Artificial Nature: Immersive World Making

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Abstract. Artificial Nature is a trans-disciplinary research project drawing upon bio-inspired system theories in the production of engaging immersive worlds as art installations. Embodied world making and immersion are identified as key components in an exploration of creative ecosystems toward art-as-it-could-be. A detailed account of the design of a successfully exhibited creative ecosystem is given in these terms, and open questions are outlined.

Keywords: Creative Ecosystems, Generative Art, Aesthetics, Bio-inspired, Art-as-it-could-be, Computational Sublime.

1 Introduction

Artificial Nature is a trans-disciplinary research project drawing upon bio-inspired system theories and an aesthetics of computational world making toward the production of immersive ecosystems as art installations (Fig. 1). Our motivation is to develop a deeper understanding of emergence and creativity as a form of art, study and play, by taking inspiration from nature's creativity but recognizing the potential of natural creation beyond the known and the physical.

Bio-inspired computational models such as evolutionary computation, multi-agent systems and computational development can be utilized in the construction

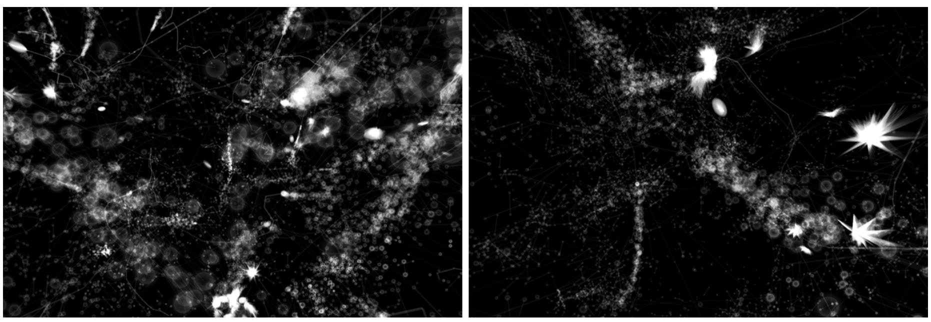

Fig. 1. Two screenshots from within the ecosystem

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of artificial worlds with significant aesthetic potency [5]. From the perspective of ALife research, Etxeberria calls speculative or exploratory worlds *instantiations* in order to distinguish them from problem-solving *tools* or theory-producing *models*. Instantiations are more intuitively defined in terms of the 'lifelike', with a diffuse boundary between the natural and artificial; new creations of ontology that offer "the most radical ways of exploring life-as-it-could-be." [6]

The suffix -*as-it-could-be* is central to our work: it indicates a shift in thought beyond the immediately apparent to the imaginable and possible: a shift which lies at the heart of exploratory creativity [13]. Indeed, Jon McCormack paraphrased Lagton's *life-as-it-could-be*[8] into *art-as-it-could-be*[9]: an exploration of generative creativity not bounded by existent notions of aesthetics or artist.

For Artificial Nature we suggest a sensibility in which the viewer is embedded within the ecosystem itself, both through embodied interaction with complex systems, and by emphasizing an engaging, immersive aesthetic. The embodiment of an autonomous, emergent world allows us to explore and discover, rather than impose, its beauty. As such, we hope to dissolve the apparent tension in the conjunction of *nature* with *artificial*, the realization of creative *physis* through extended *poiesis*.

We can thus divide our project into a twofold demand: the construction of a world engendering emergent structures, and the design of an immersive mode of involvement in this world.

1.1 Exhibits

The installation has been exhibited at the Shanghai Exhibition Center, China (ASIAGRAPH, June 2008), Total Museum of Contemporary Arts, Seoul, Korea (thisAbility vs. disAbility, July-August 2008, Fig. 2), Seongnam Art Center, Seongnam, Korea (Universal Electronic Art, October-November 2008.) It is an ongoing installation (since January 2009) at the California Nano Systems Institute Allosphere[1], University of California Santa Barbara.

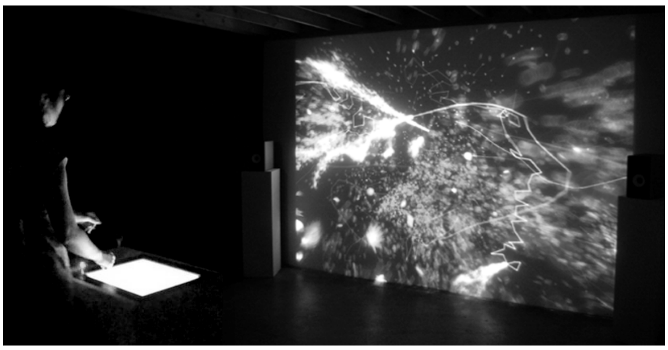

Fig. 2. Installation at the Total Museum of Contemporary Art, Seoul, Korea, 2008

2 Embodied World Making

The strategy of embodiment offers a means to preserve a sense of coherent materiality in the midst of unpredictable emergence. Embodiment asks that every structural observable have a systemic function within the world, and a genealogical or developmental account must be given as to how such structures and functions emerge from basic constituents (and how they disappear).

Ultimately the goal is not an aggregate of distinct models, but a single model with potential for many different kinds of creative development. In this respect we draw inspiration from Manuel De Landa's readings of Bergson and Deleuze [3,4], accounting for the production of apparent qualities as local emergent stabilities through progressive differentiations of an intensive virtuality into the multiply stratified.

This section covers progress toward this goal, in the form of a computational ecosystem, followed by an outline of the presently outstanding open questions.

2.1 The Current Ecosystem

At the heart of an ecosystem are animate organisms, or agents, however the importance of a dynamic supporting environment cannot be understated [14]. A self-organizing substrate can provide the building blocks of biological strata as well as a dynamic environment to spur endogenous evolutionary selection, in turn progressively determined by an increasingly autonomous biosphere.

Our ecosystem begins with a spatial field of mobile particles, coagulations of elementary pseudo-chemicals, which are continuously transported within a medium of fluid dynamics. Particles may react with one another, but matter/energy is preserved. The substrate is kinetic, thermodynamic, and dissipative [10]. Visually, particles have many advantages: individually they display chemical content (color), and collectively they indicate density and the turbulent flow.

We introduce animacy in the form of spatially situated concurrent processes with internal state (agents). Kinetically, agents may drift in the fluid currents or may also use stored energy to trigger autonomously directed movement (influencing the fluid flow). Energetically, agents must constantly exchange elements with their local field for growth and behavior, and discharge toxic waste to prevent decay (metabolism/autopoiesis); however an organism with sufficient energy storage may also reproduce by binary fission.

Agent growth follows a developmental pattern by *gradually* evaluating genome data: arbitrarily structured graphs of elements that are converted piecewise into executable functions. Functions respond to organism state, including form, age, energy storage, and perceptions of the local environment etc., to produce behavior of movement, reorientation, consumption, growth, fission and genetic transfer.

The genes themselves evolve independently of reproduction through lateral gene transfer with other agents in close proximity. Agents may sing their genome and adopt the genome of a song heard, while mutation occurs through sonic imperfections. Selective pressures thus emerge endogenously through the complex feedback between gene expression, organism behavior and abiotic conditions

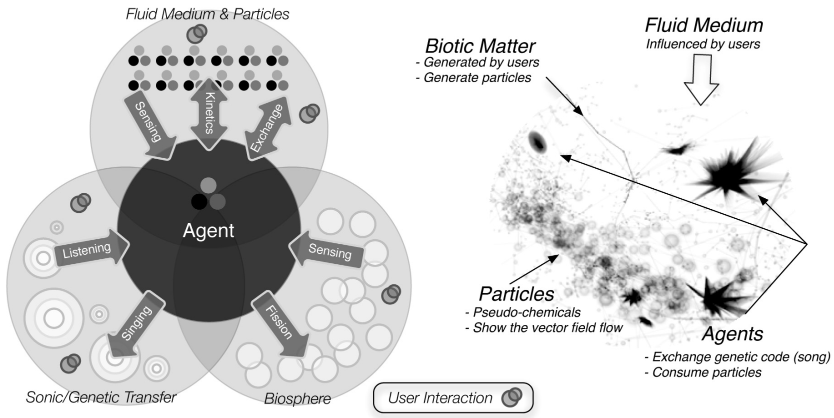

Fig. 3. Elementary components within the Artificial Nature ecosystem

(Fig. 3), transcending selective optimization problems of a priori fitness or the human bottleneck [9].

The installation software was developed using LuaAV [11] with extensions based upon [12] for fluid dynamics and [2] for organism geometry.

2.2 Open Questions

Our current research endeavors to flesh out details of how undifferenciated points of autonomy develop into differenciated, constrained organisms in mutual feedback with the environment [7] from elementary potentials that tie form to function. To follow the strategy of embodiment, the distinction between agent and environment ought not to be absolute: the process by which the animate (and likewise genetic material) emerges from the inanimate should be defined. This initial emergence remains an open research question.

At the macro-scale, we are interested in developing modes of agent communication that engender emergent behavior, such as territory marking or collaboration. Again, an account must first be made as to how such a capacity emerges in an agent.

3 Immersion

Throughout the design of the installation, we take into account the principle of the human as part of and embedded within the artificial ecosystem, both objectively in the form of mutual systemic interactions, and subjectively by heightening the sensation of immersion.

The viewer is situated locally within the 3D world rather than viewing from outside the system; the exhibition space supports aural immersion by surrounding the visitor with the background sounds of the world and songs of the agents (the 360-degree stereographics and spatial audio to be available in the Allosphere [1] later in 2009 will greatly strengthen this impression.)

The design avoids easy visual referents to the actual world, supporting the exploratory context. For example, the sense of scale relative to the real is ambiguous (it may suggest star systems as much as a pre-biotic soup).

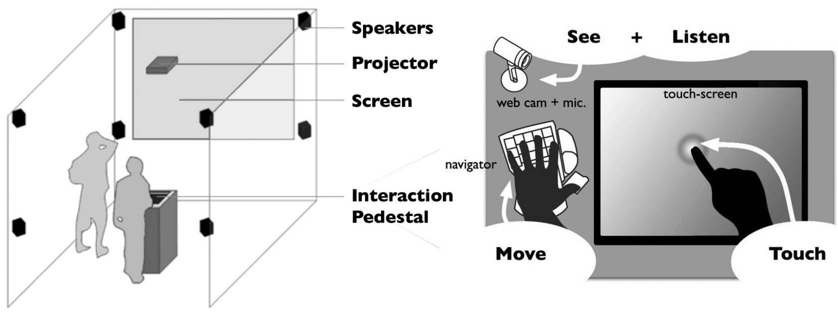

Fig. 4. Schematic of the installation, with interaction pedestal detail

3.1 Interactions

The visitor may interact with the world wilfully by means of a physical navigator device and touchscreen, mounted on a central pedestal (Fig. 4). Navigation (in six degrees of freedom) permits a literally exploratory mode of interaction, while immersion is intensified by the mutual influence of the fluid medium and the navigating user. The touchscreen can be used to add biotic matter to the local environment. By using the touchscreen and navigator together complex spatial distributions are possible.

In addition, involuntary activity of the visitor is detected through a camera and microphone, adding turbulence to the local fields. The world persists without need of human interaction, but responds in rich ways to it. It is very difficult for human interaction to have any intentional selective impact upon the ecosystem; such impact may only emerge through the complex detail of chain reactions.

3.2 Responses

Responses to the installation have been rich and varied, and many viewers have remained engaged with the work for extended periods of time. We have been pleased to discover that children are particularly fascinated by the work. Several viewers have commented on a sense of 'being present', or engaging with another life, regardless of their familiarity with the complex systems involved.

4 Conclusion

Artificial Nature provokes speculation on the concepts of creativity and beauty in both nature and culture. The evolving beauty of emergent complexity in our project is intrinsically man-made yet follows an understanding of the mechanisms of nature itself: both cultural and natural worlds create and are formed by information flow through the traces of their own becoming.

Artificial Nature is not yet emergent to the extent ultimately desired, however it is unpredictable in detail while relatively stable in general. By making the systemic requirements and processes explicit through our development of the project, and following a strategy of embodiment, the next steps to be taken have been clearly revealed.

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