Unformation and Information, more or less (than) human.

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1. Introduction

Unformation is a piece of generative computer music completed in 2023. The work uses feedback networks, machine listening and machine learning and aims at an aesthetic associated with a relative void of direct human judgement and manual intervention with materials, yet featuring a degree of agency, detail and fidelity normally associated with manually-composed music. This paper is a reflection on how the generative techniques in the work are manifest acousmatically in terms of agency and communication. Agency is addressed from a listening perspective, as relating to questions such as 'who or what is it that is doing something in this music?' and is manifest in how the music appears to happen. Agency carries a sense of purpose, gesture, or ability to create change, and it seems inevitable that any music would have a human agency on some level, because ultimately it presumes a human listener. My own experience of fixed-media studio composition suggests that a manual approach, where one is heavily involved directly in the moment-to-moment construction of a work often leads to a strong human agency regardless of what the sounds are, because repeated listening and revision imparts an embodied psychology of timing, anticipation and impact upon the work. I am interested in how real-time performance with algorithmic systems can affect the sense of agency, and *Unformation* is one of several works in which I explore how, what might be termed, *post-human agency* can be manifest in a music where both listening and sound organisation are shared between human and computer system. I am interested in qualities that suggest cognition, spontaneity, communication and ecology, but on a speculative plane, as if what we hear were not necessarily human music for human listeners. If, hypothetically, we encountered an intelligence at a level equivalent to human, but decidedly not human, our reference frame for interpreting its behaviour would be limited and we might well perceive communication even if the intelligence is not communicating at all. We would be further alienated if our exposure were limited to one sensory medium, such as sound. This acousmatic and epistemic void is what the title of my work refers to: the word *unformation* suggests, *possibly not information, but most likely worthy of attention*.

Artificial intelligences are typically modelled to pass as human, but an AI that is good as human will have nothing else than human agency. Instead, I aim for what I call *systemic agency,* a situation where events are caused by a system of forces, actors, connections, variables, signals etc. Systemic agency is an *intra-action*, to use Karen Barad's terminology (Barad 2007), meaning it is not reduced to individual, preexisting objects or agents. In music, systemic agency is coherent enough to be perceived as agential, as opposed to inconsequential; it is less cohesive than human consciousness, but more powerful than human capacity of action.

My work is in no way independent of the long history of algorithmic computer music. On the contrary, it is indebted to composers such as Herbert Brün, Gottfried-Michael Koenig, and Iannis Xenakis among others. Indeed, much music associated with mid-20th century formalism does

carry a non-human agency which is different from music composed with a more directly listening-guided craft. However, my music takes an acousmatic perspective on algorithmic composition, using contemporary technological means to embed acousmatic listening in formal systems. Acousmatic listening is especially important to my use of the concepts of information and unformation, but also in how I have embedded a listening-guided systemic agency within the system. My discussion invokes concepts from cybernetics and artificial intelligence, as well as Herbert Brün's writings on 'anticommunication'.

2. The generative system in Unformation

Curtis Roads warns that,

> some of the philosophical justifications behind algorithmic methods are confusing or contradictory. One issue is that non-formal assumptions, preferences, and subjective choices permeate the design and application of formal processes. This can make it difficult to assess the meaning and significance of a generative approach. (Roads 2015: 340)

Since I could not remove myself from the discussion, I approach my technical strategies in the context of my 'non-formal' aesthetic interests. *Unformation* is performed or recorded in real-time under the live supervision of the composer, who adjusts parameters that affect the music without directly controlling it. The incorporation of real-time interaction sets the work apart from experiments such as Nick Collins' *Autocousmatic* music. Collins' example places all the decision making in the hands of a trained algorithm, whereas in *Unformation,* listening is shared between machine and human. Moreover, Collins' work is built to test the hypothesis of an algorithm passing as a human composer. Collins makes a significant observation, however, writing that "because intensive listening is so important to the practitioners and audiences for [acousmatic] music […] it provides a clear challenge for an algorithmic study incorporating machine listening (Collins 2012: 8-9)." In contrast with Collins, Paul Berg describes how listening has had a more direct role in the algorithmic practices at the Institute of Sonology:

> Most programs were interactive in the sense of a dialog between the user and the program. This was a clear distinction from the batch-processing approach used on larger systems. Alternatively, there was no dialog but, instead, a brief compile time followed by some form of real-time sound production. […] This interaction underscored the importance of listening during the process of generating music using rules. (Berg 2009: 76)

Kerry Hagan, a composer of real-time generative works, has demonstrated an interest in "the sound metaobject and acousmatic approaches, but […] looking for a way to combine them with real-time computer music" (Hagan 2017: 37) which is concurrent with my intentions. However, her examples do not apply machine listening strategies to the real-time models and have less focus on morphology on a sound-object time scale, using Roads' terms, and the gestural sideffects I discuss here. Agostino Di Scipio's ecosystems should also be noted, not least since they deploy self-regulating feedback systems, which are also central to *Unformation*. In the above examples, agency is granted to a system, and sound is not directly controlled by human

intervention. For me, the non-human and non-natural, and the sense that the music is steering itself is an added value that I aim to capture, while simultaneously maintaining a presence of agency, even gesture, often absent in generative music and more typically associated with manual studio composition. *Unformation* is deliberately composed so that a run of the programme will perform the whole work. The system is constructed by processes that are linked on both low and high timescales, which means it does not allow one to generate material for later assembly through editing and mixing. I want to limit the scope of human intervention within progress of the work, by preventing any manual revision. Thus, all studio-compositional decisions are in the code to be executed in constrained real-time performance. The code is auditioned extensively in the studio composition process, but sound can only be addressed on a behavioural level, in terms of what is possible under certain conditions: it is impossible to generate the same output twice. For concerts, the piece can be performed in real time, or played back as a recorded take.

2. Cybernetics of Observing Systems

The work uses a feedback system to activate and regulate itself in the manner of a cybernetic mechanism. Of cybernetics, Katherine Hayles explains,

> Like animals, machines can maintain homeostasis using feedback loops. Feedback loops had long been exploited to increase the stability of mechanical systems, reaching a high level of development during the mid-to-late nineteenth century with the growing sophistication of steam engines and their accompanying control devices, such as governors. It was not until the 1930s and 1940s, however, that the feedback loop was explicitly theorized as a flow of information. Cybernetics was born when nineteenth-century control theory joined with the nascent theory of information. Coined from the Creek word for "steersman," cybernetics signaled that three powerful actors – information, control, and communication – were now operating jointly to bring about an unprecedented synthesis of the organic and the mechanical. (Hayles 1999: 8)

Written in SuperCollider, *Unformation* has as its core a network of four channels with identical synthesisers which are coupled so that they feed into one another in a circular topology – the ‘last’ channel feeding back into the ‘first’ – while also outputting their own signal to an individual speaker in a quadrophonic system (figure 1). The feedback provides spatial cohesion by linking the different channels so that they share some audio and behaviour. However, machine listening also provides a form of homeostatic control mechanism where changes in the sound output trigger a function which sets parameters of the synthesis to ensure that the output remains within a desired range of variation.

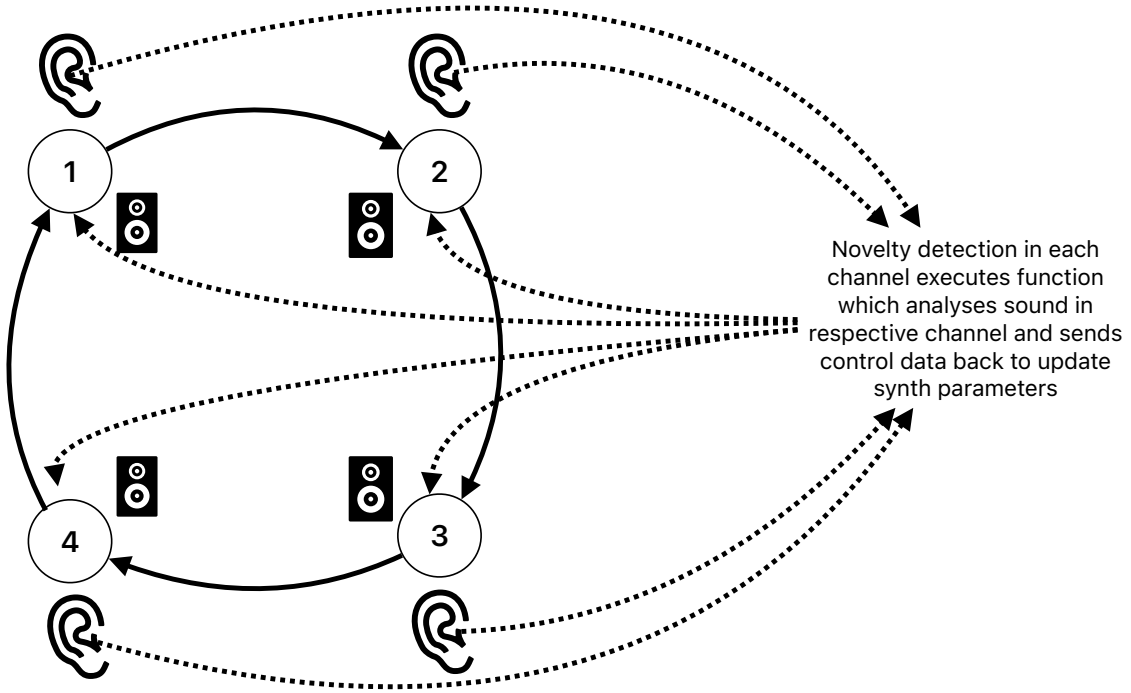

Figure 1: direct audio feedback is represented in the black arrow lines between the numbered circles. Dotted lines are data and control, generated from machine listening.

As Hayles writes, information and control are coupled: information is gathered through machine listening and used to control or moderate the synths. However, for agency to be present, there must always be something to respond to. This tension is maintained because the audio has a non-linear relation to the control input, firstly, due to internal stochastic processes and, secondly, due to feedback ensuring there is no way of exactly accounting for what happens. Two feedback systems are thus present, the first being a circular network of signals where audio outputs are fed into neighbouring synths; the second, a process where data is derived from audio through machine listening, to update of parameters of the synths and generate new sound. The system classifies the audio output using supervised machine learning (figure 2). It uses the classification as basis for decisions about new sounds to add to the texture – sounds which also become part of the observed signal. The neural network model in this case is self-referential in that it is trained on sound generated by the work itself.

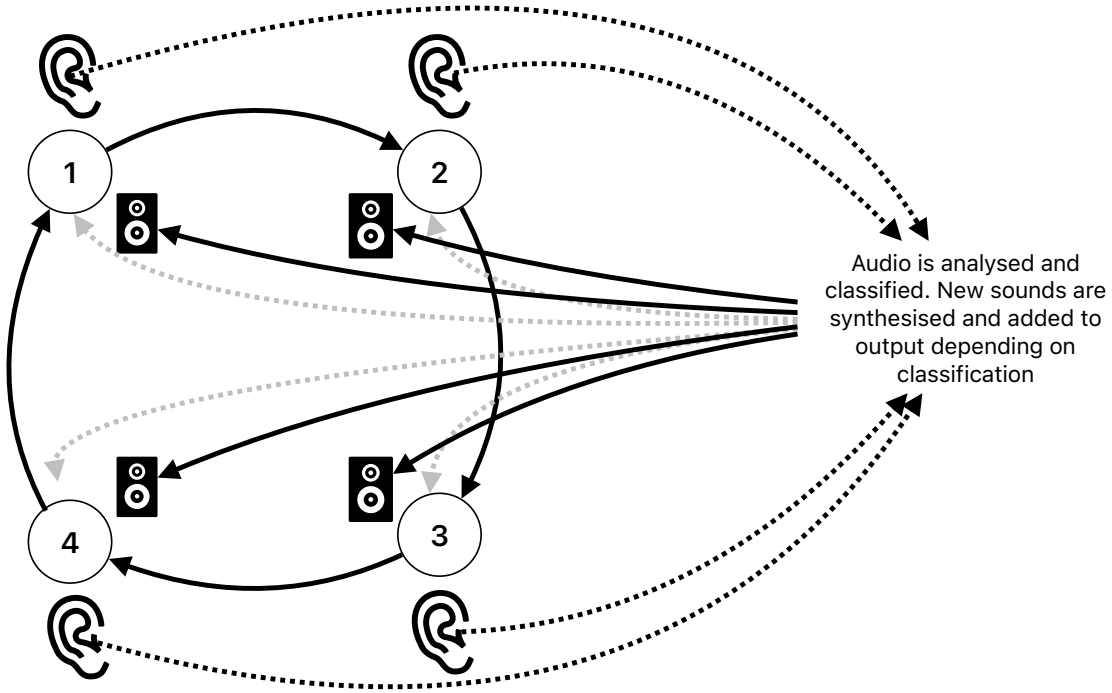

Figure 2: information to audio feedback in *Unformation.*

Because the synths feed the listening and data gathering process in the first place, the system is reflexively performing a basic cognitive modulation on its own behaviour. The process is an extension of the human composer who designed the system and trained its algorithms. This "reflexivity", according to Hayles "is the movement whereby that which has been used to generate a system is made, through a changed perspective, to become part of the system it generates" (Hayles 1999: 8). These kinds of observing systems have been labeled 'second-order cybernetics' by Heinz Von Foerster (1984). The acousmatic ear is coded into the system but it is nested in a system that does not act like a human. In run-time, the composer adjusts the sensitivity of the listening algorithm and probabilities determining how likely certain events or changes are to appear in the texture. The real-time human input, however, has a curatorial rather than expressive role, without direct control of individual sounds. Importantly, no individual agent has complete control: the synths, the human and the network are all part of a systemic agency.

3. Unformation and Information

In Koenig's words, non-standard synthesis "means not referring to a given acoustic model but rather describing the waveform in terms of amplitude values and time values" (Koenig and Roads 1978: 13). This principle that musical models result from – rather than inform – computation is reflected on several levels in this work and in how unformation and systemic agency emerges.

On the microsound level, there is near-complete entropy. The core synthesisers deploy stochastically controlled oscillators, stochastically generated audio, and a process which stochastically deletes wave sets from signals. Other techniques include spatially distributed FM synthesis, where each output channel modulates the frequency of the next in a circular network; pulsars controlled by the logistic map; oscillators with self-organised maps of wave tables; and distorted sine wave oscillators.

On an intermediate structural level, onsets and other changes in the audio trigger responses, which can cause chain reactions where events often appear in close succession or synchrony as morphological figures. An almost gestural pacing emerges as a sideffect of how the system responds to itself, how sounds coincide, trigger or punctuate one another. This is captured as time proportions by function which measures the rate of activity in terms of changes in density and spectrum of the texture and stores the time intervals of peaks in activity. For coherence, this is used for any added material that require temporal durations. Similarly, spectral information extracted from the audio output is stored in an array of frequencies to be used for any additional pitched synthesis. A sonic feature that emerges as the music progresses are stable frequency spectra, appearing as sustained chords, fast-paced chord patterns and swelling drones. These use the frequencies derived from analysis of the audio output, rather than a pre-defined tuning system. On a macro time scale, the work is constructed by overlapping generative processes, which are introduced when certain conditions are met. Many of the main developments in the work are instigated by real-time human control of probabilities that a transition could take place.

Thus, formless *unformation* gradually becomes *information* as data are harvested from the sound and used to build a structural edifice around the disorderly core. When events appear spontaneously, they do so with links to other events and processes, with which they make music together through systemic agency.

4. Anticommunication

The metaphor of the acousmatikoi, listening to Pythagoras orating behind a curtain, assumes that there is indeed someone there who delivers a message. But what if Pythagoras has gone home and there is no one on the other side? Part of what inspired me as I developed *Unformation* was the discovery of emerging silences and gestural moments. Abrupt, arbitrary, angular, blunt, but also musical, they made me listen as if the music possibly expected my anticipation, while also making me aware of a systemic agency which seemed to be infinitely churning, not even knowing it was making sound. We try to hear meaning, but we also doubt it. And indeed, the information is not a message because it is a feedback loop running on arbitrary data.
While a composer is an inevitable part of the musical system they create, since their judgements circumscribe the whole process, listeners also become part of a system because they project meaning onto the music. Shifting our perspective "from the cybernetics of the observed system to the cybernetics of the observer" (Hayles 1999: 11) helps explain the intentions behind *Unformation*. The technical process in which structure is derived from noise is similar to human auditory scene analysis taking place among listeners (Bregman 1990). In Heinz von Foerster's words, "the nervous system is organized (or it organizes itself) so as to compute a stable reality" (Von Foerster 1984: 20). On a more conscious level, intent, anticipation and purpose are common interpretations made by human listeners, seeking human agency. Yet, as Hayles' writes, "we see

only what our systemic organization allows us to see" (Hayles 1999: 11). In acousmatic terms, this is as if we were trapped at the end of a telephone line, transcribing messages even if none were ever sent in the first place. Doubting veracity, we hear our own attempt at constructing purpose whilst listening. Thus, listening makes us part of an information system even if there is no information. This 'unformation' *becomes* 'information', if it has enough significance for us to listen to, remember, think, or talk about it. The idea is relates to composer and cyberneticist Herbert Brün's concept 'anticommunication' which he described as a way of "protecting a message of contemporary relevance and significance from the unconditional surrender to the addressed receiver." (Brün 1973: 32). In his view, composers should not shape and deliver their music according to audiences' formulae of communication: "communication uses the order and the law that is meant to be found by the receiver as his own; anticommunication creates the order and the law that the receiver is to find for the first time." (Brun 1973: 33) I want to suggest that anticommunication provides a means of discussing algorithmic music in acousmatic terms, because it creates a listening condition where it feels as if the music has no meaning, but the act of listening to it does. Humans are conditioned to find purpose and communication in everything, and the fact that we repeatedly and frequently get things wrong is a good reason to learn something from exposure to the hollow gestures of anticommunication.

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