Book Review

Alice Eldridge

Centre for Electronic Media Art, Monash University

The Art of Artificial Evolution: A Handbook on Evolutionary Art and Music. Juan Romero and Penousal Machado (Eds). (2007, Springer-Verlag $119.00 hardback, 458 pages. Including DVD)

A growing number of artists, musicians, designers and researchers employ Evolutionary Computation (EC) and biologically inspired computational techniques as tools in their creative practice, or research into aspects human creativity. Interest and activity in what has come to be known as Evolutionary Music and Art (EMA) has flourished in recent years, within both academic and artistic communities. This book presents an overview of the state of the art in EMA as it gains maturity as a research discipline and artistic practice.

In the last decade a number of similar edited collections have been published with a focus on evolutionary design [3], music [1], or art [2]. Like those of previous collections, the majority of the 19 chapters included in this volume serve to illustrate the diverse ways in which various biologically-inspired techniques have been applied in art and design. However, this collection takes an important additional step in that it not only recognises current research, but looks *forward* and considers the challenges that lie ahead for EMA as a research discipline and artistic practice in its own right. The principle value of this book then, is that it distils the diversity of applications, techniques and theories into a single volume representative of this nascent field of research and practice, in addition to providing a state-of-the-art survey of activity in the field.

The book attempts to present a broad coverage of topics, with the intention of providing sufficient background for newcomers as well as highlighting hot topics of research and specific challenges, both technically and theoretically. Given the interdisciplinary nature of the area this is no mean feat, and taken as a whole the collection succeeds. Each author takes care to contextualise their particular research, typically with a conceptual and technical introduction to the biological mechanism or technique used, and provides an illuminating overview of the current state of their particular area of application before presenting a thorough description of their design and implementation process.

A selection of topics in music, art, design and computational creativity are included. These range from sound design and artificial musical improvisers to the reproduction of master painters and the evolution of faces for criminal identification. Design applications include evolutionary architectural packages and image filters. Some modelling projects in musical expression and computational aesthetics are also included. These focused projects are framed by an introduction that gives a broad overview of evolutionary art, and a selection of critical, motivational and challenging overviews toward the end of the book. Contributions are divided into five sections: *Evolutionary Art, Evolutionary Music, Real-world Applications, Artistic Perspectives* and *Future Perspectives.* The distribution of some chapters amongst these sections seems a little arbitrary: it is not clear why the 'Ant Art' of Monmarchè et al is any more 'artistic' than the Swarm Art of Christian Jacob; or why the evolved Escher-like pictures of Eiben are any more 'real world' than Tim Blackwell's Swarm Music. Nevertheless, taken as a whole the book provides a suitably diverse collection. Indeed credit must go to the editors for selecting such a range of application areas, perspectives and personalities that is representative of the field.

The first section, *Evolutionary Art*, opens with an introduction from Matthew Lewis, who first outlines the basic concepts of Evolutionary Computation (EC) and then gives a whirlwind overview of applications to the visual domain. Although he starts gently with some easy-to-understand analogies to explain the basic principles of artificial evolution, other concepts and terminology are less well explained and lack clear

references. Having said this, for readers who aren't put off by the lack of comprehensive introduction, the latter chapters provide ample illustration not only of key technical concepts, but of the intricacies of adapting them to particular creative domains.

John Collomose's chapter on artistic renderings of photographs demonstrates how evolutionary approaches can be used in conjunction with heuristics to create 'painterly' renderings of photographs. Scott Draves' *Electric Sheep* project, described at the end of the first section, is one of the largest and longest running distributed evolutionary art projects. It involves around 40,000 computers (and the people using them) to create a distributed rendering farm for evolving and animating visual artificial life forms (which Draves refers to as *sheep*). Such projects demonstrate that early Artificial Life dreams of 'life in silico' live-on amongst enthusiasts outside the academic circle: "The goal of electric sheep," writes Draves, "is to create a self-supporting, network-resident lifeform".

The section on *Evolutionary Music* contains examples in sound synthesis, performance and modelling. James McDermott gives a detailed description of his work in evolutionary sound synthesis, which involves evolving the parameters of a simple modular synthesiser to match a target sound. The project provides a clear example of working practice, illustrating many of the concepts raised in the first chapter. As is typical of the book's project descriptions, he includes sufficient technical detail for a capable programmer to embark on a similar project. Following this Tim Blackwell gives a comprehensive overview of the motivation for, and realisation of, his various swarm music projects. Epitomising the interdisciplinary nature of the field, his introduction gives overviews of swarming behaviour firstly in descriptive terms as a biological phenomena, then formally as a dynamical system, before giving a brief introduction to the (musical) Free Improvisation movement and so contextualising his motivation for using stymergic principles as a model of the emergence of musical structure in a improvisational setting. The musical section concludes with an overview of an expressive performance modelling project at Pompeu Fabra University. This project aims to create a model that allows the automatic generation of human-like expressive performance from a written score, and represents the meeting point of EMA, musicology and cognitive science.

The section on *Real World Applications* includes applications of swarming in visual and musical settings, an evolutionary design tool for architects, a system for evolving human faces and a project that creates images in-the-style-of Mondrian and Escher. Christian Jacob and Gerald Hushlak's chapter describes numerous interactive evolutionary and swarm systems that have been developed for designing visual, sonic and physical artefacts. These include novel evolutionary strategies such as the *Swarm Grammar* which combines swarming agents with developmental programs that extend Lindenmayer systems. Martin Hemberg and Una-May O'Reilly describe an evolutionary design tool for architects, *Genr8*, and include reports from six different architectural projects in which it has been used. This is a useful contribution in that it describes the experience of users other than the programmer and as such may be of interest to those concerned with the interactive potential of Artificial Life techniques. Charlie Frowd and Peter Hanock's *EvoFit* similarly stands out as the most 'practical' application of EC techniques. EvoFit is an evolutionary alternative to Identi-Kit approach commonly used by British police for constructing the faces of criminal suspects. The contextual nature of human perception is well established, yet the classic approach is to get witnesses to select facial features individually. In contrast, EvoFit uses interactive evolution to allow users to evolve composite faces.

The *Artistic Perspectives* section includes a mixture of projects, overviews and an art manifesto from Philip Galanter. *Art made by Artificial Ants* by Nicolas Monmarché, Isabelle Mahnich and Mohamed Slimane describes just that: a selection of projects that utilise the spatio-temporal structures created by swarm intelligence and self-organisation in sonic and graphical settings. Their projects provide nice examples of how different forms of behaviours can be captured in minimal models and applied in creative contexts: in their case they utilise the cooperative behaviour of ant colonies to generate musical fragments and competition for resources to create 'ant paintings'. Gunter Bachelier describes his art practice in the twelfth chapter, a very personal approach illustrating how ideas drawn from Artificial Life can be interpreted at a metaphorical level and applied in idiosynchratic ways. The final project in this section is the *Liquid Music* programme by J.J. Ventrella, which generates MIDI-based non-linear music using interactive evolution to guide an initially random population of 'sonic organisms' from an initial random state to a coherent sonic composition.

Alan Dorin's *Survey of Virtual Ecosystems in Generative Electronic Art* is a refreshing contrast to the

inward focus of previous chapters and imparts his enthusiasm for a general class of complex dynamic systems based on biological ecosystems. He describes what he sees as the virtues of virtual ecosystems. These include formal properties such as multi-scaled temporal complexity, autonomy and adaptation as well as the aesthetic value of the conceptual coherence of this type of model. As an artist and Artificial Life researcher himself, he clearly articulates the artistic value of the computational approach to investigating life that is more commonly recognised as a science.

The section closes with a bold manifesto for EMA from Philip Galanter in which he outlines what he calls *Complexism*. This refers to the application of scientific understanding of complex systems to arts and humanities. Whilst not everyone may agree with all of his assertions, the contribution is crucial in viewing evolutionary art in the broader context of other art practices rather than as a creative curiosity on the side of more practical or epistemological applications of EC.

Three of the four chapters in the final section, *Future Perspectives*, describe various approaches to the automation of fitness measures. In creative applications, by far the most common approach is to guide evolution interactively – i.e. to used human subjective preference as the selection mechanism. Finding ways to define 'aesthetic value' formally, or developing means of circumventing the need for a fixed, formalised assessment of individuals in a population is a major research focus. Craig Neufield, Brian Ross and William Ralph describe their use various formal measures taken from aesthetic models to guide a genetic programming system in the evolution of 'Artistic Filters'. Gary Greenfield gives an overview of co-evolutionary methods, including the seminal work by Hillis before describing the various approaches in the visual domain such as the co-evolution of 'artists' and 'critics' or disease. Finally, Penousal Machado, Juan Romero and Bill Manaris describe their *Experiments in computational aesthetics*. These are based on an arms race between an EC system and an artificial neural network (ANN): the former aims to distinguish between famous paintings and the output of the EC system which is then evolved to create images that aim to get mis-categorised (i.e. as 'great works') by the ANN.

The final chapter by Jon McCormack provides another of the perspectives that make this book stand out. Taking care to point out the distinct aims of this field (creative application and scientific understanding of creativity), and the challenges that are particular to the design of evolutionary systems in the arts, he proceeds to lay down Open Problems for the field. These provide good illustration of the scope of the field, covering technical problems such as the development of evolvable genotype-phenotype mappings or formalisation of fitness functions, to a call for the formal definitions of creativity and the need for an art theory of generative (and evolutionary) art. More significantly, laying down this gauntlet represents the genesis of a research agenda for this incipient discipline. Contributions such as this, Dorin's and Galanter's act cohesively to bring together the disparate collection of activities into a unified field, not only in this book but as an area of interdisciplinary research.

The collection would perhaps benefit from a more thorough and similarly cohesive introduction, but given the range of applications and interests included this might require a whole book in itself. The choice not to include any chapters dedicated to introducing core principles and techniques themselves is, I think, sensible given the number of existing introductory texts, however a glossary, and clearer guidance in terms of references and resources would have been of benefit. The book does come with a DVD that provides examples of the output of many of the systems described in the book, as well as a selection of work by other artists not included in the text. Versions of some of the programmes are also included along with bibliographic and contact information. This is very valuable.

Overall, the authors and editors have done a great job of providing an informative and inspirational overview of this multi-faceted research area. Taken as a whole the book provides insight into the motivations, methods, results and aspirations of a great range of current practitioners in the field of Evolutionary Music and Art. Material is presented at sufficient breadth and depth so that the book is accessible to technically competent artists and musicians, but also to Artificial Life researchers who may have an interest in how familiar techniques can be applied in creative settings. This is not a glossy coffee table book, but it is a very realistic and honest overview of the current state of the Art of Artificial Evolution, in all its incarnations.

References

[1] Miranda, E. R. and Biles, J. A. (Eds) (2007) *Evolutionary Computation for the Musician*, Springer. Berlin

[2] Bentley, P. J. (Ed) (1999) *Evolutionary Design by Computers*, Morgan Kaufmann. San Francisco, California

[3] Bentley, P. and Corne, D. (Eds) (2002) *Creative Evolutionary Systems*, Morgan Kaufmann. San Francisco, California