Digital Sound:
On Technology, Infidelity and Potentiality

Ben Byrne

University of Technology Sydney
New South Wales, Australia

'Digital Sound: On Technology, Infidelity and Potentiality' attempts to rethink digital sound. Working intimately with digital technologies in my own practice as a performing musician, exhibiting artist and writer I find that digital technologies exert an acute influence over not only the work I produce but the way in which I engage with and conceive sound. Most theoretical discussions around digital sound, however, have largely failed to go beyond mere aesthetics. This is exemplified by the most prominent theory of digital sound, Kim Cascone's 'aesthetics of failure', which this article addresses in detail. Undertaking an extended investigation of digital sound utilizing Martin Heidegger's theory that Technology should be approached as a system, Gilles Deleuze and Felix Guattari's conception of striated and smooth space and Giorgio Agamben's thought on potentiality, alongside more recent articles written specifically about digital sound, this article aims to construct an understanding of digital sound as more than just an aesthetics of digital technology. It suggests that digital sound is a complex potentiality and explains digital technologies' role as agents of a system of Technology that mediates sound.

Introduction

Since the invention of phonography, the once ephemeral phenomenon of sound has existed as a cultural artefact that can be recorded and reproduced using technologies of sound reproduction and manipulation.

One of the earliest phonographic technologies was the phonautograph, developed in 1857 by Éduoard Léon Scott de Martinville, however Scott's machine was able only to transcribe sound, not reproduce it, and so it was not until Thomas Edison's phonograph that sound became not only recordable but reproducible [1]. Subsequently, Emile Berliner's development of the gramophone extended the reproducibility of sound to a scale of mass production through a shift to recording on pressable flat plates rather than the wax cylinders Edison used in the more developed model of his phonograph [2]. The development of phonography meant that for the first time sound could be captured, allowing not only its reproduction, storage and transportation but also the possibility of its manipulation.

Conceptions of sound and interactions with it have become mediated by technologies external to the body, opening a world of sound to be explored and exploited while at the same time entrenching technology at the very heart of engagement with sound.

Approaching Digital Sound

Digital technologies are the most recent in a long series of technologies of sound reproduction and manipulation that have gradually been developed, explored, subsumed and replaced since the advent of phonography in the nineteenth century.

Sound is now reducible to the binary condition of zero and one, on and off, and with that development

has come the emergence of digital sound. The role of technology in the mediation of human experience of sound is more explicit than ever and digital sound has become of interest to academics. Kim Cascone, one of the first theorists to deal seriously with the area of digital sound, coined the term 'post-digital' in reference to the specifically digital sound culture that emerged in the nineties, demonstrating explicitly the influence of digital technologies on sound. Suggesting an 'aesthetics of failure' he argues that digital sound is defined through the unique artefacts of error that result from the malfunction and failure of digital technologies. However, although aesthetically Cascone's theories have resonated with the work of many artists, particularly in the sounds produced by artists such as Oval, Yasunao Tone, and others over the last three decades, his theories have also demonstrated an element of technological determinism.

Developing an understanding of the function of digital sound, rather than a constructed aesthetics of digital sound, is crucial in engaging with digital technologies' agency on all sound. Only through such an investigation is it possible to explore fully the implications digital technologies have for engaging with sound, be it through esoteric sonic experiments, more traditional musical endeavors or even just listening to the world.

Understanding Technology as a System

Martin Heidegger argues in his essay 'The Question Concerning Technology' that all technologies are part of a greater system of Technology. Heidegger suggests that the two most common definitions of technology, that 'Technology is a means to an end' and that 'Technology is a human activity', together can be seen as the instrumental view of Technology [3]. In his opinion such a view places technology as subservient to the human subject and so 'everything depends on our manipulating technology in the proper manner as a means' [4]. However, he is dissatisfied with the instrumental view of technology, concerned that 'so long as we represent technology as an instrument, we remain held fast in the will to master it' and argues:

> *Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it. But we are delivered over to it in the worst possible way when we regard it as something neutral; for this conception of it, to which today we particularly like to do homage, makes us utterly blind to the essence of technology [5].*

Having traced the modern 'technology' back to the Greek technikon and, in turn, its root techné, which is related to epistémé and 'knowing in the widest sense', Heidegger arrived at a larger view of Technology as a kind of systematic treatment of an art or craft [6]. As Ursula Franklin comments:

> *Technology is not the sum of the artifacts, of the wheels and gears, of the rails and electronic transmitters. Technology is a* system. *It entails far more than its individual material components. Technology involves organization, procedures, symbols, new words, equations, and, most of all, a mindset [7].*

Technologies of sound reproduction and manipulation are an excellent example of the action of a system of Technology. As Jonathan Sterne argues in his book *The Audible Past*, 'the possibility of reproduction precedes the fact' such that the effect of the technologies is not to allow the recording and manipulation of some sounds but rather to render all sound recordable, mutable and even, theoretically, synthesizable. Technology has changed how people relate to sound and, to an extent, the nature of sound itself [8].

The Role of Digestion in the Development of Technologies

Technologies are developed upon the foundations and paradigms established by preceding technologies. In his paper 'Holes In The Head: Theatres of Operation For The Body In Pieces' Gregory Whitehead argues that 'successive generations of technology do not so much displace as *digest* each other' [9]. Writing specifically about radio, he claims that:

> *Churning through several generations of media, such digestion is never complete: dissect a radio, and you will find the remains of a book; dissect the book, and you will find the remains of a larynx; dissect the larynx, and you will find the skeletal trace of a twitching finger, lighting a match and sending a telegram; take the prints from the finger, and there you will rediscover the origins of radio [10].*

Digital technologies of sound reproduction and manipulation do not exist independently of the other technologies that have preceded them but rather contain within many of the preceding developments.

R. Murray Schafer coined the term 'schizophonia' to describe the contemporary situation in which 'sounds have been torn from their natural sockets and given an amplified and independent existence' [11]. In his book *The Tuning of The World*, Schafer explained

the meaning of 'schizophonia' as the 'split between an original sound and its electro-acoustical transmission or reproduction', providing a definition for the effect on the perception and conception of all sound that results from the introduction of technologically mediated sound [12].

John Potts subsequently extended this notion in his article 'Schizochronia: Time In Digital Sound', explaining that technologies of sound reproduction and manipulation not only sever sounds from their initial sources but also from their initial times such that the contemporary concept of sound is not only schizophonic, but also schizochronic [13]. For instance, while 'all of the analogue audio techniques - cutting, fading, mixing, looping, delay, reversing - are honed with greater precision and control in the digital domain' digital technologies also complete a technological deconstruction of the notion of sound as tied to the progressive flow of time [14].

Instead of recording sound as a linear flow of data, as is done in the spirals of holes on a record or lengths of magnetic fields on analogue tape, time in digital editing is much more supple as data is recorded as stores of binary information independent of existing constructions of time such as those produced by the motors of a turntable or reel-to-reel tape player. Potts explains further:

> *Digital audio presents us with a range of paradoxes. Its high precision encourages non-linear editing, in which material can be retrieved and assembled in any order. Its mathematical nature offers an infinite number of choices in non-destructive editing. It is based on tiny slivers of frozen time, yet it offers inexhaustible means to explore the ambiguities and flux of time. These paradoxes proceed from its central concept, which comprises the greatest paradox. Its stuff is numerical information, yet that stuff is a non-stuff, manipulable to an unprecedented degree. Its binary language is brutally simple, but the ways it invites us to think and create are unfathomably complex [15].*

Approaches to the manipulation of sound such as the loop, originally made possible by the locked groove of a record and subsequently more practical through the editing of a tape loop, remain prevalent as perceptual constructions of sound, but sound exists in the digital domain stored as buffers, x/y graphs of binary data that can be read in non-linear ways. While the loop implies a linear, if eternally returning, conception of time, the buffer is nothing more than an array or graph of data and does not enforce the sense of linear time inherent in phenomenal sound. It is the table of contents, codec and reader and not the mechanism of the technology itself that constructs linearity in the data manipulated by digital technologies and this shift has huge implications for how people think about and work with sound.

The 'Sound' of Digital Technology

The use of digital technologies to record and manipulate sound focused originally on the replication of existing 'musical' sounds, the possibilities of the digital used to replicate, sample and synthesize wind, string and percussion instruments. However, as Douglas Kahn argued in his paper 'Audio Art In The Deaf Century', 'recent digital sound technology has made an expanded concept of the instrument unavoidable' and so digital sound has begun to be considered in its own right, confronting the unique situation presented by these technologies [16].

Significantly, digital technologies are the first technologies of sound reproduction and manipulation that in recording and storing sound do not create an overt, physically representative materiality such as occurs in the construction of the object of the vinyl record or magnetic tape. Instead, digital technologies produce a potentiality that lacks any obvious tangible materiality, giving the impression that they sever sound more severely from its existence as a phenomenon of vibrating particles or waves of pressure. However, despite the fact that digital technologies certainly lack the haptic qualities of analogue sound technologies because they do not produce a tactile object that can be easily physically manipulated with audible results, there is still a materiality to digital technologies.

Digital sound is commonly theorized as dealing with sound at the level of the molecular, the miniature, or the granular. The reality of this, as Potts pointed out, is that, despite the flexibility offered by digital technologies, 'its principles are mathematical, its mode is extreme precision' [17]. Digital technologies impose a mathematical construction of sound divided into miniscule blocks, bits and samples. Nevertheless, the common conception that such technologies replace the continuous phenomenon of sound with the segmented, interrupted, non-linear abstraction of binary data is not entirely correct. Jonathan Sterne rightly points out his article *The Death and Life of Digital Audio* that sound in the digital world is not necessarily any less 'live' than any other sound and it is important to realize that:

> *Discontinuous modes of data storage can still provide full modes of sensory experience, and this is a sensory effect, not an illusion.*

> *Thus, we cannot say that the segmentation of digital media renders them fundamentally different from analogue media, and we cannot say that their segmentation renders the experience of digital media inherently less full or substantial than the experience of analogue media. [18]*

Digital technologies do have significant new implications for how people engage with sound but they are nonetheless a part of a long lineage of technologies that reproduce and/or manipulate sound and, rather than being based in any kind of aesthetic of poetic construction, digital sound is a complex potentiality that operates on all sound, exemplifying digital technologies role as agents of a greater system of Technology through which understanding of all sound is mediated.

The 'Post-Digital' Myth

Digital technologies emerged brandishing the promise of 'perfection', of absolute fidelity and uncompromising quality. In the realm of digital sound, this meant a promise of immediacy, of a technological sound free of the surface noise, pops, clicks and noise floors that had characterized previous generations of analogue discs and tapes. However, digital technologies represent the most total and enveloping system of mediation, in which all sound is rendered into the binary data of zeros and ones through complex, and increasingly oblique, processes of computation and translation – introducing the increased possibility of error and malfunction, of data loss and corruption. Digital technologies have come to extend, and even further complicate the role of technologies of sound reproduction and manipulation as technologies of mediation, guiding and influencing peoples' interactions with sound. Rather than producing absolute fidelity in relation to some imagined 'real' sound, digital technologies have cast a net over all sound, reading it through a mathematical language, dividing it into 'bits' of information that can be re-read, re-ordered and re-imagined. Inherent too to this process is the error, the malfunction, the 'glitch' – the digital, like the technologies before it, stamping itself through its infidelity. Consequently investigations into digital sound have focused on the 'glitch' as a way to the essential in the digital, expressed through its failure to meet the expectation of fidelity and perfection placed upon it.

The Aesthetics of Failure

In his seminal article 'The Aesthetics of Failure: 'Post-Digital' Tendencies in Contemporary Computer Music', Kim Cascone claims he was inspired to coin the term 'post-digital' by a quote from Nicholas Negroponte, 'the digital revolution is over' [19]. He argues that we have reached a situation in which 'the tool has become the message' and to date his 'post-digital' aesthetics remains the most prominent attempt to engage directly with digital sound [20]. Based on the sounds of the failure of digital technologies, Cascone theorizes a conception of 'post-digital' music as 'a result of the immersive experience of working in environments suffused with digital technology'; a response to the technologies themselves, an 'aesthetics of failure' [21]. However, although the 'post-digital' music to which his theory refers foregrounds Technology as more than merely instrumental, recognizing the agency of the technologies themselves, it is a digital sound that focuses heavily on notions of the existence of strictly digital sounds rather than on the effects of digital technologies on all sound.

Applied to technological, and in particular digital sound, this position would seemingly suggest that digital sound is nothing more than the product of digital technologies, when in fact digital technologies are mediating technologies intimately linked to the external information which input and output through them. As Ian Andrews commented on the *Microsound* email list:

> *The medium ain't the message. Apart from being an over used McLuhan soundbite, this statement has lost its relevance. We live in a time of post-medium art… [22]*

Searching for a technological essential in the sonic artefacts of such error or failure Achim Szepanski, founder of the *Mille Plateaux* label, argues in his paper 'A Mille Plateaux Manifesto,' that in digital sound 'clicks, glitches, so called mistakes become sound…the movement of zero and one made audible', mirroring the argument of Charles Mudede in respect to the Turntable [23]. Mudede argues in his paper 'The Turntable' that the disc jockey's 're-purposed turntable brings out a turntable's turntableness', invoking Heidegger's writing on the essence of equipment from his essay 'The Origin Of The Work Of Art' in which he argues that the essence of a piece of equipment is only noticed when that equipment is broken [24]. As Torben Sangild argues in his paper, 'Glitch – The Beauty of Malfunction', 'glitches are the sounds of technology not working; the sound of the grit in the machinery of sound making…but at the same time, this is where technology reveals its téchne – its material, structural and ideological foundations which in everyday life have become transparent, invisible' [25]. Heidegger

used the example of the hammer to explicate this point in his book *Being & Time* in which he argued:

> *Equipment can genuinely show itself only in dealings cut to its own measure (hammering with a hammer, for example); but in such dealings an entity of this kind is not* grasped *thematically as an occurring Thing, nor is the equipment structure known as such even in the using [26].*

In Heidegger's conception, equipment is only noticed when it no longer performs its function and is rendered redundant, losing its meaning and purpose, its essence. However, if the hammer were used for some other purpose than previously intended its meaning would be re-posited, its essence redefined, just as the turntable is redefined when re-purposed by the disc jockey. Theodor Adorno touched on this notion in regard specifically to the gramophone [27]. In his essay 'The Curves of the Needle', written in 1928, Adorno asserts:

> *There is only one point at which the gramophone interferes with both the work and the interpretation. This occurs when the mechanical spring wears out…only when gramophonic reproduction breaks down are its objects transformed. Or else one removes the record and lets the spring play out in the dark [28].*

Technologies of sound reproduction and manipulation are most discernable in their infidelity, their failure and malfunction. Individual technologies leave their own artefacts of infidelity, be it the surface noise of an old record, the hiss of magnetic tape or the aliasing or 'glitch' symptomatic of error in digital technologies. Sound is altered irrevocably by its mediation through Technology. Even when functioning normally technologies of sound reproduction and manipulation reshape sound according to specific systemic properties. Whether through reducing the available frequency spectrum, losing dynamic content, sampling only certain sections of sound or any other effect, technologies always alter the sound they mediate. Although often the effects of digital sound are indistinguishable to the human ear the effects are nonetheless no less significant or pronounced.

However, it is a misconception that the essence of digital technologies can be understood and engaged through Kim Cascone's 'aesthetics of failure', as Owen Chapman explains:

> *The notion of 're-purposing' here becomes a self-centered fiction…Technologies have no 'initial essence' to rob, but are in a constant state of negotiation as practices [29].*

Perhaps initially poignant and resonant, the 'aesthetics of failure' represents an outdated attempt to understand and explain digital sound, a theoretical point of escape that allows a quick negotiation of the complicated space of digital sound.

Technology's Infidelity

Eliot Bates argues in his paper 'Glitches, Bugs and Hisses: The Degeneration of Musical Recordings and the Contemporary Musical Work' that sound technologies have always been judged for their fidelity, their 'faithfulness to the source' [30]. After its initial advertising as a tool for creating 'aural letters', the phonograph was marketed for its 'quality of tone' and ever since more and more grandiose claims have been made around the 'fidelity' of each new technological development, such as the infamous and amorphous claim of 'hi-fidelity' sound so commonly made in reference to home stereos and personal listening devices [31].

Technologies of sound reproduction and manipulation aim for fidelity and yet, as Heidegger explored, they are most conspicuous in their infidelity. Arguably, the development of digital sound technologies has taken fidelity in sound to a level indistinguishable by human hearing. However, as with the technologies that have preceded them, the phonograph with its surface noise and magnetic tape with its noise floor and limited dynamic range, it is through their infidelities that digital technologies assert their presence. This interest in the fidelity of technological sound is misplaced, however, as it assumes a linear relationship between the phenomena of sound and its construction through Technology. Technologies of sound reproduction and manipulation do not exist simply to reproduce the 'original' sounds of 'reality'. Instead, as Jonathan Sterne observed:

> *Sound fidelity is a story that we tell ourselves to staple separate pieces of sonic reality together. The efficacy of sound reproduction as a technology or as a cultural practice is not in its keeping faith with a world wholly external to itself. On the contrary, sound reproduction – from its very beginnings – always implied social relations among people, machines, practices and sounds. The very concept of sound fidelity is a result of this conceptual and practical labor [32].*

The technological mediation of sound has served to break down any notion of a singular 'sonic reality', bringing into doubt the existence of sound as a verifiably 'real' phenomenon. Instead, the ability to technologically store, manipulate and reproduce sound re-posits it as existing in multiplicity,

repeatedly broken down, interpreted and reconstructed, and involving, as Sterne comments, 'social relations among people, machines, practices and sounds' [33]. Sound exists primarily conceptually rather than phenomenally, and any argument that technologies should achieve fidelity with an external phenomenal sound are undermined by the technologies themselves and their role in redefining all sound.

The Refrain of the 'Glitch'

In his essay 'Loving The Ghost In The Machine: Aesthetics of Interruption', Janne Vanhanen argues that digital media is characterized by its 'transparency' and 'smoothness', a kind of 'flux and mutability' which produces 'an immersive environment, rather like sound' [34]. According to Vanhanen:

> *Using the concepts of Deleuze and Guattari, we can state that the phonograph deterritorializes sound, flattens down the hierarchical organization of music into a rhizome, which is an open, multiple and temporal form of organization and subsceptible to constant de- and recoding [35].*

As Vanhanen examines with respect to the phonograph, technologies of sound reproduction and manipulation and in particular digital technologies allow the deterritorialization and reterritorialization of sound, such that digital sound exists in a Deleuzian rhizomatic construction as a 'multiple and temporal form of organization' [36]. Digital technologies generate, reproduce, manipulate and reconstitute sounds with great flexibility, enabling multiplicities of possibilities, deterritorializing and reterritorializing sound constantly. However, Vanhanen also argues that to 'approach the outside of thought', 'to be able to create new ways to feel the world, new percepts and affects, one has to court the chaos and worship the glitch' and, while this is a useful approach, the 'glitch' functions in another way [37].

In their book *A Thousand Plateaus,* Deleuze and Guattari theorized the refrain or *ritournelle* in the plateau, '1837: Of The Refrain'. When writing the refrain, Deleuze and Guattari refer to the musical refrain of repetition and thematic re-statement, a motif perhaps.

> *A child in the dark, gripped with fear, comforts himself by singing under his breath…the song is like a rough sketch of a calming and stabilizing, calm and stable, center in the heart of chaos [38].*

Deleuze and Guattari recount this scenario as one of three examples of the function of the refrain as a territorial agent. The 'glitch' can be heard as such a refrain, offering a point of anchor and reterritorialization in the alien chaos of digital audio.

Given the paradoxical situation in which sound technologies, though marketed for their hi-fi quality, are most conspicuous in their infidelity it is not surprising that the challenge of digital sound was initially met with an attempt to engage and critique the role of these technologies in sound through an 'aesthetics of failure'. Arising from a generational focus on the world as represented as data, a poetical fascination with digital code and representation, the 'aesthetics of failure' and theorized 'post-digital' music represents an important step in attempting to understand digital sound however, focusing solely on the aesthetics of the digital through the poetic construction of the 'glitch', these theories fail to engage with notions of the greater system of Technology and its function through digital sound.

Sound, Technology & Potentiality

Digital sound technologies exist as agents of relation, mediating sound through a system of technologies and efficacies. However, to expect such technologies to meet some constructed notion of fidelity fails, just as does an expectation that error is somehow essential to technologies, to understand the role of these technologies in 'enframing' all sound. Digital technologies exist as technologies of transduction based not in some form of constructed essence but rather in potentiality.

Engaging with the development of technologies of sound reproduction and manipulation, in a contemporary context sound cannot be considered simply as formless and fleeting, an ephemeral natural phenomenon of vibrating particles or waves of pressure. Instead, sound exists as a recordable and mutable cultural artefact. As Achim Szepanski finds, 'the field of possibilities of the digital is to be discovered, because as such it is a medium which produces possibilities and not evidences' [39]. Szepanski suggests that digital technologies have created a situation in which 'sounds become visible and images audible' [40]. While providing a poetic account of the possibilities, the potentialities, that digital technologies present, Szepanski does not account sufficiently for the role of the technologies in the phenomenon he describes. Digital technologies do not render sounds visible and images audible, rather they render both reducible to data that may then be actualized as sound or image (or indeed something else) regardless of its origin.

The Datasphere and Sound as 'Standing Reserve'

According to Heidegger 'Technology is a way of revealing' or 'bringing forth' [41]. Furthermore, modern Technology is not just a 'revealing' but a 'challenging' in which all is rendered potential by a process of 'Gestell' or 'enframing' [42]. Heidegger argued that with modern Technology everything is made to be available, to be made potential; with modern Technology everything becomes the 'standing reserve' [43]. He found this to be a disturbing and negative trend of commodification and objectification. With the advent of digital technologies this process is absolute, all the world becoming what Mitchell Whitelaw describes as a 'datasphere', reducible to a binary system of ones and zeros [44]. Owen Chapman argues similarly that 'sampling technology turns sound into…"standing reserve"' [45]. All sound can be represented through the binary system of digital technologies with accuracy so indistinguishable from the source as to be imperceptible to the human ear except in the case of error or malfunction in the technologies.

Smooth and Striated Space

In the plateau '1440: The Smooth and Striated' from their book *A Thousand Plateaus: Capitalism and Schizophrenia*, Deleuze and Guattari propose a distinction between smooth and striated space. Presenting a dialectical construction of space in which 'the two spaces in fact exist only in mixture' they argue 'smooth space is constantly being translated, transversed into a striated space, striated space is constantly being reversed, returned to a smooth space' [46]. In particular the technological model of smooth and striated space Deleuze and Guattari put forward serves as a useful construction of the interaction between sound and digital technologies. Using the example of fabric, Deleuze and Guattari explain a conception of striated space in which there are 'two kinds of parallel elements; in the simplest case there are vertical and horizontal elements, and the two intertwine, intersect perpendicularly' [47].

Performing different functions, one of these remains fixed, the other mobile, as demonstrated by one piece of thread remaining in place while another interweaves, or transverses, it or by the x-axis of time in a digital sound buffer which remains linear, straight, as its corresponding y-axis of amplitude simultaneously traces and diverges from it. It is crucial that 'a striated space of this kind is necessarily delimited, closed on at least one side', as 'fabric can be infinite in length but not in width' and though time does not constrain sound the limited headroom of digital audio means amplitude must [48]. Technological striated spaces are constructed with top and bottom, as belied by the seams of fabric or bit depth of digital sound [49]. Digital sound involves a constant process of translation in which sound moves between the smooth phenomenal space of actualized sonority and the striated space of potential that is the digital domain, while still presenting a smooth space of its own, and so is itself nothing more than a functional abstraction.

The Potentiality of Digital Sound

Exploring the issue of potentiality in his book *Potentialities: Collected Essays in Philosophy*, Giorgio Agamben draws on the thought of Aristotle, who believed that 'there is no sensation of the senses themselves' as 'sensibility is not actual but only potential', to argue that 'what is essential is that potentiality is not simply non-Being, simple privation, but rather the existence of non-Being, the presence of an absence' [50]. Agamben, like Aristotle, is interested in a dialectical construction of potentiality in which possibility is defined in its opposite not by impossibility, but by the possible nonfulfillment of that possibility.

Comparable to Agamben and Aristotle's examination of the potentiality of a sense is the potentiality of digital technologies. Just like the human senses, technologies interpret and manipulate the sensation, or phenomena, of sound and so sound is not actual in digital form but potential, and in this way technologies exist as independent senses of some sort, operating as a filter through which the phenomena of sound passes. Agamben refers to Aristotle's claim that 'the mind [nous] is like a writing tablet on which nothing is actually written', arguing 'the nature of the intellect is such that it is pure potentiality' and so 'nous is thus a potentiality that exists as such, and the metaphor of the writing tablet on which nothing is written expresses the way in which a pure potentiality exists' [51]. Digital sound is an excellent example of such a potentiality because it exists predominantly as an imagined possibility, which frames the use of digital technologies to record and manipulate sound.

Digital technologies render the entire world of sounds as potential, able to be recorded and manipulated like any other data. However, digital technologies act through a very definite mathematical system, breaking all data down to discrete digital bits. In the case of digital sound this means that a language of sampling rates and bit depths form a system through which all sound is treated. Technologies of sound reproduction and

manipulation have a direct impact on how sound is conceived through their role as agents of a system of Technology, acting not as simple instrumental tools of sonic manipulation but instead rendering all sounds potential, a 'standing reserve' subject at any time to manipulation and reproduction.

Conclusion

Digital sound is a potentiality that is the result of the use of digital technologies and their place within a lineage of technologies used to work with sound as part of a greater system of Technology. While digital technologies have themselves had significant effects on interactions with sound, presenting a conception of sound severed from linear time and rendered as numerical bits of binary data, simultaneously these technologies exist as digestions of previous technologies, the phonograph and magnetic tape influencing interactions with digital sound as much as digital technologies themselves.

Despite often being audible only through error, malfunction and other such evidences of infidelity, the technological mediation of sound has constant and profound effects on sound itself, altering its very construction: in the example of digital technologies, shifting sound from being a phenomenon of waves of pressure or vibrating particles to a constructed data-object of striated samples and bits. While failure in technologies of sound reproduction and manipulation is commonly the only audible trace of the technologies, this does not mean it is somehow essential to the technologies. The infidelities of technologies are inherent but not essential, asserting the technologies' presence without demonstrating any sort of unique essence.

Digital technologies, like other sound technologies that have preceded them, have had a profound effect on how sound is approached. Apart from the effects of individual technologies, Technology as a system, when applied to sound, takes a once fleeting, ephemeral phenomenon of waves and particles and renders it cultural capital, to be manipulated as desired. Digital technologies reproduce, manipulate and reconstitute sound with great flexibility, enabling a multiplicity of possibilities.

Acknowledgements

Thanks to Miyuki, my family and everyone else who assisted in the writing and presentation of this paper.

References

[1] Sterne, J. *The Audible Past: Cultural Origins of Sound Reproduction*, USA: Duke University Press, 2003, p. 31.

[2] Sterne, J. *The Audible Past: Cultural Origins of Sound Reproduction*, USA: Duke University Press, 2003, p. 46.

[3] Heidegger, M. 'The Question Concerning Technology' in *Basic Writings*, San Francisco: Harper, 1977, p. 4-5.

[4] Heidegger, M. 'The Question Concerning Technology' in *Basic Writings*, San Francisco: Harper, 1977, p. 5.

[5] Heidegger, M. 'The Question Concerning Technology' in *Basic Writings*, San Francisco: Harper, 1977, p. 4.

[6] Heidegger, M. 'The Question Concerning Technology' in *Basic Writings*, San Francisco: Harper, 1977, p. 12-13.

[7] Franklin, U. *The Real World of Technology*, Concord: House of Anansi Press Limited, 1992, p. 12.

[8] Sterne, J. *The Audible Past: Cultural Origins of Sound Reproduction*, USA: Duke University Press, 2003, p. 219.

[9] Whitehead, G. 'Holes In The Head: Theatres of Operation for The Body In Pieces', Ubuweb: <www.ubuweb.com/papers/>, 1993, p. 2.

[10] Ibid.

[11] Schafer, R.M. *The Tuning of the World*, Toronto: McClelland & Stewart, 1977, p. 90.

[12] Ibid.

[13] Potts, J. 'Schizochronia: Time in Digital Sound', in S. Davies, F. Dyson, A. Jonson & A. Cavallaro (eds), *Essays In Sound 2: Technophonia*. Sydney: Contemporary Sound Arts, 1995, p. 20.

[14] Potts, J. 'Schizochronia: Time in Digital Sound', in S. Davies, F. Dyson, A. Jonson & A. Cavallaro (eds), *Essays In Sound 2: Technophonia*. Sydney: Contemporary Sound Arts, 1995, p. 18-19.

[15] Potts, J. 'Schizochronia: Time in Digital Sound', in S. Davies, F. Dyson, A. Jonson & A. Cavallaro (eds), *Essays In Sound 2: Technophonia*. Sydney: Contemporary Sound Arts, 1995, p. 19.

[16] Kahn, D. 'Audio Art in the Deaf Century', *Soundtoys.net*: <http://www.soundtoys.net/a/journal/texts/kahn.html>, 2000.

[17] Potts, J. 'Schizochronia: Time in Digital Sound', in S. Davies, F. Dyson, A. Jonson & A. Cavallaro (eds), *Essays In Sound 2: Technophonia*. Sydney: Contemporary Sound Arts, 1995, p. 18.

[18] Sterne, J. 'The Death and Life of Digital Audio', *Interdisciplinary Science Reviews*: vol. 31, no. 4, 2006, p.341.

[19] Cascone, K. 'The Aesthetics of Failure: Post-Digital Tendencies in Contemporary Computer Music', *Computer Music Journal*: vol. 24, no. 4, 2000, p. 12.

[20] Turner, J. 'The Microsound Scene: An Interview with Kim Cascone', Ctheory.net: <www.ctheory.net>, 2001.

[21] Cascone, K. 'The Aesthetics of Failure: Post-Digital Tendencies in Contemporary Computer Music', *Computer Music Journal*: vol. 24, no. 4, 2000, p. 12.

[22] Andrews, I. 'Re: [microsound] State of Music', Post on Microsound Email List: 2004.

[23] Szepanski, A. 'A Mille Plateaux Manifesto', Synesthesie: <http://www.synesthesie.com/heterophonies/theories/Szepan-1000ptxt.html>, 2004.

[24] Mudede, C. 'The Turntable', Ctheory.net: <http://www.ctheory.net/text_file.asp?pick=382>, 2003.

[25] Sangild, T. 'Glitch - The Beauty of Malfunction', in C. Washburne & M. Derno (eds), *Bad Music: The Music We Love to Hate*, London: Routledge, 2004, p. 266.

[26] Heidegger, M. *Being & Time*, New York: Harper & Row, 1962, p. 98.

[27] Sangild, T. 'Glitch - The Beauty of Malfunction', in C. Washburne & M. Derno (eds), *Bad Music: The Music We Love to Hate*, London: Routledge, 2004, p. 267.

[28] Adorno, T. 'The Curves of the Needle', in, *Essays on Music*, Berkeley: University of California Press, 2002, p. 275.

[29] Chapman, O. 'Lifted Loops and Broken Beats: Sample-based music and the revenge of the cut', Art and Science: <http://artsandscience.concordia.ca/facstaff/m-o/mccartney/owen/opositive/liftedloops.htm>, 2004.

[30] Bates, E. 'Glitches, Bugs and Hisses: The Degeneration of Musical Recordings and the Contemporary Musical Work', in C. Washburne & M. Derno (eds), *Bad Music: The Music We Love to Hate*, London: Routledge, 2004, p. 278.

[31] Ibid.

[32] Sterne, J. *The Audible Past: Cultural Origins of Sound Reproduction*, USA: Duke University Press, 2003, p. 219.

[33] Ibid.

[34] Vanhanen, J. 'Loving The Ghost In The Machine: Aesthetics of Interruption', Ctheory.net: <www.ctheory.net/articles.aspx?id=312>, 2001.

[35] Ibid.

[36] Ibid.

[37] Ibid.

[38] Deleuze, G. & Guattari, F. '1837: Of The Refrain' in *A Thousand Plateaus*, Minneapolis: University of Minnesota, 1987, p. 310-350.

[39] Szepanski, A. 'A Mille Plateaux Manifesto', Synesthesie: <http://www.synesthesie.com/heterophonies/theories/Szepan-1000ptxt.html>, 2004.

[40] Ibid.

[41] Heidegger, M. 'The Question Concerning Technology' in *Basic Writings*, San Francisco: Harper, 1977, p. 12.

[42] Heidegger, M. 'The Question Concerning Technology' in *Basic Writings*, San Francisco: Harper, 1977, p. 20.

[43] Heidegger, M. 'The Question Concerning Technology' in *Basic Writings*, San Francisco: Harper, 1977, p. 17.

[44] Whitelaw, M. 'Sound Particles and Microsonic Materialism', *Contemporary Music Review*: vol. 22, no. 4, 2003, p. 93.

[45] Chapman, O. 'Lifted Loops and Broken Beats: Sample-based music and the revenge of the cut', Art and Science: <http://artsandscience.concordia.ca/facstaff/m-o/mccartney/owen/opositive/liftedloops.htm>, 2004.

[45] Deleuze, G. & Guattari, F. '1440: The Smooth and the Striated' in *A Thousand Plateaus: Capitalism and Schizophrenia*, Minneapolis: University of Minnesota, 1987, p. 474.

[46] Deleuze, G. & Guattari, F. '1440: The Smooth and the Striated' in *A Thousand Plateaus: Capitalism and Schizophrenia*, Minneapolis: University of Minnesota, 1987, p. 475.

[47] Ibid.

[48] Ibid.

[49] Ibid

[50] Agamben, G. *Potentialities: Collected Essays in Philosophy*, Stanford: Stanford University Press, 1999, p. 179.

[51] Agamben, G. *Potentialities: Collected Essays in Philosophy*, Stanford: Stanford University Press, 1999, p. 215.