Unformation and Information, more or less human

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1. Introduction

Unformation is a piece of generative computer music which I completed in 2023 and have performed at events in Europe, the USA, and the UK since then. The work uses feedback networks, machine listening and machine learning with the aim of creating an aesthetic discourse characterised by 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. In this chapter I reflect on how generative techniques in the work may translate into agency and communication in acousmatic listening. Though the term acousmatic is often equated with fixed media-music, it is here agnostic to composition format: acousmatic listening is engendered by the sound material and its relation to any visually-evidenced cause or absence thereof. Thus, 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, in this view, carries a sense of purpose, gesture, or ability to create change, and it seems inevitable that human listeners would seek and find human agency on some level. As such, agency is manifest in a composer's or performer's interaction with a listener. My own experience of fixed-media studio composition, and my observations of wider acousmatic repertory, suggests that a manual approach to composition, where the creator is very directly involved in the moment-to-moment construction of a work, often leads to a strong human presence regardless of what the sounds are, because repeated listening and revision imparts an embodied psychology of timing, anticipation and impact upon the work. This can of course also be the case in a gestural live performance. I am interested in how agency is manifest in performance with algorithmic systems, and *Unformation* is one of several works in which I explore how listening and sound organisation can be shared between human and computer systems. Rather than taking a utilitarian approach, where machines are used as a practical advantage, this research pursues aesthetic qualities that suggest cognition, spontaneity, communication and ecology on a speculative plane, as if what we hear were not necessarily 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 the work refers to: the word *unformation* suggests something along the lines of *possibly not information, but most likely worthy of attention*.

Artificial intelligences are typically modelled to pass as human intelligence, behaving with human agency. Instead, the aim in *Unformation* is *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 Barad's (2007) terminology, meaning it is not causally reduced to individual, preexisting objects or agents, but rather a confluence of events. Although AI

techniques are used as part of the composition process, Hayles' (2017) term *non-conscious cognition* seems an appropriate a description of the systemic behaviour, as *intelligence* is broader concept that often infers consciousness. For Hayles, non-conscious cognition can exist in any level of biological life and in technology and consists of processes "that interpret information within contexts that connect it with meaning" (20). A system of many such distributed processes is not conscious, nor especially intelligent, but can give rise to activity that possesses systemic agency.

Unformation is indebted to the history of algorithmic computer music and acousmatic music. The electronic music of composers such as Herbert Brün, Gottfried-Michael Koenig, and Iannis Xenakis among others, and much music associated with mid-20th century formalism, does carry a non-human agency which is different from music composed with the more directly listening-guided craft of the acousmatic, musique concrete, tradition. Nevertheless, any electroacoustically mediated loudspeaker music has an acousmatic dimension in its audition, especially related to sounds that are causally ambiguous within its context, or which have qualities which stimulate imagination beyond evident causes. This research takes an acousmatic perspective on algorithmic composition, investigating sound morphology as linked to cognition and agency of machine listening systems rather than direct human composition. Since listening— especially acousmatic listening— involves identifying and understanding sound, the concept of information is important here in terms of what listeners derive from sound, including any perceived communication. This chapter positions *Unformation* in relation to relevant existing electroacoustic and computer music research and explains how concepts from cybernetics have informed the design of the work. It demonstrates how modelling of sound with feedback and machine listening regulation of stochastic processes yields certain structural characteristics in the work. This leads to a consideration of structure as a form of acousmatic *information* and how this relates to the notion of music as human *communication*. Herbert Brün's writings on *anticommunication* are invoked to provide a perspective on the ambiguity between what an acousmatic listener may interpret as communication, on one hand, and the incidental output of a technological system, on the other.

2. Generative models in composition

On the topic of algorithmic and generative strategies in electronic music, Roads (2015) 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. (340)

This is an important observation because it reminds us that any composer who is engaged with formal systems or non-standard synthesis techniques which have no acoustic precedents or models, will also be a listener with (more or less conscious) aesthetic models which likely will frame their judgement on some level. A central theme in this research is that acousmatic listening is present in the assessment of the meaning and significance of a generative approach and, further, that the conflicts between, and syntheses of, formal procedure and informal listening imagination can be fascinating in their own right. In this vein, *Unformation* generates

sound relatively autonomously in real-time under live supervision of a human, who adjusts parameters that affect the system without directly controlling the music. All sounds are synthesised in real-time and while the work has a loosely built-in temporal structure, its sound material and overall proportions are never identical from one instance to another. The incorporation of real-time interaction sets the work apart from experiments such as Collins' (2012) *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 different in that it is explicitly built to test the hypothesis of an electroacoustic Turing test of sorts, asking if an algorithm could pass as a human composer. Collins (2012) 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" (8– 9). In contrast with Collins, Berg (2009) 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. (76)

Hagan (2017), who works with real-time generative composition, has demonstrated an interest in "the sound metaobject and acousmatic approaches, but … looking for a way to combine them with real-time computer music" (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 side effects I discuss here. Di Scipio's (2003) 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. 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— that is more typically associated with manual studio composition, while often absent in generative music. *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. The scope of intervention within the progress of the work is thus limited by preventing any manual revision of generated sound material. All studio-compositional decisions are in the code to be executed in constrained real-time performance. While the code is auditioned extensively in the studio composition process, sound within the system can only be addressed on a behavioural level, in terms of what is possible under certain conditions: as far as I have tried, 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.

3. **Observing systems**

The work uses a feedback system to activate and regulate itself in the manner of a cybernetic mechanism. Of cybernetics, Hayles (1999) 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 Greek 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. (8)

Information, control and communication are important themes in *Unformation*. The work is written in SuperCollider (2026), a composition and synthesis programming environment, and 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 quadraphonic system (see F ig. 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 keep the output within a desired range of variation.

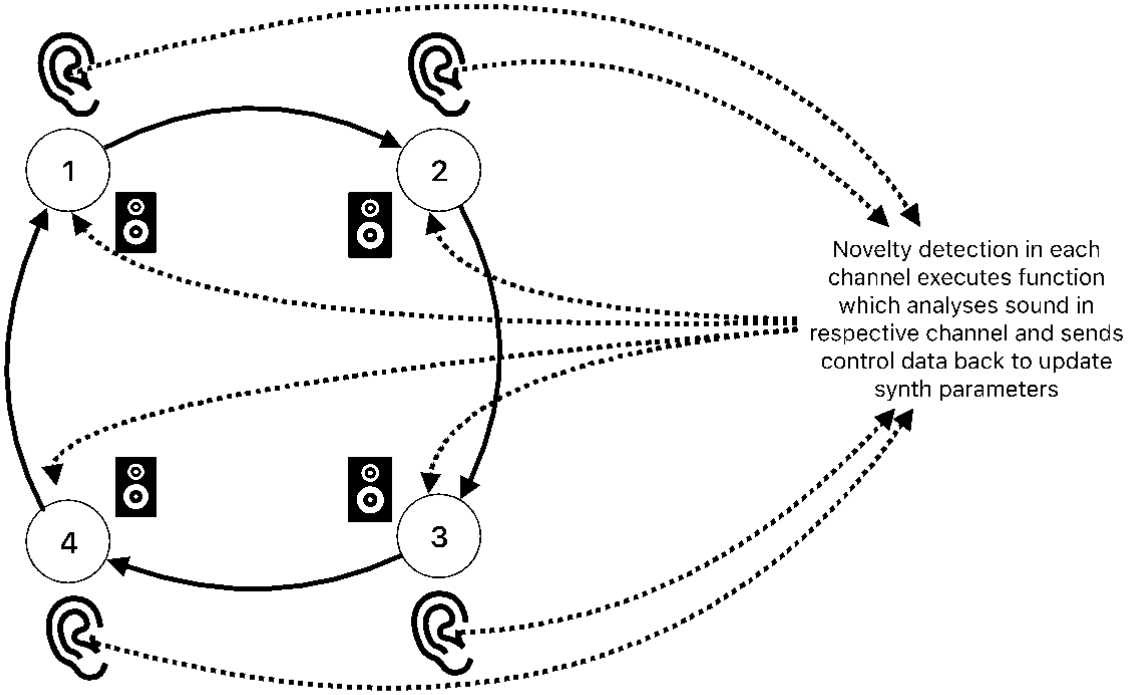

Figure 1: Information flow in *Unformation* by Erik Nyström. Direct audio feedback is represented in the solid black arrow lines between the numbered circles. Dotted lines are data and control, generated from machine listening.

The underlying principle is that information is gathered through machine listening and used to control or moderate the synthesis processors. However, a real impression of agency only arises with events that do not follow a strictly predictable pattern, instead suggesting a responsive awareness of a current context. Responsivity is foregrounded because the audio has a non-linear relation to the control input, firstly, due to internal stochastic and chaotic processes and, secondly, due to feedback ensuring there is no way of exactly tracing 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 parameters of the synths and generate new sound. However, the system is also active beyond regulatory control in that it observes its own audio output and classifies it using supervised machine learning (see Fig. 2). It uses the classification as a basis for decisions about new sounds to add to the texture— sounds which also become part of the observed signal. The machine learning model in this case is self-referential in that it is trained on sound generated by the work itself.

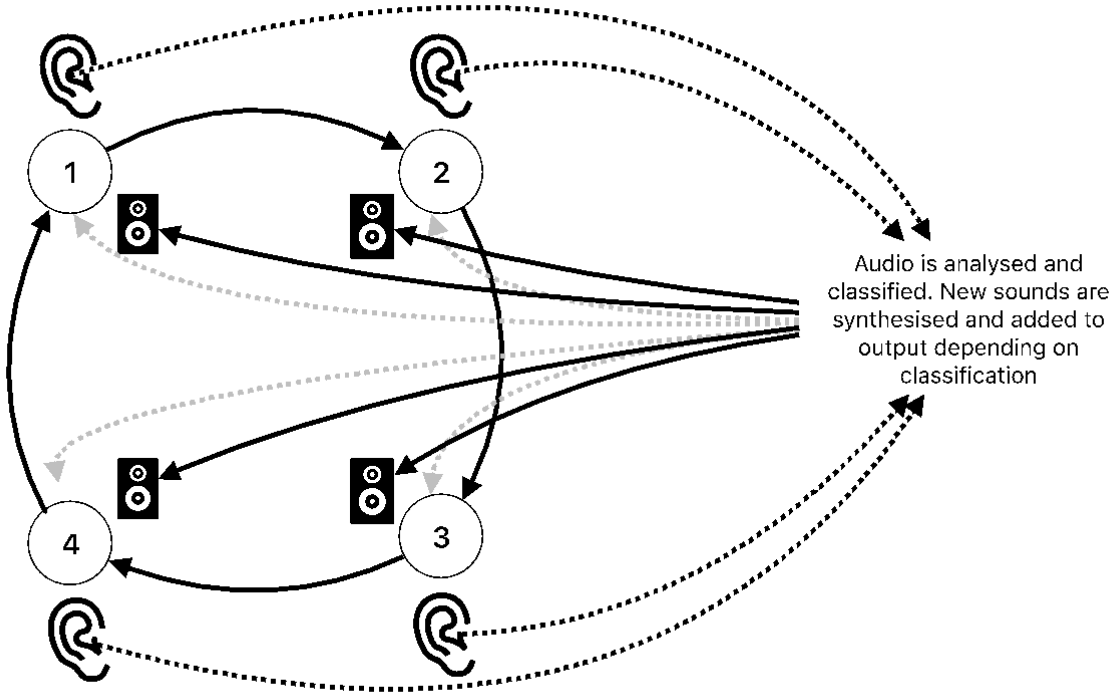

Figure 2: Information to audio feedback in *Unformation* by Erik Nyström. The grey dotted lines represent the control illustrated in F igure 1, to show that both audio and control results from the process.

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. In run-time, the composer adjusts the sensitivity of the listening algorithm and the 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. Reflecting on my own role as the human composer who designed the system and trained its algorithms. I can only consider myself part of it. This "reflexivity", according to Hayles (1999) "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" (8). Von Foerster (1984) wrote of " observing systems", and this becomes more relevant when we also factor in the listener.

4. Unformation and Information

The core sound material is primarily generated with non-standard synthesis methods, which are based on abstract concepts and not modelled on acoustic events (Holzmann 1994). 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 systemic agency emerges. However, as noted in relation to Roads' words above, it is also important to know that an

aesthetic bond is formed with the sound material on the basis of a materiality that is manifest in acousmatic listening.

On the microsound level, there is near-complete entropy. The core synthesis processes deploy stochastically controlled oscillators, stochastically generated audio, and a process which stochastically deletes wave sets from signals. Other techniques include spatially distributed frequency modulation 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 various forms of distortion.

On an intermediate structural level, responses to onsets and other changes in the audio cause chain reactions where events often appear in close succession or synchrony as morphological figures. An almost gestural pacing emerges as a side-effect of how the system responds to itself so that sounds coincide, trigger or punctuate one another. This is captured as time proportions by a timer 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 materials 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. Textural features that appear as the music progresses are stable frequency spectra, appearing as sustained clusters, 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 control of probabilities determining how likely a transition is to take place.

Thus, there is a linkage between events and processes across the system, allowing *unformation* to gradually become *information* as data are harvested from the sound and used to build a structural edifice around the disorderly core.

5. Anticommunication

The story of the acousmatikoi, in reference to which Pierre Schaeffer named *acousmatic music*, tells us of pupils listening to Pythagoras orating behind a curtain (see Chion 2009), and it assumes that there is indeed *someone* there who delivers a message. But what if Pythagoras has gone home and there is no one there on the other side? Will the pupils still interpret what they hear as if it came from a human speaker? Such questions seemed relevant as I initially discovered the silences and gestural moments that appeared in the texture in *Unformation*. Abrupt, arbitrary, angular, but also musical, these moments made me listen almost if they expected my anticipation, while simultaneously revealing an infinitely churning system, unaware that it was making sound, let alone being listened to. Even though the systemic agency of the music is isolated from the presence of any human listener, a speculative and fragmented dialogue of expectations and assumptions seemed to occur. This suggests a tension between, or synthesis of, the acousmatic imagination and the non-conscious machine. Of course, any composing, including the nurturing of these qualities, is in itself an act of creating listening expectations, but the disconnect between machine and human is still there because of how the systemic reactions among internal listening processes drive the work, rather than a directly constructed teleology.

We can shift our perspective "from the cybernetics of the observed system to the cybernetics of the observer" (Hayles 1999, 11) to put the listener into the communication system of *Unformation*. While a composer is an inevitable part of the musical system they create, listeners also become part of a system because of what they project onto the music. Intent, anticipation and purpose are common interpretations made by human listeners, seeking human agency, on the assumption that all events are intentional and functional because they are part of a piece of music. Yet, as Hayles (1999) writes, "we see only what our systemic organization allows us to see" (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. The act of deliberately trying to establish such a situation in composition appears similar to what Brün (1973) described as *anticommunication*: "protecting a message of contemporary relevance and significance from the unconditional surrender to the addressed receiver " (32). In his view, "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 " (33). The concept of anticommunication can be applied to acousmatic scenarios where the discourse seems to be operating according to principles divorced from an audience, due to not being directly managed by the 'primacy of the ear' of the composer. Yet anticommunication has added value because it can stimulate speculation and bring to attention the fragility of communication. Acousmatic theory and music have always celebrated hearing without seeing as an adventure, but it tends to be an adventure under the leadership of a composer's communicative rhetoric of purposeful gestures. In this way a readymade teleological reality is made available to a listener who, in a sense, communicates with the music through a shared language of expectations. Such a language has been established through both repertory and theory, often anchoring sound in models of human gesture and nature (Emmerson 1986). On the peripheries of such stable and controlled realities, however, the acousmatic challenge is perhaps more like traversing an information wasteland in a world that is not guaranteed to have purpose. Such a scenario could of course fail to satisfy a listener who thinks the music might make more sense if it were manually composed rather than generated by an unpredictable computer program. However, the point here is that alienation is central to acousmatic listening, and therefore generative technology appears as a powerful domain for developing the acousmatic medium, precisely because of how it introduces its own agency.

6. Conclusion

It should be obvious that *Unformation* remains more or less human, since the system is designed by a human composer. As such, its aim is to model a scenario which balances between having sufficient direction, detail and structural intricacy for listeners to stay engaged, while simultaneously maintaining a spontaneous internal causality in the form of systemic agency. Since the acousmatic listening condition is predicated on alienation from information about sound, the system is designed to synthesise incidental events, morphologies, spectra and textures, in order to enrich the speculative dimensions of musical discourse by subverting evidence of causality.

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