GENERATIVE NARRATIVE IN COMPUTATIONAL ECOSYSTEMS

FILIPE ANTUNES & FREDERIC FOL LEYMARIE

This paper analyses modes of interpretation of that part of the generative art practice making use of computational ecosystems, i.e., virtual reality-based worlds mimicking or simulating an equivalent real-life ecosystem. We discuss the notion of generative narrative, as the model for this genre of works. This argument is illustrated with a case study, *Senhora da Graça*, which artistic concept is grounded on this model.

1 Introduction

By computational ecosystem (CE) we understand an artificial environment, produced in silico in the form of a virtual world, populated by an heterogeneous class of artificial life forms; such class, will in the more complex cases represent multiple trophic levels, forming a continuum in a food chain, with representatives from the plants, herbivores and carnivores. Simplest simulations however often have two distinct trophic levels represented, with one species of producers and another of consumers, such as is the case of Jefferey Ventrella's *Swimmers* or Jon McCormack's *Eden*.

As artistic artifacts CEs appear throughout the last thirty years in different curatorial projects, galleries, and art festivals. This artistic practice had its first major blooming season in the mid 1990s, when produced by pioneers such as Christa Sommerer or Jane Prophet established the roots of the practice with a series of works which are nowadays seen as early landmarks of evolutionary art.

Engaging in a discussion on CEs as artistic instruments, the aim of the present paper is to formalize the concept of generative narrative as the model these works operate. This model of narrative confers CEs the potential to address projects which are significantly distinct from those of their aesthetic cousins: other evolutionary art in the computational medium, such as the Scott Draves's *Electric Sheep*, or carbon-based ecosystems based art such as Ken Reynaldo's *Hydroponic herb garden*.

Throughout this document we will articulate a number of voices (Latour, Klastrup, Hayles, Eco and Holland) to lay out a theoretical framework which attempts to see behind CEs' formal novelty and invention, and understand the mechanisms at play in conveying context and artistic meaning.

Our previous work *Senhora da Graça*, where the apparent two realms (the formation of narrative and the physical ensemble) articulate the artistic concept, will be brought into the discussion as case study to assist in the deconstruction of the processes of narrative.

2 Computational ecosystems as works-in-movement

With an algorithmic and systemic understanding of the artistic artefacts, this practice takes expression in the construction of rich generative computer-based works which renew themselves, and evolve dynamically. Rooted in ALife, CEs operate within an aesthetics of complexity where emergence, self-organization and autopoiesis appear as a focus of interest in an agenda pursuing novelty and spontaneity.

The foundations for the mechanism driving this evolution lie, in the internal dynamics of the complex adaptative system formed by the populations which inhabits the worlds. Its structure follows a bottom-up logic common to ALife systems where the complexity of higher level structures emerges in recursive interactions from lower level building blocks and rules.

To discuss aspects of an aesthetics of emergence it is pertinent to recall Umberto Eco's concept of the open-work. Eco, suggests works of art to operate in a state of potentiality, of unexplored possibilities which they may admit. An open work is not limited to a single linear reading. Its open-ended nature is complex and offers an unlimited range of possible readings, works are 'open' to continuous generation of internal relations which the addressee must uncover and select in his act of perceiving the totality of incoming stimuli. [4]

Particularly critical for this discussion is the 'work in movement', a term Eco uses to describe pieces which operate as invitations "to make the work together with the author," works that "characteristically consist of unplanned or physically incomplete structural units." [4] In CEs, the building blocks of the system interact autonomously. Emergent processes create new trajectories. The work admits a large number of possibilities. However each run will only see one sequence of these potential outcomes. The complexity of the ecosystem generates such wide range of combinatorial possibilities that two different runs of the system will systematically diverge in outcomes. Amongst the illustrations of the 'work in movement' are Calder's generative mobiles. As in CEs the modular structures of the mobiles pre-exist the viewing experience. And in a somehow similar way the work articulates time in its substance. The 'Open work' was first published in Italian in 1962. Three decades later, laying their foundations on emergent behaviors, and bringing the audience to intervene in the evolutionary course of the simulations, CEs seem to be mature ontologies of systemic-open-works. However, the ontology of CEs does not exhaust itself with the production of novelty and the exhibition of multiple scales of visual and audio complexity. They are more than accelerated versions of Calder's mobiles for the digital ages.

CEs are a sub-genre of ALife art, which is art drawing on ALife and is discussed in great extent in Mitchell Whitelaw's *Metacreation: Art and Artificial life.* [13] ALife is a sub-field of Artificial Intelligence which focuses on computational systems mimicking some of the processes of natural life and evolution. Whitelaw sees ALife-art as a natural follow up of the modernist attempt to imitate not only the appearance of nature but also its systems of functioning. [13] The practitioners agenda appears to be ambitious, and is inscribed with an interest in questioning life itself. The project of ALife is the chimera of exploring "Life-as-it-could-be." [10] The strong claim of Alife is that life is reducible to information, and as such, Alife models can extend the knowledge in biology. Artistic uses of ALife inherit this dialectics/ethics.

This forces a change of perspective in the analysis, moving away from mere pictorial and chromatic spheres. According to the anthropologist Stephen Helmreich, cultural pre-conceptions from the dominant western culture such as dominant notions of gender, monogamous families, heterosexual and productive sex appear widespread across models camouflaged in a Darwinian struggle for survival. [7]

To Helmreich, authors of CEs rather than neutral modelers of life actively shape the world and its narrative re-inscribing cultural values in the simulations: they "transport received stories into new hardware." [7] If in the inception of ALife Christopher Langton described it as "life-as-it-could-be", Helmreich argues that these constructions "are built from specific visions of Life-as-we-know-it." [7]

This presence of the authorial hand is also identified by literary critic Katherine Hayles: “Analogy is not incidental or belated but central to the program’s artifactual design.” [5] She reminds us, “in these representations, authorial intention, biomorphic interpretation and the program’s operations are so interwoven that is impossible to separate..." [5] Hayles continues to say "statements about the program’s operation and interpretations of its meaning are in continuous interplay with each other.” [5] The difference between the material space of the computer and the imagined space appears blurred. In the imaginary space, one ’hungry’ creature moves towards another. In the material space, segments of code instruct an agent that as a consequence of the state of some variable, below a certain threshold the agent will adjust its variables defining its position to those of some other agent which global pattern is compatible.

Hayles puts it clearly: it is a narrative that “changes electric polarities on silicon into a high drama of a Darwinian struggle for survival and reproduction.” [5] Behaviors restricted to organisms appear juxtaposed with the execution of segments of code in the informational domain. Assumptions we have about natural behavior are transported into the narrative when these two spaces collapse.

John Holland, one of the leading pioneers of ALife, refers to models as maps or cartoons of life. Some features are captured, emphasized, exaggerated while some others are neglected or removed. As in cartooning the skill goes into choosing what is to be emphasized and what is to be thrown away. [8] Practitioners appear, as such, as promoters of a spectacle (in Barthes terms), orchestrators of representations of life. Referring to CEs as representations Holland implicitly concedes that we are operating in the literary realm: the power of discourse and the identification of the audience and its practitioners with a shared common narrative. It is this literary and metaphoric process which transports into the narrative the meaning of death or birth to squares disappearing or appearing in a simulation.

3 Generative narrative

Departing from the understanding of CEs, firstly, as representations of life permeated by structural gaps which are filled by narrative processes; and secondly, as open-works which dynamic interaction of components generates new relationships in a potentially endless evolution, we can start building a theoretical framework under which light we can formalize the narrative process.

As seen earlier, Katherine Hayles alludes to the active role of the viewer, filling in the gaps in the narrative, by the transition from the material to the imaginary spaces. She emphasizes these as works in which the author, the viewer, and the model are connected parts in a gestalt where meaning results from this relationship. [6] Flickering pixels in the screen might become ’alive’ in the mind of the beholder when the appropriate story is associated. This comes in accord with the concept of the actant from the actor-network-theory (ANT). Latour disputes any distinction between nature as opposed to culture. In the actor-network-theory an actant is any intervenient, be it human or non-human, in a momentary network of forces in a given situation, in a dynamic network of relationships. [11]

The first of the actants we will discuss is the shared context or story. Lisbeth Klastrup is an internet theorist who studied the poetics of virtual worlds. In her study of the ’worldness’ of virtual world. Kalstrup addresses this concept as ’interpretative framework’. The world as interpretative framework, or fiction, is the concept or story behind the world. It constitutes a reference from which the actions makes sense to participants; for instance the story of its creation and evolution, the cosmology of its inhabitants. [9]

The interpretative framework contributes significantly to situate the elements in a common and shared territory, a contextual space and time.

In Klastrup's media-inclusive proposition, textuality is described as 'the place of the reader and text in the process of reading. The text contains signs that the reader, in the process of reading, decodes and interprets, be it graphical, auditive or verbal signs'. She continues 'the text does not necessarily need to be written text, but can be all forms of cultural artifacts with a signifying function.' [9] Extending the notion to 'multiuser textuality' this author widens the notion of textual construction to encompass the networked aspects participating in the interactive experience of the world, as well as the agency from all the human participants in the virtual world. With CEs this textuality also include actants such as the computational forms of life, as well as the processes in the rendering pipeline, or yet the vertices of a 3D-surface (We will illustrate this further in the case study, when some of these elements are brought to the center of the narrative process). In Jane Prophet's *Tecnosphere*, for instance, when the user is selecting a creature to be either a carnivore or an herbivore they are actively participating in the construction of a narrative process which will unfold throughout the 'lifetime' of that creature. The emails the creature will 'send' later informing about who it has fought against or ate are actants which will reinforce this dialectics.

Equipped with this framework we will now attempt to formalize a notion of generative narrative in CEs. Generative narrative is a term we borrow from electronic literature, which is found in [2] to describe some works where integral or partial components of the text are automatically generated, such as in the case of *Prolix* by Christophe Petchanatz, a playable generator. [12] Generative describes here an automatic (re)construction of the system (be it partial or integral).

Deriving from these premises we start by situating the narrative of CEs as the model of story which emerges from the dynamic interactions from the author, the viewer, the computer where the model runs, and the agency of the creatures in the virtual world. Generative narrative can be understood as a dynamic form of narrative emerging by this network of relationships as time flows. A free-understanding of generative narrative is about narratives where the system not only adds new events to the world but, in doing so, it reinvents itself. The author sets the system, the initial conditions of the story which then unfolds autonomously, living a life of its own. This autonomous life might, in turn, recreate the system in feedback loops, in an auto-catalytic process. The interplay of the components generates new behaviors or properties. The system might even generate behaviors which re-define the rules of the evolution of the system. The system and the emergent story become inseparable from each other.

In summary, in CEs, the narrative is emergent. Meaning is conveyed from the textuality of the CE, a by-product of the conjugation of the interpretative framework and the material aspects such as sounds, or textures implemented as 3D surfaces, or the processes modeled describing the behaviors. The final interpretation of the work incorporates the agency of a triangle in a 3D-mesh of the landscape, and the process driving the way a certain character is displayed, and the text in the website where the work is accessed, and the website itself, and the viewer who accesses the work. The resulting dynamics produces an ever-changing landscape, a context for interpretation.

4 Senhora da Graça

We introduce in the discussion a case study to analyse this narrative process at play in conveying meaning in an artistic CE, Senhora da Graça. [1] Senhora da Graça denominates a valley, near Sabugal, in

North-East Portugal, which in 2000 was submerged to build a new dam. The artwork *Senhora da Graça* is a memorial in the form of a virtual ecosystem composed of clouds of rain, soil, plants, herbivores, carnivores and scavengers. With the help of photographs taken at the site from which this work borrows the name, around 20 years ago, this work was aimed to reference a period or moment in time. However, the photographs of reference are presented in a distorted and somehow abstract way, when applied as 3d textures in the exterior surfaces of the creatures (skin), on the soil, and in the skies of the virtual world.

As the surfaces aren't static, the generative dynamic of the interaction of creatures permanently rebuilds the world and the shapes. As a result, the photographs keep making reference to a moment of time, however, the living and dynamic frames where they are applied (the creature's bodies) as 3d textures, evolve over time making them unrecognizable. Having lost their pictorial value as photographic object they keep maintaining their conceptual and chromatic values. In a metaphoric way, as it happens with the submerged place of Senhora da Graça, in this work the photographs appear unrecognizable, they are shadows of the moment they evoke.

Accessing Senhora da Graça, a spectacle is offered, a parade of abstractions that we have difficulty unravelling any meaning, if any at all. However, in the website we have access to a text describing the intentions and motivation, illustrated with an introductory short story. Whereas, in an operatic performance we need a libretto to help to introduce and decode the narrative, the interpretative framework.

One of the keys for our discussion resides in this libretto, precisely, since it provides access to the interpretative framework. Gilles Deleuze, in his two volumes of work dedicated to cinema, suggests the 'mental automaton', a circuit made of body, flesh and light, which is formed by the cinematographic object and the viewer. This cybernetic circuit is initiated by the sensory stimuli of the electrical pulses from the movie and the nerve signals and impulses that are generated in the viewer. Once this circuit is established the impulses no longer come from the movie but from the circuits formed by the brain, 'mixing a multitude of cinematic signs with bodies.' [3] Extending this concept to Senhora da Graça, we can observe that the object virtual world and the libretto combine to feed this mental automaton.

In Senhora da Graça the virtual world is part of a circuit initiated with the introductory text. Due to its material properties, the virtual world has an obvious interest as isolated sculptural and material object. But the semiotic significant is entirely dependent on the textual narrative, derived from the mental automaton. However, this relation is not passive as the virtual world also prolong, continue and expand the narrative: The texts finds a natural follow up in the deformation of the surfaces and the evolution of the creatures/pictures in the virtual world. In this sense, the virtual world has a dual and hybrid quality since it is only complete when in the presence of the libretto, its extension. Rather than finishing with their physical boundaries the virtual world extends and is extended with/by the mental automaton.

5 Conclusions

CEs offer rich endeavors to those authors interested in exploring this unconventional artistic practice. We have attempted to lay out a theoretical space for situating and experiencing CEs as instruments for artistic dialogues. We have discussed how the story and the material properties of the CE participate in the narrative and might be incorporated in the artistic concept. This process is open and other actants might be invoked in this process.

We propose the term generative narrative as a conceptual tool in understanding these works. We saw earlier how works which are structurally incomplete, which the audience completes in the act of perceiving the work, are suggested to be open by Umberto Eco. On the other hand N. Katherine Hayles emphasizes a gap between the material space and the imaginary space in ALife. This gap, she argues, is filled by narrative. A series of actants (in the ANT sense) are invoked by the artists/modelers filling in these gaps, generating a field for interpretation. Generative narrative is the textual construction articulating the different aspects which define the CE (the actants). This goes to include a wide network of influences, from the language of code used in the implementation of the virtual system, to the the story read by the audience or its processes of diffusion. This process is dynamic and non-stop. Due to its open nature works evolve when new relations and interactions establish and evolve in time.

6 Acknowledgments

Fundação para a Ciência e a Tecnologia assisted in the production of this paper in the form of the studentship SFRH / BD / 61293 / 2009 to Mr. Antunes.

References and Notes:

1. *R. F. Antunes and F. F. Leymarie, "Epigenetics as Aesthetic Instrument in a Generative Virtual Ecosystem," Proceedings of the 5th International Conference on Digital Art (ARTECH 2010), Guimarães, (2010).*
2. *S. Bouchardon, "The Aesthetics of Materiality in Electronic Literature" (paper presented at Electronic Literature in Europe, Bergen, November 8-10, 2008).*
3. *G. Deleuze, Cinema 2: The Time-Image (Minneapolis: University of Minnesota Press, 1989).*
4. *U. Eco, Obra Aberta, trans. João Rodrigo Narciso Furtado (Lisboa: Difel, 1989).*
5. *K. Hayles, "Narratives of Artificial Life," in FutureNatural: Nature, Science, Culture, eds. G. Robertson et al., 146 (London: Routledge, 1996).*
6. *K. Hayles, My Mother Was a Computer: Digital Subjects and Literary Texts(Chicago: University of Chicago Press, 2005).*
7. *S. Helmreich, Silicon Second Nature: Culturing Artificial Life in a Digital World(Berkeley, CA: University of California Press, 1998).*
8. *J. H. Holland, Hidden Order: How Adaptation Builds Complexity (Boston, MA: Addison-Wesley, 1996).*
9. *L. Klastrup, "A Virtual World Aesthetics: Theorising Multi-User Textuality" (paper presented at the Internet Research 3.0: NET / WORK / THEORY Conference, Maastricht, October, 2002), http://www.it-c.dk/people/klastrup/airpapfinalver.pdf (accessed April 12, 2012).*
10. *C. Langton, "Artificial Life," in Artificial Life: An Overview, ed. C. Langton, 1-47 (Boston, MA: Addison-Wesley, 1989).*
11. *B. Latour, Reassembling the Social: An Introduction to Actor-Network-Theory(New York: Oxford University Press, 2005).*
12. *C. Petchanatz, "Prolix," in Alire 6 (1992).*
13. *M. Whitelaw, Metacreation: Art and Artificial Life (Cambridge, MA: MIT Press, 2004).*