Living Architecture Systems Symposium

WHITE PAPERS

November 2016

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Recent Realizations of Artificial Nature

HARU JI & GRAHAM WAKEFIELD
York University

abstract

Since 2007 the authors have been pursuing a line of research-creation that utilizes installations of highly-immersive mixed reality and interactive generative art to investigate new relationships with a future that is increasingly immersed in computation, but which draws more inspiration from the complex sense of open-ended continuation found in nature than any closed character of utilitarian closure. This project has produced in a series of "artificial natures", whose installations account for over thirty-five exhibits across nine countries. These are proposed as viscerally-experienced explorations of the physical and cultural future of near-living interconnected architectural environments saturated in computational media. In this white paper the central concerns of the artificial nature project are illustrated with three examples, including ancillary contributions and key questions for the future.

Since 2007 the authors have been pursuing a line of research-creation that utilizes installations of highly-immersive mixed reality [Milgram & Kishino, 1994] and interactive generative art to investigate new relationships with a future that is increasingly immersed in computation, but which draws more inspiration from the complex sense of open-ended continuation found in nature than any closed character of utilitarian closure. This project has produced in a series of "artificial natures", whose installations account for over thirty-five exhibits across nine countries, including festivals such as SIGGRAPH (Yokohama), Microwave (Hong Kong), Digital Art Festival (Taipei), conferences such as ISEA (Singapore), and EvoWorkshops (Tubingen), venues including La Gaite Lyrique (Paris), CAFA (Beijing) and City Hall (Seoul), and recognition in the Finished Project category of the international VIDA 16.0 Art & Artificial Life competition. In this white paper we illustrate the central concerns of the artificial nature project through three examples, including ancillary contributions, and outline key questions for the future.

We propose artificial natures as viscerally-experienced explorations of the physical and cultural future of near-living interconnected architectural environments saturated in computational media. Each artificial nature presents a computational world with its own rigorously simulated physics and populations of life, within which visitors interact to become essential participants within an unknown ecosystem. We use simulation strategies that can engender open-ended behaviours together with methods of display and interaction that emphasize immersion, presence, and agency, prioritizing indirect modes of interaction that integrate with the complex network of feedback relations in the world to eschew pre-defined tasks and promote exploratory discovery. It brings the generative capacity of computation into an experiential level reminiscent of, yet different to, the open-endedness of the natural world, to evoke extended aesthetic experiences that recapitulate something akin to the child-like wonder regarding the complexity, beauty, and sublimity of nature.

time of doubles

With "Time of Doubles" we project onto a three meter high wafer-thin curved membrane angled in the centre of the gallery space. By drawing attention to itself, rather than hiding on a wall, this surface confounds unconscious categorization as a screen. We live in a time of doubled and involuted space in which, through the dimensions that augmented and virtual spheres of information can

open, frontiers are not out there but all around. Likewise, though the world of Time of Doubles is bounded, the projection surface is two-sided, each side having two panels, presenting four views of the same world in which visitors from both sides are present (Figure 1).

The blending of real and virtual is personified by the projection of visitors' "doubles" into the ecosystem, tracked by means of range cameras. These doubles are not avatars, but mirror existences that closely reconstruct the shape and movements of visitors as volumes of high-density, high-energy particles. The mirroring of shape and movement induces an immediate somato-psychological link, despite the alien appearance of the double, and its different roles within the virtual world. This design is addressed in terms of presence and agency in [Wakefield & Ji, 2013]. The particles emanating from the visitors' doubles, and flowing away in fluid currents created by the visitors' movements, are the primary nutrients artificial organisms must

Figure 1. Time of Doubles, Haru Ji & Graham Wakefield. At type:wall, Seoul Olympic Museum of Art (SOMA), Korea, March 31 - May 29 2011. One visitor is seen with doubles in each panel of the display. Another visitor, situated on the other side of the display, is also present in the world.

consume to metabolize and survive, sing and reproduce. Visitors thus see, hear, and feel themselves as sun and the wind, feeding, and being fed to, unknown species.

The organisms intermittently emit chirps of granular pulse trains as they move, parameterized by properties of their genome. These sounds are spatialized over an array of loudspeakers, and readily localizable due to the bursty envelope; many individual voices can be concurrently identified. As populations grow and collapse the soundscape develops from isolated pulses to dense clouds of sound, whose timbres vary with the evolving gene pool, sometimes rapidly due to evolutionary events.

archipelago

In "Archipelago" a virtual ecosystem is projected from above onto several square meters of white-grey sand; a space large enough to convey a sense of environment rather than object, and sustain a diversity of artificial organism populations (Figure 2). Visitors may wander freely through the island cluster and observe the behaviours of the alien life-forms that inhabit it and hearing the sounds they emit. The life-forms are busy finding sources of food to metabolize, harvesting or foraging, and reproducing: locating niches of existence through processes of evolution subject to precarious environment

Figure 2. Archipelago, Haru Ji & Graham Wakefield. At Capitaine Futur, La Gaite Lyrique, Paris, France, Oct 10 2014 - Apr 2 2015.

defined in part by the terrain of the islands themselves. The sand is infinitely-malleable and easy to sculpt, clean and safe for children, allowing visitors to reform the landscape throughout the exhibition period. Visitors can reshape the sand landscape directly, even separating a land-mass into distinct bio-spheres, or reuniting two islands into one.

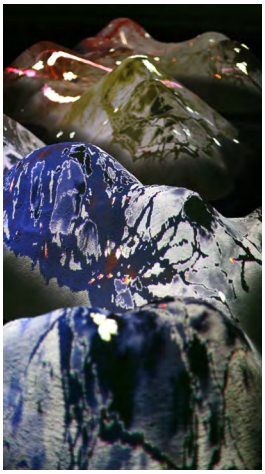

Figure 3. [Left] Archipelago, Haru Ji & Graham Wakefield. At Systems and Subversions, IDEA Space, Edith Kinney Gaylord Cornerstone Arts Center, Colorado Springs, USA, Oct 28 to Nov 5, 2013. Islands in the foreground are in daytime; islands in the rear are at dusk.

Figure 4. [Right] Archipelago, Haru Ji & Graham Wakefield. Detail, showing virtual organisms of projected light being carried by a visitor's motion-tracked hands, and the shadow destroying life beneath.

From above, an array of depth-sensing range cameras precisely determine the topography of the landscape, whose variety affects the environmental conditions of vegetal life. A pulsating lichen-like substrate, modelled using a large state cellular automaton, sustains several species of motile organisms that display various foraging, scavenging, predatory, and social behaviours (Figure 3). Higher altitudes are more fertile, as are more recently touched lands (encouraging organisms to visit new structures), but these areas can also be more rapidly exhausted. The installation also uses the precisely calibrated cameras to respond to the geometry and movements of visitors. It can be predicted when visitors would block projections and cause shadows, and thus we duplicate the real shadows with virtual counterparts that are projected in black. This prevents accidental incorrect illumination of visitors, but more importantly it allows the real-world shadows to play an ontological role in the virtual world. Where shadows are cast, they annihilate vegetal

life while re-fertilizing the ground. If the human plays god, it is not a god of omniscient control, but one of destructive and creative forces (perhaps akin to the forest spirit of Hayao Miyazaki's Mononoke Hime).

The system distinguishes between humans and sand by the rate of change of movement and rate of difference in elevation. That is, any surface that is not changing rapidly or has a smooth contour is assumed to be the sand landscape, while fast moving objects with large differences of height with neighboring areas are assumed to be humans. Three-dimensional optical flow analysis of visitor movements are used to generate wind forces able to disturb organisms. But the mixed reality becomes more sensitive as visitors reach down to touch the land. Visitors may see organisms creep onto their hands, and then be able to 'lift' these organisms up and carefully transport them to deposit in other regions or islands, or to their oblivion (Figure 4).

endless current

Figure 5. Endless Current, Haru Ji & Graham Wakefield. At the Currents New Media Festival, El Museo Cultural de Santa Fe, New Mexico, USA, July 16 to July 26, 2016.

The inset image shows a visitor experiencing the work via a HTC Vive head-mounted display. The main image is a screenshot taken simultaneously. The physical hand controllers are duplicated as oscillating translucent forms in the virtual space (foreground).

"Endless Current" presents an infinitely explorable virtual world whose architecture is constantly shaping and being eroded by the fluid currents permeating the space, and is populated by evolving species of organisms continually swimming, singing, eating, and reproducing (Figure 5). It is a descendent of work created for the AlloSphere (Figure 6), a unique immersive virtual reality instrument at the University of California Santa Barbara in which a bridge is suspended through the centre of a 3-storey perforated aluminium spherical projection surface [Wakefield et al, 2013]. The AlloSphere is conceived as an instrument in both scientific and musical senses, and our own work for the space refines an art-science techné of data visualization with a uniquely endogenous principle [Ji & Wakefield, 2015]. This principle requires that every visible (and audible) element must have dynamic ontological capacity in the virtual world, playing an active role in multiple processes with other elements. Since there can be no "non-diegetic" media, all display of the processes of the world must be conveyed through the components of the world itself. Just as in nature we see the wind by how it moves the leaves, in our virtual world we see the fluid simulation by how it moves suspended particles. Just as the fallen leaf's shape and colour describes its state of decay, spherical particles crumple and desaturate as their energy dissipates. Organisms are semi-translucent such that up close it is possible to observe the nutrient particles being digested inside, changing as they are metabolized until they are ejected back into the environment, and how the energy gained allows organisms to spawn spherically-symmetric eggs that gradually mature into fully-developed creatures with undulating appendages.

Each organism's behaviour is modelled by a uniquely evolved program, derived according to a genotypic process of inheritance and mutation, in a variation of genetic programming [Koza, 1990]. This program is invoked repeatedly through the organism's lifespan using a subsumption architecture [Brooks, 1986]. It takes a number of sense inputs, applies a series of expressions, and according to applicative predicate conditionals may produce motor actions, growth, reproduction, and memory storage. The evolutionary model has no external fitness measure, no final goal, but the viability requirement that organisms must locate and consume food in order to reproduce imparts an endogenous selection pressure. Organisms thus constitute a distributed search within an environment of nutrients, in which each individual is an improvised solution; but this is a search without end as the environment is changed by the organism's activities.

Figure 6. Fluid Space, Haru Ji & Graham Wakefield. Wide-angle photograph of Fluid Space taken from the bridge of the AlloSphere, University of California Santa Barbara, 2012. The Fluid Space application is distributed over 16 computers and 26 projectors covering an almost completely spherical screen, and 54 loudspeakers mounted behind it.

Efficient implementation is necessary for virtual reality, but standard ahead-of-time and parallelized optimization techniques are generally incompatible with the open-endedness and diverse heterogeneity of evolving phenotype programs. To support thousands of differentiated organisms simultaneously, each organism's program is instead dynamically compiled to efficient machine code at birth, using the LLVM compiler infrastructure [Lattner, 2007]. This is not simply a technical note, it reflects a real tendency of differentiation (breaking symmetry) characteristic of life that contrasts with the more readily quantifiable tendency of the inanimate (predictable by its homogeneity) [Bergson, 1907].

continuations

We are deeply inspired by the manner by which nature works; particularly the connections, organizations, and structures that exist beyond and below the human scale. An important strategy for future work is to further replace statically aggregated systems with genealogical processes that may generate them: that is, fully-working accounts as to how every structure and function emerges from simpler initial elements. In this regard, our exploration of code generation and rewriting systems opens a path to a broader diversity of worlds. However this alone cannot ensure sustained novelty and generative open-endedness. Making a world more genuinely creative means increasing its rate of rare events without simultaneously diminishing their rarity, which is to say, creating events whose primary discernment resists quantitative simplification. We hope our living architectures and computational worlds will be open to rewriting from within & without, engaging with mind and body and preserving themselves away from an equilibrium of predictable homogeneity, by amplifying their sensitivity to the most interesting of external indeterminacies [Schmidhuber, 2010], and prolonging their differences and incompleteness along contingent histories of strongly constructive endogenous processes, vast in possibility yet inhomogeneous in actuality.

Artificial natures invite humans into worlds to become part of an ecosystem, but not as the main subject. By giving life to mixed reality we're anticipating futures more pervasively immersed in computation, which we hope can be resonantly open-ended, inspired by life's example but not a mirror of it, in which humans are deeply present but not overly-privileged, and where top-down control and the homogeneous materialistic order of connectivity is disrupted by an unfolding bottom-up creativity akin to nature: a world making itself within a world unmaking itself. By presenting the virtual as an expansion of our physical world, and thus that what can be imagined is greater than what is known, perhaps we may reveal that what is real is greater still.

More information on the Artificial Nature project can be found at http://www.artificialnature.net and http://worldmaking.github.io.

references

Bergson, Henri. L'Evolution Créatrice. 1907. (Henri Bergson, Creative Evolution, tr. Arthur Mitchell, Henry Holt and Company, 1911)

Brooks, Rodney. "A robust layered control system for a mobile robot." IEEE journal on robotics and automation 2.1 (1986): 14-23.

Ji, Haru Hyunkyung and Graham Wakefield. Endogenous biologically-inspired visualization immersed within an art of complex systems. In Proceedings of the IEEE VIS Arts Program (VISAP), Chicago, Illinois, October 2015. 30-37.

Koza, John R. Genetic programming: A paradigm for genetically breeding populations of computer programs to solve problems. Stanford University, Department of Computer Science, 1990.

Lattner, Chris. "The LLVM compiler system." Bossa Conference on Open Source, Mobile Internet and Multimedia, Recife, Brazil. 2007.

Milgram, Paul, and Fumio Kishino. "A taxonomy of mixed reality visual displays." IEICE TRANSACTIONS on Information and Systems 77.12 (1994): 1321-1329.

Schmidhuber, Jürgen. "Formal theory of creativity, fun, and intrinsic motivation (1990–2010)." IEEE Transactions on Autonomous Mental Development 2.3 (2010): 230-247.

Wakefield, Graham, Tobias Hollerer, J. Kuchera-Morin, Charles Roberts, and Matthew Wright. "Spatial interaction in a multiuser immersive instrument." IEEE computer graphics and applications 33.6 (2013): 14.

Wakefield, Graham, and Haru Hyunkyung Ji. "Becoming-There: Natural Presence in an Art of Artificial Ecologies." Ubiquitous Virtual Reality (ISUVR), 2013 International Symposium on. IEEE, 2013.

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