The Algorithmic Muse:
New Listening Paradigms and the Harmonies of Chaos

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Abstract: Algorithmic music is receiving increasing attention which has not been universally welcomed, and condemned by some as 'unmusical'. This paper argues that any algorithm derived from or related to prevailing scientific models and theories should have valid musical potential, and can be important in reinforcing for contemporary society the symbolic role which music has always possessed and which continues to be manifest in many cultures worldwide. In particular, fractal geometry, in redefining the boundaries between order and unfathomable chaos, inevitably implicates fundamental instincts of what constitutes 'harmony' in its broadest sense.

All music is to some extent algorithmic, that is, it follows some agreed formula, even at the most intuitive of levels. Substantially different musical cultures exist worldwide, each of which possesses a supporting foundation of theory and formulae which relate to, or derive from, broader symbolic cultural imperatives. Apart from the most elemental of children's song improvisations, which appear to have some sort of worldwide commonality, anything more developed, and particularly music involving instruments, will always fit to local cultural norms. Even 'free' improvisers seeking to liberate themselves from musical constraints of both western serious and popular musical traditions, will need to be familiar with the 'formulae' which define a style in order to avoid or exploit them. And anyone playing a musical instrument can not escape from the constraints of its design, which functions as a sort of built-in mechanical set of algorithmic boundaries. Algorithmic metaphors are consistently employed as a means of approaching and understanding music as a phenomenon. Indeed, the process of education of composers and improvisers in many cultures can be understood as a process of learning algorithms, exploring means of selection, invention, manipulation and application in an attempt to tame pure intuition - intuition which in any case might otherwise be perceived as an untutored and naively limited encounter with misunderstood algorithms.

But an algorithmic composer can not claim that 'all music is algorithmic therefore algorithmic music is O.K.' The problem is essentially one of degree. Some algorithms are generally accepted as inherently 'musical' - comfortably derived from traditional theory - whereas, others are dismissed as abstract, arbitrary manipulations. Music which is overtly algorithmic is construed to be difficult, or 'unnatural and cerebral' music, whereas music with a less evident algorithmic basis is associated with pleasing, 'natural' music. The implication is that 'unnatural' algorithms produce 'unnatural' music. Yet even Gershwin and Rachmaninov, not usually considered to be the most cerebral of composers, nevertheless used very formal systems of manipulation to produce universally 'popular' and 'moving' music. Is it possible that effective utilisation of newly-fashionable algorithms might provide new routes into aurally-induced transcendental ecstasy as an intuitive familiarity with alternative musical formalisms develops?

No society's traditional corpus of music theory can claim to be based on empirical 'musical' values which are more valid than those of any other society. It is only historical familiarity which breeds acceptance. Likewise, where conventions are established by scientists, mathematicians or philosophers in the context of any society's developing cosmology or world view, to establish preferences, priorities and ideals against which to validate algorithms devised to model natural forms and patterns, these conventions will develop in the context of a culturally inculcated, intuitive sense of underlying 'harmony', which lies at the heart of what music has always been and should continue to be. It is not only acceptable, but it is important that the application of abstract algorithms should be explored in a musical context, for music can not only reflect, but also define our perception of the world.

The late Lejaren Hiller used to relate an incident which occurred when he was working in the 1960's on a computer normally given over to high-powered research in nuclear physics, to which he had been granted access at slack times to conduct his pioneering algorithmic music experiments. He was sure that an error in the system was producing curious and unexpected aberrations in his musical output, but the engineers remained unconvinced. Eventually, after much persuasion, an error was identified which turned out to have been corrupting the 'serious' scientific work yet had escaped detection amongst the bewildering imbroglio of numerical data. It had been uncovered through the agency of a deeper sense of 'harmony' perceivable through auditory mapping.

In the early days of computer music, algorithmic production and manipulation of note data as a form of musical composition was accepted as an appropriate part of the experimental research process. It could assist musicians to understand and come to terms with formal systems and productive processes. As technology advanced producing more sophisticated systems for digital sound synthesis, so formal interest switched to means of sound definition through algorithmic models of physical processes at the signal level, but applied to generate compositions presented within a familiar, traditional expressive paradigm. And so the potential aesthetic threats of early note-based experiments in algorithmic composition were side-stepped, with its exponents marginalised as a small group pursuing an esoteric hobby tolerated as harmless but inconsequential. However, the development of non-teleological, systems approaches to composition in the broader musical domain, independent of computer music, and its evident public success extending to both popular and formal cultural domains, has encouraged algorithmic techniques to be rediscovered and revisited by larger numbers of computer musicians to potentially create something of a challenge to more generally accepted values associated with the modernist-expressive tradition. As algorithmic music moves closer to centre stage, it becomes increasingly necessary to mount a vigorous defence in the face of more vociferous attacks from its uncomfortable critics who remain wedded to fading notions of what constitutes valid artistic activity.

John Cage left a valuable legacy in his championing of non-intentional composition, moving away from general acceptance of the Freudian obsession with the 'expressive' psyche and related perceptions of the heroic artist as patriarchal priest-substitute, to recover an appreciation of external, real-world processes and associations as the basis of 'art'. His pioneering explorations of chance operations, provided a conceptual embryo for the exploration and development of a much broader range of algorithmic approaches to composition. Where Cage's legacy has been perverted, however, is in blurring the distinction between 'sound' and 'music' so that to some they have become virtually equivalent concepts. Although Cage's aural revolution has opened our ears to a generous appreciation of all sounds as having potentially musical status, one result has been to lead to a preoccupation with the superficial sound image itself and its expressive contextual manipulation, and a neglect of the rich symbolic function of music. Trevor Wishart (1985) expresses this particularly cogently in his dismissal of the tradition of 'lattice' composition, which works with discreet units, as opposed to a more fluid 'spectral' model of continuous sound composition. (There are interesting parallels here with competing 'particle' and 'wave' theories of matter and energy). Algorithmic composition is, of course, stubbornly lattice-oriented being predicated in the manipulation of discreet symbols. There is no reason why the logical lattice within which algorithmic manipulations take place may not be mapped onto a finely quantised sound space in the form of granular synthesis, or even through algorithmic control of spectral manipulation, but the noble 'note' nevertheless remains as powerful a symbol as ever.

The literal origin of the term 'music' has always been understood to refer to a sublime art derived from the activity of the Greek muses. But the potent symbolism and active engagement with all that the Muses represent has nothing at all to do with the term 'muse' in common use today, with which it has almost certainly become confused. Contemporary use of the term 'muse' implies aimless thought and passive introspection, etymologically linked to the idea of 'amusement' and pastime. As a result of being reduced in the minds of so many to such a limited and inappropriate role, the significance of all that music stands for, has accordingly been cheapened. Evidently, 'muse' in its contemporary sense derives

from an old French term for 'snout', implying the idea of someone standing around with their nose in the air! This link is more recognisable in the word 'muzzle', which comes from the same root, and also helps highlight the danger of this semantic confusion in identifying an activity which constrains and denies. Real music should liberate and affirm through active, creative involvement with the 'Muses' and all the rich cultural symbolism they represent, and so reinforce the platonic context of music's role in forging and confirming the perceptual priorities which define humankind's relationship to the cosmos.

Amongst algorithmic composers and researchers there has recently been an interesting debate taking place between 'rule-based' and 'connectionist' approaches. A 'rule-based' scheme will build up a transparent set of generative rules to define a new or preexisting musical style, usually based on traditional music theory, empirically chosen and constructed by the designer. A 'connectionist' approach will make use of a more general scheme for pattern processing, typically a neural network, which can be driven by different musical data sets, each representing a different 'style' which is to be reproduced. A connectionist model is opaque in its operation and will not easily identify generic stylistic features of any data set. It has been argued that connectionist algorithms merely reproduce shallow surface characteristics of a style, and are unable to take account of any deeper, underlying 'intelligence' implicit in a musical work (Laske 1990). This may be the case, and some inflated and inappropriate claims have certainly been made, but that does not invalidate such approaches. I would suggest that the mere desire to use such general models for musical ends is a genuine example of appropriate contemporary engagement with the 'muse'. The model may not succeed in replicating a given style in any substantial sense, but all outputs from the same model will carry their own set of characteristics, or 'deep' imprint, unique to that model no matter what musical material is used as data to drive the system.

Even though some of my own work (Jones 1981) has been cited as representing a precursor to more recent connectionist models (Todd 1989, Mozer 1991, Lewis 1991), some of these citations have perhaps missed a thread, in that although the stochastic systems described could have been driven by existing, or even specially composed, musical data, they were essentially presented as interesting systems in themselves, with a rich variety of intrinsic structural properties which can be described in a musically-relevant vocabulary. When used to compose, the models have been initially self-seeded with random values. It is the value-system represented by the model, implicit in any output, that provides the aesthetic interest and validity, not the explicit surface detail of note arrangements.

This point might be more easily understood by imagining an algorithmic connectionist model which might have been designed to work on data sets made up of paintings, to identify and produce some sort of statistical analysis of attributes such as lines of maximal contrast, colour clusters, density gradients, etc., and then produce a new work based on that analysis. A Renoir, or Turner, for example, fed into the system would not produce anything remotely resembling a new work by that artist, but the output might nevertheless still be an interesting artwork in its own right, representing values implicit in the design of the model. If the model produced more convincing output when fed Mondrian or Pollock, that might reflect a measure of commonality linking the artists' values and priorities with those of the designer of the algorithmic modelling system, which in turn might reflect broader common contemporary cultural perceptions. Indeed, neural networks have been successfully employed to extract features, distinguish between, and so 'recognise' individual faces. I am not sure whether such systems have been used in 'synthesis' mode, but they would, no doubt, be capable of yielding a fascinating sequence of distorted portrait variations which would function as significant contemporary artistic statements.

In the history of musical thought over the last few centuries, and even on a millennial scale, it has been possible to observe swings between more 'expressive' and more 'formal' approaches to musical activity. Times of significant cultural change, provoked by a radical reappraisal of accepted scientific thinking, have been accompanied by significant shifts in musical style, with theoretical constructs developed as part of a web of symbolic associations springing from the virile dynamic active at these historical hot spots of cultural synergy (James 1994). Parallel association of musical theoretical imperatives with symbolisms evident in the prevailing local cultural cosmology may be observed in societies worldwide,

where music's role in defining and sustaining relationships between a society and the local ecology is nurtured and cherished (Small 1977, Crump 1990).

For thousands of years, western cultural axioms were essentially derived from Euclidian Geometry where straight lines and circles formed the central reference points against which to measure the natural world. Music possessed an equivalent Pythagorean basis in its use of simple ratios to define the basic notions of modal, monodic 'harmony'. As it became increasingly difficult to stretch simple Euclidian methods to accommodate more complex phenomena, so too did the simple Pythagorean basis of music begin to change. A few hundred years ago, the new mathematical universe of Cartesian Geometry and Newtonian calculus established continuous, cyclic functions as new conceptual reference tools - with the contemporaneously fixed lattice of equal temperament supporting equivalent, musical developments in the establishment of the tradition of 'classical' harmony, which has massively underpinned western formal and popular culture up to the present day.

Recent changes in western scientific thinking, precipitated by revolutionary increases in computational capacity, include redefining the boundaries of what constitutes 'chaos', as the fractal geometry of iterative and recursive functions provides more elegant and powerful means of modelling natural systems. Similarly, the use of computer-modelled neural networks challenge traditional causal, or sequential, paradigms. Such approaches are epoch-making in questioning previous scientific assumptions, provoking a significant shift in the prevailing cultural climate. Today's post-modern society is moving away from an obsession with the individual expressive psyche, to a renewed appreciation for the natural environment and a holistic interest in the processes and systems which sustain the planet, reflecting the arrival of a new 'geo-metry', or literally 'earth-measure'. It is appropriate that a new or broader aesthetic of what constitutes acceptable musical activity should accompany this shift as contemporary humankind follows age-old and worldwide practice, using music as a means of coming to terms with the complexities of the cosmos, with the intuitive concept of 'harmony' in its broadest sense being reinforced and enlarged.

Although some algorithmic applications in composition may sometimes appear to be derivative, routine or unimaginative, as in any type of music, nevertheless selection, development and successful mapping of algorithms should inevitably reflect the composer's perceptions of broader cultural and scientific priorities. Care should be taken before condemning most forms of algorithmic generation or mappings as inherently 'unmusical'. Historical attempts to broaden the scope of acceptable musical activity have always provoked a similar response. Algorithmic musicians must not retreat to the shelter of an 'O.K.-we'll-accept-it-as-an-alternative-art-form-so-long-as-we-don't-have-to-call-it-music' label. Historical precedent is supportive. Algorithmic music should be embraced and celebrated.

References:

Crump, T. 1990 *The Anthropology of Numbers* Cambridge University Press

James, J. 1994 *The Music of The Spheres:Music, Science & The Natural Order of the Universe* London: Little, Brown & Co.

Jones, K. 1981 "Compositional Applications of Stochastic Processes" *Computer Music Journal* 5(2) pp.45-61

Laske, O. 1990 Letter: "Connectionist Composition" *Computer Music Journal* 14(2)

Lewis, J.P. "Creation by Refinement and the Problem of Algorithmic Music Composition" in Todd, M. & Loy, D.G. Eds. *Music and Connectionism* MIT Press pp.212-228

Mozer, M. 1991 "Connectionist Music Composition Based on Melodic, Stylistic and Psychophysical Constraints" in Todd, M. & Loy, D.G. Eds. *Music and Connectionism* MIT Press pp.195-211

Small, C. 1977 *Music. Society. Education* London: John Calder

Todd, P.M. 1989 "A Connectionist Approach to Algorithmic Composition" *Computer Music Journal* 13(4) pp.27-43

Wishart, T. 1985 *On Sonic Art* York: Imagineering Press