y[n]$). The input signal, for example, could be a choral recording of a choir done in a relatively dead environment. The impulse response by which this input signal is multiplied, might be the trace of a starter gun fired in a cathedral (I will provide more details below on how the IR is generated). The output signal might then be the sound of the choir singing in the cathedral space with its significantly wet acoustic character. This convolution can be seen in the figures below.

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59 In Nathaniel Sjarif, 'Unreal Convolution', 2012.
60 Sam Kantorik, 'Convolution Reverb & Impulse Responses' (Capstone Projects and Master's Theses, Monterey Bay, California State University, 2014).
61 Sjarif, 'Digital Audio Systems Review', 3.
62 *Ibid.*
63 *Ibid.*

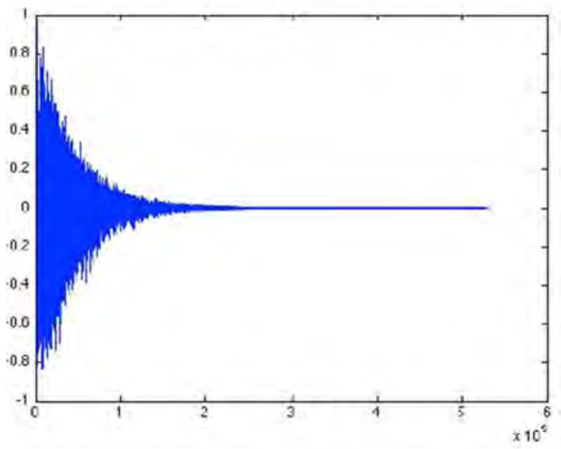

Figure 3.8.1: Impulse response of a space denoted by h[n].[64]

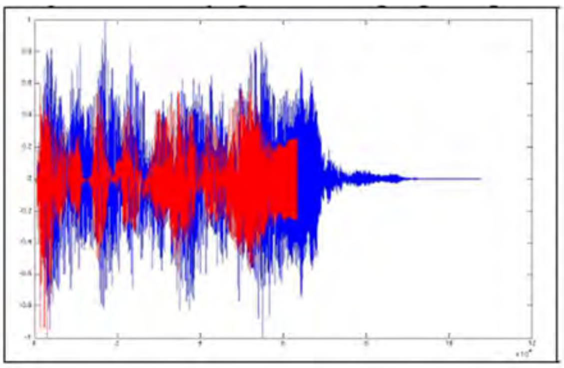

Figure 3.8.2: The input signal (red) placed over the convolved output signal (blue).[65]

The red-coloured signal is the input x[n], and the blue-coloured signal is the output y[n]. A simplified convolution system works in this manner: sample of x[n] input is sampled at a selected n^{th} point, and that input is put through a system h[n]. The output of this system is y[n]. The output is the result of x[n] convolved with h[n].

Deriving the IR

The impulse response can be derived in several ways. One way of measuring real acoustic space is achieved by recording the impulse response of that space using a linear system that produces an impulse and captures the impulse response of a room. According to Andrew Reilly and David McGrath, the components of the system include 'a power amplifier that takes the system input and applies it to a loudspeaker', 'the loudspeaker, placed in a particular location within the room, with a particular frequency response and directivity pattern', 'the room itself,

[64] *Ibid.*
[65] *Ibid.*

with floor, ceiling and walls with particular reflection properties', and 'the receiver, such as a microphone, placed in a particular location, with a particular frequency response and directivity pattern'.[66] This system produces an impulse and captures the impulse response of the room. However, there are alternatives to this system. Reilly and McGrath state that

> as an alternative to measuring real acoustic spaces, new methods for simulation of acoustic spaces are now making it possible to create acoustic impulse responses based on a computer model of the space.[67]

Such models allow a user to create a virtual model of an acoustics space. Reilly and McGrath state that these systems are 'generally tailored towards the goal of allowing an acoustics practitioner to analyse the characteristics of a new or modified space prior to the expensive construction or renovation of the space'.[68]

Time Domain

According to Sjarif, there are two ways convolution can be achieved. The first is direct convolution in the time domain and the other is achieved in the frequency domain. The time domain approach requires both the input signal and the convolution signal to be of the same length, otherwise the output of a system with samples that are not of the same size in time length yields negative results. Sjarif describes direct convolution in this manner,

> direct convolution can be done in the time domain by storing each sample of the impulse response as a coefficient of an IR filter. Direct convolution becomes easily impractical if the length of the target response exceeds small fractions of a second.[69]

Figure 3.8.3 is a visual representation of this system. X[n] is the input signal, h[n] is the impulse response signal, and y[n] is the output of this system.

[66] Andrew Reilly and David McGrath, 'Convolution Processing for Realistic Reverberation' (Audio Engineering Society Convention 98, Paris, France: Audio Engineering Society, 1995), 3.
[67] *Ibid.*, 4.
[68] *Ibid.*
[69] Sjarif, 'Digital Audio Systems Review', 3.

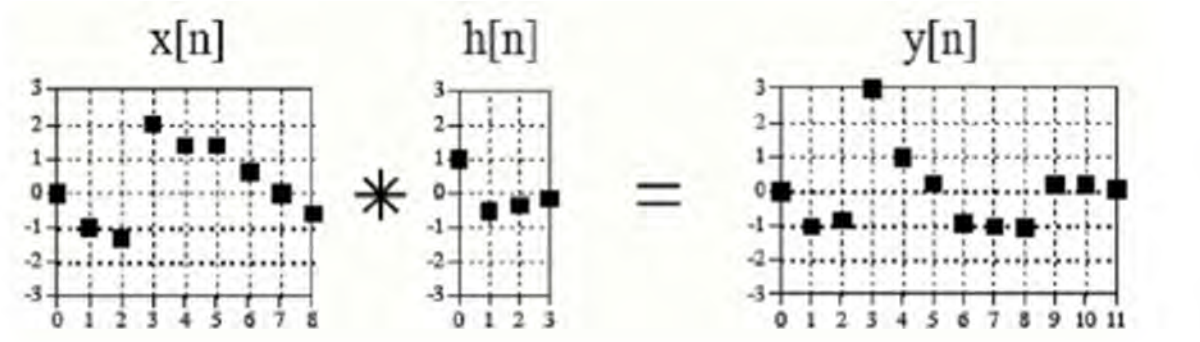

Figure 3.8.3: Convolution in the time domain.[70]

Frequency Domain

Convolution can also be achieved in the frequency domain. Sjarif states that with Fast Fourier Transform (FFT) of an impulse response and that of the input signal, convolution can be made simple. According to Cooley et al., the 'fast Fourier transform algorithm is a method for computing the finite Fourier transform of a series of N (complex) data points in approximately N log, N operations'.[71]

> Given the Fast Fourier Transform (FFT) of an impulse response as well as a discrete FFT of an input signal, a convolution can be made by multiplying, sample by sample, and then transforming back into the time domain. The drawbacks of this are that it requires a lot of CPU power, but then again with the advancements in CPU threading this shouldn't be a problem.[72]

In simple terms, considering the time domain system, it multiplies the input sample with the impulse response sample in the time domain. The frequency domain, FFT, converts the input signal x[n] and the impulse response signal h[n] to the frequency domain and computes in the frequency domain. Before producing the output, both samples are converted to the time domain together with the output of the system.

Limitations

Convolution reverb can theoretically provide an accurate sonic signature of a space. This accuracy presents certain limitations when compared to generic artificial reverberation. According to Sjarif, convolution reverb does not allow for the modification of reverb

[70] *Ibid.*
[71] J.W. Cooley, P.A.W. Lewis, and P.D. Welch, 'Historical Notes on the Fast Fourier Transform', *Proceedings of the IEEE* 55, no. 10 (October 1967): 1675.
[72] Sjarif, 'Digital Audio Systems Review', 3.

parameters over time.[73] This is because, as Wells shows, 'samples of reverberation [impulse responses] do not provide a model of the underlying processes that create them and therefore do not readily offer parameters by which they may be adjusted post-hoc'.[74] This means that the IR is applied uniformly to the input signal throughout with little means of modification. This unified application of reverb parameters might not, as in a live concert, necessarily conform to listeners expectations of clarity. Indeed, it is often the case in post-production of recordings that engineers would change the level of reverb applied to certain parts of the music according to their own or their client's tastes or aesthetic desires.[75] Yet be this as it may, this lack of modification of parameters does present the possibility of using an acoustic space as is. Moreover, this lack of malleability of the acoustic space foregrounds the need to think about ways to adapt the music to suit the acoustic space, rather than adapting the acoustic space (and perhaps erasing it in the process) to suit the music.

The other limitation that comes with convolution reverb is the use of an impulse. According to Yuki Nakahara, each impulse has a predefined fixed spectrum.[76] One common impulse is a balloon because it produces high frequency content when popped to excite a space. However, the excitation would excite more high frequencies of the space compared to mid and low frequencies. This can have a negative impact on the signal to noise ratio.

Conclusion: Convolution Reverb and Ecological Listening

As much as convolution reverb presents a number of limitations, I want to suggest that it offers an alternative to generic artificial reverb as a means for replicating a form of ecological listening in recordings. This form of reverb does not have to reproduce the forgotten technological traces that I suggested might be encoded in generic artificial reverb and can instead be used to reproduce with more accuracy the spaces of isiXhosa choral music. Specifically, in the case of this thesis, the venues are the Assegaaibos SDA church, Seven Fountains community hall, and the Seven Fountains sports club. Of course, this is not to say that it will reproduce the exact acoustic nature of a performance in such spaces, especially given that the parameters of this form of reverb remain constant based on an IR. Yet it does circumvent, to some degree, the schizophonic effect of forgetting the context of the music.

[73] Sjarif, 'Unreal Convolution'.
[74] Wells, 'Modal Decompositions of Impulse Responses for Parametric Interaction', 530.
[75] Blesser, 'An Interdisciplinary Synthesis of Reverberation Viewpoints', 869.
[76] Yuki Nakahara et al., 'Shortest Impulse Response Measurement Signal That Realizes Constant Normalized Noise Power in All Frequency Bands', *Journal of the Audio Engineering Society* 70, no. 1/2 (2022): 24.

Moreover, it might also provide new creative avenues for the production of isiXhosa choral music as it provides alternative acoustic signatures for use in post-production processes.

That said, the greatest draw of turning to convolution reverb is, at this point in this thesis, theoretical. Thinking through this form of reverb has problematised the reliance on generic forms of artificial reverb and the ways in which, either as presets or otherwise, depend on the coding of Western spaces. Convolution reverb, while not itself a technology that originates in the Global South, thus proposes an alternative in the form of a vernacular sound technology which is more acutely attendant to its own environment. In the following chapter, I consider the theoretical underpinnings for such a technology and suggest that it may provide a critique of the universalism, presented in this chapter by the unacknowledged presence of the concert hall in early models of digital reverb, that pervades many sound technologies.

Chapter 4: Vernacular Technologies

Introduction

In the previous chapter, I provided an overview of the history and theories of artificial reverb used in the post-production of recordings. Differentiating between generic artificial reverbs and convolution reverb, I showed how the latter might be situated as a tool for facilitating a type of ecological listening in recording. On its own, this might seem at first glance enough for enabling post-production processes for isiXhosa choral music, which draws this music closer to its site of performance. However, in the following chapter, I want to argue that it is not. In fact, I suggest here that there is a geopolitical tension, which underpins the use of technology in the Global South and that there is a need for critically appraising these systems. This, in some sense, is not a new argument. Authors such as Rayvon Fouché have started to consider the ways in which music technologies are appropriated in the African diaspora for the purposes of identity creation, but seldom consider how existent technologies within these communities are altered or jettisoned in favour of Western digital media.[1] Other scholars such as Louise Meintjes and Steven Feld provide early critical readings of the circulation of music in the digital era, yet they fail to question the ways in which technologies of music production and dissemination already code skewed power relationships in musical representations.[2] This is still the case in recent studies, such as Shzr Ee Tan's work on digital inequalities, which foreground digital inequalities in music but fail to consider the networks of technologies – both analogue and digital – which are drawn on in music-making processes.[3]

Departing from the approaches used by these authors, my aim in the following chapter is to tease out the notion of vernacular technologies as a critique which highlights some of the geopolitical tensions often overlooked in the interrogation of music technological systems. Drawing on the notion of the vernacular, I specifically want to problematise the current music technology systems used in music post-production processes. To do so, I will use architecture as a lens to better understand vernacular technologies. The understanding of the vernacular

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[1] Rayvon Fouché, 'Analog Turns Digital: Hip-Hop, Technology, and the Maintenance of Racial Authenticity', in *The Oxford Handbook of Sound Studies*, ed. Trevor Pinch and Karin Bijsterveld (Oxford: Oxford University Press, 2011), 505–25.

[2] Louise Meintjes, 'Paul Simon's Graceland, South Africa, and the Mediation of Musical Meaning', *Ethnomusicology* 34, no. 1 (1990): 37; Feld, 'Pygmy POP A Genealogy of Schizophonic Mimesis'.

[3] Shzr Ee Tan, 'Digital Inequalities and Global Sounds', in *The Cambridge Companion to Music in Digital Culture*, ed. David Trippett, Monique M. Ingalls, and Nicholas Cook, Cambridge Companions to Music (Cambridge: Cambridge University Press, 2019), 253–73.

from the perspective of architecture will lay the ground for the way in which I experiment with space in isiXhosa choral music recordings in Chapter 6. To better understand the geopolitics linked to music technological systems, I will consider ways in which these systems silently impose a universality based on Western understandings and practices of music. In this discussion, I also return to my reading in the previous chapter on reverb, particularly generic artificial reverb.

Vernacular

Considering that vernacular is a key term here, it is important to first pause on its definition. The term itself has gained a variety of applications and meanings since the latter half of the twentieth century, but stems originally from the seventeenth century, where it was used to describe regionally recognisable language patterns (as opposed to *lingua franca*, which is a common language used to communicate across regions).[4] Mihaela Hărmănescu and Cristina Enache define vernacular by drawing on the work of Hubert Guillaud as follows:

> Vernacular comes from the Latin "vernaculus" and means native, indigenous, and "verna" means "slave house", reminding of what is indigenous, what is not for sale, but for home use, therefore, what is "indigenous" has no market value.[5]

Hărmănescu and Enache's definition draws on a distinction in Classical Latin between enslaved people traded with foreign powers and those who are born within a country's borders, which suggests that the vernacular connotes the indigenous. Hubert Guillaud summarises vernacular and states that vernacular is 'everything that was crafted, woven or reared at home and not for sale, but for domestic use.'[6] Thus the vernacular, in this sense, describes a type of societal domesticity, and I want to suggest that it is also a reflection of the domestic environment. The link to domestic use means that it is local to a specific environment, and what that environment provides is vernacular. For Xhosa choristers, the language used in their songs would then be considered vernacular, but equally, the spaces they commonly use to render their music would be considered vernacular spaces for that region. This type of environmental definition is seen, for instance, in the work of Fátima Finizola, Solange Coutinho, and Virgínia Cavalcanti, who define vernacular using the Aurélio Dictionary in three distinct ways:

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4 Kingston Wm. Heath, 'Defining the Nature of Vernacular', *Material Culture* 35, no. 2 (2003): 48–54.
5 Hărmănescu and Enache, 'Vernacular and Technology. InBetween', 414; Hubert Guillaud, 'Defining Vernacular Architecture', in *Versus: Heritage for Tomorrow: Vernacular Knowledge for Sustainable Architecture*, ed. Mariana Correia, Letizia Dipasquale, and Saverio Mecca (Firenze, Italy: Firenze University Press, 2014), 33.
6 Guillaud, 'Defining Vernacular Architecture', 33.

> 1. Particular from the region in which it exists. 2. Pure language, without foreignness [...]. 3. The idiom of a country.[7]

From these definitions, Finizola, Coutinho, and Cavalcanti summarise vernacular and state that it 'is originally related to the native language of a particular country, region or locality'.[8] Yet they are also quick to point out that, 'while the primary concept of "vernacular" is understood as something, which is genuine and authentic, and from a specific place', the vernacular has gained different meanings dependent on the places and contexts in which it is applied.[9] Ono and Sloop develop this point further by arguing that the vernacular can be thought of as a discourse that resonates within its local communities, as mentioned in the introduction to this thesis.[10] For them, this opens the vernacular up to culture, which is formed by the language, music, art, dance, and architecture of local communities. The vernacular thus refers to the markers that are specific to certain communities.[11] Given the variability of the term vernacular, in the context of this thesis, I will apply the idea of the vernacular as a marker of the locality of isiXhosa choralism and propose that sound technologies can be adapted to better resonate with these markers. To do so, I want to propose that sound technologies can be localised and reframed as vernacular technologies of sound production.

Vernacular Technologies

With a broader, if somewhat nebulous, definition of the vernacular established, I want to turn to the idea of vernacular technologies. Drawn from discourses in architecture, vernacular technologies refer to forms of architecture that are social representations closely linked to belief systems and cultural values of certain communities. Ayesha Wahid argues, for instance, that vernacular architecture is 'a consequence of local conditions as it tends to evolve over time to reflect the environmental, cultural and historical context in which it exists'.[12] Vernacular technologies thus are not a static reflection of societal conditions, but are tied to change. Wahid continues to write that "it is far from the suggested 'primitive form of design, lacking intelligent thought', that it was once perceived as".[13] These forms of technology and architecture are a

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[7] Fátima Finizola, Solange G. Coutinho, and Virgínia P. Cavalcanti, 'Vernacular Design: A Discussion on Its Concept', vol. 1, 1 (Design frontiers: territories, concepts, technologies [ICDHS 2012 - 8th Conference of the International Committee for Design History & Design Studies], São Paulo: Blucher, 2014), 558.
[8] Finizola, Coutinho, and Cavalcanti, 3.
[9] Finizola, Coutinho, and Cavalcanti, 5.
[10] Ono and Sloop, 'The Critique of Vernacular Discourse', 20.
[11] Ono and Sloop, 20.
[12] Ayesha Wahid, 'Adaptive Vernacular Options for Sustainable Architecture', *J Int Soc Study Vernac Settl* 2, no. 2 (March 2012): 74.
[13] Wahid, 74.

reflection of not only environmental conditions; they are also a cultural reflection of the region where they are located and are subject to the knowledge of the inhabitants of the region. Ahmadreza Foruzanmehr and Fergus Nicol state that 'vernacular resources, technologies and forms are generally seen to be well adapted to local climate conditions and are often considered an appropriate base for environmental design'.[14]

Vernacular technologies, like vernacular architecture, draw on different forms of knowledge which are used to create buildings and other systems to meet the livelihood needs and cultures of people linked to their environments and available resources.[15] Golani and Sharma provide an example of vernacular technologies in relation to architecture.

> In North Western India, in states such as Gujarat and Rajasthan, it's a common practice to coat the roofs white, using lime and chalk. China mosaic also is another popular practice in which women arrange the broken tiles (mostly white) in a spider web pattern. Based on the local climate of the place, and availability of the material, the roof finishes use to vary. The white coating always helped to keep the terrace surface cool, and emit less radiation during the cooler parts of the day, when the roofs are occupied for other activities.[16]

As seen in this extract from Golani and Sharma, vernacular technologies are linked to regional climate, culture, and available resources. Ken-ichi Kimura states that 'the vernacular technologies have been devised uniquely to the region where people lived to cope with the severe climate by inventing various devices without resorting to fossil fuels, thus the form of vernacular architecture representing regionalism of their own'.[17] Vernacular technologies are thus devices that not only have a unique link to the region, but often also show the deficiencies in universalised technological developments. In other words, these forms of technology meet the needs of the community without putting the ecology of the community in an imbalance. Paul Oliver summarises the description of vernacular technology and writes that 'vernacular technology is conceptually situated within a large cognitive map or territory that constitutes

[14] Ahmadreza Foruzanmehr and Fergus Nicol, 'Towards New Approaches for Integrating Vernacular Passive-Cooling Systems into Modern Buildings in Warm-Dry Climates of Iran' (Proceeding of Conference: Air Conditioning and the Low Carbon Cooling Challenge, Windsor, London, Cumberland Lodge, Windsor, UK: Network for Comfort and Energy Use in Buildings, 2008), 3.
[15] Hărmănescu and Enache, 'Vernacular and Technology. InBetween', 3.
[16] Deepa Golani and Shankar Sharma, 'Analysis of Cool Roof Techniques for Energy Saving in Buildings', *International Journal of Modern Engineering & Management Research* 7, no. 3 (September 2019): 13.
[17] Ken-ichi Kimura, 'Vernacular Technologies Applied to Modern Architecture', *Renewable Energy*, Climate change Energy and the environment, 5, no. 5 (1 August 1994): 900.

the totality of building and settlement knowledge encompassed by a specific society'.[18] Vernacular technologies are not only there to make life better for the people of a region, but they are also linked to the way of life of the region. The way of life in a particular region is governed by the thinking of the occupants of that region. The cognitive thinking of people also forms part of the vernacular technology of a region.

Foreign Technologies

With European colonisation and the establishment of the Global South, however, many of these vernacular technologies have been erased to make way for a (material and intellectual) market and a regime for European technology. The introduction of the technology in the colonies indeed was framed and deployed against a backdrop of universalism. David Arnold writes the following:

> one of the characteristic features of Europe's technology in the 19th and 20th centuries (along with science and medicine) was its claim to universality. The significance of the Earth's different climatic and geographical regions was immense and technology was no freer than science and medicine from the appreciation (involving degrees of subjectivity) that certain kinds of places, such as the arid and semi-arid 'Orient' or the hot, wet 'tropics' (in which so many colonies were located), were in some way different from Europe. Technology was sited in a space called "nature".[19]

Arnold's argument here shows the duality of the colonial technological mission, which assumes a universalism of thought but is quickly confronted by the difference of global regions. He makes this point more succinctly when he writes that

> European engineers overseas were forced to recognize that railway construction and bridge-building in "tropical" India or Africa presented rather different problems and called for somewhat different solutions than in Europe, as did large-scale irrigation works in South Asia and Indonesia.[20]

The universality of the technology proffered by European colonisers thus proved ill-prepared for applications in regions outside of Europe. The claim of universality, in this sense, crumbled when it encountered spaces outside of Europe. This notion of universal technology pitted against the particularity of their new environments gave rise to contradictory forces in their

[18] Paul Oliver, 'Vernacular Know-How', *Material Culture* 18, no. 3 (1986): 114.
[19] David Arnold, 'Europe, Technology, and Colonialism in the 20th Century', *History and Technology* 21, no. 1 (March 2005): 95.
[20] Arnold, 95.

deployment. Arnold writes, for instance, that 'the apparent ineluctability of "nature" gave rise to repeated tensions within the colonial medical, scientific and technical services, or proved, as in the case of agriculture and forestry, that what was standard practice in Europe was neither feasible nor desirable in a very different African, Asian or Caribbean environment.'[21] The lack of environmental adaptability of this technology also engendered forms of instability in the new colonial environment, creating pockets of resistance but also ingenuity as a response. In this way, the resistance to this lack of adaptability was also influenced by the local culture of the new environment. Arnold states that

> the environment, though frequently invoked as a self-explanatory and scientifically legitimating factor, does not stand alone in marking and effecting difference between technology in Europe and technology in the colonial/postcolonial world: the role of the environment, real or perceived, was influenced and supported by a range of cultural, economic and political considerations. Technology, in the colonies and ex-colonies, no less than in Europe (and perhaps to a more extreme degree) functioned within a politically configured and culturally differentiated space and was profoundly shaped by that context.[22]

Arnold's assessment here suggests that culture and politics added to the complexity of European technologies' deployment in the colonies. Surveying the mutualism of the translocation of technology brings us back to the key themes of the ecological approach, namely affordances, resonance, and adaptation. Thought of from this perspective, we can draw the conclusion that rather than presenting universal applications, European technologies first had to become aware of their new environments (resonate) and further, being found unfit for purpose, had to adapt accordingly. Equally, however, as in ecological theory, it is important to note that it was not only the technology that adapted here, but that these technologies also changed the environments in which they were now found. One can, in a particularly complex instance, see this in the history of colonial biomedical technologies in the mining sector of South Africa. Alexander Butchart, in this case, shows how the establishment of mines and the deployment of medical apparatuses reconfigured human migration patterns in South Africa when tuberculosis screening prohibited miners from returning to their rural homes.[23] In turn,

[21] Arnold, 95.
[22] Arnold, 96.
[23] Alexander Butchart, *The Anatomy of Power: European Constructions of the African Body* (Pretoria: Unisa Press, 1998).

this affected farming and agriculture in rural areas of the country, which physically and culturally changed the environment.

Universalism of Music Technologies

While these tensions and adaptations were visibly present in the history of technology in the colonies, it is important to note that the universalism to which these devices laid claim was not entirely eradicated.[24] This is also the case in music technology, which like other forms of technology, follows the 'universality' of colonial technological expansion. In this field, however, the adaptation to new environments is less apparent but can be seen in the example of the notion of universality in the MIDI protocol. The MIDI 1.0 protocol was invented as a standard to facilitate communication between electronic musical instruments and processors. According to José Castanheira, however, this protocol, although claiming a type of universalism through its strong claim to standardisation, was largely only able to reproduce Western aesthetic values in music.[25] Castanheira argues this is the case because 'MIDI is largely based on the diatonic-tonal patterns of Western music' meant to best reflect the collection of Western art music instruments assigned to its 128 available channels.[26]

Of course, there have been significant developments since 1991, when the General MIDI specifications were first created. Castanheira acknowledges that the MIDI 2.0 protocol, which was adopted in 2020,

> is currently being publicized by MMA as "the biggest advance in music technology in decades", promising a series of improvements, including higher resolution and greater compatibility with different families of instruments, as well as more comfortable reproduction of sounds that do not follow the Western standard.[27]

The extent to which MIDI 2.0 enables interfacing with non-Western musical aesthetics (or instruments) should be questioned. Not only does this newer protocol still depend on the logic of an equal tempered scale (it has simply increased the subdivisions of this same scale), it more problematically still claims a form of universalism that simply starts from a more complex version of the Western tonal language. When non-Western instruments are then shoe-horned

[24] Butchart; Arnold, 'Europe, Technology, and Colonialism in the 20th Century'.
[25] Castanheira, 'Studio Sounds: Digital Tools and Technocolonialism', 115.
[26] *Ibid.*
[27] Castanheira, 'Studio Sounds: Digital Tools and Technocolonialism', 116.

into this standard, as Castanheira argues, they are 'inevitably denuded of their unique character in their adaptation to the MIDI protocol.'[28]

DAWs as Hungry Listeners

Of course, this form of what Castanheira calls 'technocolonialism' is not only present in the MIDI protocols. Digital Audio Workstations are similarly attuned to Western standards of music making. This has recently been highlighted by Khyam Allami, one of the many musicians who find the current software dedicated to music production limited in reproducing the melodies of his native Arabic culture. In a 2021 Pitchfork article by Tom Faber, Allami expresses how over a period of fifteen years, he created software that gives musicians a blank slate and allows them to choose the type of tuning they want.[29]

That said, the arguments of authors such as Allami and Castanheira, as attractive as they are, are in some sense easily dismissed. In the case of Allami, for instance, it is clear that he is specifically interested in the melodic production capabilities of a DAW, which does not attend to the fact that any melody can be recorded and played back through a DAW. If thought of as an interface purely for recording purposes, then it is clear that a DAW has no apparent bias for or against certain musics.

I say apparent, however, because the bias is perhaps more far reaching than simply the different functionalities of the DAW. I want to propose instead that the Western-centricity of the DAW perhaps lies at a more systemic level in the way that it has been designed to process sound as an abstractable concept. My argument in this regard hinges on Dylan Robinson's theorisation of the hungry listener. With this term, Robinson describes 'an interest in – and often a fixation upon – Indigenous content, but not Indigenous structure' in music.[30] Kristina Jacobsen, in a review of Robinson's work, writes

> "Hungry listening" is defined as a settler's starving orientation toward sound, or listening that "fixes" and "fixates" on resources provided by Indigenous musical content. But hungry listening is also a habitus, a state of perception into which we are socialized as listeners.[31]

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[28] Castanheira, 7.

[29] Faber, 'Decolonizing Electronic Music Starts With Its Software'.

[30] Dylan Robinson, *Hungry Listening: Resonant Theory for Indigenous Sound Studies* (University of Minnesota Press, 2020).

[31] Kristina Jacobsen, 'Hungry Listening: Resonant Theory for Indigenous Sound Studies, by Dylan Robinson', 2021.

In this sense, hungry listening is the lack of understanding indigenous musical qualities beyond the sonic, which is enabled by a conception of music as abstracted from practice in a real environment.

It should be said that Robinson does not equate DAWs to hungry listeners, but drawing on this notion, I want to argue that the current digital audio workstations we use are hungry listeners by default in the way they fixate on a notion of sound defined from the perspective of starving Western ears. DAWs, in the way they interface with music as abstract audio data, necessarily cannot engage with the broader structural elements of music making which often are ontologically bound up with indigenous musics. How, for instance, might a DAW cope with the relationship between music, dance, and cosmology encoded in the Nguni word, *ngoma*? Or what part does the DAW play in the ritual use of instruments such as the *mbira dzavadzimu*? These questions, while somewhat facetious, point to a more problematic connection between much of the standard music technologies used in the recording and reproduction of music today, namely, the epistemological link between Western ways of knowing the world and material technological manifestations in the machines we use. Returning to Paul Oliver's notion of vernacular technologies as situated in a cognitive map discussed before, we might understand that a DAW reflects the knowledge cartography of Western thought.

Conclusion: Reverb as Vernacular Technology

And reverb, as a function of DAWs, is also situated within this same map. Unlike the software created by Allami, like other forms of music technology available in the Global South, artificial reverb has also imposed its Western thought onto musical spaces in recordings. As explored in the previous chapter, plugin presets from the popular DAWs available show a skewed view of musical spaces. As I will share in the following chapter, sound engineers who use these presets do not use them as they are. However, the concern of this thesis is the lack of other forms of musical performance spaces at the default state of DAWs' plugins. Beyond the skewed view of performance spaces presented by the reverb plugin software, the universalism of Western thought can also be traced back to the first iterations of generic artificial reverb, as mentioned in the previous chapter. At the root, generic artificial reverb is based on a Western view of space. The concert hall is the point of reference for the development of Schroeder's generic artificial reverberators.[32] The subsequent developments by James Moore were contributions of

[32] Moorer, 'About This Reverberation Business'.

modifications of Schroeder's reverberators. These reverberators are compared against the natural sounding reverberation of concert hall.

Understanding the common usage of the current music technology, I want to propose instead a form of reverb as a vernacular music technology. Like in the architecture discourse, vernacular music technologies can be introduced to the technology. In the case of Xhosa choral recordings, instead of employing the Western notion of music's performance space that creates a schizophonic effect, I present in the following chapter an experiment in creating convolution reverb presets, which reproduce musical spaces in and around Makhanda.

Part II

Empirical Reflections on Vernacular Sound Technologies

Chapter 5: Vernacular Acoustics Among Composers and Sound Engineers

Introduction

In the first part of this thesis, I presented a number of theoretical considerations for thinking about reverb as a vernacular technology. First, I placed it within the context of ecological listening before discussing convolution reverb as a possible way of incorporating this form of listening into the design of reverb. I then suggested that, theoretically, we can (and should) problematise the universalist geopolitics of recording technology. In this chapter, and in the following chapters, I present empirical data to illustrate these issues in the form of interviews with composers and sound engineers, the design of a set of vernacular reverbs, and feedback on these reverbs from a choir whom I recorded. In this chapter, I present the data collected on how composers and recording engineers think about acoustics in isiXhosa choral music. The data was collected through semi-structured interviews, and the responses have been anonymised to protect the privacy of the participants. This technique of data collection is appropriate for this part of the study because it can provide access to opinions, thoughts and feelings of the research participants.[1] This kind of interviewing gives participants a certain degree of freedom to explain their thoughts and it also allows the interviewer to question certain responses in depth, which is crucial for collecting valid data on an issue as complex as perceptions of acoustics.[2]

The semi-structured interviews have been broken down into two categories describing the participants: composers and sound engineers. Each category brings a different view to the research, which necessarily sits in the intersection between aesthetics and recording technologies. The semi-structured interviews are not meant to take the views of the interviewees as an industry standard reaction to the questions posed in the interviews, and nor do I aim to draw out generalised views about composition or engineering from these interviews. Rather, the data from these interviews are used to illustrate the theoretical considerations presented in the first part of the thesis, and to provide insight into how some composers and engineers might think about acoustics and reverb.

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[1] Hove and Anda, 'Experiences from Conducting Semi-Structured Interviews in Empirical Software Engineering Research'.

[2] Horton, Macve, and Struyven, 'Qualitative Research', 340.

Composer Interviews

For the composers, I interviewed two Xhosa choral composers who are local to the Eastern Cape context of this research. They have each been composing for over a decade, and both started composing at very early ages. Both these composers have been through the higher education system and were exposed to different ways of composing and to various music technologies.

To gain access to the rich experiences of the composers, I conducted the interviews with derived intentions to gather a general idea of their creative process, the role of acoustics, if any, in their workflow, and their thoughts on current recording technologies. These focus areas provided the structure for the semi-structured interviews. The interviews used the same basic questions, which I reproduce below.

1. Take me through your process of composing isiXhosa choral work, from the idea to the finished composition: how the whole process works. 2. Do you think of the different venues in which your compositions might be performed? 3. If so, how does this affect the way you approach a composition? 4. What is your understanding of acoustics? Do they play a role in your approach to composition? 5. Do you think that current recording technologies adequately capture the spaces in which your compositions are performed?

Table 5.1.1: A set of prepared questions for the composer interviews.

These questions shed light on three themes: creative process, acoustics, and technology. In focusing on these three areas in my data collection, I aimed to uncover how the thoughts of these composers might be read against the theories of ecological listening and vernacular technologies discussed in the previous chapters of this thesis without giving them leading questions which might be primed to reinforce my theoretical suppositions.[3] Two of these themes directly link to the core focus of the research in this thesis, namely acoustics and recording technologies. My aim with including discussions of acoustics was to survey how these composers thought about space in their music, and to see what might be gained from

[3] Heather Cairns-Lee, James Lawley, and Paul Tosey, 'Enhancing Researcher Reflexivity about the Influence of Leading Questions in Interviews', *The Journal of Applied Behavioral Science* 58, no. 1 (2022): 164–88.

these thoughts with regards to reverb. A better understanding of the composer's view on acoustics can, in a way, shape how reverb presets or plugins are developed for isiXhosa choral music.[4] In discussing recording technologies, my aim was to determine whether some of the tensions around vernacular technologies mentioned in the previous chapter might be reflected in the composers' experiences, or whether this issue remains a theoretical critique. Overall, in these interviews I aimed to collect data on the source of isiXhosa choral music with the intention to bring about a better understanding of the music and also the composers' views on current recording technologies and space.

I did not want to make any assumptions about the compositional process and the inclusion of the thoughts of venues in which the compositions might be performed. My own experience of isiXhosa choral music has been indoors in multi-purpose venues. These include vernacular school halls, churches and town halls, which are all venues associated in some way with the missionary ethos and education which underpins much of this music.[5] The responses from the composers on the question of venues, however, presented a more complex set of considerations. One composer said that the question of venues is determined for him by two scenarios: one where the composition is commissioned for a specific occasion and venue and the second where he personally composes for a performance to take place in a specific venue.[6] Speaking about the first scenario, Composer X states that

> there are two venues that I will think about when I compose. If it's a commission and I'm handing it over, the only venue I think about is the first venue. This is the venue that's gonna be performed at first because once you hand over your commission, you have no control of where [it might be performed again], and it's really difficult to kind of think, well, it might be performed here, it might be performed in front of a thousand people, or 10,000 people or 500 people.[7]

Composer X's approach to composing for his projects is somewhat different. Here he shows far more creative control and adapts compositions mainly to the size of the venue.

[4] The insight acquired from this thesis can potentially be extrapolated to various other forms of music originating from the Global South.
[5] Olwage, 'Singing in the Victorian World'.
[6] Composer X. Interview with the author. 2022-06-17.
[7] Composer X. Interview with the author. 2022-06-17.

> If I'm writing for myself, it's the target one. So say you are writing a choral piece that you want to be performed at a 2000-seater venue. So I will write with that in mind, and then if it needs to be performed somewhere else, I might scale it back.[8]

Both these scenarios described by the composer require some form of acoustic knowledge. The analysis of the views of the composers on acoustics and their understanding of acoustics, and how they implement compositional techniques have shown that acoustics form part of their compositional process. Composer Y, for instance, states that

> when I'm talking of the acoustics, I am looking at the space of flow of the sound. So the flow of space. Now, is the space flowing openly or is the space sound bouncing back to me and those things, you know, so that's my understanding of the acoustics.[9]

Composer X, on the other hand, thinks specifically about issues of orchestration in relation to a venue's acoustics.

> So when we talk about acoustics, particularly from music, our working understanding is, how does this venue's [acoustic] strengths and weaknesses affect our show? What can we do? Can you have a drum in this venue? Can you have a brass section in this venue? Or should you just have strings? That is the working kind of, if I'd say, practically, that's how I understand acoustics.[10]

The composers' understanding of venue acoustics thus seems to be determined by issues of clarity and volume. Composer X, in another example, considers the acoustics of venues when it is indicated to them that microphones will not be available to the choristers.[11] Yet acoustics also seem to enter the compositional process in an aesthetic way as a generative compositional source. In the composition process, Composer Y uses compositional tools to mimic delays that come from enunciating across a valley.

> The concept of the storyline is that this person is standing on the cliff, and he's shouting on the side to be heard [on the opposite side]. But now I want to capture; I want to capture the echo of the voice by allowing the other voices in the choir to do that thing he cannot do for himself because he does not have the reserve to do it in the hall.[12]

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[8] Composer X. Interview with the author. 2022-06-17.
[9] Composer Y. Interview with the author. 2022-06-07.
[10] Composer X. Interview with the author. 2022-06-17.
[11] Composer X. Interview with the author. 2022-06-17.
[12] Composer Y. Interview with the author. 2022-06-07.

> I'm able to create that cycle of the reverb echoing by assigning different voices to echo that. But now, when I do that, I make sure that the first cycle of echo is lower than the statement and then the second cycle of echo even lower and then the third cycle lower. Then the last cycle, which is the fourth, is even lower than that.[13]

> You start to visualise the echo in what they are singing. Now composition allows us to even create the space where we can be able to bring the visualisation of the spaces themselves in how the singers are captured in the spaces themselves.[14]

This aesthetic consideration of acoustics differs in an interesting way from the practical considerations of venue acoustics. Here, the composer seems acutely aware of local markers of place and practices of calling across the vast valleyed landscape of the Eastern Cape, producing a strongly regional cultural ecology, which seems at the same time informed by scientific thought seen in the lowering of the pitch in the echo. In contrast, the discussion of venue acoustics is far less culturally coded. Here, it is a question of pragmatics around whether or not one's music will be heard. The difference between these conceptions of space suggests perhaps that musical space (space thought of in aesthetic terms) more clearly expounds a sense of the vernacular, which does not translate explicitly in terms of the physical space of performance. In both answers, however, the composers show a sense of ecological listening in which the environment of the composition is clearly an important consideration.

How, then, are these complex acoustic considerations relayed through recording technologies? Both composers share similar sentiments on this point in that they feel that the recording technology available does not adequately capture spaces where the compositions are currently performed. On this point, Composer Y states that

> no, they don't. The technology is trying its best to try to capture these things, but we can see the weakness of the technology at times when it fails to give the perfect depiction of what is happening as far as these acoustics and everything. We try to put these effects [artificial reverb] because we tried to make up for it at times. It could come closer to the real thing.[15]

Composer Y's concern here is with fidelity and perhaps specifically with the issue raised by the need for close microphone placements in choral recordings, which opens the need for the

[13] Composer Y. Interview with the author. 2022-06-07.
[14] Composer Y. Interview with the author. 2022-06-07.
[15] Composer Y. Interview with the author. 2022-06-07

application of artificial reverb in post-production to achieve compositional goals. Composer Y speaks about using everything in his compositional arsenal to make his compositions come alive. If the target audience of his composition is Xhosa people, he hones in on that. He knows that certain melodic fragments, for instance, will elicit a particular reaction in this audience and invoke a reaction from them. I wonder, in hearing this description, whether the acoustic signature of spaces might be equally evocative.

Composer X presents a more cryptic interpretation of this problem. In response to the question about whether technology adequately captures the spaces of performance, he simply states

> I don't think so, and I don't think people want them to.[16]

In asking him to expand on this answer, he touches on the lack of transferability of experience from the reality of a concert to the living room of a listener. To shed more light on transferability, he uses an example of an outdoor concert experience. This experience is saturated with the sense of being around people, the smells of this environment, and a rich assortment of the outdoor sounds. These experiences cannot be transferred to a listener who is streaming a recording of the concert. Instead, current technology does, according to him, allow sound engineers to create a new space in place of the outdoor experience. This leads to the new spaces where the consumers of recorded music encounter a different experience of space.[17] In this response, I detect a sense of the anxiety of Schafer's schizophonia in that something of the original context of the music is invariable (and irrevocably) lost. However, upon further reflection, I realise that the turn of phrase 'I don't think people want them to' actually speaks more to the ecological model, which acknowledges that sound is always bound up with its environment. As Clarke shows, recording impacts this in some way, but it does not erase the need for an environmental sense of understanding sound, even if that means creating a new virtual environment in place of the original outdoor environment of performance.[18]

Engineer Interviews

As much as composers provide valuable insights into how they conceive of space in isiXhosa choral music, the responsibility of crafting these spaces in recordings lies more often than not with sound engineers in the recording and post-production process. For this reason, I include

[16] Composer X. Interview with the author. 2022-06-17.

[17] It should be added that the virtual experience of music can be highly significant in cultural terms. See Tan, "Digital Inequalities and Global Sounds".

[18] Clarke, 'The Impact of Recording on Listening'.

here data from semi-structured interviews conducted with two highly accomplished sound engineers who both have significant experience in recording Xhosa choirs. Combined, they have worked as sound engineers for more than five decades and have worked on a number of important choral music recording projects.

In designing the interviews, I followed the same procedures as with the composers. Again, I wanted to get a sense of their ways of working with choral music, but in these interviews, I also introduced focused questions on reverb presets, acoustics, and their thoughts on current recording technologies. The questions on their working process had a dual purpose: as much as it would provide a deeper sense of their approach to acoustics, I also aimed to gain insights into the practice of recording the choirs, which I would need to complete the experiment detailed in the next chapter. This was imperative because there is currently no existing literature or standards published on recording these types of choirs, and much of the knowledge in this field resides only with engineers.

1. Take me through your process of engineering isiXhosa choral work, from the unedited mix to the finished mixdown. How the whole process works. 2. Do you use your different reverb effect presets in editing the work? What is that process like? 3. What is your understanding of acoustics? 4. What are your thoughts on acoustics in relation to isiXhosa choral? 5. How do acoustics play a role in your process of post-production? 6. Do you think that current recording technologies adequately capture the spaces in which isiXhosa choral music is generally performed?

Table 5.2.1: A set of prepared questions for the sound engineer interviews

The workflow of both sound engineers includes the following tasks: pre-production, recording, editing, and mixing. In choral recordings, pre-production involves meeting the choirmaster and discussing the goals of the choir for their recording or meeting the choir at rehearsals to become familiar with their sound. The recording includes capturing the sound of the choir either during a live performance or at a studio. Editing includes putting together single tracks from various takes, cleaning the recording and piecing together rough tracks. Mixing involves the process of using DAW functions to render the final version of the recording before creating a stereo version ready for public consumption. Working with reverb enters most of these processes, from dealing with room acoustics in the recording phase, to manipulating reverb in the editing and mixing stages.

The time spent on the various stages of the workflow depends on the financial resources of the choir. The quality of this workflow is dependent on how much time with the engineer the choir can afford and the various goals they have set for the engineer. Sound Engineer X states, 'I never forget that we are the engineers. We are not the bosses of the choir'.[19] This means that the engineer follows the aesthetic goals of the choir rather than imposing their own tastes or judgements. However, these goals cannot always be achieved within the hours for which the engineer is paid. As Sound Engineer X states,

> [the choirs] want to spend the smallest amount of money in the smallest time, but to get a good result still. So sometimes people will say, oh, you know, I've got a choir, and we are going to do 14 songs, and we just need one hour because, you know, we can sing the songs in one hour, and usually, I'll have to say to them, look, it's possible to do it in one hour [but the result might not be what you expect].[20]

In this sense, financial considerations are exceedingly important and often impact on the final project, disadvantaging groups such as community choirs who have limited financial resources.

Decisions about the site of recording are important for both engineers and are discussed with the choirs/ choirmasters during the pre-production phase. Sound Engineer Y, for instance, says that

> depending on the goals of the choir, you know, in other words, what type of album release they want to have, they might choose to record a live event or a controlled studio event.[21]

For Sound Engineer Y, knowledge of acoustics also plays a vital role in this early phase of the project and helps him prepare for whichever venue option the choir decides on.

> My knowledge of acoustics is, first of all, understanding the variety of spaces and understanding the limitations and the benefits of the space that the choir has chosen to

[19] Sound Engineer X. Interview with the author. 2022-06-06.
[20] Sound Engineer X. Interview with the author. 2022-06-06.
[21] Sound Engineer Y. Interview with the author. 2022-06-06.

> work in. You know, and understand what I'm going to be expecting from that space and not to be surprised.[22]

The spaces that some of the community choirs have access to are multi-purpose venues. This can be challenging for sound engineers when choirs choose venues with undesirable acoustic qualities. To address these issues, Sound Engineer Y plans microphone placement to remove much of the room sound and emphasise the voices in the room blend.

> So if there was any imbalances or too much reverb or whatever, I know that's to be expected right from the start. And I have to already make adjustments to make the choir sound good in that less-than-optimal place basically.[23]

To address the imbalances that come with venues, both sound engineers also use sound absorbers. A curtain is useful in this regard and can be used to cut out a section of the room from the section where the choir is recording. This way, the environment can be treated to suit the recording.

While Sound Engineer Y finds venue important in the discussion around the goals of the choir, Sound Engineer X finds it more of a practical consideration around the type and size of the choir being recorded.

> Well, normally what happens is, the choir leader will ask us about recording. They maybe come and look at the studio. I will ask them, for example, what is the size of the choir? And is it, for example, male only or female only, or is it a mixed choir, acapella or is there some instruments with it? And all of those things will help me to decide how to record the choir.[24]

The recording day for the choir is dependent on the type of project the choir has chosen. If the project is to record a live performance and they have chosen a location, this would require taking equipment out of the studio or renting out special equipment. Sound Engineer Y says that the venue would be rigged with microphones and treated if its acoustic quality does not fit in with the sound of the choir.[25] This means using close microphone placements for each voice type – soprano, alto, tenor and bass – of the choir so each part has its own track. In addition, room microphones are used to capture the sound of the choir in the room, but the engineers use

[22] Sound Engineer Y. Interview with the author. 2022-06-06.
[23] Sound Engineer Y. Interview with the author. 2022-06-06.
[24] Sound Engineer X. Interview with the author. 2022-06-06.
[25] Sound Engineer Y. Interview with the author. 2022-06-06.

both microphone placements to ensure that there is a usable recording to work with in the editing and mixing processes. Another approach used by Sound Engineer X is to create a live mix in which there is minimal editing or post-production mixing.[26] This, according to him, is a popular option for choirs because the limited time with the engineer saves money. Yet live recordings have their limitations. Sound Engineer X, for instance, states

> we could actually mix [the album] like a live show so that as you sing, that's the finished product. But usually when people have heard their recording they think, oh, why did the soprano sing so loud in this part? Why are the bases weak in this section? And they want to be able to [change it]. And you can't do that afterwards without booking more time and recording it separately.[27]

For a studio recording, the choir would be recorded in a more acoustically controlled environment. This recording process is often similar to the live recording, says Sound Engineer Y, but the editing and mixing would be handled separately.[28] The microphone set-up for studio recording would be the same as that of the live venue recording, with microphones allocated to sections, and the room microphones would be set further away from the choir. Even though studios are often built to be acoustically dead (or as near to this as possible) with no or very little natural reverb or built in such a way that the natural reverb can be easily manipulated, they are often limited in terms of space. Sound Engineer X tries to mediate this by asking the choirmaster to bring only the strong choristers for recordings. He continues to say that

> from my experience if you've got a smaller group, for example, 25 or 30 people, that is enough to sound big in the studio that I work in. And when you start to get too many, it actually makes the sound thinner. And I think that is a result of the room itself being so full of sound when everyone is singing loudly.[29]

For both engineers, editing follows shortly after recording. This involves cleaning the recordings by removing any unwanted sounds and, depending on the number of takes available, choosing the best sections of takes to piece together a complete recording.[30] While a very rudimental part of the recording process, the editing is crucial to the success of the final mix. Sound Engineer Y corroborates this when he states that

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[26] Sound Engineer X. Interview with the author. 2022-06-06.
[27] Sound Engineer X. Interview with the author. 2022-06-06.
[28] Sound Engineer Y. Interview with the author. 2022-06-06.
[29] Sound Engineer X. Interview with the author. 2022-06-06.
[30] Sound Engineer Y. Interview with the author. 2022-06-06.

> editing is a big part of choir [recordings]. This isiXhosa choir recording is the factor of editing meaning, choosing which performance, if they sang the song three times, or you happen to record three concerts, or three takes of the same song in the studio. You would select which was the best take of the three.[31]

The mixing process, which follows editing, is both pragmatic and creative for both engineers. Sound Engineer Y, for instance, gives the simplistic definition, stating that 'mixing is blending the multi-tracks into one stereo mix'.[32] However, in further discussion, it becomes evident that it is a highly technical process, which involves using plugins to manipulate various aspects of the recording, including the reverb. He complicates mixing even further by adding an aesthetic dimension when he equates it to the creation of a painting.

> Mixing is like painting. You're painting with different sources, meaning you're adding a bit of the room microphone and bringing down the volume of the altos or the tenors, and you are actually creating a painting. And once that painting is made or forged into one fabric or one physical thing, you can't reach into that painting and separate anything. Again, that's now been all blended into one. Nowadays, we deal a hundred percent with digital audio so that the mix is actually a stereo left and right WAV file.[33]

The mixing process is often done in consultation with the choirmaster to make sure that each of the goals for the project are met. This process can be time-consuming and, thus, financially costly. Acknowledging the limited financial means, Sound Engineer X creates a rough mix of the recording and sends it to the choirmaster as an MP3. This allows the choirmaster to make notes of what they like, what they want to change, and to get feedback from other people before returning to the studio. He found that this process has helped the choirmasters determine what they want from the mixing process, which can save significant sums of money on a project.

The mixing process is also where the fine-tuning of the reverb takes place. This process starts from a point of listening for both sound engineers, which is emphatically aimed at the effect of the room acoustics on the recording. As Sound Engineer Y states,

[31] Sound Engineer Y. Interview with the author. 2022-06-06.
[32] Sound Engineer Y. Interview with the author. 2022-06-06.
[33] Sound Engineer Y. Interview with the author. 2022-06-06.

> I first listen to the choir, and I say, I like the way the low frequencies are adding up and making a sound, but there's a certain frequency in the middle that I don't like, and a certain colorization of the room of the acoustics that I don't like.[34]

Listening to the recording gives sound engineers a clear idea of what needs work and what can be left as is. One particularly interesting problem that Sound Engineer Y raises is that of too much reverb in the initial recording. In the past, reverb was treated as an effect that can only be added, and not subtracted in a recording. Sound Engineer Y, however, points out that

> there's a plugin made by SPL, they have a plugin it's called De-verb. So what that plugin is for is if you are in a room, when you come back from recording, and you're now mixing and you realize there was too much reverb still in that room. The software plugin can actually minimize the reverb after the fact, which is quite a remarkable technology. That is quite new.[35]

While removing reverb is something quite new, the addition of reverb is a far more common phenomenon. In speaking to the engineers, it quickly becomes apparent that neither use reverb presets in their standard form. Sound Engineer Y, instead, explains that

> I tend to like to work from scratch and customize the reverb exactly the way I want it for the project I'm working on. So I start from what they call default, in other words, how the reverb is straight when it comes from the manufacturer or from the designer. Just simple, straight and then I changed the settings by ear to follow what I'm hearing.[36]

Sound Engineer X takes a similar approach.

> We don't necessarily work with presets, but we do use plugins to fix things. So normally we will, maybe we would start with the preset and adjust it.[37]

In the process of working with reverb, both engineers use plugins, or software packages that do not come as a standard feature of the DAW they are using. These plugins do offer preset reverb settings (such as those discussed in Chapter 3), but it seems that especially Sound Engineer Y changes the parameters of these presets to achieve the desired reverb. The process changes based on the specific choir’s sound and goals. Sound Engineer Y states that

[34] Sound Engineer Y. Interview with the author. 2022-06-06.
[35] Sound Engineer Y. Interview with the author. 2022-06-06.
[36] Sound Engineer Y. Interview with the author. 2022-06-06.
[37] Sound Engineer X. Interview with the author. 2022-06-06.

> it's definitely different from case to case, from choir to choir, and so, for instance, if we recorded in a large room, then I won't need as much reverb, and I won't need a large reverb. Potentially, I might not need any reverb to add, and then if I record in a medium size room or small room, I definitely will need to add reverb.[38]

From the description of this strategy, it seems that Sound Engineer Y prefers a wetter, more reverberant sound for choral recordings. Yet the need for the addition of artificial reverb can arise due to various practical reasons, including having to record in a non-reverberant recording space or having to compensate for a close microphone placement technique used to cut out room noise. In the case of the latter, the sound engineer might add artificial reverb with similar sonic qualities as the venue where the recordings were captured. Fidelity in this regard, however, is not always the goal. Instead, artificial reverb is also used to conjure entirely new spaces. Sound engineer Y describes this when he says that

> if we recorded in a [small] hall, but when I came back home to mix or came back to my studio to mix, and I wanted a slightly larger reverb sound or hall sound, I will trick the listener into thinking that we were in slightly a larger hall by selecting a hall preset or a hall setting on the reverb, not a chamber setting on the reverb.[39]

Microphone placement, however, also affects the need for additional artificial reverb to create a blended sound for the voice parts. When sound is recorded, and close microphone placement techniques are used, the recorded audio does not feature the reflections from the room boundaries prominently, but it can also result in a disjointed sound which has not mixed together in the room in the way that we as the audience might perceive it. In this case, Sound Engineer X uses reverb to amalgamate the sound after using equalisation and compression, and they would ‘add artificial reverb to everything to make it sound like it's in one, maybe bigger space’.[40]

For all this, however, there remains the question about whether recording technologies adequately capture choral sounds. On this question, the sound engineers had different opinions. Sound Engineer Y felt that it is especially microphone technologies which pose an issue in this regard.

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[38] Sound Engineer Y. Interview with the author. 2022-06-06.
[39] Sound Engineer Y. Interview with the author. 2022-06-06.
[40] Sound Engineer Y. Interview with the author. 2022-06-06.

> One thing I've learned with isiXhosa choirs is to factor in the movement of the people, the choir members. So for instance, to make it natural for them to dance and move and clap and stomp their feet potentially.[41]
>
> So quite often, I've set up [and] ready to record, and I've asked them to sing. They sing, [and] everything's sounding good. And then by the second or third song, suddenly there's movement. And I didn't factor that in and now they're moving out or away from the microphones. And then songs that have clapping in. The clapping usually is way too loud for the microphones compared to what the voices are.[42]

While companies like SHURE and Audio Technica have built microphone stands that hang from the ceiling, and these would allow the choir to move around during the recording, the issue here is perhaps the fact that in whichever configuration, microphones tend to work best with a sound source that is stationary in relation to it (in the case of lapel microphones, for instance, both the microphone and source moves, meaning that the source is stationary in relation to the microphone). The way in which this issue is addressed by Sound Engineer Y corroborates, in some sense, the issue I raised in the previous chapter about the DAW as a hungry listener. In making this argument, I suggested that the issue around the DAW is that it abstracts sound, fixating on content rather than the form of performance. In this case, dance, which is integral to so many choral performances, upsets the requirement of the stationary source in the recording process.

Sound Engineer X focuses on the issue of venues as a technology in recording.

> If you're in a bad space, an acoustically bad space, there's almost nothing that you can do to make it sound like a good space. You can try and hide some things, but if it's a bad sound, it's still a bad sound. So by far, the best way to do it is to find the best-sounding room or hall that you can find.[43]

Conclusion: Bad Acoustic Spaces

What is striking here is the notion of an 'acoustically bad' space. Read in the context of how these two sound engineers work with choirs, we might understand this idea as space which does not conform to the recording goals of the choir. Yet I do wonder whether 'bad acoustic space' might not also here be used as a shorthand for a space that does not easily conform to

[41] Sound Engineer Y. Interview with the author. 2022-06-06.
[42] Sound Engineer Y. Interview with the author. 2022-06-06.
[43] Sound Engineer X. Interview with the author. 2022-06-06.

the types of generic artificial reverb discussed in Chapter 3. Here, I showed that these forms of reverb are, in some sense, implicitly based on Western concert halls with very little interference in the acoustic spectrums. Yes, these types of spaces give an engineer and choirmaster more room for forming the type of virtual acoustic space presented on an album, but they do little for harnessing the unique sonic attributes of the performance spaces used in isiXhosa choral music.

The interviews with composers and sound engineers did not lead to ground-breaking insights about recording isiXhosa choirs. To a large extent, they perhaps simply reflect commonly held views. What is striking in both sound engineers' accounts, however, is the absence of the use of convolution reverb as a viable alternative to generic artificial reverb. The engineers do not strictly use this type of generic reverb in the way that they change the parameters of preset reverbs, but they do seem to rely on this form of reverb as a type of baseline. Creating a convolution reverb for each new space would add to the sound engineer's time that the choir needs to pay for, which would not make it a commercially viable option. However, I want to suggest that one way of addressing this issue would be to create presets which more closely mimic the traditional spaces of performance of this music.[44] To draw the ecological theory of vernacular sound technologies closer to the practice of composers and sound engineers detailed in this chapter, I present in the following chapter an experiment in vernacular reverb as a potential alternative in this space.

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[44] The economic implications of this suggestion are beyond the scope of this thesis. However, I want to suggest a similar approach to the one in Brandon Lucia, 'Balloon Pops, Convolution Reverb, and You!' (Capstone Projects and Master's Theses, Monterey Bay, California State University, 2020). Lucia creates a package of impulse responses of spaces in the California State University at Monterey Bay campus. A similar approach for isiXhosa choral performance spaces has the potential to reduce the economic burden carried by choirs who wish to use convolution reverb.

Chapter 6: Creating Vernacular Spaces: Experiment

Introduction

In an attempt to draw together the theoretical research presented in Chapters 2, 3 and 4 of this thesis with some of the empirical findings presented in Chapter 5, I designed an experiment in which I used convolution reverb to recreate vernacular performance spaces in recordings of isiXhosa choral music. As explained in Chapter 3, convolution reverb is a result of codifying the acoustic character of a specific space, exciting it with an impulse, which, according to Fons Adriaensen, allows for a realistic aural recreation of spaces.[1] To produce a form of vernacular performance spaces by using this form of reverb, I have split the experiment into three parts: 1) the capture of venue impulse responses, 2) the production of convolution reverb, and 3) the application of these presets in a recording. These three stages will be explored in this chapter. First, I present the process of capturing impulse responses from the local venues. I will then show how I used REVerence, a Steinberg Cubase plugin, to create convolution reverb presets from the impulse responses of the local venues. Lastly, I present the process of using these presets in recording a local choir.

Space Recordings

For this experiment, I recorded sonic signatures of three venues at Seven Fountains and Assegaaibos, which are located in rural areas around Makhanda. The venues were chosen because they form part of the ecology of performance spaces in the rural community around Makhanda and are often used for various forms of isiXhosa choral music. Furthermore, I grew up in these areas, having attended church in the Assegaaibos venue and spending much of my childhood in the Seven Fountains community. My intimacy with these areas meant that I would bring a particular kind of insider knowledge to the process of recreating these sonic spaces.

The first venue I recorded was the Seven Fountains community hall. The venue hosts a number of events for the community. During weekdays it serves as a teaching space for grade R pupils from the community, and it also hosts other events, which include, for instance, community meetings and entertainment events which include choir performances. The second venue I recorded is the Seven Fountains sports club. It also hosts different events for the community. Next to the sports club, there is a tennis court and a soccer field where sports events for the

[1] Sjarif, 'Unreal Convolution', 1; Fons Adriaensen, 'Acoustical Impulse Response Measurement with ALIKI' (Linux Audio Conference Proceedings, Karlsruhe, Germany: ZKM | Zentrum für Kunst und Medientechnologie, 2006), 9.

community and its local school are held. The hall hosts events for the local community children's choir. The sports club's multipurpose usage makes it easily accessible to the community of Seven Fountains. The third venue I recorded is the local Seventh-Day Adventist (SDA) church at Yarrow Farm, Assegaaibos. The Assegaaibos area is approximately six kilometres away from the Seven Fountains area. Some members of the Seven Fountains community walk to the SDA church in Assegaaibos. The church building was once a school for the locals of Assegaaibos, and due to people migrating from the area, the school underwent several occupations and was later converted into a church. It is now mostly used by the current elderly residents of Assegaaibos who were once taught in it and hosts local SDA church gatherings for the local community of Assegaaibos and Seven Fountains, which includes much isiXhosa singing. I felt that the extensive community usage of the venues, as well as my own intimacy with these spaces, made them the best candidates for the production of vernacular performance spaces.

To record the sonic signature of the spaces, I travelled from Makhanda to Seven Fountains and Assegaaibos. The initial plan was to record the impulse response of the venues in a day to save travel time. However, the availability of the venues was not consistent, and as a result, the sonic signature of the spaces was recorded over two trips which took place two months apart. The Seven Fountains venues are located within close proximity to community housing. This presented an environmental noise variable from the community, and I had no control over it. To minimise the impact of this variable on the recording of the impulse responses, I arranged for the recordings to be done on a Sunday morning. Usually, on a Sunday morning, most people in this area attend church, lessening the noise levels around the venues. Of course, part of my considerations in including these venues was that the environmental noise would form part of the convolution reverb eventually, and for this reason, I did not take any other measure to artificially reduce environmental noise.

Impulses

During the first trip, I recorded impulse responses at the Seven Fountains community hall and the Assegaaibos SDA church. To capitalise on the relatively low environmental noise, I decided to start the recordings at Seven Fountains because it is more densely populated than Assegaaibos. During the second trip, I recorded the impulse responses of the Seven Fountains sports club. The recording was also done in the morning to minimise environmental noise. However, this time it was done during the week on a Thursday morning because the manager indicated that the venue was only accessible during the week. The impulse response recordings of each venue took approximately an hour to do, including setting up equipment in the venues.

Initially, I had planned to use a starter gun, two wooden planks, and a sine sweep as the impulses to excite the venues. The three impulses were chosen for a number of reasons. A starter gun uses explosive caps to create an extremely high amplitude sound. The wooden planks also produce a relatively explosive sound when clapped together but could easily be repeated, which was not the case with the starter gun, given the limited availability of caps. The sine sweep produces a 2'24" ascending sine tone that excites all frequencies between 20hz and 20kHz. To produce this sound, a portable JBL Bluetooth speaker was used. Aside from creating a variety of impulses, these devices were also chosen because both the community hall and the SDA church did not have power outlets which would be needed to power a monitor to create the equivalent high amplitude sound.

Initially, I had planned to choose the single impulse of the three which offered the closest reflection of the signature of the room. However, this plan had to change because the noise-to-signal ratio for the sine sweep meant that it did not create a stable or consistent impulse response. Most problematic in this regard was wind noise, which presented a particular issue at the Assegaaibos SDA church. One of the zinc roofing panels of the venue had a loose edge which resulted in a louder noise during the recording than the sine sweep's amplitude. This meant that the sine sweep impulse response at Assegaaibos was not usable. To keep the experiment consistent, I decided not to use the sine sweep impulse and use the starter gun and the wooden planks as impulses.

Equipment

To capture the impulse response of the local spaces, I used equipment available at Rhodes University's Department of Music and Musicology. For the experiment, I wanted to use equipment that was easy to assemble without taking too much time, and also, it had to be easy to carry, given that vehicle access to the SDA church may pose some difficulty. This meant using minimal equipment while still ensuring that the quality of the impulse responses was not compromised. Table 6.2.1 shows a list of equipment used in the experiment.

Name	Version	quantity
Recorder	Zoom H6	1
SD card	SanDisk	16GB
Condenser Microphone	AKG C460B	2
Condenser Microphone	AKG C5600	2
XLR Cables	Warwick RockCable	6
Microphone stands	-	4
Recorded stand	-	1
Tape measure	-	1
Notebook & pen	-	1
Speaker	JLB Flip 6	1

Table 6.2.1: A list of equipment used in the entirety of the experiment.

Microphone Setup

Image 6.2.1: A set-up used in the experiment with William Fourie preparing the starter gun at the Seven Fountains community hall.

Image 6.2.1 shows the setup used to capture the impulse response at the Seven Fountains community hall. The setup comprises four condenser microphones, two AKG C460B and two AKG C5600, with the Zoom recorder setup to mark the centre of the room. All the microphones used in the experiment are directional. The use of four microphones was aimed at creating an omnidirectional sonic capture of the venue. Both AKG versions have a cardioid polar pattern meaning that they would capture predominantly the wall reflections of the impulses, but would also capture some of the floor and ceiling reflections. All microphones were connected to a Zoom H6 recorder with the use of four XLR cables. All microphones were at the same height, and they were pointing to the wall at a similar 45-degree angle. The Zoom H6 recorder has 6 channels, 4 mono channels and 1 stereo channel. In this experiment the stereo channel was not used. To get high quality recording, the sampling rate for the zoom recorder was set to 24-bit/ 48kHz.

The above set-up was used in all the venues. The floor plan for the Seven Fountains sports club was different from the two venues. Both the Seven Fountains community hall and the Assegaaibos SDA church had a basic rectangular floor plan with no dividing walls. This made it easy to set-up. However, in contrast to this, the Seven Fountains sports club had a dividing wall and a sliding door. This had the venue divided into three sections. The first section had a bar with a secluded section behind it, and the second section was the big hall section. At the end of the hall section, there was a kitchen section. The bar and the hall section were accessible and were included as part of the experiment.

The placement of all microphones in the set-up was formulated with the use of calculations. The microphones were placed at a distance of one-third of the width and length of the room from the wall they were pointing towards. Additionally, between two parallel microphones, there was a distance of one-third of the width and length of the room. The purpose of this calculation method was to capture the entire room's sonic signature efficiently. The excitation positions were calculated to be at the centre width of the venue and moved in thirds across the breadth of the venue.

The standing positions for impulse excitation were not exclusively from the performance positions. The positions were the front of the room, centre, and the back. The wooden plank impulse was the only impulse used in all the excitation positions. This format was not possible for the starter gun impulse because there were not enough caps for all excitation positions. Instead, the excitation position for the starter gun was set at the centre of the room. Given the loudness of the impulse, the centre was the chosen efficient location for room excitation. The excitation positions for the venues were easily devised except for the Seven Fountains sports club. The unique floor plan of the sports club presented unique challenges, which will be explored further in the chapter.

Impulse recording

Seven Fountains Community Hall

The recording of the Seven Fountains community hall was captured with the setup displayed in Figure 6.3.1. The hall had an open floor plan with chairs packed at the end of the hall and on the sides. The concrete floor was covered in two thin layers of synthetic carpeting, and the walls of the hall were constructed of concrete and brick and were painted. The hall had four windows, two on the east wall and two on the west. The hall's ceiling was pitched and comprised wood support beams and exposed zinc roofing panels.

Calculations

The hall had a rectangular floor plan. Table 6.3.1 below shows the measurements of the hall's dimensions. Alongside Table 6.3.1 is Figure 6.3.1, which shows a floor mock-up with labels.

Label	Measurement (cm)
Length	1120
Width	510
Wall height Full Height	265 421

Table 6.3.1: Measurements taken from the Seven Fountains community hall.

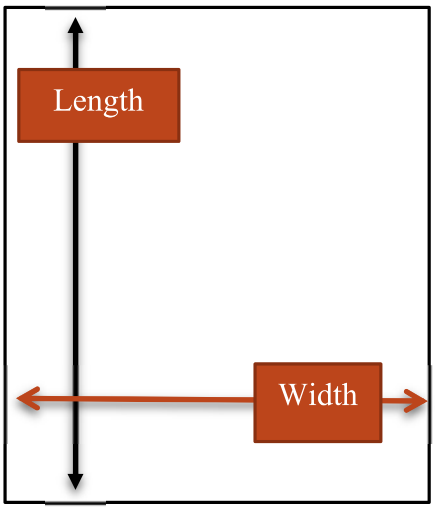

Figure 6.3.1: Basic floor mock-up of the Seven Fountains community hall.

After measuring the width and breadth of the hall, the microphone positions were calculated. The recorder position was also calculated to mark the centre of the hall, making it easy for the central excitation position to be located within the hall. Table 6.3.2 shows the formulae used for both the recorder and microphone positions at all the venues. This formula was chosen because it would ensure the most even statistical distribution of microphone placement against room size, meaning that the microphones would capture the most balanced distribution of sonic reflections in a manner that could be controlled across all the venues. Of course, this does not directly mimic the impulse of a choir singing in the space, which would create an impulse distributed to one side of the hall. However, given that it would be impossible to recreate a realistic sound diffusion in these venues, it was decided that simply creating a controlled distribution would at least enable comparisons across the venues.

Label	Calculation
Recorder position	$Width\ position = 0.5 * width$ $Length\ position = 0.5 * length$
Microphone positions	$Width\ position\ = \frac{1}{3}\ width$ $Lenght\ position\ = \frac{1}{3}\ length$

Table 6.3.2: Microphone and zoom position calculations.

Each of the microphones in the hall were positioned in calculated positions using the formulae in Table 6.3.2. After the microphone positions were calculated, the height of each microphone stand was set to 120cm. Again, this measurement was used as a controlled variable, given that the pitches of the ceilings of the different venues would vary considerably.

Impulse response capture

The microphones were connected to the recorder with XLR cables. After connecting each microphone to its mono track on the Zoom recorder the sensitivity gain of the microphones on the Zoom recorder was initially set to 5dB. The first impulse that was used was the starter gun. The first take of the impulse response recording was not captured clearly. This was due to two related reasons: 1) I underestimated the loudness of the starter gun, and 2) thus the sensitivity gain on the recorder was too high, and the starter gun impulse caused the recording to clip.

Adapting to this factor, the subsequent takes of the starter gun were taken with the recorder sensitivity gain set to 2dB to avoid clipping.

After capturing the starter gun impulse, the second impulse that was used in the Seven Fountains community hall was the sine sweep. For this take, the recorder gain sensitivity was set to 6.5dB. The high gain sensitivity was used to allow the recorder to capture the relatively low amplitude impulse and reflections clearly. The sweep was played from the JLB Flip 6 speaker positioned at the centre of the hall for the first take, and for the second take, it was positioned at the front.

Following the sine sweep impulse, the plank claps were captured. The recorder sensitivity gain for these impulses was set to 5dB. The impulses were positioned at the front, centre and back of the hall. In each of the positions, one take was recorded. For each of the plank clap impulse takes that were captured, three claps were produced with a delay of 1 second between them. This was deemed a sufficient delay given the small size of the venue, which would result in a reverb time roughly calculated to be around 0.7 seconds.

Assegaaibos SDA Church

The microphone configuration used to capture the sonic signature of the Assegaaibos SDA church was the same as the one for the Seven Fountains community hall. Similar to the community hall the church had an open floor, however, the church had movable pews which formed four rows in the church. The pews were not moved during the experiment. The floor of the church was also concrete but covered with a linoleum sheet. The windows of the church were positioned on the north and south walls. There were two windows on the north wall, and on the church's south wall, there were three. The indoor walls of the church were plastered with cement and painted. Inside the church, similar to the Seven Fountains community hall, the ceiling was made of exposed zinc roofing.

Calculations

Although smaller than the Seven Fountains community hall, the church floor plan was also rectangular. Table 6.3.3 below shows the measurements of the Assegaaibos church dimensions. Alongside Table 6.3.3, Figure 6.3.2 shows a floor mock-up of the church with labels.

Label	Measurement (cm)
Length	760
Width	615
Wall Height Full height	315 400

Table 6.3.3: Measurements taken from inside Assegaaibos SDA church.

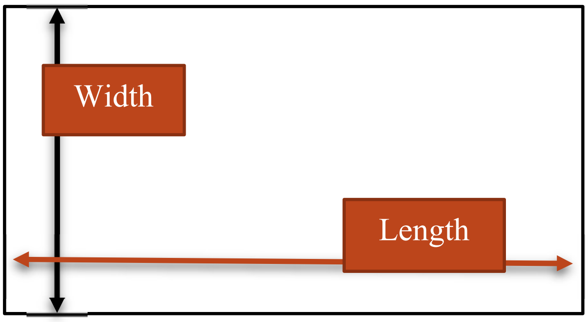

Figure 6.3.2: Basic floor mock-up of the Assegaaibos SDA church.

Following the indoor dimension measurements of the church, the positions of the microphones and that of the zoom recorder were calculated with the use of the formulae shown in Table 6.3.2.

Impulse response capture

While setting up the church, the location of the SDA church within the Yarrow farm presented significant environmental noise. The SDA church was located less than 2 kilometres from the N2 highway, and even though the traffic on the day was low, it was still audible. While this noise would not necessarily be captured by the microphones, the extreme wind in the valley caused the loose zinc roofing to rattle significantly, as mentioned before. This had an effect on the quality of the sine sweep, which could not be made louder than the wind noise, making it impossible to use. For consistency, I decided to leave out the sine sweep impulse recording for other venues too.

The usable impulse responses recorded at the church included the plank claps and the starter gun impulses. Using the adaptation made at the Seven Fountains community hall, the sensitivity gain of the recorder was set to 2dB for the starter gun impulse. Two takes of the starter gun impulse were captured in the church, and in both takes, the position of the impulse was at the centre of the church.

Following the impulse of the starter gun, the plank clap impulses were captured. Due to high winds, the number of claps per take were increased from 3 to 5. Again, the gain sensitivity was set to 5dB for these. The excitation positions were the same as those from the Seven Fountains community hall (front, centre and back).

Seven Fountains sports club

Following the impulse response recording at Assegaaibos and Seven Fountains community hall, I recorded the impulse response of the Seven Fountains sports club on the second recording trip. The sports club's indoor design was different from the other venues. It had an interior hardboard ceiling that was painted and a hardwood floor. The east side of the wall had six sliding-door windows and the western side had four large windows. The walls were plastered and painted.

Calculations

The hall was separated into three sections: the bar area, the main hall area and a kitchen. Behind the bar section, there was a walled-off room, and the bar was covered with an indoor thatch roof. Between the bar and hall there was a sliding door. Inside the hall there were chairs and tables set against the walls. The kitchen section had a wall with a serving opening roughly the size of a window.

At the time of recording, the bar and the hall were accessible. Both had a rectangular shaped floor plan. Figure 6.3.3 show the basic floor plan for the sports club. Table 6.3.4 below shows the measurements of the hall section, including the bar section dimensions.

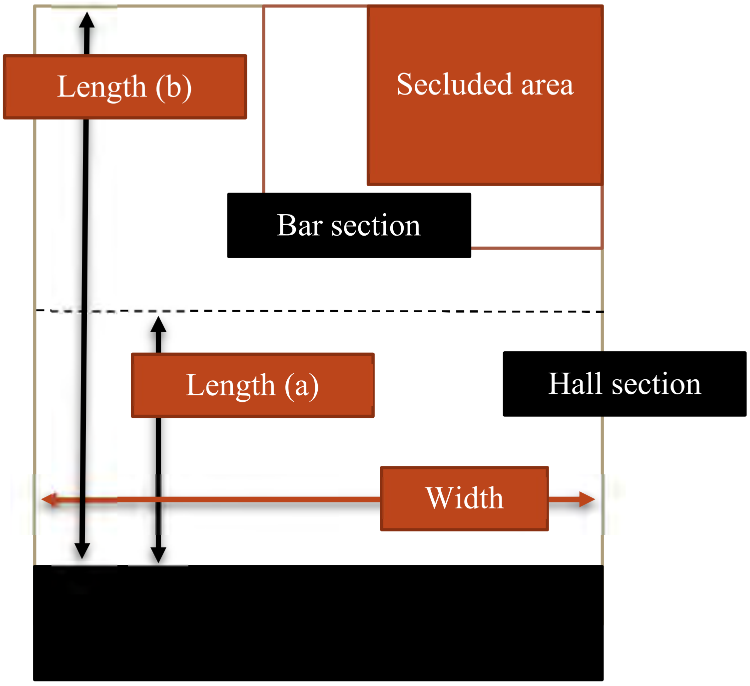

Figure 6.3.3: Basic floor plan of the Seven Fountains Sports Club.

Label	Measurement (cm)
Length (a)	860
Length (b)	1797
Width	927
Wall Height	296

Table 6.3.4: Measurements taken from the Seven Fountains sports club.

To accommodate the different floor plan of the sports club, the impulse recording of the venue was done using two different setups. The first focused on the hall section, and the second combined both the bar and the hall section. The formulae in Table 6.3.2 were again used to calculate the microphone placements and recorder positions. For the second setup, the formulae were used to calculate the microphone positions for the microphones at the back of the hall, situating the microphones roughly on the path of the sliding door dividing the hall and the bar (the back of the hall is the section below the dotted line in Figure 6.3.3). The formula did not work for the front microphones because it placed one of the microphones behind the bar in the walled-off area. For both parts of the recording, the microphones were pointing towards the wall.

Impulse response capture

The first impulse response recorded in the first setup used the plank claps as the impulse. The sensitivity gain was set to 5dB. Three takes of the wooden planks were captured from the front, centre and back of the hall. Four claps for each take were recorded separated by an interval of 1 second. Following the wooden plank impulse, the starter gun impulse was recorded at the centre of the hall with the sensitivity gain set to 2dB.

In the second setup, the starter gun was the first impulse to be used. Two takes of the starter gun impulse were recorded. On the first take, the impulse was positioned at the front, next to the bar. On the second take, the impulse was at the centre of the hall and bar sections. After the starter gun impulse capture, the wooden planks were used. Three takes of the plank claps were captured, and the impulse was positioned at the front, centre and at the back of the hall section. For each of the takes, the sensitivity gain was set to 5dB.

Impulse Response Processing

Following the recordings at the Assegaaibos SDA church, Seven Fountains community hall and sports club, I processed the impulse responses. The initial plan was to use an impulse response with the best of the two remaining impulses (plank claps and starter gun) captured in the experiment.[2] However, the result of this was an impoverished sound with a minimally excited spectrum. Reviewing this, I decided to combine all recorded impulse responses and produce one stereo impulse response for each of the venues. Combining the three excitation positions (front, centre and back) used in this experiment created a fuller sonic signature of the venues.

I used Cubase to create the combined impulse responses. For each venue, I imported all the impulse response takes with the starter gun and wooden plank impulses as mono tracks into a single project file. For the Seven Fountains sports club, both impulse responses with the starter gun and wooden impulse plank were imported for both setups. After the importation of the impulse response, I began editing the takes. In the editing process, I chose the takes which included the most audible impulses from the same excitation position.

After editing the project files of each venue's impulse response, I started adjusting the levels of all tracks on each project file. The levels of all tracks were pushed as high as possible without causing clipping. After adjusting the levels for each project file, I panned the impulse responses with the plank clap impulse to match the excitation positions in each venue. The front excitation

[2] Kantorik, 'Convolution Reverb & Impulse Responses', 6.

position was panned with differing positions to the left. The back excitation position was panned with differing positions to the right. The centre position was centre panned. This panning configuration was similar for the Seven Fountains community hall and the SDA church, but the Seven Fountains sports club was treated slightly differently. Here there were four impulse response takes with starter gun impulse (two for each setup), and one of the takes had the front excitation position. I decided to centre-pan the impulse responses with centre takes and panned the impulse responses with the front take the same way I panned the impulse responses with the front plank clap impulses. After adjusting the levels and panning the tracks for each project file, I exported a single stereo .WAV file for each project. The stereo outputs were a single impulse response for each of the venues.

Visualiser

As a way of visually showing the difference between the impulse responses generated in the venues, I created high-definition spectrogram images using two software applications. The first application is ARTA, version 1.9.5, developed by Artalabs. According to the website of Artalabs, the ARTA program can be used for 'impulse response measurement, real-time spectrum analysis and frequency response measurements'.[3] In this application, I used the cumulative spectrum with two visualisations: waterfall and sonogram. Both options display the frequency content of an impulse response over a period of time and amplitude within a given range. For all the spectrograms, the set range is from 0dB to -10dB. Image 6.4.1 is an example of a waterfall spectrum. Image 6.4.2 is an example of the sonogram. The second software application I used is Spek version 0.8.2. This is an acoustic spectrum analyser developed by Alexander Kojevnikov.

[3] 'ARTA Software', accessed 1 February 2023, https://www.artalabs.hr/index.htm.

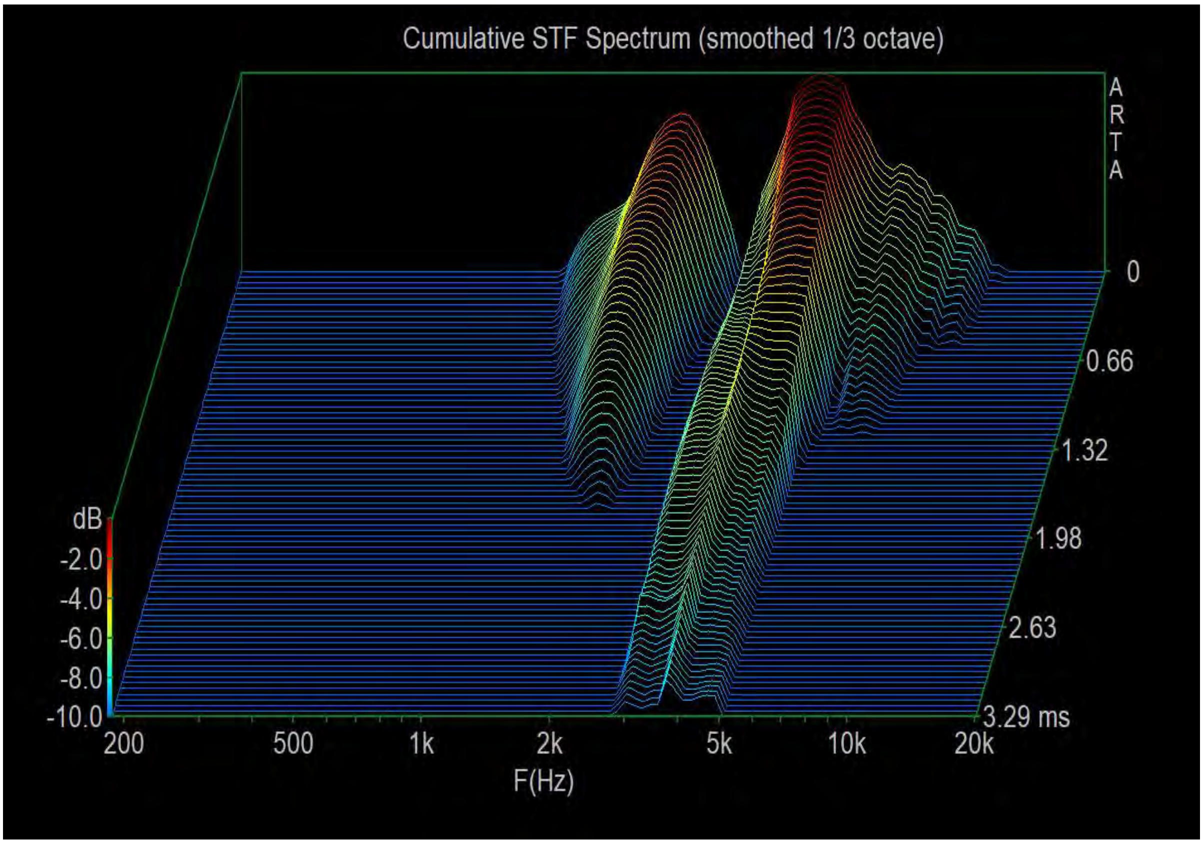

Image 6.4.1: Waterfall spectrum of the Assegaaibos SDA church impulse response by ARTA.

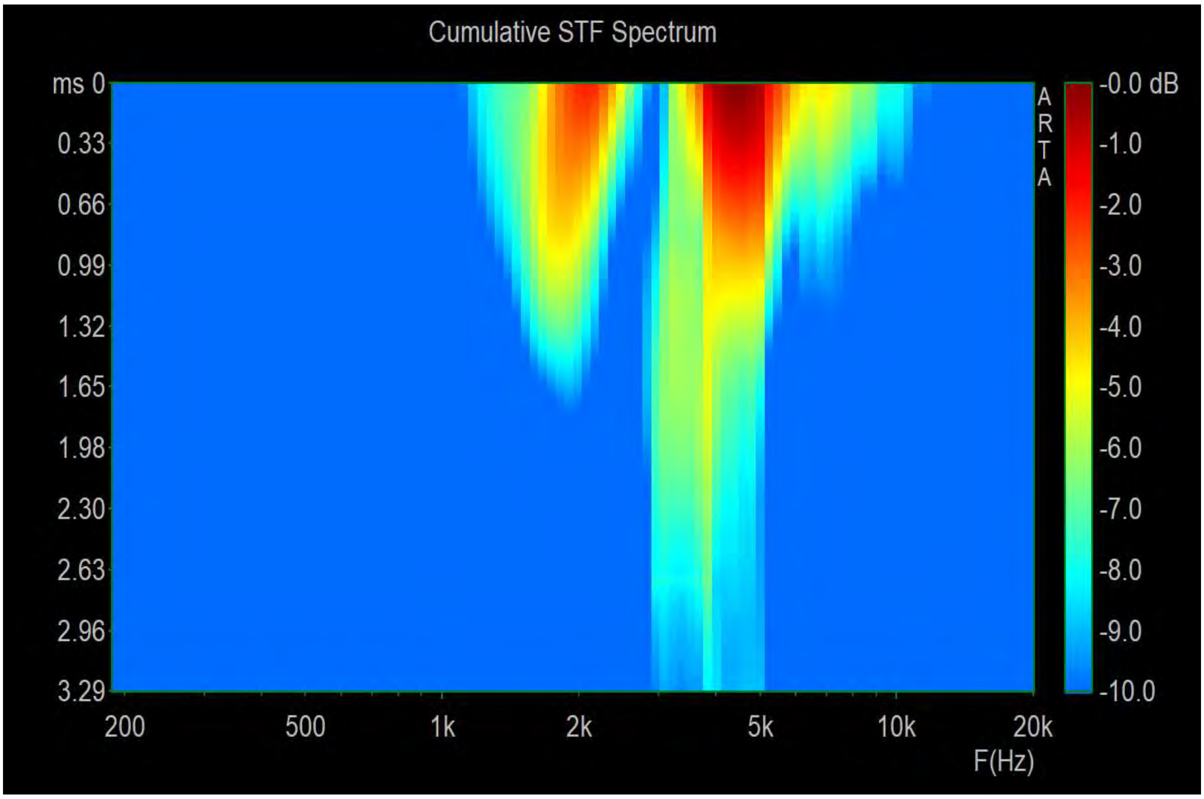

Image 6.4.2: Sonogram spectrum of the Assegaaibos SDA church impulse response by ARTA.

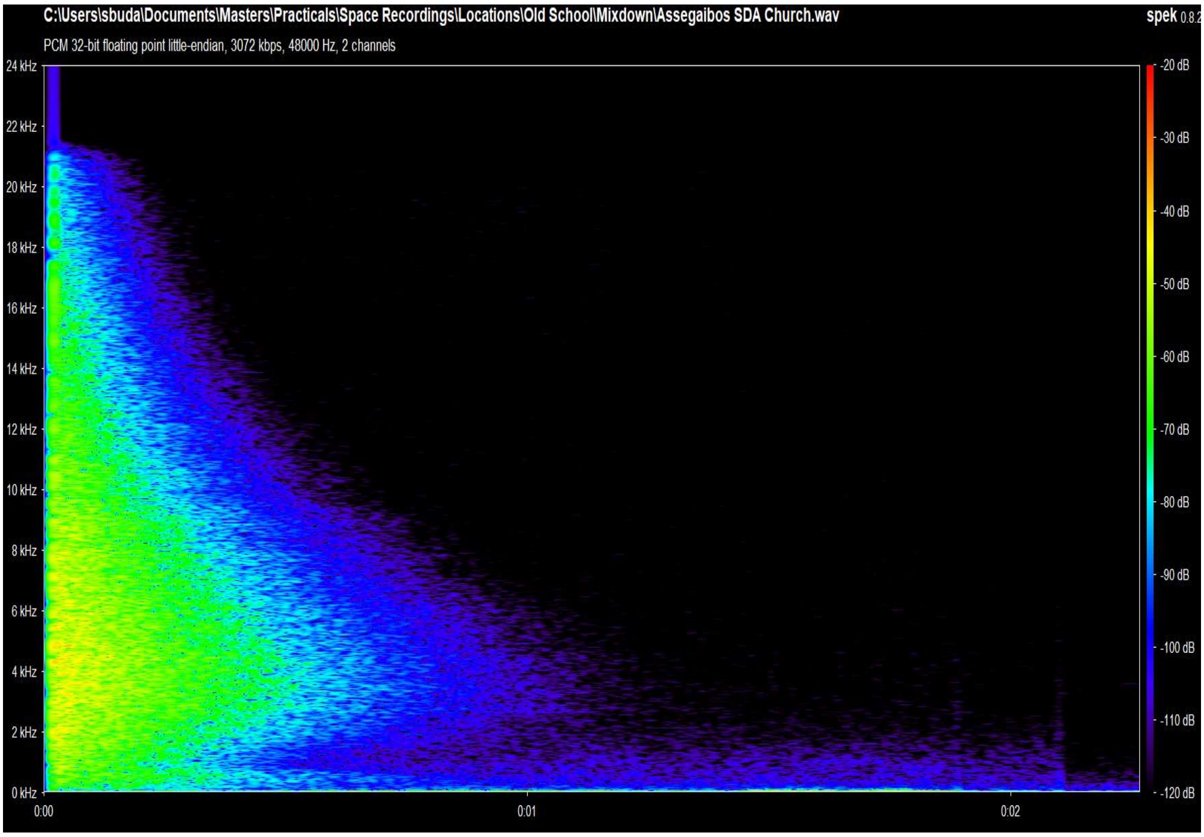

Image 6.4.3: Spectrum of the Assegaaibos SDA church impulse response by Spek.

Images 6.4.1 and 6.4.2 show the frequency spectrum of the Assegaaibos impulse response produced with the use of ARTA. Image 6.4.3 shows the frequency spectrum of the Assegaaibos SDA church impulse response with the use of Spek. In image 6.4.2, there is a clear depiction of the amplitude of frequencies within 3.29ms. Frequencies like 2kHz and between 4kHz and 5kHz have high amplitudes between 0ms and 1.32ms. Frequency content distribution for the Assegaaibos SDA church ranges from 1kHz to 10kHz, with 2kHz and between 4kHz and 5kHz having the loudest frequencies.

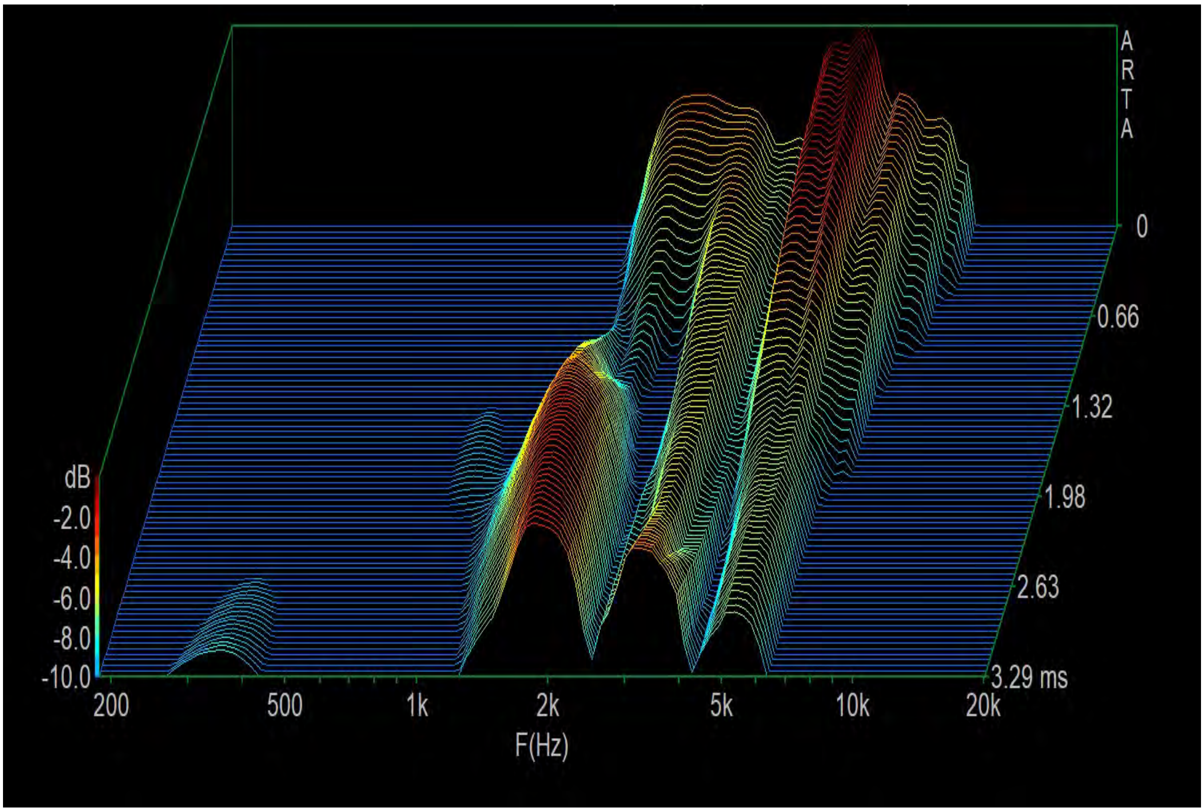

Image 6.4.4: Waterfall spectrum of the Seven Fountains Community Hall impulse response by ARTA.

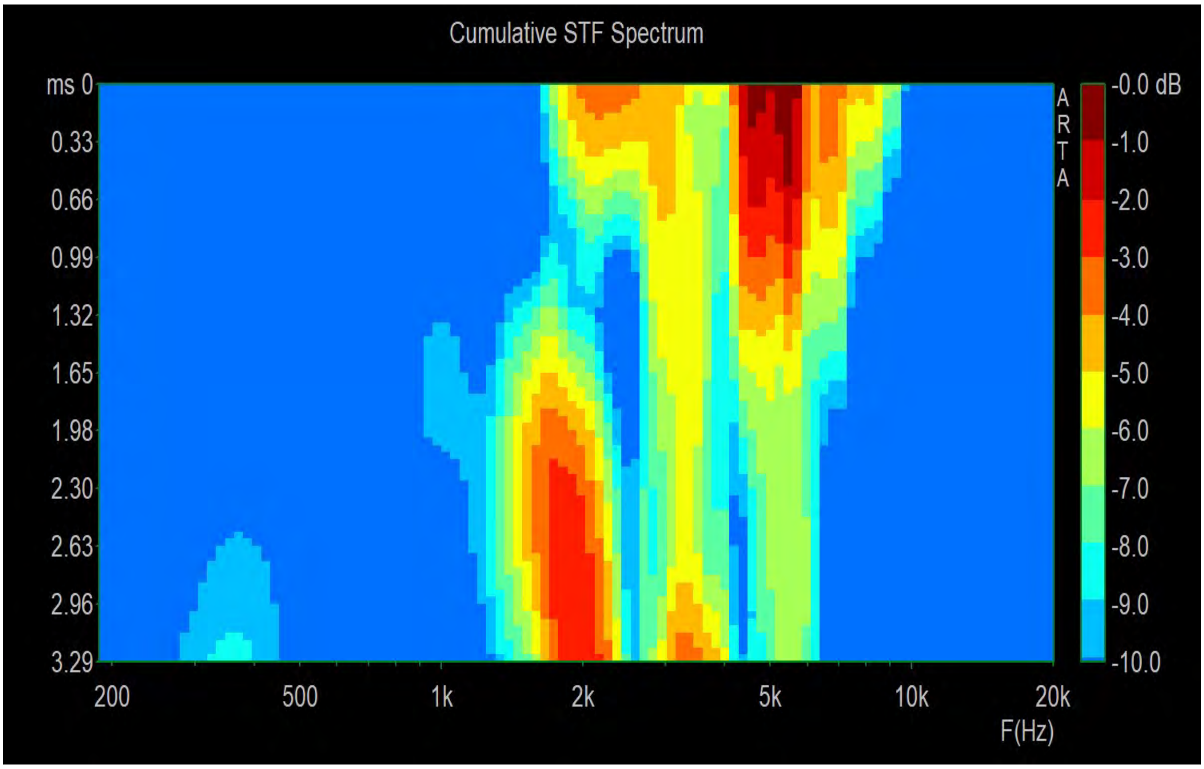

Image 6.4.5: Sonogram spectrum of the Seven Fountains Community Hall impulse response by ARTA.

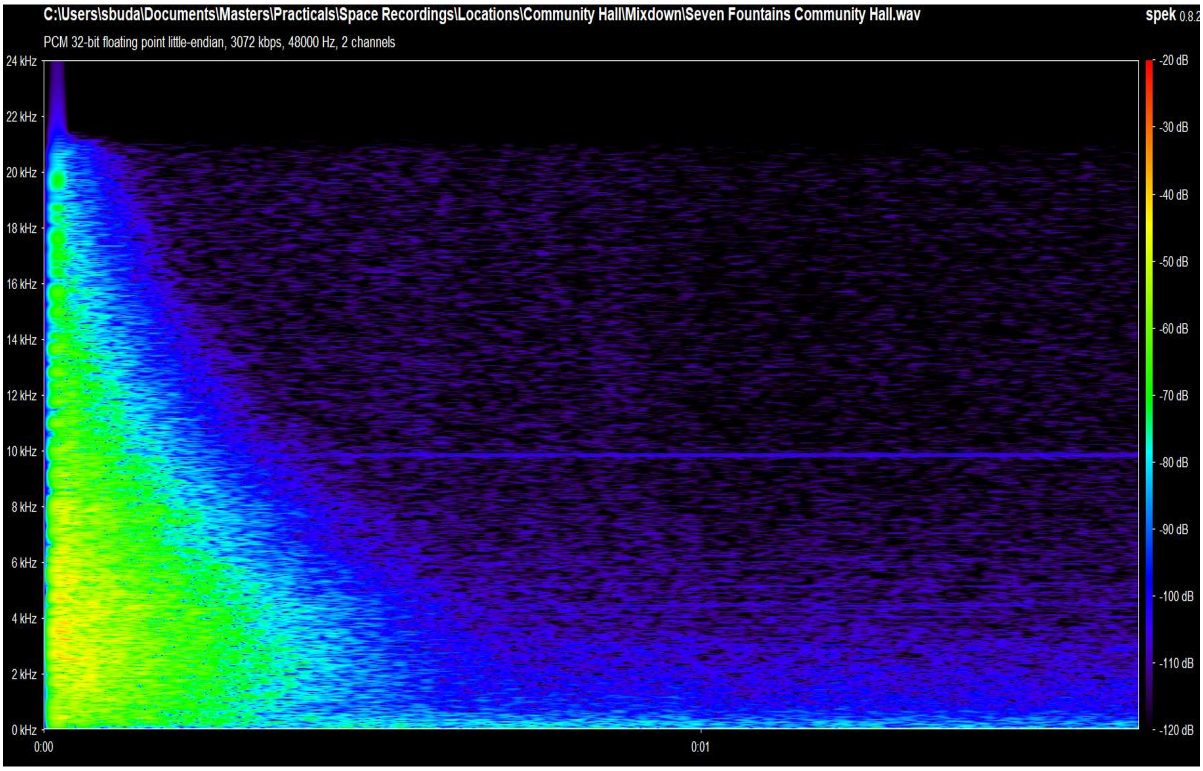

Image 6.4.6: Spectrum of the Seven Fountains Community Hall impulse response by Spek.

Images 6.4.4 and 6.4.5 are produced with the use of ARTA, and they show the frequency spectrum of the Seven Fountains community hall impulse response. Image 6.4.6 shows the Spek frequency spectrum of the Seven Fountains community hall. Considering image 6.4.5, the frequency content of this impulse response is scattered over the period of 3.29ms, with the loudest frequencies ranging from 1.5kHz to 8kHz. The frequency spectrum of the Seven Fountains community hall has a unique frequency distribution. The frequency content of the impulse response is sparsely distributed over the period of 3.29ms. Over 3.29ms, the 2kHz and 5kHz regions have the loudest frequencies in the impulse response.

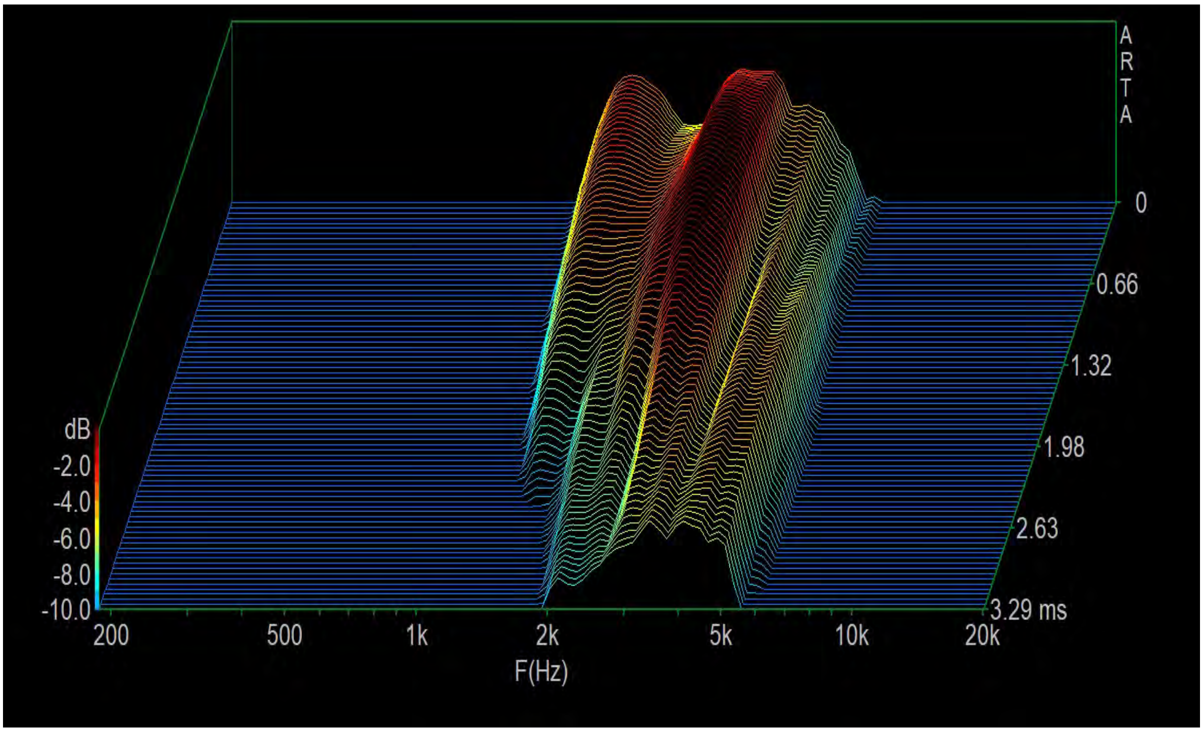

Image 6.4.7: Waterfall spectrum of the Seven Fountains Sports Club impulse response by ARTA.

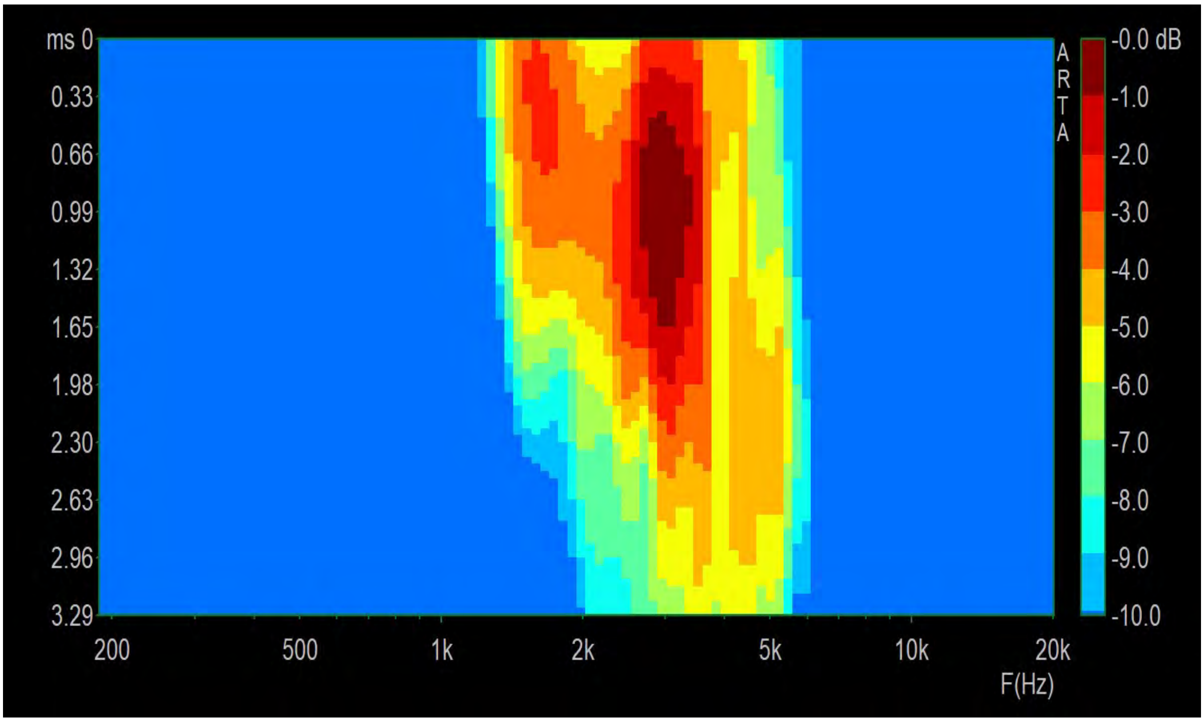

Image 6.4.8: Sonogram spectrum of the Seven Fountains Sports Club impulse response by ARTA.

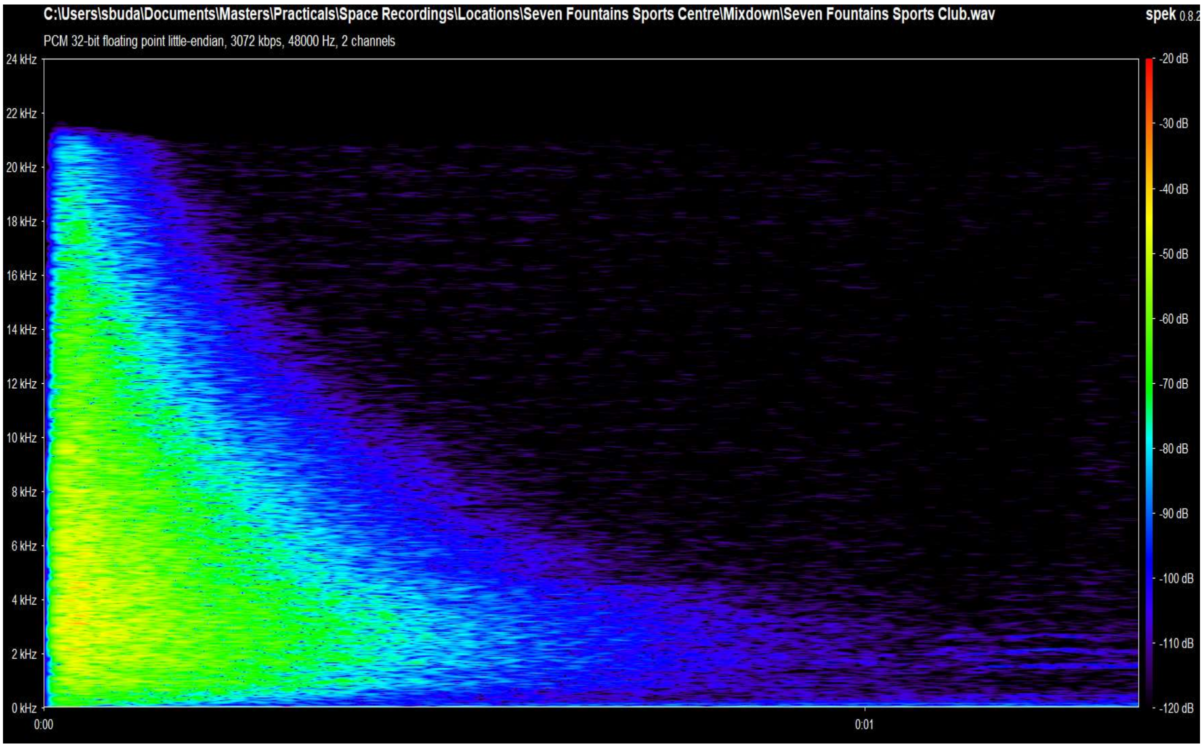

Image 6.4.9: Spectrum of the Seven Fountains Sports Club impulse response by Spek

Images 6.4.7 and 6.4.8 display the frequency spectrum of the Seven Fountains sports club impulse response produced with the use of ARTA. Image 6.4.9 shows the Spek frequency spectrum of the Seven Fountains Sports Club impulse response. From image 6.4.8, the frequency distribution of the impulse response is slightly uniform compared to the other impulse response. Image 6.4.7 shows a waterfall frequency distribution of the impulse response over a period of 3.29ms. Image 6.4.8 shows the loudest frequencies for the impulse response range between 3kHz and 4kHz. The loudest peak of frequencies starts from 0.66ms and end at 1.65ms.

REVerence: Preset Creation

In order to create the convolution reverb, I used the REVerence plugin developed by Steinberg Cubase. I decided to use the Cubase product because it is the only available licenced DAW in the Department of Music and Musicology. This plugin also made it easy for me to import all the impulse responses. According to the Steinberg documentation of the REVerence plugin, it is 'a convolution tool that allows [its user] to apply room characteristics (reverb) to the audio.'[4] The plugin allows a sonic signature or room characteristics (the impulse response) to be applied to audio that is inputted into the plugin. The documentation describes the REVerence plugin process as follows:

> [the convolution is] done by processing the audio signal according to an impulse response – a recording of an impulse in a room or another location that recreates the characteristics of the room. As a result, the processed audio sounds as if it were played in the same location.[5]

The plugin allows the use of external impulse responses and the creation of presets. Using the Steinberg documentation, I used the plugin to create the convolution reverb presets. Presets created with external impulse responses create a link between the preset and the impulse response. All presets created in this section can be found in the cloud folder link in the appendix page.

Preset configurations

The REVerence plugin allows a user to create both programs and presets. Programs contain settings for impulse responses and presets contain settings and parameters for the impulse

[4] Steinberg Media Technologies, 'REVerence' (Steinberg Media Technologies GmbH, 2 March 2022), https://steinberg.help/cubase_pro_plugin_reference/v12/en/_shared/topics/plug_ref/REVerence/REVerence_r.html.
[5] Steinberg Media Technologies, 'REVerence'.

response.[6] To keep all the venues separate, I decided to create a preset for each venue. As the default state for all the presets, I used the default settings that comes with the REVerence plugin. In the default state, the REVerence preset loads with the default parameters shown in Image 6.5.1 below. For the purposes of this project, I decided to leave the settings as they are. I did not inspect further the impulse response measurements for each venue's impulse responses. Each venue's specific modifications in relation to the time difference between the split of early reflections and the tail were set to 35ms, which would capture the entire useable response as shown in the visualisations in the previous section.

Image 6.5.1: REVerence default parameter values for stereo output configuration.

The auto gain function allows the impulse response to be automatically normalised. The reverse button reverses the impulse response. The first row labelled 'main' is applied to all speakers or the front speakers if the output configuration is set to surround sound format. The row below labelled 'rear' is applied to the surround sound format 5.1. According to the REVerence documentation, the rear row allows 'to set up an offset for the rear channels'.[7] Pre-delay is the time interval between the initial and subsequent reflections that reach a microphone or observer. Time scaling controls the reverb time. The percentage indicates how much of the reverb time is applied. The size indicates how much of the sonic signature of the impulse

[6] Steinberg Media Technologies, 'REVerence'.
[7] Steinberg Media Technologies GmbH, 'REVerence'.

response is used. Level controls the gain of the impulse response. It controls the loudness of the reverb within the plugin. ER tail split is the time before the split between the early reflections and late reflections. The ER tail mix allows a user to create a relation between the early reflections and the tail. The REVerence documentation also states that 'values above 50 attenuate the early reflections and values below 50 attenuate the tail'.[8] Following the exploration of the Steinberg documentation of REVerence, I created three presets.

Images 6.5.2 to 6.5.4 show the impulse responses of the different venues imported to the REVerence plugin. The impulse responses have been trimmed. The trim cut the tail end of the impulse response to manage the environmental noise that comes after the tail of the impulse response.

Image 6.5.2: Assegaaibos SDA church impulse response uploaded into REVerence.

[8] Steinberg Media Technologies GmbH.

Image 6.5.3: Seven Fountains Community Hall response uploaded into REVerence.

Image 6.5.4: Seven Fountains Sports Club impulse response uploaded into REVerence.

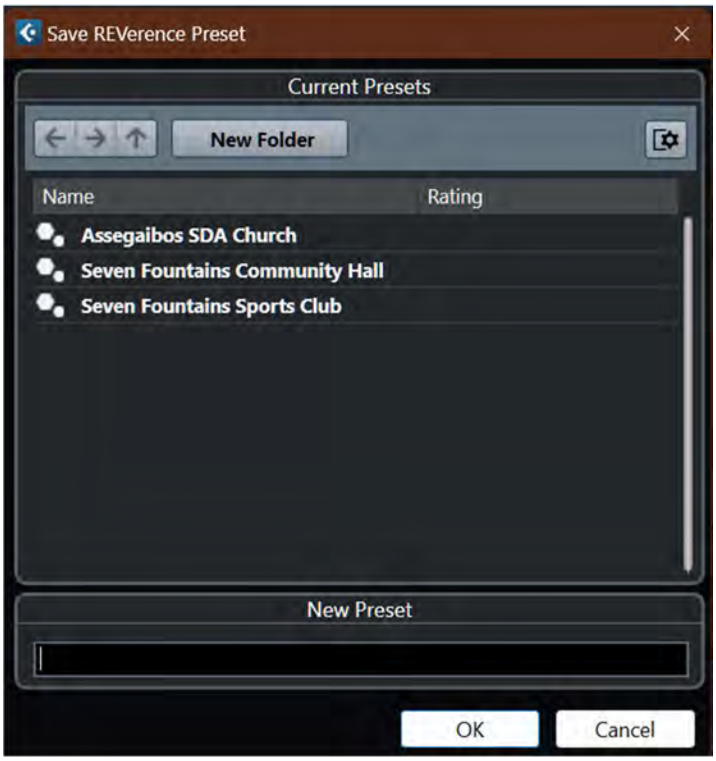

Image 6.5.5 shows the list of presets for recorded impulse responses created with the REVerence plugin.

Choir Recording

To test the convolution reverb presets created in REVerence, I recorded a local choir who specialises in isiXhosa choral music. I document this process in the following section. In doing so, I aim to show how the application of reverb cannot simply be thought of as an abstract process itself, and, in corroborating the views of the sound engineers interviewed in the previous chapter, that it is an integral aspect of every step of the recording process. A secondary aim is to show the complexities of recording community choirs.

The initial plan was to record the choir in the Department of Music and Musicology's sound technology studio. The studio has a short reverb time which would create little interference when the convolution reverb was to be applied to the recordings.[9] However, this plan was not feasible for two reasons which were not in my control. The first reason was that the choir was larger than expected, which meant that COVID regulations would not be met in the studio. The only available time for recordings also coincided with exams taking place in the department's studio, which meant that the venue was unavailable. In the absence of any other studio environments in Makhanda, I decided to use the department's main auditorium. The auditorium

[9] The exact reverb time of the sound technology studio is unknown, but an estimated time has been calculated by comparing it with the reverb time of rooms from the NTi Audio website, and the rough estimate is less than 1s.

has a longer reverb time and is much noisier than the studio, which raised the likelihood of affecting the application of the convolution reverb.[10] In an attempt to mitigate this, on the second day of the choir recording, I recorded the auditorium's empty space, which I used as a base sound for room noise cancellation.

The choir recordings took place over two consecutive Friday evenings, and lasted 1 hour 30 minutes each. While the first recording went well, the choir had chosen to perform songs with extensive solo passages in them, which I had not properly compensated for in my initial setup. As such, I requested a second recording session.

On both evenings, I used a range of different microphones available in our department's studio. In addition to the diverse selection of microphones, I decided to use the Yamaha O1V96i digital desk linked to a computer running Cubase Artist 11. On both recording sessions, I set up the digital desk for recording. The tracks were recorded in mono for all vocal parts. The Yamaha digital desk made it easy to accomplish this as it is split into 2 layers (channels 1 – 16 as the first layer and channels 17 – 32 as the second). I set up the first-layer channels for recording and to simultaneously send all the recording via the USB out channels to the Cubase DAW. Cubase was also set up for recording, and all audio tracks were set to mono. For monitoring the recording, I used Samson SR850 headphones.

Day 1

On the first Friday evening, I used 8 microphones for the recording. Each vocal part in the choir was divided into two sections. I used condenser microphones for both soprano 1 and 2, alto 1, tenor 1, and bass 1 and 2. For alto 2 and tenor 2, I used dynamic microphones. For both sopranos, I used AKG C5600 microphones. For alto 1 and tenor 1, I used AKG C460B microphones. For both bass 1 and 2, I used Samson C03 microphones. For alto 2 and tenor 2, I used SM58 dynamic microphones. I used the condenser microphones on the sopranos because their frequency responses particularly suited this voice range. I used a close microphone placement in an attempt to further mitigate the room noise.

The auditorium is separated into two sections: stage and audience section. The choir was standing on the stage and formed a semi-circle arrangement. The soprano and bass sections were positioned at opposite ends. Altos and tenors were in the middle, respectively. For vocal

[10] The reverb time of the Beethoven Room, the main auditorium for the department, is less than 300ms.

parts that had more than two choristers, I asked them to form two rows. All the strong singers for each part were placed in the front row and the rest in the second row.

The signal chain for the recording and vocalist monitoring playback was relatively simple. For recording the choir, each microphone was connected to the digital desk with the use of XLR cables. To accommodate the distance between the mixing desk and the choir, I decided to use two XLR cables for some of the vocal parts. All channels on the mixing desk were assigned to a mono USB out and to the desk stereo channel. The stereo channels were used to monitor the recording. The headphones were connected to the stereo output of the digital desk.

Having set up the studio and the recording desk, I turned my attention to the recording process. The actual recording was meant to start at 18:00, but it was important that the choristers rehearse beforehand and settle into the auditorium. The rehearsals helped the choir to familiarise themselves with the setup of the environment. While the choir was rehearsing and settling into the environment, I adjusted the gain of each channel to avoid clipping.

The recording of the choir started approximately around 19:00. I decided not to record the different parts of the choir separately. Instead, I opted to record all parts simultaneously because I did not want to lose the cohesiveness of the songs. This decision was also motivated by the fact that the choir members had a set time for departure with their transport. Some of the choir members live in the township adjacent to Makhanda, which meant making the departure time imperative. Recording the choir as a whole meant that there would be a slight bleed between tracks, which in retrospect, added to the fullness of the different vocal sections captured. In this sense, the choir recordings strongly reflected a sense of choir singing. During this session, I managed to record only two songs.

After recording the choir, I spent the following week editing. During this process, I realised that the solo passages were unbalanced against the other voices, which overpowered them. This was not the only noticeable issue. For some choir members, it was their first time in a recording session and using microphones. Some choristers were microphone shy and struggled to project as loudly as they should. Having noticed this, I asked the choirmaster to arrange another recording session with the choir.

Day 2

On the Friday following the first recording session, I had the second recording session with the choir. Instead of using 8 microphones, I decided to use 10 microphones. The same brands of microphones from the first recording session were used. The difference in the second recording session was that I decided to add condenser microphones for both the soprano and tenor solos. For the soprano, I used the AKG C5600, and for the tenor, I used the Samson C03.

The choir arrangement for the recording session changed to the front of the stage. The standing arrangement was in the form of a semi-circle, and the soloists were positioned between alto and tenor. Fewer choristers showed up for this session, which meant that some voices had one person instead of the original three, making the tracking somewhat easier.

In this recording session, I again only managed to record two songs. One of the songs was a rerun of the one song that was recorded in the previous recording session. The recording session was an hour long because I wanted to keep to the transport time for the choristers. After the recording, I again returned to the editing process.

Challenges

There were a few challenges that surfaced during the two recording sessions, one of which was the lack of experience for some of the choir members. As mentioned above, for some of the choir members, this was their first time being recorded, which meant that I had to do a certain amount of coaching on how to use microphones.

The other challenge that I noticed was time. Much like the issues brought up by the sound engineers interviewed in the previous chapter, I realised that the choir did not have the luxury of spending hours in the session. This was not because they could not afford the cost of the engineer (who was not financially compensated in this case) but because there were peripheral costs involved in travelling to and from the session. Furthermore, both recording sessions were in the evening, which meant that some of the choir members arrived tired, and although they were helpful, the rehearsal sessions made the choir members even more tired. These issues together meant that I had only managed to capture two takes for the first song and one take for the second song.

Post-Production

Over the two Friday evening sessions of recording and including sections of the rehearsals with the choir, I managed to record five songs, but only two of these were useable. All the songs have been uploaded onto an online drive. The link to the drive can be found on the appendix page of this thesis.

After completing the first and second recording sessions, I sat down and started the post-production process. During this time, I edited the songs individually. I removed all unwanted sounds by trimming certain sections of the songs. For example, on *Hamba Kahle Mkhonto*, all voice parts start except for the bass section. For that section, I trimmed out the bass section until just before it joined the rest of the voices. During this time, I was also picking the best two songs from both recording sessions. The criteria for choosing the songs was based on the clarity of the recordings and whether the choir was cohesive in their rendition. In some of the songs, some choristers did not know their lyrics or did not sing the right notes for their vocal parts. For some of the songs where I only had one take, I decided to keep only certain sections. After completing the editing process, I continued to adjust the levels, panning, EQ, and compression in the various individual project files to produce a rudimentary mix.

Before going into the detail of the processes I applied, it is important to mention that in mixing, I prefer to take an iterative approach. This approach moves from a rough to a fine mix by iterating through the processes.[11] In mixing the choir recordings, I adjust levels, pan tracks, and apply EQ and compression. The processes are applied iteratively until the recordings of the choir are cohesive. Image 6.7.1 below shows a visual representation of the iterative mixing approach.

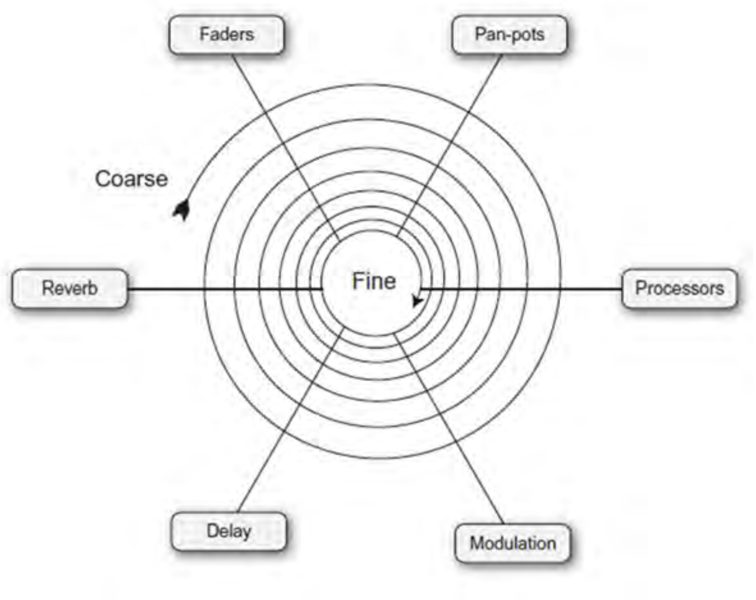

Image 6.7.1: A visual representation of the iterative process moving from coarse to fine.[12]

Initially, in the mixing process, I worked on the levels of each mono track's channel, paying attention to the balance of the choir. These were the preliminary levels and were subject to

[11] Izhaki, *Mixing Audio*, 41.
[12] Izhaki, 41.

change as I applied other processes. Following the adjustment of levels, I decided to adjust the panning of each channel. All the songs had two vocal parts for each section of the choir, and as a result of this, I decided not to pan the same voice to the same side. For example, the soprano section had soprano 1 and 2, soprano 1 was panned to the left and soprano 2 was panned to the right. This allowed each voice to be audible and not be masked by voices of the same frequency. Each track of the vocal parts was assigned to a stereo group channel. I decided to assign all the mono channels to their respective vocal group channels to keep their panning configuration and apply EQ and compression.

EQ was applied to mono and group channels. On all the voice parts, excluding the bass section, I applied a 24dB low-cut between 200Hz and 500Hz. Cutting these frequencies gave space for the bass section to be audible. On bass 1, I applied a 24dB low-cut at 50Hz, and on bass 2, I applied a 12dB low-cut at 50Hz. On all the mono voice parts, I applied two EQs. The first was meant to generally cut and boost the voices. The second EQ was meant to do specific cuts and boosts for the vocal parts. For example, on the second EQ of the soprano 2 mono track, I cut 5dB at 1kHz; on the soprano 1 mono track, I left it at 0dB. By adding the second EQ, I wanted to make the vocal part audibly distinct. On the group channels, I did the same. I decided to apply compression to the stereo group channels only and only after the EQ process. Applying compression on the mono channels brought up the noise floor, which would impact the application of the reverb negatively.

After applying each of the above processes, I revisited the levels of the mono channels and the panning configurations. The introduction of the EQ and compression processes would create an imbalance in the levels and panning, which had to be corrected. It was only at this point that I decided to apply the convolution reverb from the impulse responses recorded at Seven Fountains and Assegaaibos. I also created a mix which included the Cathedral reverb preset that comes with the Cubase RoomWorks SE plugin as a control. The preset parameters from the RoomWorks SE plugin were not changed.

I also decided not to change the default parameter values for the convolution reverb presets. Table 6.7.1 shows the different parameters with their values.

Parameter	Value
Pre-delay	0ms
Time Scaling	100%
Size	100%
Level	0dB
ER Tail Split	35ms
ER Tail Mix	50%

Table 6.7.1: A list of default parameter values determined by the REVerence plugin.

All the group channels for the voice parts were assigned to a stereo choir group. This allowed me to easily assign the different auxiliary sends to the choir group. The level of the choir group that was sent to the auxiliary sends was set to 0dB. The auxiliary sends on the choir group were also set to pre-fade to allow the control of the reverb in accordance with the fader of the channel. In the mixing console of Cubase, I controlled the amount of reverb applied to the choir group channel using the master level for each convolution reverb. The master levels were set at different levels for each convolution reverb. I decided to do this because I wanted to maintain the cohesion of the song and avoid adding too much or too little reverb to the channels.

Cubase RoomWorks SE: Cathedral preset

Alongside the convolution presets, a cathedral preset from the Cubase RoomWorks SE plugin was used to create a comparative mix. Image 6.7.2 shows the preset default parameters set by the developer. For this experiment, the parameters were not altered and were left as is.

Image 6.7.2: The image shows the parameters of the cathedral reverb preset by RoomWorks SE.

Impulse Responses and Choir Recordings

After completing the mixing process for each of the songs, I compiled spectrograms for each preset on all the songs as a means of showing some form of comparison. To compile the spectrograms, I used Sonic Visualiser version 4.5. Sonic Visualiser is an open-source application developed in the Centre for Digital Music at the Queen Mary University of London.[13] Compared to the other software application, the sonic visualiser can produce high-quality spectrograms. I produced eight spectrograms for both songs (*Hamba Kahle Mkhonto* and *Indodana*) recorded with the local choir. Images 6.8.1 to 6.8.4 are spectrogram images for *Hamba Kahle Mkhonto,* and Images 6.8.5 to 6.8.8 are spectrogram images for *Indodana*.

[13] Chris Cannam, Christian Landone, and Mark Sandler, 'Sonic Visualiser: An Open Source Application for Viewing, Analysing, and Annotating Music Audio Files', in *Proceedings of the 18th ACM International Conference on Multimedia*, MM '10 (New York, NY, USA: Association for Computing Machinery, 2010), 1467–68.

Hamba Kahle Mkhonto Spectrograms

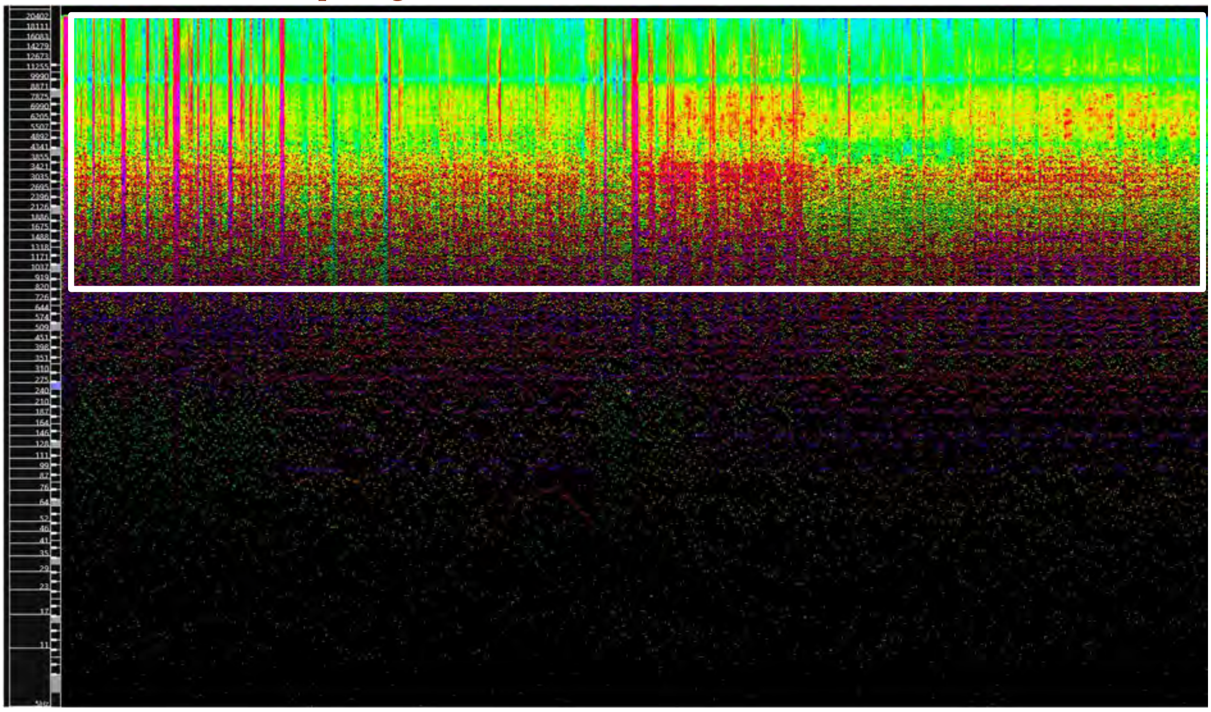

Image 6.8.1: *Hamba Kahle Mkhonto* spectrogram with the Assegaaibos SDA Church convolution reverb.

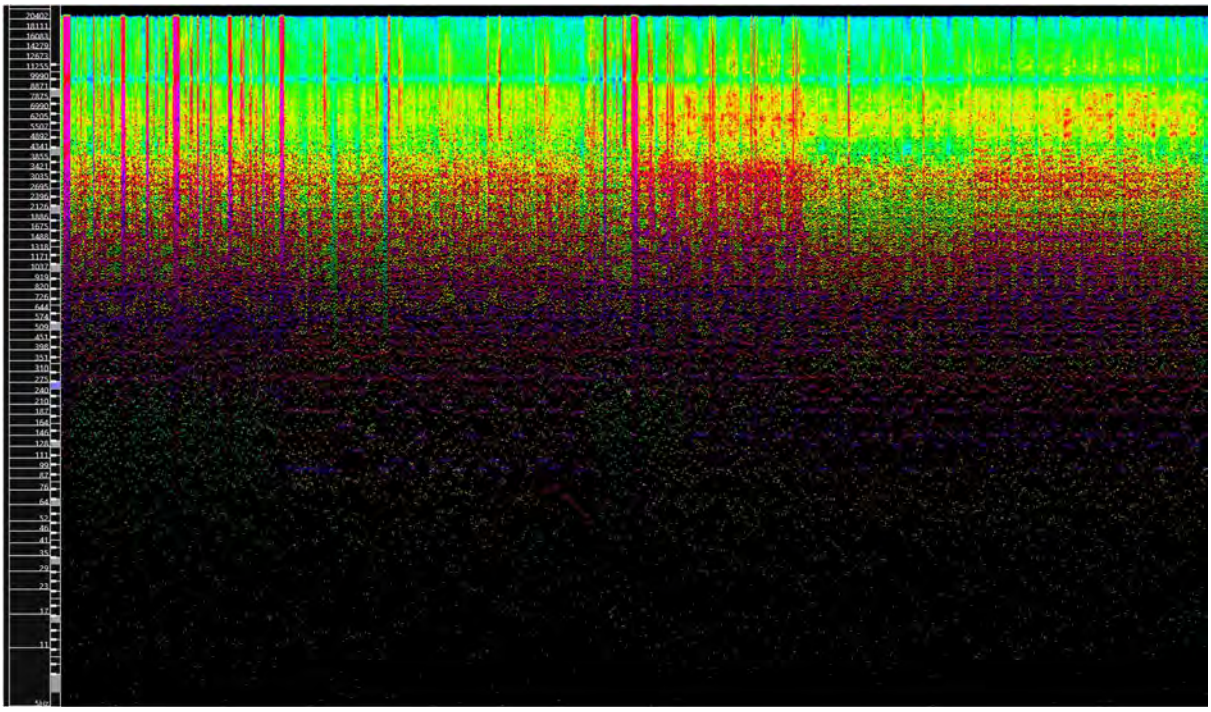

Image 6.8.2: *Hamba Kahle Mkhonto* spectrogram with the Seven Fountains Community Hall convolution reverb.

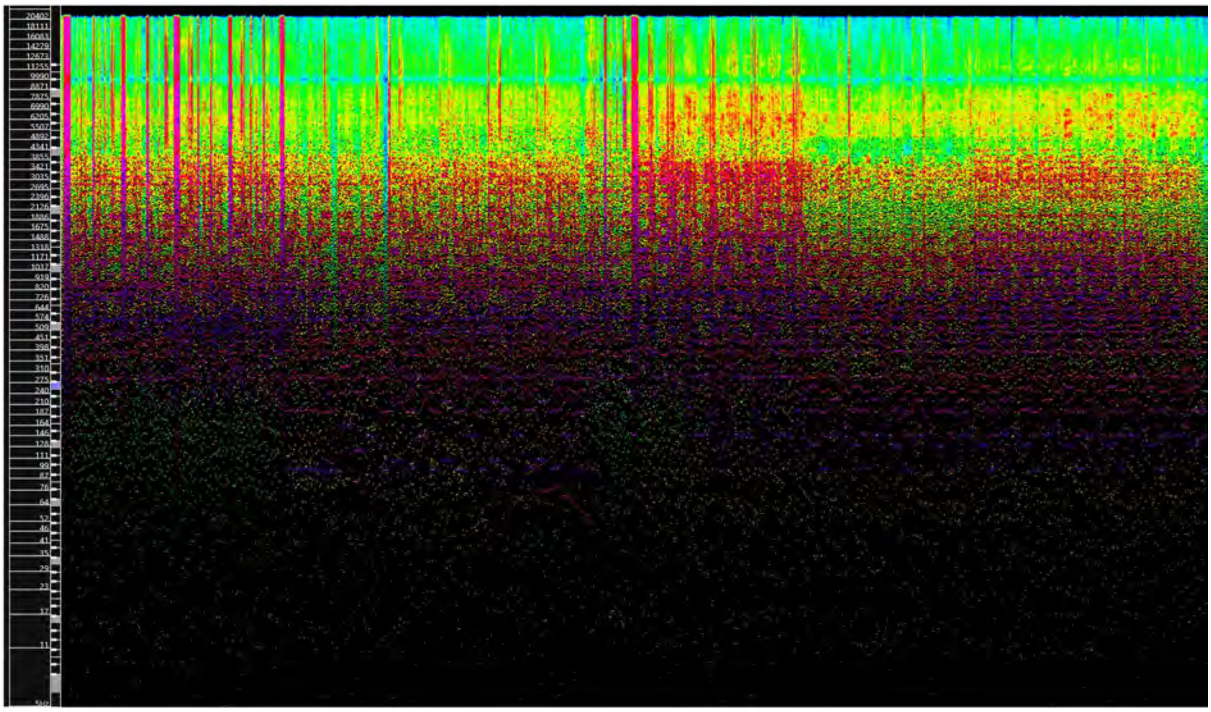

Image 6.8.3: *Hamba Kahle Mkhonto* spectrogram with the Seven Fountains Sports Club convolution reverb.

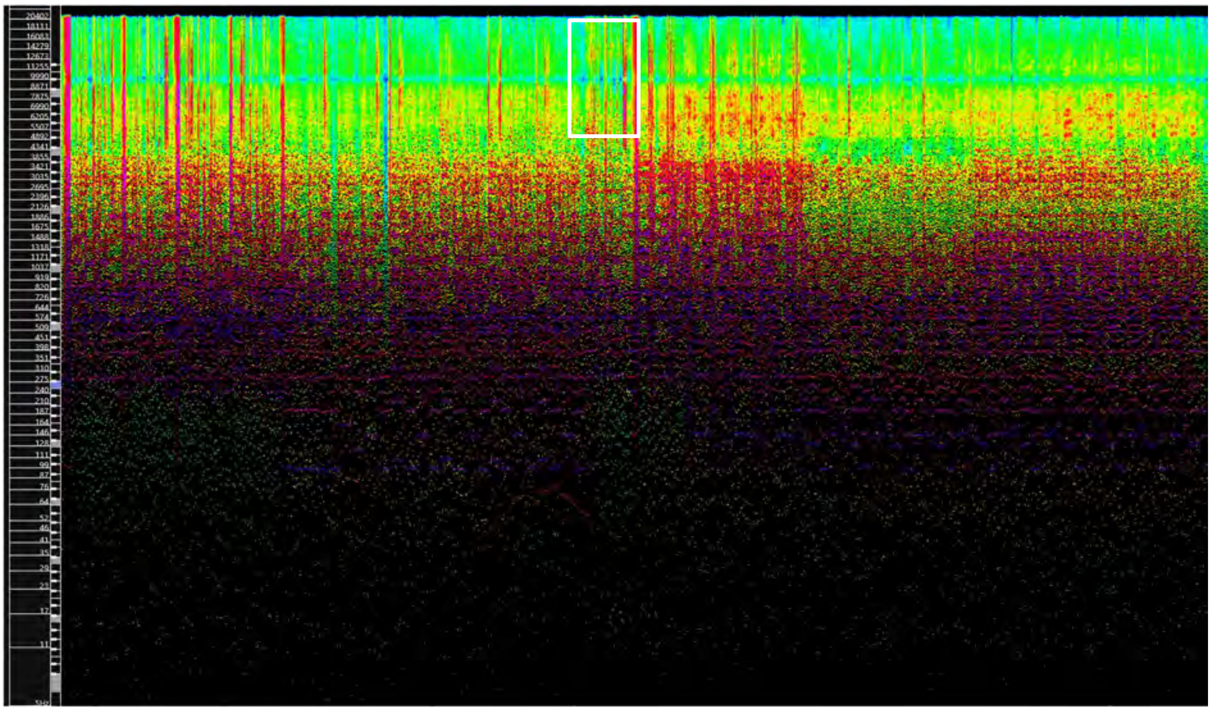

Image 6.8.4: *Hamba Kahle Mkhonto* spectrogram with the RoomWorks SE Cathedral Preset.

For the first song, *Hamba Kahle Mkhonto*, there are minor visual differences between the reverbs. In all the spectrogram images, there is a noticeable high activity from 800Hz (the area in the square outlined in Image 6.8.1). From Images 6.8.1 to 6.8.3, there are minor differences between the convolution reverbs. However, for the Cathedral preset in Image 6.8.4, the difference is visible. The square outline in Image 6.8.4 shows a section in the song where there is a visual difference when compared to previous images. The frequency density in the area of the square is higher than in the previous images.

Indodana Spectrograms

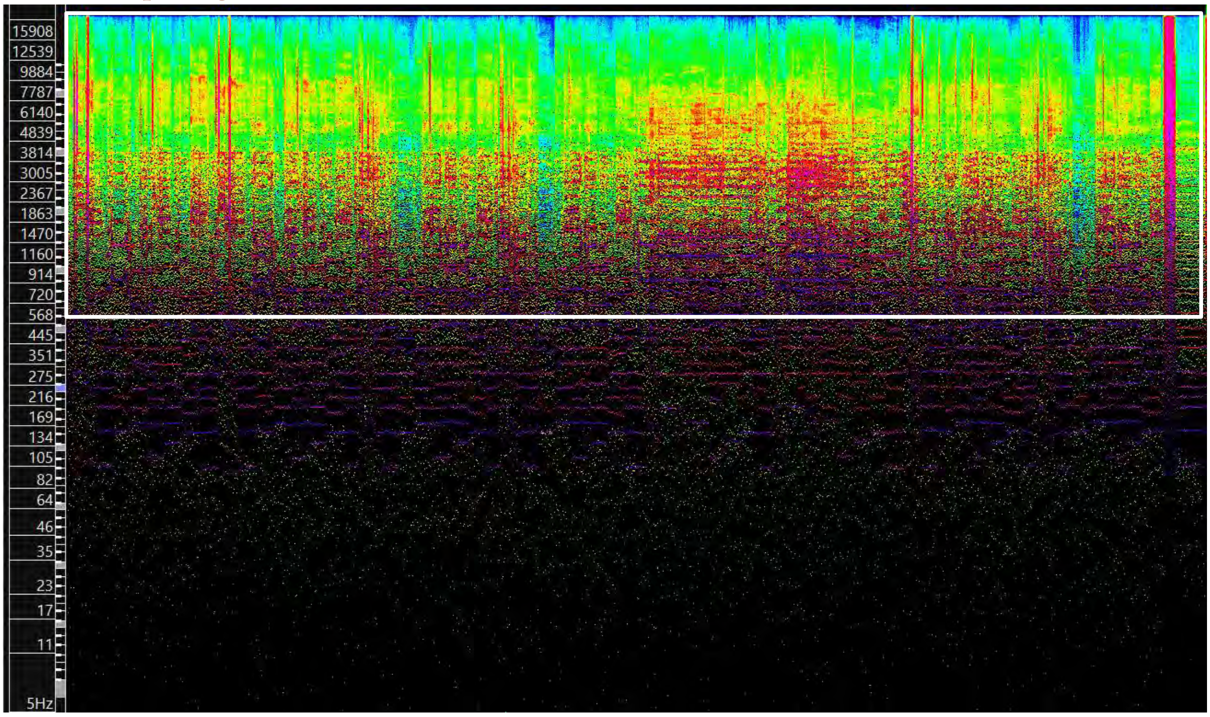

Image 6.8.5: *Indodana* spectrogram with the Assegaaibos SDA Church convolution reverb.

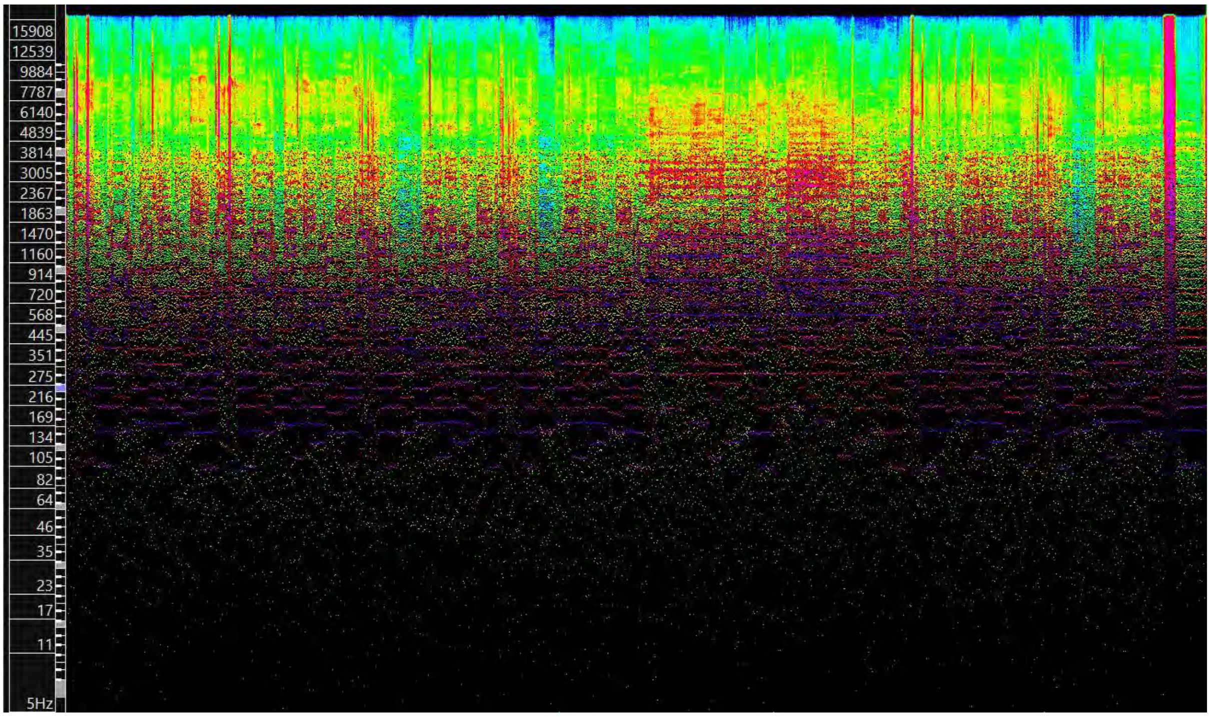

Image 6.8.6: *Indodana* spectrogram with the Seven Fountains Community Hall convolution reverb.

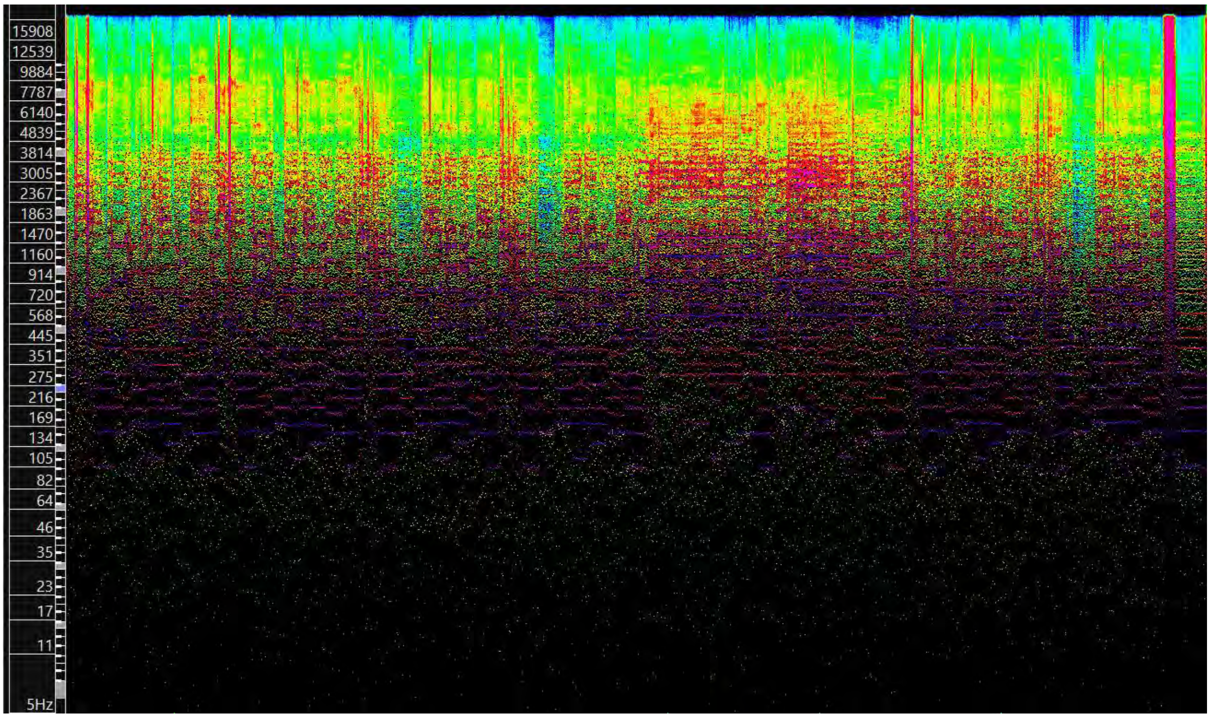

Image 6.8.7: *Indodana* spectrogram with the Seven Fountains Sports Club convolution reverb.

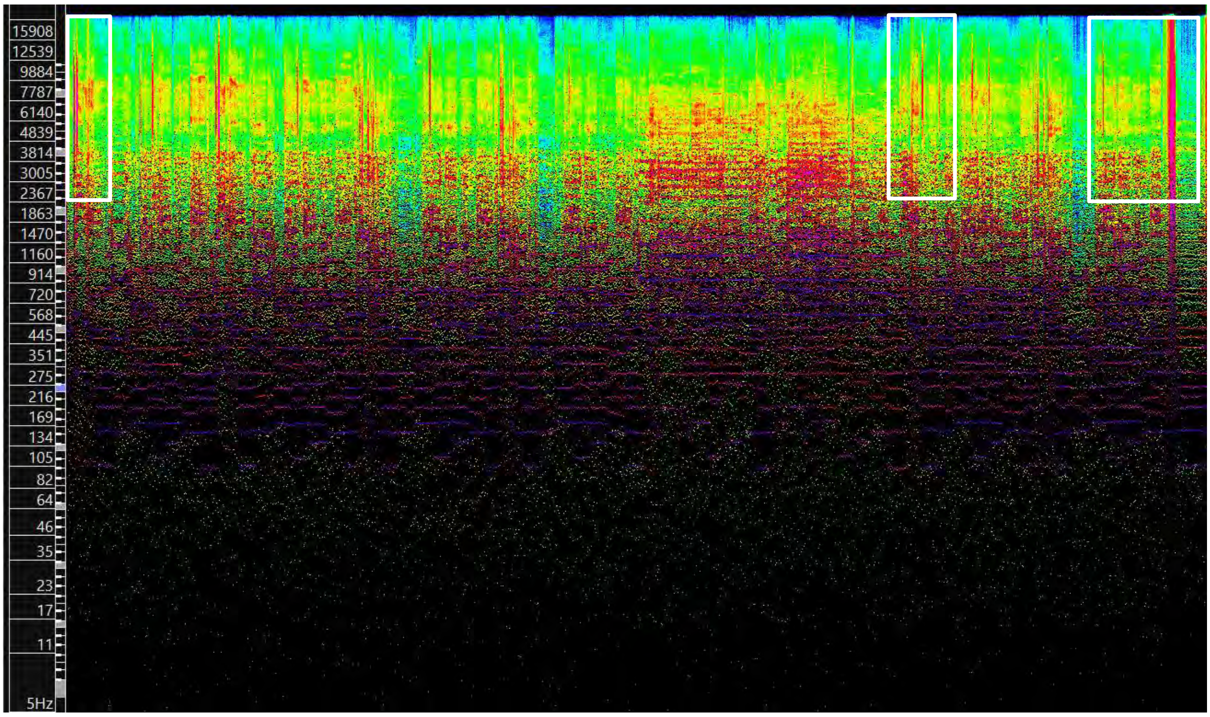

Image 6.8.8: *Indodana* spectrogram with the RoomWorks SE Cathedral Preset.

In the spectrogram images of the second song, *Indodana*, the differences are also minor between the convolution reverb presets. Like the first song, there is a relatively high activity from approximately 500Hz, shown in the square outline in Image 6.8.5. Images 6.8.5 to 6.8.7 are spectrograms of the song with the convolution reverbs, and Image 6.8.8 is a spectrogram of the song with the RoomWorks SE Cathedral preset. The differences between the convolution reverb are minute. Again, however, for the Cathedral preset in Image 6.8.8, the difference is clearly visible. In Image 6.8.8, there are three sections with square outlines showing the differences when compared to previous images.

For sonic reference, a link to the two songs referenced in this section can be found on the appendix page. When sonically comparing the convolution reverbs to the Cathedral reverb preset, room size is one difference that is perceptually noticeable. The Cathedral has a perceptual vastness. The voices of the choir are sustained for longer in this space. In contrast, the convolution reverbs sound drier than the Cathedral preset. This dryness of the reverbs can be attributed to the room sizes. All three venues are relatively small when compared to the perceptual size of a Cathedral.

Conclusion

In this chapter, I have documented an experiment in creating a set of vernacular reverb technologies. This experiment was informed by Clarke's theory of ecological listening and the notions of vernacular sound technologies discussed in the first part of this thesis. I have also drawn on the experiences of composers and sound engineers interviewed in Chapter 5 of this thesis in an attempt to illustrate the theoretical considerations developed earlier.

This experiment aimed to create a set of convolution reverb presets of venues used by local communities in Seven Fountains and Assegaaibos. The experiment was designed with the environmental factors of these sites in mind (for instance, high environmental noise levels and lack of power outlets in the venues). Even as such, the experiment was met with certain limitations, such as the inability to use a sine sweep to map the acoustic spectrum of the venues. The experiment, in this sense, does not represent the best possible way to record the acoustic signatures of rural venues, but it perhaps presents a first trial in doing so, which can be improved upon by future researchers. The main result of the experiment was the creation of three usable reverb presets, which represent the Seven Fountains community hall, the Assegaaibos SDA church and the Seven Fountains sports club, respectively.

Key to developing this technology was also the need to acknowledge that reverb is an issue that permeates all the phases of a recording project, and as such, it was imperative that a full recording session with a choir also be included in the experiment. This part of the experiment corroborated many of the assertions made by the sound engineers in Chapter 5, but also revealed how intimately the application of reverb is tied up in the process of editing and mixing recordings.

Chapter 7: Choir Focus Group Interviews

Introduction

While creating the convolution reverb presets based on impulse responses recorded at Seven Fountains and Assegaaibos presented opportunities to address some of the theoretical concerns around vernacular sound technologies raised earlier in this thesis, it is also important to see whether the soundscapes rendered here held any resonance with practitioners in the field. To test this, I designed a feedback session with some of the choristers who took part in the recording process in the form of focus group interviews. The use of focus groups allows for an in-depth discussion of vernacular sound technologies and gives participants the opportunity to share their opinions regarding issues such as identity in music.[1] The more complex issues are adequately addressed in this format because, as Morgan and Spanish argue, 'small group discussions that explores topics selected by the researcher and is typically timed to last no more than two hours.'[2] Fatemeh Rabiee further suggests that a focus group is

> a [data collection] technique involving the use of in-depth group interviews in which participants are selected because they are a purposive, although not necessarily representative, sampling of a specific population, this group being 'focused' on a given topic.[3]

In the case of this project, the choristers are indeed not representative of a sampling population of choristers (they, for instance, are not particularly active in the choral music recording market), but given the experience they had working on the recording and their specialised roles in singing isiXhosa choral music, they could contribute meaningfully to this research. In selecting this group to provide feedback on the convolution reverb, I follow Jenny Kitzinger, who argues that this form of data collection is 'particularly useful for exploring people's knowledge and experiences and can be used to examine not only what people think but how they think and why they think that way.'[4] For this project, I employed focus group interviews

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[1] McLafferty, 'Focus Group Interviews as a Data Collecting Strategy', 188; Cox, Higginbotham, and Burton, 'Applications of Focus Group Interviews in Marketing', 77.

[2] David L. Morgan and Margaret T. Spanish, 'Focus Groups: A New Tool for Qualitative Research', *Qualitative Sociology* 7, no. 3 (1 September 1984): 254.

[3] Fatemeh Rabiee, 'Focus-Group Interview and Data Analysis', *Proceedings of the Nutrition Society* 63, no. 4 (November 2004): 655; Lennox Thomas et al., 'Comparison of Focus Group and Individual Interview Methodology in Examining Patient Satisfaction with Nursing Care', *Social Sciences in Health* 1, no. 4 (1995): 206–20.

[4] Jenny Kitzinger, 'Qualitative Research: Introducing Focus Groups', *BMJ* 311, no. 7000 (29 July 1995): 299.

to allow the choristers to share their unfiltered thoughts on the topics touched on in a predetermined questionnaire. This method of focus group interviews is similar to semi-structured interviews. Like semi-structured interviews, this technique of data collection can provide access to opinions, thoughts and feelings of the participants. The questionnaire was devised to focus on three areas of concern. The first was how the choristers relate to the music they sing, while the second theme focused on their thoughts on identity.[5] The final theme was the chorister's thoughts on acoustics.

Choristers Feedback Interviews

The focus group interview was conducted with choristers who sang in the recording session and comprised university students and high school learners. The choir has been active in the Makhanda community for more than five years. They have a diverse repertoire ranging from classical Western choral pieces to choral works in various South African languages. However, their focus on specifically isiXhosa choral pieces makes them especially strong participants in this research.

The focus group interview with the choir was conducted with five questions that touched on the abovementioned themes. Table 7.1.1 below presents the questions posed to the choristers. The recordings of the choir mixed down with the convolution presets were also presented to the choir as part of the focus group interview and were interspersed throughout the discussion. To protect their privacy, all the names of the choristers have been replaced with pseudonyms to keep them anonymous[6].

1. Introduction of the choristers
2. When you sing isiXhosa choral works, how do you normally identify with the sound of the song?
3. What is your understanding of identity in music?
4. Do the acoustics of the song change your perspective of its identity?
5. What are your thoughts on the sound of the recordings?
6. In your opinion, are acoustics important in forming identity in music?

Table 7.1.1: A set of prepared questions for the choir focus group interview.

[5] In this particular instance, I am delving into the topic of identity solely to the extent of its relevance to the notion of the vernacular. I am not attempting to analyse or discuss identity in any more intricate or multifaceted ways.
[6] All quotations attributed to the choristers are taken from the Makhanda-based choir, focus group with the author, on 11/11/2022.

Analysis

The first theme that I addressed with the choristers was the techniques they used to relate to the songs they sang. I particularly wanted to see if the different venues they perform their repertoire in would have an influence on the ways they identify with the song. In their discussion, I noticed that they forge relationships with the music they sing in similar ways. Chorister X and M respectively stated the following when they were trying to convey their process.

> For me, I could say it's two things: It's the context of the song ‘cause some of the songs that we get usually have a context as to why they are written, or it could be the lyrics of the song itself, and then in most cases, the lyrics go hand in hand with how the harmony is based. So that helps me personally express that in […] the music, how I visualise like the sound is how I express the feeling.

> I think also what helps in some cases for me, ’cause usually [the choirmaster] will give us a song. Right. And he'll explain the meaning behind the song. Right. So going back to what [Chorister X] said, it's about the context. What is the song about? Why was the song written? And people relate to things differently, right. But then, for me, it goes back to what was said about the song and how do I interpret it.

In this sense, the context, lyrics, harmony, and feelings engendered by the music shape Chorister X’s process, and for Chorister M, the context is equally important. With context here, I gather that the choristers refer to the historical context that gave rise to the composition. This provides me with my first indication that perhaps ecological relationships between context (albeit historical context) and sound is important; it could suggest but equally that the situatedness of the composition with its original vernacular site of enunciation is perhaps equally important.

That said, mood and feeling, largely engendered by lyrics, are also important. Chorister X provides a practical example of this and states the following,

> for *Indodana,* for example, it's pretty apparent that it's not a happy song. So, and then with the lyrics, it's talking about *indodana,* so it helps me, I guess, express that without [smiling], as much as when we do perform, we have to engage our faces. I don't smile.

Here, lyrics, harmony and mood play a role in how the chorister relates to the music. In a case where the context of the song is not known, Chorister X relies on the lyrics of the song to provide context, which is underpinned by the harmony of the piece. In both cases where contextual information is available and where choristers conjure this context, visualisation of the sound becomes important as a means of expression. The visualising technique is tied to how they engage their body (sadness is related to not smiling). This visual impetus is essential and further suggests an ecological relationship in which sight interpolates upon the aural.

Choristers J and S take a slightly different approach in the process of identifying with the song. For Chorister S, feelings attached to life experiences play a role in the process.

> I think *boy'three abantu abathethileyo* [the three people who spoke] have said it all, but for me, I feel like I always try to, like, relate to the song, to the certain song. 'Cause as a person, *kudala silapha neh, aph' elife-ini* [we have been around for a long time]. So you get to experience certain kinds of, like, emotions and stuff. So now *xa kukh' ingoma* [when there's a song], for example, *Indodana*, the song is about loss. Everybody has lost someone. So that's what I try to do. I try to think of the person that I've lost, *okanye* [or] the emotions that I went through when I lost that person, and then I projected to, like, the song and *kwenzeke ndizokwazi* [be able to] send off the message and be able to, like, sing the song.

Chorister S's answer shows the relationality of sound to lived experiences. This is not a case of sound being split from its context but sound finding new contexts (in this case, their lived experiences) to which it attaches. Chorister J also gives a slightly different approach to the process of identifying with the song. They shared that they first look for an already available arrangement of the song to get how the song goes and how it feels. After having listened to the arrangement, they associate the feelings they get from that version to the song they are singing. Furthermore, the context of the songs also plays a role in the process. The feelings the songs evoke, together with the context of the song, form part of their process. Chorister J explains their process of connecting feelings to a song after having listened to an already existing arrangement by stating the following:

> because you have that feeling, and that feeling is connected to the song; you know exactly how to produce the sound to match that feeling, so you know exactly how to shape your mouth. For example, [in] most songs that we sing, our mouth is kind of, like, it's wide open. Like, so the sound can travel through, but that's to produce a certain feeling that we get from the song.

> So if by like everything that we do [is] based off the feeling we get from the song that matches the context, then I think for many of us we use that, and then we sing with that feeling in mind. And it kind of just, like, I feel like it's a type of thing that automatically just translates when you sing it.

The approach of choristers J and S involves projecting their feelings onto the song. The feelings can either stem from life experience or from listening to an already existing arrangement. There may be similarities in the process of identifying, but none of the choristers speak about the relationship between venues and the ways in which songs gain meaning. In reflecting on this, I realise that perhaps the choristers do not assign meaning to the immediate physical environments of performance in the same way vernacular reverb might.

To further probe this issue, it is useful to consider the chorister's responses to the second question regarding identity and music. Chorister E gives an interesting perspective on identity in music. They see identity in music as an extension of themselves. The following transcript extract is Chorister E's complete answer to the question.

> I think for me, like, my understanding of identity in music, it all stems from my individuality and how I portray myself and represent myself in my music if I were ever to create music. Because I think there would be aspects of spirituality, African ethnicity, and everything, and that would make my identity in music and the thing that I craft. I think that's basically my understanding of what identity in music is, my oneness, myself, my being.

Chorister E's answer is particularly interesting because they do not equate the singing of composed music with 'creating music'. That said, the music acts for them as a reflection of themselves. Spirituality and African identity form part of their view of identity in music, which suggests that their performances are perhaps vernacular at a deeper level. Chorister B presents a different perspective to Chorister E. They look at the music as an embodiment of identity, in a way, they immerse themselves in the music. They become the music's identity.

> For me, identity with music is treating music as if it's the most imperative thing. Well, in a sense that you have to lose yourself in order to become the music, and that's how people identify with music as in the crowd is who I'm talking about. Once they don't see a choir on stage and hear the music, that is true identity. It's something that has quite a lot of power. It can stop wars, as we have seen with the Berlin Philharmonic, and yeah, that, that's how like I identify with music.

Chorister B's answer perhaps also suggests an underlying ecological approach to music in which the mutualism between music and individual distorts the boundaries between the two. Yet their answer reflects only one part of two themes which emerge in the discussion. The other trope is that music's identity is informed by the practitioners of the music. They impose their identity onto the music, and it becomes a reflection of who they are.

Before posing the next question regarding the relationship between acoustics and identity, I play a single segment three times, each treated with one of the three convolution reverb presets. On answering the question which follows, Chorister B shares their thoughts and says the following:

> yes. I would say in a sense that it adds a certain dynamic or a certain depth to the song. I think the more kind of echo a song would have acoustically, the [more] you would have to dial back on the speed of the music, take it slower so that we can hear each thing clearly.
>
> It would change the certain feeling 'cause I think we can sing the same song, but if it's at two different speeds, it's going to change the actual feeling of the song. And also kind of like how our voices sound also changes. When you hear certain voices individually versus hearing the thing together is what I mean.

This is a somewhat disappointing answer, in which a possible discussion of place is substituted for a technical answer regarding tempo as a generic marker of identity. Yet upon further reflection, I realise that perhaps what they mean is that the music described here adapts to the acoustic signature of the environment it is being performed in. This is a significant statement because it corroborates the mutualism of ecological listening in which perceivers change their environment as much as the environment changes the action of the perceiver. In their answer, the music changes to resonate with the environment.

In the next part of the discussion, I ask directly for feedback on the recordings. As experienced regional choristers, the participants have been exposed to different venues, and they have listened to various recordings of their choir. They also have a very diverse repertoire with different acoustic qualities. I wanted to hear their critique of the recordings with the convolution reverb presets. For Chorister S, the recording made them realise that researching the venues they may perform in has an influence on the sound produced by the choir.

> My thoughts are: in order for you to, like, produce great sound, we have to research about the venues that you gonna sing in, in order for your sound to be as good as you want it to be.

Their answer speaks to the ways in which the sound engineers in Chapter 5 preemptively visit venues to ensure that they are prepared for the acoustics they will have to deal with in recording. Chorister B, perhaps in contrast, answers the question by drawing a relationship between the identity of the music and the acoustics.

> I don't know, maybe it's a personal preference, but for me, I feel as if all of these African songs […] sound much better in more drier acoustics. Like the songs themselves were built for the outside, and then when Western things are added, like those cluster chords that the Sopranos are doing, the cathedral sounds more suited.

This answer strongly corroborates what I found during the design of the presets. All three venues had a short reverb time with relatively dry impulse responses. It is an exciting answer in this sense, but I remain cautious not to ascribe too much value to it. Rather, I draw the conclusion that the answers given by Choristers B and S show that the venues of performance are important because they influence the sound produced by the choir. This, in turn, affects the viability of compositional tools, which are in some sense determined by the space of performance.

The final question in the session considers value judgements and, specifically, whether acoustics are important in the formation of identity in music. Chorister J answers the question as follows:

> I would say acoustics are important 'cause if you think about it, music, it's all sound at the end of the day. […] What my music sounds like is important. So obviously, in better acoustics, or well as chorister B said, if you have acoustic that's better suited for the type of music you're making, then your identity in your music will be kind of relayed onto whoever is listening to music.

The shift between music and sound is interesting here. It suggests, in some sense, perhaps a more ecological approach to listening to choral music in which this music takes on similar acoustic functions as everyday sounds, which through their resonant character, draw the perceiver's attention to the environment. Chorister X provides a similarly ecological answer.

> I could say yes. […] For me, well, for most people, when they think acoustics, they think the room and how the sound will bounce, but for me, I include like the people you're singing to, because they, I don't know if it's like in like a spiritual sense or in like an emotional sense, they add to the acoustic.
>
> So it wouldn't help to sing in a cathedral with, let's say, children who wouldn't understand the concept of the song. I'll just be singing it *nje* [as is], but if I sing it again in the cathedral with people who are emotionally intelligent, it helps change how you see the song *wena* [you] as a person singing and as the people receiving the song. So I do think acoustic is, like, a big part in how you identify the music.

Chorister X broadens the scope of acoustics and includes the perception of the people in the venue. The people in the venue shape how the song is delivered and also how it is received by the audience. The audience's ability to relate to the song is also vital as it adds a different dynamic to the performance of the song. The added dynamic can be attributed to the response of the audience to the song. Here, I want to suggest that we see a particularly strong correlation between ecological listening and acoustics as a vernacular technology. Of course, Clarke does argue that culture forms part of the ecology of listening, but Chorister X suggests a special kind of specificity around the identity of the listener and the environment.

Chorister B hones in on a similar specificity in their answer.

> I wouldn't say [acoustics are important in forming identity in] music, like as in the broader aspect of music. I would say for choral music, yes. And for instruments that can hold a note. Unlike the piano, 'cause I remember playing in very, very different acoustics than [the Beethoven Room] on a piano.
>
> And it all sounds the same for the piano, oddly enough. I think the most important thing when it comes to instruments is how the instrument itself is designed, but with the voice, it needs something to carry it and make it shine.

Chorister B includes the body where the sound is produced as part of the acoustics. In essence, for choral music, the body of the chorister is an acoustic embodiment of the sound. Their answer also suggests that acoustics become particularly important when there is an overlap between the sounding of music and the resultant reflection from the room. Unlike a piano, which does not necessarily continue producing sound after its initial attack, the sustained voice bounces against its reflection as it is continuously produced. This moment of interaction is perhaps the clearest indication of the mutualism between environment, sound and perceiver, which is emphatically foregrounded here in a moment of sonic collision. For Chorister B, however, this collision does not necessarily represent a distortion of tension, but a moment for adaptation and symbiosis.

Conclusion: Language and Vernacular Technologies

Within the focus group interviews, I encountered a few limitations which I did not foresee prior to the interview. One of the limitations was the language barrier between isiXhosa and English. The diversity of the choir's repertoire led me to believe that there might not be restrictions of expression in either language. However, when I posed the second question to the choristers, I realised that I should have curated the questions in a way that used everyday language without losing the essence of the question or, alternatively, conducted the interview in isiXhosa. The wording of the question especially created confusion amongst the group. The intention behind the question was to find out the ways or techniques the choristers use to better express the song they sang. This was meant to draw out their own personal experiences of relating to the diverse repertoire the choirmaster presents to them. To alleviate the confusion in the group, I rephrased the question with context and asked it in this manner instead:

> when you sing the song, you have to be present in the song, and you find a way to be present in the song. You find a way to send the message through your singing. How you sing. So, what's your method in terms of identifying with the song?

The added context to the question seemed to have alleviated some of the confusion in the group, but I did feel that some of the choir members stopped engaging after this point. In addition to this limitation, during the introduction section of the interview, I asked the choristers to answer the questions in English. I believe this also contributed to the low number of responses from the group. This issue highlights how vital the role of language is in this discussion. Of course, the notion of the vernacular stems from a regional particularity in language and this should have suggested to me that in speaking about vernacular technologies of reverb, it might have been best to do so in the language associated with this technology (in this case, isiXhosa). In some sense, the fact that I did not make this initial connection perhaps betrays a certain universalism that I associate with technology, namely, a universalism of English as a *lingua franca* for communicating about technology. In another sense, it perhaps betrays a universalism around the scientific nature of acoustics, which holds that as 'natural fact', the language in which it is spoken about is immaterial. The focus group showed me that this is not the case, and that language forms an important part of the ecology of vernacular technologies.[7]

[7] This point has been made more broadly about epistemologies of the Global South as they are recentred in the process of knowledge creation. See, for instance, Achille Mbembe, 'Decolonizing Knowledge and the Question of the Archive', 2015, https://wiser.wits.ac.za/system/files/Achille%20Mbembe%20-%20Decolonizing%20Knowledge%20and%20the%20Question%20of%20the%20Archive.pdf; Laurent Dubois and Achille Mbembe, *Critique of Black Reason* (Durham: Duke University Press, 2017); Carina Venter, William Fourie, and Neo Muyanga, 'Decolonising Musicology: A Response and Three Positions', *SAMUS : South African Music Studies* 36–37, no. 1 (2018): 129–56.

Chapter 8: Conclusion

In this thesis, I argued that identity in isiXhosa choral music is formed by and challenges the sound technology that is used today. By considering theory and practice, I showed that sound technologies are crucial to determining the overall aesthetics of this music as it relates to its context in terms of compositional strategies, recording practices, and choristers' own engagement with this music. Equally, however, through an experiment in vernacular sound technologies, I suggested one possible way of departing from the recreation of conventional generic acoustic signatures in the post-production process of this music, thereby challenging normative practices in this space. To do this, I explored four theoretical issues – schizophonia, ecological listening, reverberation, and vernacular technologies – in relation to practices of composing and recording isiXhosa choral music.

To conceptualise how we might engage with the acoustic characteristics of spaces of choral music performance, I explored schizophonia and ecological listening. I showed how schizophonia conceives of a separation between source and sound as a result of the use of recording technology. In the case of choral music recordings, the sound would be the recorded voices of the choristers, and the source would be their bodies resonating in the local environment. Schizophonia, according to Schafer, would occur when these voices are recorded and stripped away from their corporeal and spatial contexts. Problematising this conception of listening, I suggested that what is perhaps most important in Schafer's theory is the need to remain conscious of the context of recorded sound. To pursue this line of thought, I turned to Clarke's notion of ecological listening, in which such a separation is in some sense impossible because it disregards the mutualism between listener and environment when sound is perceived. Clarke's theory, building on the earlier work of James Gibson, proposes three important relationships between perceiver and environment, namely affordances, resonance, and adaptation. These relationships describe the ecological nature of perceiver and environment in which the environment provides certain perceptual affordances, the perceiver resonates with these affordances and the environment. The perceiver adapts to ensure the best fit between the two.

Using these two models, I turned to the history and theory of reverb. My argument here was that reverb presets provided by some of the most popular DAWs are culturally biased toward Western spaces. I then further developed this argument by suggesting that the model of the Western concert hall remained throughout the development of generic digital reverb algorithms and thus deepened this bias but also reflects a type of schizophonia in terms of having context go unarticulated. In contrast to this, I suggest convolution reverb as a possible way in which sensitivity to context can be retained, and a type of ecological listening can be foregrounded in the post-production process.

That said, the theoretical supposition here still needed to be grounded in the specificity of isiXhosa choral music's contexts, which led me to suggest that there is a need to think about this form of reverb as a vernacular sound technology. This view stands in contrast to the types of technological universalism which dominate sound technology, which also assumes a Western-centric position. Technologies in the broad sense have been dominated by scholarship of the Global North. To critique this notion, I proposed considering vernacular technologies as a framework in which to think about sound technology. This term is drawn from discourses in architecture, and refers to forms of architecture that are a social representation closely linked to belief systems and cultural values of specific communities. In this sense, vernacular technologies also suggest the culture of technology which is formed by music, art, dance, and architecture of local communities. The vernacular sound technologies thus refer to sound technologies which enable the use of the aural affordances of cultural tropes specific to certain communities.

While the first part considered the theoretical framework for a vernacular reverb technology, Part II of the thesis focused on illustrating this theory in empirical research. For this, I conducted interviews with two local isiXhosa choral composers and two sound engineers who have experience in recording isiXhosa choral music. The interviews with the composers revealed that they do consider acoustics in their compositional processes both in terms of practical issues around venue sizes and in terms of aesthetic content in their compositions. Both composers, however, felt that current technologies do not adequately capture the acoustic spaces of their compositions. Interestingly, one of the composers remarked that the technologies should not attempt to recreate the performance space, a sentiment that I read as acknowledging the ecological possibilities of virtual environments. The interviews with the sound engineers revealed a number of interesting considerations in this field, especially around the financial burden of recording. The ability to conjure new performance spaces, as suggested by one of the composers, was also raised by the sound engineers, particularly in relation to dealing with so-called "bad acoustic" spaces. I suggested that this term might be understood as a shorthand for venues which do not conform to the pliable spaces engendered by generic artificial reverb.

Drawing on the experiences and thoughts of the composers and sound engineers, I then developed a set of reverb presets which reproduced a form of ecology in isiXhosa choral recordings using convolution reverb. Convolution reverb is a result of codifying the acoustic character of a space by exciting it with an impulse, which allows for a realistic aural recreation of spaces. To create this form of reverb, I recorded the acoustic signature of three spaces local to the Seven Fountains and Assegaaibos area. The spaces were the Seven Fountains community hall, Assegaaibos SDA church and the Seven Fountains sports club. The three spaces were then used in choral recordings of a local choir. I used the impulse responses recorded to create a set of reverb presets, which were then applied to a recording made of a local choir who have experience in singing isiXhosa choral music.

The mixed recordings were later played back to the choir during a focus group interview. This discussion revealed a number of interesting points regarding how these choristers engaged with music, including the importance of context in forging a connection with the music, that a sense of vernacular situatedness is of importance in making music, and lastly, that there is for them a sense of ecological adaptation in the performance of this music that is informed by the sites of performance.

In sum, I showed in this thesis how the application of convolution reverb in isiXhosa choral music recordings might engender notions of space in choral music, which are acutely linked to issues of identity. The recordings at Seven Fountains and Assegaaibos have shown that acoustic space is a technological marker of identity, and indigenisation also has to do with the acoustic characteristics of the spaces of choral music performance.

Limitations and Avenues for Future Research

While this thesis yielded important insights in the debates around the relationship between sound technology and spatial identity, there are still a number of shortcomings and limitations which need to be addressed. In the first theoretical part of the thesis, and especially in the discussion of reverb, an important consideration was left underdeveloped, namely that of taste and value judgement in the use of reverb. This is a vexing issue which I have found able to disarm even the most theoretically sophisticated discussions around post-production. As much as one can establish sound theoretical grounds for approaching reverb in a certain way, at the end of the day, its use is largely determined by the values of the choir or the sound engineer. This is not to say that these values cannot or should not be critiqued, but rather that there is a danger in this discourse which emerges in its reduction to a question of preference. How one deals with the issue of preference in relation to theories of perceptions or ideological critiques in discussions of vernacular technologies needs to be carefully thought through.

Another theoretical conundrum arises in the assertion about DAWs as hungry listeners, which has not been adequately addressed in this research. This issue concerns the critique of Western-centric technologies but the continued dependency in the absence of alternative systems. As much as I argue that DAWs abstract sound from its context, I still go on to use these same systems to create a type of reverb that is sensitive to context. I do not feel that this undermines the value of the experiment, nor do I think that this detracts from the critique of Western-centric technologies. Instead, I want to suggest that it points to a need for more research into the relationship between digital sound technologies and cultural practices that do not neatly align with them.

In the development of this thesis, I also encountered a number of practical challenges which influenced the research. One of the most significant was the inability to generate a sine sweep as an impulse in the different venues. One of the results of this was that the impulses that were used in the end did not vary much in terms of frequency distribution. Both impulses that were used had predominantly high presences of high frequencies. This dominance of high frequencies thus may only have activated equally high-frequency responses in the venues, thus only reflecting a partial sonic signature of the space. I want to suggest that future research in this area considers using a broader spectrum of impulses to register the full spectrum of impulse responses more carefully. Other considerations in designing a similar experiment in the future might also include testing various microphone placements and changing the absorption factor of the room by including people to mimic a real choral performance.

The use of the REVerence plugin as a tool to create the presets presented both advantages and disadvantages. The main advantage was that it was able to create an abstract impulse response by separating the impulse from the impulse responses recorded at Seven Fountains and Assegaaibos, which is a highly complex algorithmic process which can easily be miscalculated when executed manually. However, this type of black box approach meant that I was not able to interrogate the actual creation of the reverb presets more deeply. Future research in this regard will be required to dissect this algorithm and determine the accuracy with which it extracts the impulse from the impulse response.

Several limitations in the interviews should also be noted. Even though these interviews were helpful in the research, I acknowledge that my lack of interview experience may have limited the data collection, especially in the focus group held with the local Makhanda choir. The choir predominantly comprises choristers who do not use English as a home language and are more comfortable communicating in isiXhosa. An experienced interviewer may have encouraged the choristers to share their thoughts in the language they feel most comfortable with, which may have significantly changed the results of the data collection. In future research, I suggest that more attention is paid to language. As stated at the end of Chapter 7, when dealing with issues of vernacular identity, whether in technology or cultural practice, it is important to revert to the lexigraphy and taxonomies of the cultural bearers whom the research purports to represent.

Appendix

All the recordings mentioned in this thesis are on the Google Drive cloud storage link below. The folder has three folders: presets, impulse responses and choir recordings.

https://drive.google.com/drive/folders/1TSAOMxcZg2pIHzjZrC4BRRxHVz0lgR-0?usp=share_link

Convolution Reverb Presets

Each preset is available for cloud storage download and compatible with the REVerence plugin. In an instance where the presets are incompatible, I have provided the stereo .WAV file for all impulse responses. Table 1 below shows links to specific presets and to the folder hosting the presets. Table 2 shows links to the impulse responses of the venues and a link to the folder hosting the impulse responses.

Preset Name	Link
Assegaaibos SDA Church	https://drive.google.com/file/d/1L-KwX9BFSM9vqcHLSAxZWGQ59gUZQ4CV/view?usp=share_link
Seven Fountains Community Hall	https://drive.google.com/file/d/1QjU0CcT_CVrEEHvma6EDQbNxjeMTx5S6/view?usp=share_link
Seven Fountains Sports Club	https://drive.google.com/file/d/19Jpm9esLGTBQ0WLmYFEnCOpBqbdfwCWi/view?usp=share_link
Folder link	https://drive.google.com/drive/folders/1PNikSse3s-i8zbaNJugvdq8RJWek8ihl?usp=share_link

Table 1: Links to the convolution reverb presets of the Seven Fountains community hall, Assegaaibos SDA church, and Seven Fountains sports club.

Impulse Response	Link
Assegaaibos SDA Church-IR	https://drive.google.com/file/d/16g5NXHMQqosGRpxnfBVtZjPM1f18S3wU/view?usp=share_link
Seven Fountains Community Hall-IR	https://drive.google.com/file/d/1xUWB0g3-T56ySHxyWzRSVpQWd0xmuQYO/view?usp=share_link
Seven Fountains Sports Club-IR	https://drive.google.com/file/d/1dIOipeeO8CCJIOR29_wTx1j1nW7DZeBX/view?usp=share_link
Folder link	https://drive.google.com/drive/folders/1LGc3IfyKvJGfVSufneP-aexh-_yz33uT?usp=share_link

Table 2: Links to the impulse responses of the Seven Fountains community hall, Assegaaibos SDA church, and Seven Fountains sports club.

Choir recordings

The tables below show links to the two songs recorded for this thesis. There are four versions of both songs. Each version is linked to a different convolution reverb preset, including the version with the RoomWorks SE cathedral. Table 3 has links to the versions of the first song – *Hamba Kahle Mkhonto* – and Table 4 has links to the versions of the second song – *Indodana*. The last row of each table has a link to the folder hosting all versions of each song.

Song name and preset	Link
Hamba Kahle Mkhonto - Assegaaibos SDA Church	https://drive.google.com/file/d/1OhoAIdfS08ozlNUE_aJEEkZSzO5LL4jp/view?usp=share_link
Hamba Kahle Mkhonto - Seven Fountains Community Hall	https://drive.google.com/file/d/1oREyT8XrjYz3axj1XIRHBWwz5fOrcjoz/view?usp=share_link
Hamba Kahle Mkhonto - Seven Fountains Sports Club	https://drive.google.com/file/d/1vu4SXw3uyvSU-uhPuG-Xb4l-jDgIkPk_/view?usp=share_link
Hamba Kahle Mkhonto - Cathedral	https://drive.google.com/file/d/1Rc3O2Gh_kOHBt7vHmJ-lSYx99tAEiwtQ/view?usp=share_link
Folder link	https://drive.google.com/drive/folders/1YfTgyu5paj1KUoT6qvs2yNQCR6QJ2pmj?usp=share_link

Table 3: Links to four versions of the song *Hamba Kahle Mkhonto*.

Song name and preset	Link
Indodana - Assegaaibos SDA Church	https://drive.google.com/file/d/14Cyzuv0i-J_gQF-EhleDTgaI6CxyumRq/view?usp=share_link
Indodana - Seven Fountains Community Hall	https://drive.google.com/file/d/1mTybdGHQiTjt4yFlA5YYdCnnrfoefM-p/view?usp=share_link
Indodana - Seven Fountains Sports Club	https://drive.google.com/file/d/1J2l5_zTw4saZxSFalhmyQGjme_-1sM-6/view?usp=share_link
Indodana - Cathedral	https://drive.google.com/file/d/1QPSjmJv3nr1DosO2y925Ipif_eauuhNP/view?usp=share_link
Folder link	https://drive.google.com/drive/folders/1w2BP6RQYITsYW2o4cqMpO1KZQYH6Tfn3?usp=share_link

Table 4: Links to four versions of the song *Indodana.*

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