Embracing the Temporal Deterioration of Digital Audio: A Manifesto

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Most of today's media output, be it audio or video, is produced and stored in the digital domain. Although digital data are adorned by the myth of lossless transmission and migration, everyday experience does prove the existence of degradation and, ultimately, data loss in various forms. This pertains to the physical nature of storage media and playback devices as well as to media formats and software in the context of their technological infrastructure.

We have recently launched the project of artistic research 'Rotting sounds – Embracing the temporal deterioration of digital audio', funded by the Austrian Science Fund (FWF). Since degradation cannot be avoided by principle, we therein propose alternative perspectives on the nature and the implications of deterioration in theory and artistic practice, specifically for the domain of digital audio.

This manifesto shall represent an introduction to our endeavour, as much as it shall form a guideline for us carrying out the research.

Digital audio. Degradation. Obsolescence. Manifesto.

1. INTRODUCTION

The predominant share of contemporary media is produced and stored by means of computers, i.e. in a digital representation. Efficiency as well as ease of use of computer-based media production has led to an overwhelming abundance of data representing audio and video content, inscribed to various forms of storage media. Such 'digital media' is advertised with the promise of precision and accuracy, implying flawless copying and wear-free storage (cf. Manovich 2001, p. 68ff). However, actual experience with digital media of several decades has shown that the amount and structure of data and the delicate physicality of its carriers pose serious challenges to its persistence even for durations well shorter than a human lifetime. Archival institutions of all kinds (libraries, museums etc.) are required to deal with the various physical threats and obsolescence phenomena pertaining to digital media, also leading to intense research in the field of 'digital preservation' (Kenney et al. 2003). The aging characteristics of digital media used as artistic material gave rise to specific artistic practices, comparable to novel physical materials:

In twentieth-century sculpture, artists increasingly used new materials which were unfamiliar to them in terms of resistance to aging, and so were unable to foresee the speed and degree of decay these works would undergo — many of them turning out to have only a fraction of the lifespan to that of works from earlier periods. On the other hand, artists played with the foreseeable and deliberate disintegration of works in which the process of decay is a central aspect of the artist's intention. (Skowranek 2007)

This twosome of the digital material's fleeting nature on one hand, and its reportedly fascinating artistic possibilities caused by its very fugacity on the other, is where we situate our artistic research project 'Rotting sounds – Embracing the temporal deterioration of digital audio' (Grill et al. 2018).
In the course of the project, we intend to closely examine *degradation* and *dissipation* through environmental and other forces, *flow of time* and *irreversibility*, the relationship between *microscopic* and *macroscopic* processes in audio software and hardware and its environment, *information content*

and *loss thereof*, as well as possibilities of *degradation reversal* through external restoration work.

In our context of digital sound art, we will analyse these notions experimentally by means of artistic methods. It also implies holistic analyses of the used technologies, including their materials and algorithms, domains of operation, and environment. This is a broad scope as "everything is becoming obsolete all the time" (Tacita Dean in Woodward 2011).

2. TERMINOLOGY: DEGRADATION, ENTROPY AND THE FLOW OF TIME

> Since all matter is subject to entropy, it is impossible for any designed object to retain its full function forever; all products will ultimately break down, no matter what steps are taken. (Wikipedia contributors 2018b)

The term 'obsolescence' has become a key term in today's ecology and economy. Products reach their end of life prematurely because of an, often deliberate, design choice that subverts a long lifetime.

Ensuring the *reliability* and *compatibility* of data carriers and media reproduction devices has become an important part of contemporary media production. Issues arising inevitably by the time, like degradation artefacts, readability problems and data loss can have a considerable impact on the media production process, to time requirements and, consequently, costs.

Science has developed a formal characterisation of degradation dynamics, which employs *entropy*, a measure of thermodynamic disorder, as the fundamental measure of degradation. It relates entropy generation to irreversible degradation and shows that components of material degradation can be related to the production of corresponding thermodynamic entropy by the dissipative processes that characterise the degradation (Bryant et al. 2008). *Dissipation* describes processes of transformation from one form of energy to another, e.g. of electrical energy into heat. Since dissipation applies to all physical materials, it also affects technology used for digital media (Bianchi et al. 2001).

The fundamental laws of physics are essentially time-symmetric, meaning, that if a process is physically possible, then generally speaking so is the same process run backwards. The second law of thermodynamics, however, is an exception: In a closed system, *the progression of time* is given as the increase of entropy. It gives rise to a definite direction (or *flow*). Ludwig Boltzmann's view of entropy suggests that this irreversibility is an *emergent phenomenon*, generated by the statistics of underlying microscopic physical processes (Lebowitz 1993). It must be emphasised that the irreversibility only applies to closed systems: also

according to everyday practice, disorder can be reverted to order by applying external work, thus decreasing entropy over time by the expense of said work.

In 1930, Gilbert N. Lewis provided a link to the notion of *information*, stating that "the increase in entropy comes when a *known* distribution goes over into an *unknown* distribution. The loss which is characteristic of an irreversible process, is *loss of information*. [...] Gain in entropy always means loss of information, and nothing more." This can be seen as a precursor to Claude Shannon's (1948) definition of the information-theoretical entropy, a measure of information content.

3. ARTISTIC CONTEXT

Canonical artistic works deliberately employing temporal degradation include large parts of the oeuvre of Dieter Roth, e.g. 'Kleiner Sonnenuntergang' (1968), 'Portrait of the artist as Vogelfutterbüste' (1968), 'Staple Cheese (A Race)' (1970), or his infamous 'Schimmelmuseum' (1992–2004), all made from organic materials, decomposing over time and consequently and continuously changing their appearance. Similar transformations through temporal instability were used by Joseph Beuys, e.g. in 'Stuhl mit Fett' (1964), today a part of the 'Block Beuys'.

In the media domain, Tony Conrad has created his series of 'Yellow movies' (1973) using cheap household paint on photographer's paper, which is destined to age and changes its tint over long durations. Christian Marclay has created various meta-musical works, for instance 'Record Without a Cover' (1985) which was "[...] sold without any packaging, such that the wear and tear on it gradually transformed the sound of each copy. [...] The record's transformation can be interpreted as a form of spontaneous composition, with each copy becoming a distinct performance. Marclay wanted to ensure that 'you can't ignore the medium'."

Similarly, magnetic tapes develop forms of temporal degradation by environmental forces such as heat, moisture, dust and dirt, for example bleed-through or deformations. William Basinski's (2002) seminal album 'The Disintegration Loops' stands as a canonical example of recordings of slowly disintegrating magnetic tapes.

Phenomena of deterioration are no less present for contemporary digital audio carriers like the Compact Disc (CD) (Sydell 2014). The technical possibility to conceal damages up to some degree by the use of appropriate error-correction technology hides away creeping problems until the accumulation of defects becomes fatal. This pertains in the same fashion to all other digital audio carriers such as DAT and ADAT tapes, Minidiscs, and many other media types.

Working with (or against) the complex technology of data storage on CDs (with techniques such as

disc preparations and electronic modifications) has been an important part of the glitch genre of electronic music (cf. Cascone 2000), with proponents such as Nicolas Collins, Oval, or Yasunao Tone. In their works, the fragility of the digital medium has been challenged using a well-targeted manipulation of the technology, in order to achieve specific results.

A more heuristic approach is the practice of *circuit bending* where readily available (and usually out-dated or partly broken) consumer electronics are abused to 'find' temporally changing currents in the circuits, waiting to be probed, amplified and *repurposed* as a source for aesthetically unique and novel sounds. Hertz and Parikka (2012) describe this as 'zombie media' because the technique gives new life to what is considered obsolete. Just as McLuhan and McLuhan (1992) write: "Obsolescence is not the end of anything, it's the beginning of aesthetics, the cradle of taste, of art, of eloquence and of slang. That is, the cultural midden-heap of cast-off clichés and obsolescent forms is the matrix of all innovation."

4. THE DIGITAL

In the context of our research project, we interpret the term digital as an entanglement of the purely technical examination of the *bit*, its associated technologies (e.g. *1-bit audio*), and the hereof arising cultural implications. According to Manovich (2001), the notion of *digital representation* defines "three unrelated concepts: analog-to-digital conversion (digitization), a common represen-tational code, and numerical representation", where the ability of lossless copy lies within the notion of the numerical representation.

The ambiguous existence of the digital is pictured by Jones (2005) using light as metaphor: since the notion of discreteness is represented by photons, but disproved through the accumulation in waveforms. Concluding the logic of the particulate discreteness we refer to the pure technical definition of the Open Archival Information Standard (OAIS), defining the digital object as a set of bits (bit stream), possibly associated with a physical object, founding the data object and building through descriptive information (meta data for correct interpretation) the information object. This abstracted standard faces the notion of the cultural object (Guttenbrunner 2014), digital materiality (Brown 2010), and links to its complex entity (Kirschenbaum 2009), respectively.

Another contradiction within the digital realm is exposed by means of access: Starting with the 'floppy copies' in the 80s and reviewing the open source/open culture movement today (e.g., Soundcloud, archive.org, GNU, Pure Data, Audacity), the digital proves itself as being a free, understandable, transparent, accessible and democratic tool for everybody (Wark 2004). The thereof emerging cultural object grows incredibly fast through dissemination and preserves itself through redundancy.

In contrast to this flexible and robust existence, access to the underlying digital object (bit stream, i.e., the numerical representation) can be challenging since the quality of digital data relies on its adequate description and interpretation. Specific knowledge about recipes for interpretation (codecs) is fundamental. Failing on any level (codec knowledge, missing or corrupted meta-data) means the collapse of stored information into possibly non-interpretable data. Fragility is therefore omni-present, the concept of obsolescence a given fact.

5. MANIFESTATION

'Decay' should not simply be understood in terms of subtraction – the reduction of fidelity and the loss of meaningful information. Rather, it can be understood (perhaps more neutrally) in terms of modification – the gradual morphing and mutating of matter over time, as it is acted upon by its milieu. The sound-signal is affected by the medium and the medium is affected by the wider milieu. While particular medium-bodies are affected to a greater or lesser extent by the conditions of their environment […] no medium remains unchanged forever. (Thompson 2014, Chapter 3).

Consequently—and also supported by everyday anecdotal experience—we state that

Data degrade inevitably.

Digital artworks are products, and often containers, of digital data. As these data degrade,

Digital (and other) artworks are, to a considerable extent, products of their symptoms of decay.

We do not mind. Already Heraclitus of Ephesos (having lived around 500 B.C.) has been cited by Plato in his 'Cratylus' dialogue to identify *change as a fundamental principle*, "[…], that all things move and nothing remains still, and he likens the universe to the current of a river, saying that you cannot step twice into the same stream." (Fowler 1970, p. 402)

Technological tools of software or hardware are required to produce digital art. Typically, these tools are dependent on a complex and heavily entangled technological infrastructure. Millions of lines of software code operate on Millions of transistors, even on conventional computing devices. Minia-turisation of electronic circuits to sub-microscopic scales and the large number of interacting elements in use on such systems obstruct efforts to gain insights (cf. Cilliers 1998, p. 3). Hence,

In order to understand modes of degradation, we must avoid unnecessarily complex technological systems.

Reducing the complexity of technological means to a functional minimum for a given problem counteracts processes of systemic obsolescence. This also means an act of liberation and self-entitlement for the artist. All in all, we put forward our conviction to

Embrace degradation and apprehend it as transformation

instead of fighting it as a problem. Following Hegel, "becoming, not being, is the highest expression of reality" (Wikipedia contributors 2018a) – accepting symptoms of change and decay is a necessary prerequisite.

Gaining pertinent knowledge about (digital) degradation and developing tools that account for it in a constructive manner turns the inevitable from a source of irritation into an aesthetic opportunity.

6. ACKNOWLEDGEMENTS

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