Artificial Nature as an Infinite Game

Haru (Hyunkyung) Ji
Media Arts and Technology Program
University of California Santa Barbara
jiharu@mat.ucsb.edu

Graham Wakefield
Media Arts and Technology Program
University of California Santa Barbara
wakefield@mat.ucsb.edu

Abstract

"Artificial Nature as an Infinite Game" is a trans-modal media art installation consisting of an evolutionary virtual world with a physical user interface. This virtual world is a complex, open, dynamical and dissipative system, interweaving physico-chemical, biological and symbolic strata. In actual space, spectators can witness, control and discover beautiful, generative and abstract spatio-temporal patterns evolving from the behaviors of a-life agencies in the virtual space, while the art work itself is questioning of a new understanding the concept of beauty and creativity in nature, culture and actual, virtual world.

Introduction

One may recall experiences from childhood playing with his/her fingers in the flow of a river, or in the path of small marching insects, to alter their emerging patterns. Such interactive play with complex systems not only produces fascinating natural patterns but also provokes deep insights: ludic investigations within an infinite game.

Our motivation is to develop a deeper understanding of emergence and creativity as a form of art, research and play; in short, a path to knowledge, understanding and expression.
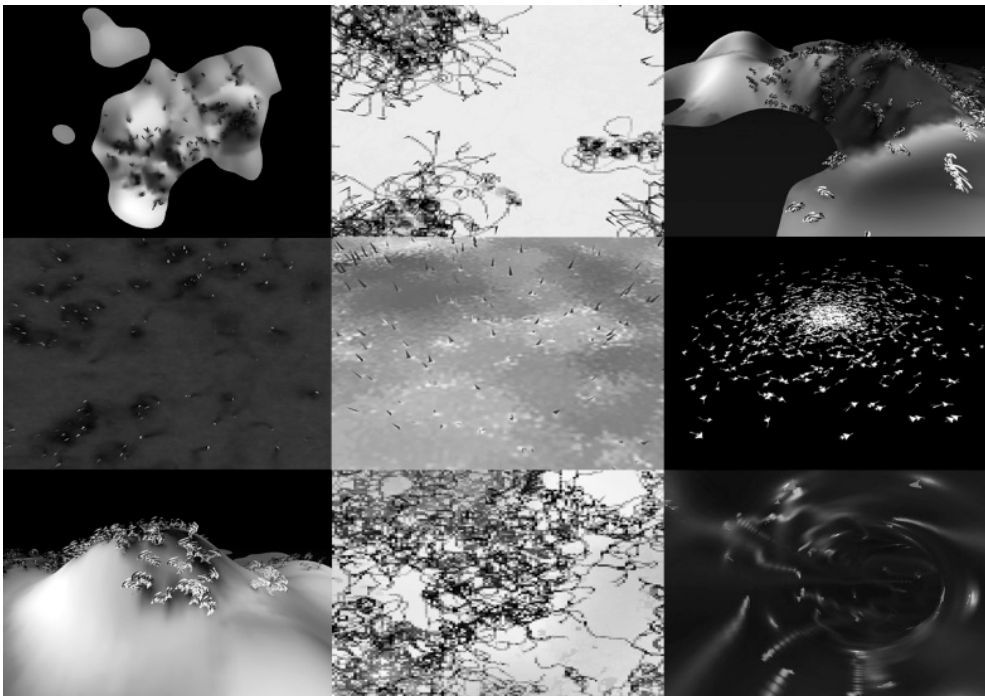

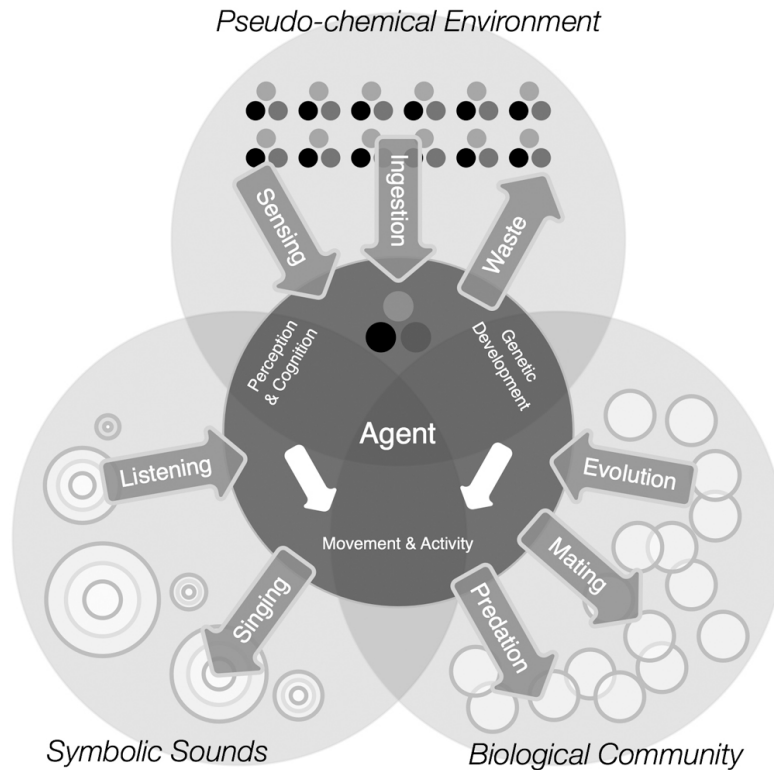Figure 1: Excerpt images from "Artificial Nature as an Infinite Game"

Figure 2: Significant properties and processes within the ecosystem.

We approach this cross-disciplinary subject through an audiovisual evolutionary art installation and multi-agent system entitled 'Artificial Nature'. Our goal is to provoke in spectators as well as our selves questions of life, beauty and self.

In the following sections, we will describe our two principal concerns; the design of the ecosystem and the aesthetic questions of Artificial Nature.

Worldmaking: ecosystem

The world contains numerous agents with an environment of three superimposed strata with distinct processes and properties (Figure 2). The world is self-sufficient yet also responds to user interaction.

Three Strata

Our ecosystem begins with a spatial field of pseudo-chemical elements (represented as RGB color concentrations). The field itself may generate order as a dissipative structure:[5] it receives a free influx of continuous but variable energy and is subject to entropic decay.

Within this field live populations of active biological agents. Agents constantly exchange pseudo-chemical elements with the environmental field in order to gain energy for growth and behavior, and discharge toxic waste. Agents contain virtual genes, hierarchical data structures which are gradually evaluated to guide development and behavior. Evolution of genes occurs through crossover and mutation in reproduction, while fitness emerges due to adaptive environmental conditions in the ecosystem itself.

Agent behavior may include movement, growth, chemical exchange, reproduction, predation and building, however it also encompasses a symbolic realm of perception and cognition. Agents may perceive and act upon internal and environmental properties, but also emit and listen to local sonic signals. Signals have no a priori meaning yet may self-organize by association within social groups.

Interaction

The spectators can navigate and interact with this evolving ecosystem as if one might encounter a new, unfamiliar species in a "cultural" forest. An immersive visualization of agents and environment is projected

alongside the spatialized agent sounds. Input using a touch screen, contact microphones and additional sensors may change local properties of the environmental field, and the viewer may actively observe and learn how the feedback systems produce new behavioral patterns in the virtual world.

Implementation

The system is implemented using the LuaAV[6] software framework. LuaAV supported the rapid development of an interactive, audiovisual virtual world, while the embedded language Lua[1] is naturally suited to real-time simulation because of its extensible, dynamic nature and efficient garbage collection.

Aesthetic and philosophical approach

Why are we, as artists and researchers, eager to work with complex adaptive systems? One answer is that it allows us to question the world itself, rather than merely a view of it.[4] On that account, we can integrate our understanding of the world, art and life into the creation of speculative new worlds, so that worldmaking may engender more powerful aesthetic experiences. As Langton suggested a-life may research 'life-as-it-could-be',[2] McCormack identifies a class of evolutionary art, to which our research belongs, exploring the concept of creativity in general (paraphrased into 'art-as-it-could-be').[3]

Nature and culture, actuality and virtuality

Artificial Nature provokes speculation on the concepts of creativity and beauty in both nature and culture. The evolving beauty of emergent complexity is intrinsically man-made yet follows an understanding of the mechanisms of nature itself. As such it may emphasize the comparison and fusion of virtual and actual, cultural and natural. The virtual world functions as information visualization just as the actual world presents to us traces of underlying processes of becoming.

Locus of authorship

The consideration of Artificial Nature as a living system with autonomous creative potential calls for a reconsideration of relationships between artwork, spectator and artist. All three living systems work together in the process of emergent creation. The locus of authorship is shared among a less hierarchical assemblage of living systems.

Spectators will be conductors or performers playing a generative multi-domain open work. However, the method to conduct or to perform is not direct. The indirection invoked through the emergent environmental feedback of the a-life agencies is crucial to allow the integration between learning, playing and creating.

Conclusions

Artificial Nature is an ongoing research project. Throughout its development, we have implemented case studies to prototype-reduced portions of the entire system, to synthesize minimized core algorithms and aesthetic approaches at each level. It has allowed its system designers-artists to learn deeper insight and to enjoy the balance and tensions in linking the multiple nodes and layers to produce beauty.

The meaning of our research leads towards our cultural evolution. We believe that art will be a great adaptation tool in the future of our species, which will continuously desire and generate intelligent cultural information.

Most of all, our ecosystem will continuously grow as a living system. What we ceaselessly play and learn from through the making of Artificial Nature is truly an infinite game.

Acknowledgements

1   Ierusalimschy, Roberto, de Figueiredo, Luis H., Celes, Waldemar. 1996. "Lua - an extensible extension language", in *Software: Practice & Experience* 26 (6). USA: Wiley, pp. 635-652.

2   Langton, Christopher G. 1989. "Artificial Life." In *Artificial Life, SFI Studies in the Sciences of Complexity*. Addison-Wesley, pp. 1-47.

3   McCormack, Jon. 2005. "Open Problems in Evolutionary Music and Art." In *EvoWorkshops 2005, Lecture Notes in Computer Science* (3449). Berlin Heidelberg: Springer-Verlag, pp. 428–436.

4   Popper, Frank. 1993. Art of the Electronic Age. London: Thames and Hudson.

5   Prigogine, Ilya and Steners, Isabelle. 1984. *Order Out of Chaos: Man's New Dialogue with Nature.* New York: Bantam.

6   Smith, Wesley and Wakefield, Graham. 2008. "Computational Audiovisual Composition using Lua." In *Communications in Computer and Communication Science* (7), edited by Randy Adams, Stefan Müller Arisona and Steve Gibson. Berlin Heidelberg: Springer-Verlag.