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Computers, Music & Intermedia: (Re)(Trans)lation

Abstract

Historical lines of inquiry reveal the development and nature of information acquisition, control and intermedial relations, translations and retranslations. Information has become an important tool in governance and the embodiment of meaning in modernity. Appropriating this understanding of governance, power, neutrality and constructs of meaning, informational theory will be reposited to highlight lines of examination with regard to computer music, the domain of the computer and its intermedial interplay.

Introduction

> Nam et ipsa scientia potestas est.
> (Francis Bacon 1597)

The words of Francis Bacon translated mean "Knowledge is power", a phrase often used and referred to by theorists, philosophers and political thinkers alike. The origins of the association between knowledge and power relate specifically to information – its capture, control, manipulation and transmission. Indeed information does afford power; and interestingly the origins of this idea have a pertinent cultural association with the exercise of control in the virtual domain. Both real world and virtual information systems examine and capture the real world in terms of quanta - discrete glances of the physical universe. However, such glances in their virtual measure have no *real* meaning in actuality, except through their mediation, or interpretation and reproduction. Mediation rightly treats the meaning of these discrete glances as neutral, decentred and unfixed until the point of realisation. As Buckland clarifies by elaborating Bacon's position -

> Knowledge is power. He did not say, "Information is power." Knowledge is power, because "Scientia et potentia humana in idem coincidunt, quia ignoratio causae destuit effectum." (Human knowledge and human power meet in one, because where the cause is not known the effect cannot be produced.) Knowledge is empowering. Information, then, can, at most, be indirectly empowering to the extent to which knowledge is derived from it. (Buckland 1999)

Real

> Counting is hungry for categories.
> (Hacking 1982)

The axiom espoused by Ian Hacking in his article *Biopower and the Avalanche of Printed Numbers* refers to the specific advancement in governmental practice whereby the recording of information about a population is seen as instrumental in governing that population. In essence, information provides the ruling authority with a measure by which the amount and quality of paternalistic control can be gauged and exercised.

Hacking's phrase is derived from the notion that governing forces have historically believed they could better manage the affairs of their subjects through the process of gathering and analysing statistics, and that such a process was continual and cumulative. The genesis of the real world information gathering process began by counting and recording the hearths within the geopolitical space of societies. Initial assessments revealed a range of governance strategies that could be adopted through the statistical bounty gathered. This recognition of the inherent powers of statistics led to the terms of statistical, and therefore governmental reference, being extended to include other areas of life. These included livestock, domestic and familial arrangements.

At a rudimentary level, Hacking's theory espouses a direct correlation between the amount of statistical information available on subjects and the ability of an authority to more ably manage and control the affairs of the everyday lives of these subjects. Micro-statistical acquisition is understood to provide macro control, governance and objective delivery. Once a statistical niche is understood and has been quantified, the counters, or census gatherers, require additional categories to count. Procedural repetition leads to an accumulative stream of categorisation, where categories are created, counted and recorded.

Numbers themselves have no intrinsic meaning. They require association to be meaningful, and consequently, useful and relevant. Enumeration, or quantification, requires categories, or qualification. Further, the categories themselves require a useful, clear definition to allow consensual interpretation of their relevance in the process of legislative governance. Regardless, once such processes are enacted they begin to permeate themselves into the spheres of those whom they quantify and qualify.

Quantification and qualification is not selective, nor restrictive in the way it behaves or exists in broader contexts. Pervading all facets of life, the practice reaches it tentacles into the domain of politics, personal life, pedagogy, academia, judiciary, legislatures, science, humanities, arts and music. Becoming part of the language that subjects speak, the lense through which they see themselves and the real world in which live is a *fait accompli* (Foucault, 1988).

Virtual

Enumeration and its operational counterpart, categorisation, are the mechanisms that promote transmigration from actuality to abstract representation. The physical objects of the census collector's gaze are now a series of alphanumerical elements organised together, and in respect of one another, on the pages of a ledger.

Such elements thrive in the domain of the computer, not simply as glorified statistical enumerators and interrelational correlators, but at a fundamental representational level. The computer counts, quantifies and quantises objects into qualitative pigeonholes or categories. Following this, new forms of control can be exercised upon the objects being counted. The elements lend themselves suitably to methods of mathematical and numerical manipulation. Once content, the satisfaction is momentary and desires arise to find new qualifications to be quantified.

By nature of their design, and theoretical underpinnings, computers and computational mechanisms enumerate and qualify the world with a glancing eye. Glimpses quantify skimmingly, allowing moments to pass as they take stock and ignore the *ad infinitum* detail (Shannon 1948). Moments in the domain of the computer are not endlessly granular, they are discrete, selective and restrictive, but nonetheless do allow other freedoms. These freedoms are born not only of the physical realities of modernity but also the ideological impetus that accompanies it. Information is not endless and uncontrollable, but limited, measured and tame.

Theories of Information

Sonic representations in the computer domain are commonly realised using the sampling theorem, often referred to as the Shannon-Nyquist theorem. The sampling theorem is a subset within the field of information theory, a mathematical field concerned with the transmission, exchange and storage of information or data. In the case of the sampling theorem, information is understood in terms of statistical representation, namely an interdependent qualitative and quantitative model. The sampling theorem itself uses the time domain characteristics of sound, these being frequency and amplitude, as a qualitative foundation upon which to enumerate. Frequency exists within the domain of time and is consequently made discrete along the temporal scale, whereas sound level is a product of pressure variations and is made discrete, quantised in the amplitude domain (Nyquist 1928).

In information theory, the links between the quantitative and qualitative are insoluble. Frequency range is determined by the sampling rate, the quantitative degree of measurement that is undergone in the temporal domain. Further, qualitative outcomes associated with frequency representation and the ability to accurately manipulate sound is tied to the sampling rate - the number of samples taken in a given time period. For example, high-end audio recording systems, such as Pro Tools | HD (Digidesign 2006) allow sound to be recorded with a sampling rate of 192kHz. Theoretically, the HD system should yield a maximum frequency, referred to as the Nyquist frequency, of 96 kHz - if such a frequency range could be reproduced by the currently available sound reproduction system.

Within each sample the dynamic fidelity is made discrete or quantised. The quantisation level determines attributes such as the range of dynamic reproduction and the signal-to-quantisation-noise ratio (SQNR). For example, the Redbook CD standard specifies the use of 16 bit samples, each of which can is able to be quantised into 65536 measures (Korst and Pronk 1994). Such a bit depth, or sample width, would yield a dynamic range in the order of around 96dB.

Regardless of the reproduction fidelity in this instance, the important point relates to the notion of a qualitative measure directly associated with a quantitative measure. In essence, the sampling theorem takes the two characteristics of sound, quantifies them and produces a result with a qualitative equivalent to the real world sound. Tolerable representations are produced through a reductionist approach to the information, consequently yielding a representation more susceptible and malleable because the detail is manageable rather than infinite (Nyquist 1928).

Relation

Information theory provides a fundamental underpinning for representation of the real world using representational systems within the modern computer. The computer allows for continuous, non-discrete, real world events to be quantified, stored and reproduced. In this way information theory provides a meaningful connection, or *relation*, between the real world, its actualities and the domain of the computer.

Information theory is one of triadic relation: receive – represent – (re)produce, with the computer facilitating the exchange amongst each relation. The computer may receive, or sample, events from the real world, represent them in the abstract and then reproduce them. Further, the computer may produce information without real world acquisition and extrapolation. Demonstrably the computer is not only a top-down mechanism but also a bottomup mechanism in the information stream. An example of this is sound synthesis (Roads 1996).

Translation

Within the triadic relation, the representation of information, sound, image, or otherwise, is, for the most part, not readily discriminable in its raw form, neither to its authors or audience. To clarify, in the domain of technology, information exists on the level of the abstract and requires *translation*. The means of translation usually resides in the form of an interrelation between software and/or hardware. Software must apply the theories of information to understand, appropriate and translate the virtual abstract, whereas hardware is involved in the negotiation and translation of the physical world, be it through buffering, storing and moving (Shannon 1948).

For example, the sampling theorem relates specifically to the transmission, storage and production of sound and its technological manifestation, audio. What becomes critically apparent is that sound in the domain of technology is no longer sound as we conventionally understand it. Sound can be seen as the property of the *apparent* real world, whether that be the physical world or through the psychophysical makeup of the listener (Worrall 1997). However, sound represented in, or via, the domain of technology is considered audio. As compared to sound, audio is comprised of continuous or discrete electrical currents, numerical representations, magnetic charges, pits, etched grooves (Borwick 1997).

The distinction here is important because audio is simply a measure of sound in the abstract and has no intrinsic and explicit link to the real world. Audio only exists as sound through the process of *translation* and the associated meanings derived through this process. During the *translation* of information, technology negotiates electrical currents, bringing voice and authenticity to their words, bits, pits magnetic charges and grooves. In essence, technology provides mediation of the information, establishing a line of association and hence a line of meaning and tangible result.

Retranslation (Mediation)

In so far as technology acts as a translator for information, it raises the important point that information is just that - information. How the information is interpreted, given meaning and used is guided by the intrinsic bias within a set of principles and structures inherent within the technology. For example, the digital-to-analogue (DAC) converter in a CD player is usually designed and manufactured to interpret a predefined set of parameters associated with the Redbook standard. The DAC will take a stream of samples at a rate of 44100 samples per second, with each sample represented using a 16 bit word, and interpolate them into an electrical signal analogous to a real world sound (Korst and Pronk 1994).

What becomes poignant is that the computer empowers users to redefine the way information is negotiated or translated. Information that is stored according to the principles of the sampling theorem need not be subject to the processes or devices that make an intended or usual interpretation of this information. Naturally, free to do as they please, users can choose to reproduce sound from the samples. However, sample information can be readily *retranslated* by other structures, devices and methodologies and subsequently be used to produce, guide and influence other forms, events, representations or media. *Retranslation* in this sense is the idea that the information may be treated in the pure abstract, the intended meaning and real world association being loosened from its origin. Consequently, the origins of the information, and hence their intended meaning, are reappropriated through *retranslation* to serve other purposes and yield other outcomes. In this regard, the computer provides an ably suited tool for the dissolution of barriers between music and other media, and the formal strengthening of dialects between them.

> … media have broken down in their traditional forms, and have become merely puristic points of reference. The idea has arisen, as if by spontaneous combustion throughout the entire world, that these points are arbitrary and only useful as critical tools, in saying that such-and-such a work is basically musical, but also poetry. This is the intermedial approach, to emphasize the dialectic between the media. A composer is a dead man [sic] unless he [sic] composes for all the media and for his [sic] world. (Higgins 1965)

Although Higgins' statement predates the refinement and marked ascendancy of computer-based musical and artistic practice, the statement is extremely relevant in the current historical context. The traditional ties and boundaries between artistic media, practice and interplay have yet become further blurred and less relevant. The advent of computational relation, translation and mediatory retranslation has ensured the boundaries are now entirely porous, with the traditional notion of artistic form, as Higgins suggests, merely a conservative point of departure as technology provides liberal mediation.

Interpretative Methods

In terms of information the following models provide suitable compliments, and frames of reference, by which to comprehend and apply the notion of intermedia and (re)(trans)lation.

Data-anticipated Interpretation

Data-anticipated interpretation can be defined as the expected interpretation, or translation, of information. Again, this is the intended purpose for which the theoretical and practical underpinnings of the information were designed. For example, the purpose of the sampling theorem is to capture sound, store it and allow it to be reproduced with a measure of fidelity comparable to the original sound. In this sense, the data is treated as anticipated; sound is sampled, stored in the computer as audio and reproduced as sound.

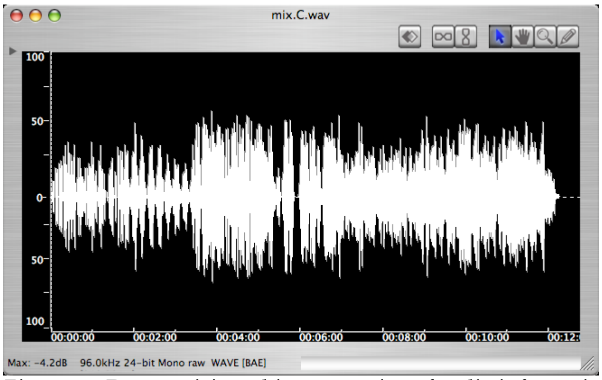

Figure 1 - Data-anticipated interpretation of audio information using Bias' Peak LE software (Bias 2006).

Data-literal Interpretation

Data-literal interpretation can be defined as the literal translation (retranslation) of information without consideration for its origin, intended purpose or function. An example of this is opening an audio file in an image editor such as Photoshop (Adobe 2006). In this case, Photoshop examines the information as raw data, attempts an extrapolation and produces a visual signature of the audio information. As a form of visualisation, the retranslation is entirely literal, as the image software directly interprets a stream of bits without concern for its genesis. Of note is the fact that some interpretative parameters are usually issued by Photoshop at the onset of this process. However, these relate specifically to image parameters, such as physical dimensions, bit depth and colour channels, and not to parameters that reference or acknowledge the source as an audio file.

Naturally the reverse process of visualisation through data-literal interpretation can be applied inversely as sonification. For example, an image file, such as a JPEG (JPEG 2006), can be opened in an audio editing program, such as Audacity (Mazzoni 2006), literally interpreted, rendered as sound and then listened to. Data-literal interpretations may have their applications; however the notion of literal interpretation does not necessarily yield an obvious and explicit association with source information. Further, aesthetic and conceptual outcomes and control may be somewhat varied (Figures 2 - 4).

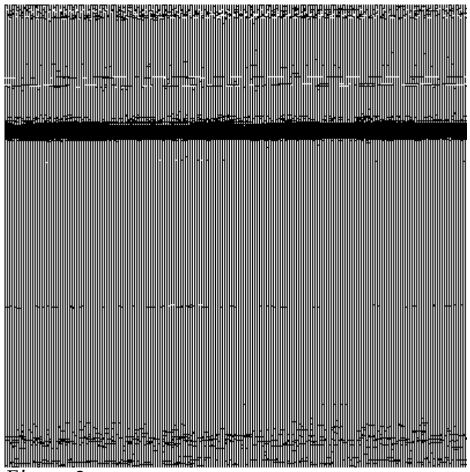

Figure 2

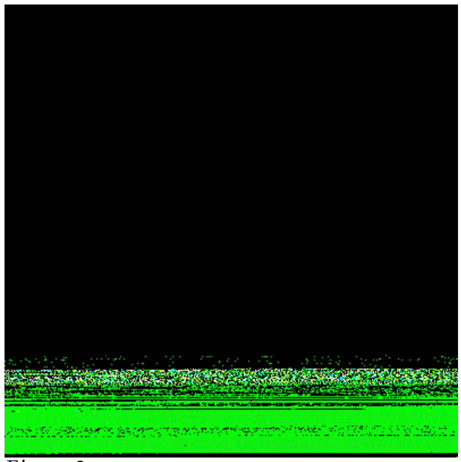

Figure 3

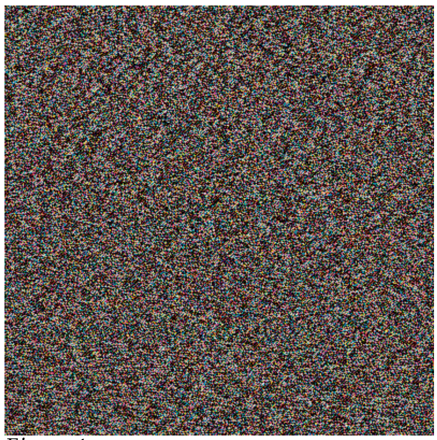

Figure 4

Each figure is derived from an audio file containing 73536018 samples opened as a raw Photoshop file, 400 by 400 pixels. Figure 2 – 2 Channels, 8 bits; Figure 3 – 16 Channels, 8 bits, interleaved; Figure 4 – 4 Channels, 16 bit, interleaved.

Data-meta Interpretation

Data-meta interpretation can be defined as making a meta or metaphorical retranslation. Typically, this involves meta interpretation, representation and manipulation of data. The term meta has a number of historically posited meanings, such as: data about data; one descriptive level in ascension; selfreferential; and so on. In this case, meta can be used to refer to one concept, or information, being abstracted from another concept and consequently represented, analysed and controlled by new associations. This differs from data-literal interpretation in the sense that data-meta interpretation makes explicit use of defined, design-specific and intentional retranslatory mechanisms. Such mechanisms provide a way of peering into the information in a controlled and deliberate fashion (Figure 5).

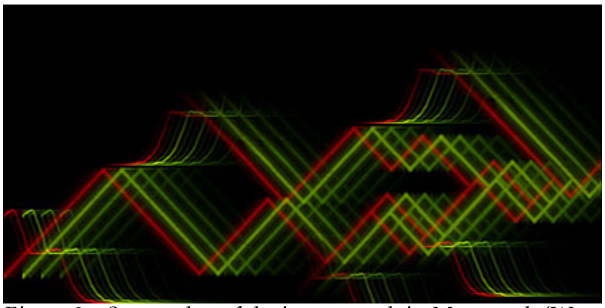

Figure 2 - Screen shot of the image synth in Metasynth (Wenger 2006).

Technological Sets

Essentially, software is about the process of interpretation, representation and manipulation of data. Historically a plethora of software applications have arisen that apply these processes to musical data. Such applications can be generally categorised, and derived, from the three data interpretative methods – anticipated, literal and meta set.

Anticipated

The anticipated set includes audio and MIDI editors, sequencers and processors and publishing applications. Such applications are devised to work with musical data in a more conventional and design-specific manner. This includes applications such as Pro Tools (Digidesign 2006), Logic (Apple 2006), Audacity (Mazzoni 2006), Cubase (Steinberg 2006), Peak LE (Bias 2006) and Sibelius (Sibelius 2006).

Literal

The literal set extends to any application that can understand, interpret and render raw data within the context of its objective functions. As mentioned previously, Photoshop (Adobe 2006) has the ability to interpret raw data from an unrelated source and present this data as image; however the number of applications included in this is somewhat open-ended.

Meta

The meta set refers to applications that examine and work with music from new vantage points. Some of these applications include UPIC (Xenakis 1992), Metasynth (Wenger 2006), Audiosculpt (Bogaards, Niels et al 2006), Frequency (Arstrom 2005) and Spear (Klingbeil 2005).

It should be noted that some members of the meta set obviously make anticipated interpretation of data. Information may for example be stored using an intentional form such as the Sound Description Interchange Format (SDIF) (Freed et al 1995). However, the mode of presentation is now loosened from its analogue and the information can be approached differently from the more culturally and historically entrenched methods. More importantly, however, is the notion that those members of the meta set permeate a natural intermedial synergy - sound as image, image as sound.

Further, other applications make themselves readily viable for membership to this set. These are the symbolic language applications such as CSound (Verco 2006), Supercollider (McCartney 2006), Impromptu (Sorensen 2006), Max/MSP (Zicarelli 2006), Audiomulch (Bencina 2006), Plogue (Beaulieu et al 2006) and Sonasphere (Tokui 2006). Although it is beyond the scope of this paper to fully expand upon the differentials within this last array of applications, it is essential to note that they allow music and intermedial practice to permeate diffusely because of the level of control, expression and abstraction they afford. The retranslation and mediation of music through, and by, other media is empowered through language-centric applications because the user becomes the architect of the translatory mechanism and the symbolic associations that will be imbued.

Representational Systems

Within the three sets, representational systems allow the quantitative measurement and qualitative depiction of different kinds of information. They are typically derived from and employed in the various domains of human inquiry such as music, visual arts, physics, biology, chemistry, geography and politics. In the field of some contemporary artistic practices they can be understood as formalised with two strands – medium and structure.

Medium

Medium is the representation of the phenomenon. The representation of the medium or media could involve a variety of forms such as single / multichannel / diffuse and multidimensional sounds, still / moving / immersive image, smell, taste and touch. Each of these forms is encoded and decoded using an array of theorems and processes. For example, as previously mentioned, sound is commonly encoded as audio within the computer domain using the Shannon-Nyquist sampling theorem.

Structure

Structure is the way in which the medium is organised. It provides the sense of a medium's relation to other media in absolute terms, and also in media instances where relative terms are achieved, perhaps by qualitative variation. The formal assertion could, for example, examine the lineage within time, position with space, interaction and audience interpretation.

Nexus

What becomes clear via the micro representation of medium and the macro representation of structure is that music and intermediality have viable, fluidic nexus points. Such nexus points are seemingly easier to navigate and mediate, as information, once translated from its physical reality, belongs to an ancestrally closer genomic pool of neutrality.

Neutrality within the medium and structure of information theory, and its various subsets, promotes transmogrification and dialect between and amongst music and other media – text to/with music, music to/with image, and image to/with text. To facilitate this, all that is required is the establishment of mediatory methodologies or translational mechanism. An example methodology may involve software that makes data-anticipated interpretation of an SDIF file using software from the meta set. This software could present the result as a three-dimensional fly-through space.

To reiterate, real world atomic entities in the virtual domain, such as sound as audio, are now privy to a broader context, an almost exponential differentiation in terms of environmental conditions, molecular composition and decomposition. They can be isolated, measured, simplified and controlled as a stream of symbolic entities readily translatable to new and unique medial contexts. The computer in this regard is a transformational nexus that constructs pathways of relation between different kinds of meaning neutral information in the virtual domain. The computer as nexus acts using hardware as realisation and software, endowed with mathematical and symbolic processes, to extrapolate and abstract between different medias. Such abstractions may not necessarily be obvious in their application or result, but exposure may in time yield familiarity and new artistic and aesthetic possibilities.

Conclusion

> Human knowledge and human power meet in one, because where the cause is not known the effect cannot be produced. (Bacon 1597)

The notion of power can be epistemologically linked to qualitative and quantitative informational accumulation in the real world. Such information is neutral in meaning unless associations are made, either implicitly through use in language or explicitly in practice in the real world. The shift in relation from the paper ledger (real world) to the virtual ledger (computer) further neutralises the meaning as it requires some degree of (re)translation before it can ever be seen to be an actuality - information in the domain of technology is only a stream or series of bits or pits. Further, according to Buckland, information is indirectly empowering insofar as knowledge can be derived from it (Buckland 1999). Knowledge can only be achieved once neutrality is dissolved, cause is known and effect can be produced.

However, the neutrality of virtual information predisposes it to be readily (re)appropriated. Qualitative and quantitative informational measure will render a version of the physical universe, our day-to-day lives, different mediums and the sounds we project into a suitably acquiescent form that can be readably transmogrified. Whether this is an anticipated, literal or metaphorical interpretation of medium and structure, via the array of mediating translatory software devices, it is apparent that music, and computer music, in the virtual domain can exist and interplay intermedially with new liquidity.

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