

# Music-AL Workshop 2007

**Workshop on Music and Artificial Life part of ECAL 2007**

**10 September 2007, Belem Cultural Centre, Lisbon, Portugal**

**Organised by ICCMR, Plymouth, UK - <http://cmr.soc.plymouth.ac.uk/>**

Welcome to Music-AL 07. The Artificial Life approach to music is an exciting new development for composers and researchers. For composers, it provides an innovative and natural means for generating musical ideas from a specifiable set of primitive components and processes, reflecting the compositional process of generating a variety of ideas by brainstorming followed by selecting the most promising ones for further iterated refinement. For researchers, such techniques are used to model the cultural transmission and change of a population's body of musical ideas over time. For example, the development and maintenance of musical styles within particular cultural contexts and their reorganization and adaptation in response to cultural exchange.

In both cases, the musical evolution can be influenced by a variety of constraints and tendencies built into the system, such as realistic psychological factors that influence the way that music is experienced, learned, stored, modified, and passed on between individuals. Realistic Artificial Life models of music require sophisticated techniques for the implementation of such constraints and tendencies, which involves an interdisciplinary understanding of music from different points of view, ranging from neuroscience and psychology, to computing and musicology.

This workshop focuses on the applications of Artificial Life to music and the tools needed to create and study such systems. These tools are mostly drawn from research into the origins and evolution of biological organisms, ecologies, and cultural systems on the one hand, and in part from A-life computer modelling methodologies on the other.

The goal of this workshop is to bring together a multidisciplinary core of musicians and scientists who are working at the crossroads of A-life and music, to provide a common ground for dialog and interaction, to highlight the latest advances, and to discuss the main directions for the future. In addition to scientific and technical standard research papers, composers and practitioners were encouraged to submit papers reporting practical applications of A-life to music; e.g., discussing a musical composition using A-life.

Most A-life and music researchers are musicians in their own right using A-life in their musical activities in a way or another. Music is perhaps one of the few domains that can readily convert the outcomes of highly specialised A-life basic research into ordinary practical use, thus contributing to promote public understanding of the significance of A-life as a field of research. Musicians working with A-life were invited to propose compositions for performance at the Music-AL concert in the evening of 12 September 2007, at 9.30pm, at the "Instituto Franco-Portugues". The Music-AL concert will be the second concert of the Musica Viva Festival, which will continue for a few days after the workshop. The Musica Viva Festival is a prestigious international contemporary music festival organised by Miso Music Portugal.

Three members of the scientific committee reviewed each paper submission. The organising committee is thankful to the members of the scientific committee for their availability to review the papers:

Amilcar Cardoso (University of Coimbra, Portugal)  
Andrew Brown (Queensland University of Technology, Australia)  
Andrew Horner (The Hong Kong University of Science & Technology, China)  
Christopher Ariza (Towson University, USA)  
John Al Biles (Rochester Institute of Technology, USA)  
John Matthias (University of Plymouth, UK)  
Jon McCormack (Monash University, Australia)  
Geraint Wiggins (Goldsmiths College University of London, UK)  
Larry Bull (University of the West of England, UK)  
Marc Leman (Ghent University, Belgium)  
Mitchell Whitelaw (University of Canberra, Australia)  
Palle Dahlstedt (University of Göteborg, Sweden)  
Peter Bentley (University College London, UK)  
Tim Blackwell (Goldsmiths College University of London, UK)

Enjoy the workshop!

Sincerely,

The organisers:

Eduardo R Miranda (Chair, University of Plymouth, UK)  
Joao Martins (University of Plymouth, UK)  
Qijun Zhang (University of Plymouth, UK)

## **Provisional papers programme**

Subject to slight amends on the day.

**9:15 – 9:30**

Welcome from the organisers

**9:30 – 9:45**

*The Hypothesis of Self-Organization for Musical Tuning Systems*

Jean-Julien Aucouturier

**9:45 – 10:30**

*Emergent Musical Environments: An Artificial Life Approach*

Marcelo Gimenes, Eduardo R. Miranda, Chris Johnson

**10:30 – 11:45**

*Emergent rhythmic phrases in an A-Life environment*

Joao M. Martins, Eduardo R. Miranda

**11:45 – 12:30**

*The Evolving Drum Machine*

Matthew Yee-King

**12:30 – 14:00**

Lunch break & POSTERS

**14:00 – 14:45**

*Evaluating Mappings for Cellular Automata Music*

Alexis Kirke, Eduardo R. Miranda

**14:45 – 15:30**

*Evolving Expressive Music Performance through Interaction of Artificial Agent Performers*

Qijun Zhang, Eduardo R. Miranda

**15:30 – 16:15**

*Autonomous Evolution of Complete Piano Pieces and Performances*

Palle Dahlstedt

**16:15 – 17:00**

*Generative Composition with Nodal*

Jon McCormack, Peter McIlwain, Aidan Lane, Alan Dorin

**17:00 – 18:00**

Open group discussion

## **POSTERS**

*Interaction and Self-organisation in a Society of Musical Agents*

Peter Beyls

*Artificial anuran chorusing*

David Michael

*Transformation and mapping of L-Systems data in the composition of a large-scale instrumental work*

Nigel Morgan

*Remembering the future: applications of genetic co-evolution in music improvisation*

David P. Casal and Davide Morelli

## **ABSTRACTS**

### ***The Hypothesis of Self-Organization for Musical Tuning Systems***

Jean-Julien Aucouturier

**Abstract:** Musical tuning systems are found in intriguing diversity in human cultures over the world and over the history of human music making, from the western hegemony of 12-tone equal temperament (C, C?, D. . . ) to e.g. the inharmonic indian 22 shruti system. Traditional justifications for the adoption of such musical systems consider tuning as an algorithmic optimization of consonance. However, it is unclear how this can be implemented in a realistic evolutionary process, with no central entity in charge of optimization. Inspired by the methodology of artificial language evolution, we propose that tuning systems can emerge as the result of local musical interactions in a population. We show with computer simulations that such interaction mechanisms are capable of generating coherent artificial tunings that resemble natural systems, sometimes with diversity and complexity unaccounted by previous theoretical justifications. However, the self-organization of realistic tuning systems is found here to require non-trivial environmental and cultural constraints. Notably, advanced musical activities such as primitive harmonic accompaniment (drone tones) and using different types of instruments simultaneously seem to be necessary ingredients.

### ***Emergent Musical Environments: An Artificial Life Approach***

Marcelo Gimenes, Eduardo R. Miranda, Chris Johnson

**Abstract:** Our research is aimed at investigating the genesis and development of musical styles in artificial worlds. Focusing on the analysis of piano improvisation, we designed and implemented a computer system (iMe) with which we analyse processes involved in music perception and cognition in order to evaluate how musical influence can lead to particular musical worldviews. iMe also entails interaction between software agents and human pianists playing improvised music. This paper introduces the main components and algorithms that comprise the system and demonstrates their functioning.

## ***Emergent rhythmic phrases in an A-Life environment***

Joao M. Martins, Eduardo R. Miranda

**Abstract:** The Artificial Life approach to music is a promising new development. The vast majority of existing Artificial Life systems for musical composition employ a Genetic Algorithm (GA) to produce musical melodies, rhythms, and so on. In these systems, music parameters are represented as genotypes and GA operators are applied on these representations to produce music according to given fitness criteria. We have identified two limitations of such GA-based systems: one relates to the fact that composition should not be constrained by a definite set of fitness criteria and the other is to do with the fact that music is largely a cultural phenomenon driven by social pressure and this is cumbersome to model with standard GA alone. An approach to address these limitations is to build systems with A-Life algorithms designed primarily to address musical issues, rather than using algorithms that were not designed for music in the first place. The work presented in this paper contributes to this line of thought by proposing the design of algorithms that consider music as a cultural phenomenon whereby social pressure plays an important role in the development of musical conventions. We introduce three algorithms: popularity (focus of the paper), transformation and complexity algorithms, respectively. The algorithms were implemented in the context of a system for composition of rhythms, where the user can explore their potential to generate rhythmic sequences and also monitor their behaviour.

## ***The Evolving Drum Machine***

Matthew Yee-King

**Abstract:** The expectation of the listener from house and techno music seems to be that percussion sounds will maintain the same timbre for the duration of a piece of music. For the composers of such music the synthesizing of drum sounds of a quality equal to those available from commercial drum machines or samples is difficult and seems unnecessary. A system is presented here, which provides a unique method for the composition of rhythmic patterns with dynamic timbres. A genetic algorithm using a heterogeneous island population model is applied to the problem of percussion sound synthesizer design. Multiple percussion sounds are evolved simultaneously towards different targets where the targets are audio files specified by the user. The fitness function driving the evolution compares the evolving sounds to the target sounds in the frequency domain, awarding higher scores for closer matches. The system was tested using a simple step sequencer interface, as found in classic drum machines and a MIDI controlled version has also been implemented. The system provides the user (and listener) with a tangible sense of timbre transformation as the performance proceeds, where the timbres move ever closer to the target sounds. This represents an effective application of an artificial life technique to real time, algorithmically enhanced music composition.

## ***Evaluating Mappings for Cellular Automata Music***

Alexis Kirke, Eduardo R. Miranda

**Abstract:** We discuss the importance of choosing the right mapping for music composition generated from underlying Artificial Life and emergent algorithms. Emergent algorithms are popular with composers both because their visual beauty inspires the composer, and

because they can generate complexity from simple algorithm rules. Simple mappings to MIDI are preferred as they give a composer more control and predictability. However the wrong simple mapping may produce trivial music, and can fail to capture the visual aesthetic of the emergent phenomena in the music. Furthermore the mappings need some method of evaluation. To illustrate these issues we use the example of the Game of Life (GL). A polar co-ordinate mapping is introduced and we argue it is superior to previous GL mappings when both its simplicity and its visual-aesthetic capture are considered. This mapping is evaluated by comparing it to linear mappings using Zipf's Law and using a measure of "structurality".

### ***Evolving Expressive Music Performance through Interaction of Artificial Agent Performers***

Qijun Zhang, Eduardo R. Miranda

**Abstract:** This paper proposes a model of expressive music performance (EMP), focusing on the emergence of EMP under social pressure, including social interaction and generational inheritance. Previously, we have reported a system using Genetic Algorithm to evolve EMP, exploring the effect of generational inheritance. This paper presents the design and simulation of a system that evolves expressive performance profiles through social interaction, with a built-up society of artificial agent performers. Each performer owns a hierarchical pulse set (i.e., hierarchical duration vs. amplitude matrices), inducing a performance profile for a given piece. A performer evaluates performance with a set of rules derived from musical structure, and imitates others' performances if appropriate. And it then modifies its pulse set accordingly. In this paper we demonstrate that suitable performance profiles emerge through social interaction; the diversity and commonality of evolved performances is observed in the society.

### ***Autonomous Evolution of Complete Piano Pieces and Performances***

Palle Dahlstedt

**Abstract:** Artificial Life algorithms are used to evolve musical score material and corresponding performance data, in an autonomous process. In this way complete piano compositions are created and subsequently performed on a computer-controlled grand piano. The efficiency of the creative evolution depends to a large extent on the representation used, which in this case is based on recursively described binary trees. They can represent a wide variety of musical material and corresponding performance data in a compact form, with an inherent potential for musically meaningful variations and archetypal musical gestures. This is combined with a set of automated formalized selection criteria based on experiences from human selection processes in a previous, interactive version of the same system, leading to surprisingly musical output and convincing performances. The system is also capable of rudimentary learning, through recycling of its own musical output, and an accumulated database of human musical input.

## ***Generative Composition with Nodal***

Jon McCormack, Peter McIlwain, Aidan Lane, Alan Dorin

**Abstract:** This paper describes a new generative software system for music composition. A number of state-based, musical agents traverse a user-created graph. The graph consists of nodes (representing events), connected by edges, with the time between events determined by the physical length of the connecting edge. As the agents encounter nodes they generate musical data. Different node types control the selection of output edges, providing sequential, parallel or random output from a given node. The system deftly balances composer control with the facilitation of complex, emergent compositional structures, difficult to achieve using conventional notation software.

## ***Interaction and Self-organisation in a Society of Musical Agents***

Peter Beyls

**Abstract:** This paper outlines a distributed architecture defining a virtual world where musical agents interact according to the expression of mutual affinities. Agents continuously exchange information in their respective neighbourhoods while self-organization takes place. The society functions on a scale between total autonomy and a platform that accommodates compelling man-machine interactions, providing an adaptive musical playground. Agents associate spontaneously into temporary clusters, viewed as emergent structures. These clusters are interpreted as the result of perpetual self-production following the theory of autopoiesis. The fluctuating associations are also interpreted as complex polyphonic constructs in real-time.

## ***Artificial anuran chorusing***

David Michael

**Abstract:** An artificial anuran (frog) chorus is built by simulating a population of signalers and their spacial distributions. Models and methods of the simulation are presented emphasizing the networked nature of a chorus, the consequences this has on its temporal structures, and how these models can be used to rhythmically coordinate musical automata. Additionally, the paper discusses the use of Artificial Life models in music as a literal imitation of nature.

## ***Transformation and mapping of L-Systems data in the composition of a large-scale instrumental work***

Nigel Morgan

**Abstract:** "Heartstone" is a 20-minute composition in seven movements for wind, brass, percussion and solo piano. It was the composer's first extended work using production tools for modelling processes of organic development, in particular those associated with Lindenmeyer Systems. Composed in 1992 its extensive revision prior to publication in 2007 prompted a re-assessment of the aesthetic fitness of its algorithmically-generated content and of the approach to the transformation and mapping of data into a viable performance score. The poesis of "Heartstone" is revisited; its ways and means examined

from a position informed by the experience of a further 15 years of algorithmic computer assisted composing.

***Remembering the future: applications of genetic co-evolution in music  
improvisation***

David P. Casal and Davide Morelli

**Abstract:** Musical improvisation is driven mainly by the unconscious mind, engaging the dialogic imagination to reference the entire cultural heritage of an improviser in a single flash. This paper introduces a case study of Artificial Life techniques, in particular genetic co-evolution, as applied to the frequency domain using MPEG7 techniques, in order to create an artificial agent that mediates between an improviser and their unconscious mind, to probe and unblock improvisatory action.

## **Music-AL Concert programme**

The order of presentation may change.

Title: *Lulled by an Imploding Lotus*

Type: electroacoustic tape music

Duration: 9:35

Composer: **Jack Stamps**

Title: *Whitewater*

Type: Saxophone and live electronics

Duration: 8:00

Composer: **Scott McLaughlin**

Title: *Sideral*

Type: electroacoustic tape music

Duration: 10:00

Composer: **Isabel Pires**

Title: *Exiguum Clinamen*

Type: Live electronics

Duration: 8:00

Composer: **Daniel Jones**

Title: *Unit Structures*

Type: Piano and live electronics

Duration: 10:00

Composer: **David P. Casal**

INTERVAL

Title: *Olivine Trees*  
Type: electroacoustic tape music  
Duration: 8:30  
Composer: **Eduardo R. Miranda**

Title: *H2O*  
Type: DVD music (motion picture and electroacoustic music)  
Duration: 6:00  
Composer: **Graziano Lella**

Title: *Circadia*  
Type: Live electronics  
Durations: 6:50  
Composer: **Paula Matthusen**

Title: *Repertoire of the Community 1*  
Type: electroacoustic tape music  
Duration: 6:00  
Composers: **Alexis Kirke** and **Lola Perrin**

Title: *Swarm and Attractors*  
Type: live electronics  
Duration: 8:20  
Composer: **Tim Blackwell**