Live Algorithms

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The EPSRC-funded Live Algorithms for Music (LAM) research network is establishing an inter-disciplinary community of musicians, software engineers and cognitive scientists. Our aim is to investigate autonomous computers in music.

The use of computers in live music is not new; the fields of generative (algorithmic) composition and live electronics are of particular interest to LAM. A key discriminator between these is the degree of interaction with the performer. Interaction is intrinsic to **live electronics**: a performer may jam with commercial or custom software; a 'laptop-as-instrument' paradigm, in which the computer is controlled directly. Another approach links players of traditional instruments with computers: incoming sound or data is analysed by software and a resultant reaction (e.g. a new sound event) is determined by pre-arranged processes. Such 'reflex-systems' can accompany performance but might also utilise stochasticity to effect surprise; as determined by organizational decisions made by the composer /designer. We would term such a system 'weakly interactive' because there is only an illusion of integrated performer-machine interaction, feigned by the designer. **Algorithmic composition** generates music off-line, although can be used in real-time. Algorithms from such fields as fractals, chaos theory, neural networks and evolutionary computing have been exploited by composers for their patterning properties.[1] Such systems are not interactive, since all the parameters needed for sound generation are pre-determined.

In contrast, strong interaction is exemplified in the human-only practice of **'free' improvisation**. This music rejects top-down organisation (a priori agreements, explicit or tacit) in favour of open, developing patterns of behaviour.[2] Social theories describe experiences with a sense of certainty, and with a unified artistic intent, as 'becoming situated'. An 'interactional semiotics' has been proposed, stemming from Meade's idea of emergence: an ensemble as single entity exhibiting self-organising behaviours (see 1. for references).

LAM is interested in computer systems that might interact strongly with musicians, in both a supportive and a creative capacity and the research agenda is a marrying of algorithmic music, live electronics and free improvisation. Properties of human performance – and therefore of a live algorithm (LA) - include strong interactivity, autonomy, innovation, idiosyncrasy and comprehensibility.

Strong interactivity depends on instigation and surprise as well as response. Individual decision-making is immediate, necessary and basic: when to play or not, when to modify activity in any number of parameters (loudness, pitch, tone quality), when to imitate or ignore another participant, when to 'agree' the performance is concluding. When to make a decision. And why. Without the capacity to **innovate**, listeners would lose the belief that the LA was truly engaged with the performance instead of merely accompanying it. The iterative, generative, **idiosyncratic** world of algorithmic organisation must be accessed, but the mechanical and the predictable must be avoided. It is the ability to innovate that distinguishes automation from **autonomy**. It is not hard to generate music of great complexity. Harder, though, is to ensure that these

contributions are **comprehensible** to fellow performers in real-time who might be hearing these ideas for the first time. (But an incomprehensible, opaque system can be contrasted with a transparent one where the association between input and output is too trivial.)

Such considerations show the research goal is prescient, but there are reasons to believe that it is imminent too. The authors' own Swarm Music/Granulator systems implement a model of interactivity derived from the organisation of social insects.[3] These systems embody our idea of a proxy environment which holds meaningless sonic events. The system (human or machine) explores the environment, discovering and manipulating found sonic objects. Long term organisation can develop, just as it does in termite nest construction. Within this framework, we envisage a modular system comprising of analysis (P) and synthesis (Q) functions which interface and interpret the sonic environment and relay parameters to a hidden patterning algorithm (F) (analogous to listening, playing and musical thinking enjoyed by a human performer). This picture integrates interaction with algorithmic composition and exploits recent developments in real time music analysis/synthesis.

The network has some 70 members, including representatives from France, Portugal, USA and Australia. Activities include an open meeting and two network workshops each year. Each event features invited speakers, contributions from LAM project teams and performances. The next meeting will be December 19-20 2005, with an international conference in December 2006. LAM warmly encourages AISB readers to participate: please see www.livealgorithms.org

1. E. Miranda. Composing Music With Computers. Focal Press, 2001
2. T.M.Blackwell and M.Young. Self-Organised Music. Organised Sound **9**(2): 123–136, 2004.
3. T.M.Blackwell T.M. and M.Young. Swarm Granulator. Applications of Evolutionary Computing EuroWorkshops 2004, Proceedings, LNCS 3005, Springer-Verlag (2004) 399-408

Figure Caption
The modular structure of a self-organising system. Analysis parameters ***p*** *obtained from audio (Y) are mapped into the patterning space (F). In this example we see swarm particles drawn towards a new attractor, creating new synthesis data* ***q*** *for the resulting sound (X).*